Material change for
a better environment

Waste Protocols Project

Processed Fuel Oil

Partial Financial Impact Assessment of a Quality Protocol
for Processed Fuel Oil

Contents

APPENDICIES

List Of Tables:

1.0 List of Acronyms

Acronym	Meaning
Defra	Department for Environment, Food and Rural Affairs
DOE	Distillate Oil Equivalent
EU ETS	European Union Greenhouse Gas Emission Trading Scheme
FIA	Financial Impact Assessment
HFO	Heavy Fuel Oil
MOD	Ministry of Defence
PFO	Processed Fuel Oil
QP	Quality Protocol
REGIS	Regulatory Information System for waste
RFO	Recovered Fuel Oil
ROE	Residual Oil Equivalent
SPC	Shadow Price of Carbon
TAG	Technical Advisory Group
tpa	tonnes per annum
WID	Waste Incineration Directive
WRAP	Waste & Resources Action Programme

2.0 Purpose and Intended Effect

2.1 Objective

The Environment Agency proposes to produce a Quality Protocol (QP) recognised by and developed with the support of industry which defines when waste lubricating oil has been reprocessed to such a level that it is fully recovered and can be termed Processed Fuel Oil (PFO) which will no longer be considered to be waste. This Quality Protocol will cover England and Wales. The Environment Agency currently considers Recovered Fuel Oil (RFO) to be controlled waste.

The decision to produce a Quality Protocol for Processed Fuel Oil has been prompted by a recent Court of Appeal Judgement in the case of OSS Group Ltd and the Environment Agency. The case centred on the point at which processed waste oil ceases to be waste and therefore legislative controls associated with its production, transport, handling and use no longer apply. The Court concluded that, in order for waste lubricating oil to cease to be a waste 'it should be enough that the holder has converted the waste material into a distinct, marketable product, which can be used in exactly the same way as an ordinary fuel and with no worse environmental effects.'

It should be noted that the Quality Protocol will apply to processed waste oil manufactured from hydrocarbon based waste oil and not to waste oil of animal or vegetable origin. Processed waste oil meeting the requirements of the Quality Protocol will be termed Processed Fuel Oil (PFO). The term PFO is used to describe waste oils that have been processed in accordance with the requirements of the Quality Protocol to meet either the Residual Oil Equivalent (ROE) or Distillate Oil Equivalent (DOE) specifications contained within it. The implementation of a Quality Protocol is a voluntary procedure with which producers can opt to comply or not comply. Should producers not comply with the terms of the Protocol the processed waste oil will be referred to as Recovered Fuel Oil (RFO) and will remain a waste.

The Environment Agency issued an interim position, updated in August 2008 titled *Regulation of Waste Oil: Interim Arrangements*[8] to cover the period while the Quality Protocol is developed. This allows RFO that meets the standard BS2869 specification for Class G oil (excluding the viscosity requirements but including a total halide limit, expressed as chlorine of 1000ppm) to be treated as a non-waste. This position will be withdrawn when the Quality Protocol is issued.

This Financial Impact Assessment (FIA) considers the potential impacts on industry of the introduction of the proposed Quality Protocol. It does not investigate the costs and benefits for the regulatory agencies, but does attempt to set out possible consequences for carbon emissions. A Technical Advisory Group (TAG) made up of different industry representatives supported the development of this FIA (see Appendix 2 for a list of TAG members).

For the purposes of this report, PFO is defined as 'waste lubricating oil that has been processed in accordance with the Quality Protocol'. Processed waste oil that is intended for use as a fuel but does not meet the specifications in the Quality Protocol will continue to be referred to as RFO.

The Quality Protocol will define the point of recovery to be at the point when Processed Fuel Oil (PFO) has been tested and is found to meet the relevant specification in the Quality Protocol. Companies downstream of that point (i.e. the fuel users) will no longer be subject to the requirements of the waste regulatory regime or the application of the Waste Incineration Directive to its combustion as a fuel.

The following groups will be affected by the introduction of a Quality Protocol for PFO:

- producers of waste oil – users of fuel oils and lubricants;
- collectors of waste oil, PFO manufacturers and operators of re-refining plants;
- end users – those using PFO as a substitute for virgin fuels or as a reductant; and
- virgin fuel oil producers and suppliers.

2.2 Scope

Should it be introduced, the Quality Protocol will apply to RFO that is processed in line with the Quality Protocol to meet the specifications for Residual Oil Equivalent (ROE) and Distillate Oil Equivalent (DOE). It will not apply to non-fuel products such as re-refined base oil and waste oils exported to another country.

The financial impacts on all markets for fuel and non-fuel products from waste oil have been included in this assessment where changes are directly attributable to the introduction or rejection of the Quality Protocol.

2.3 Background

What is Waste Oil and Recovered Fuel Oil?

Waste oil is produced as a result of a wide range of activities in the domestic, commercial and industrial sectors. *The Waste Strategy 2007*[1] states that approximately 1 million tonnes of oily wastes are collected each year representing 20% of all hazardous waste arisings. Waste oil represents just 1% of every barrel of crude oil sold, the remainder being used as fuel. After processing to remove water and other contaminants, approximately 350,000 tonnes of waste oil is available for recovery and re-use[1].

The '*Final Report of the Technical Advisory Group for Waste Oil*'[3] defined waste oil as 'waste lubricating oils and other oils suitable for recovery as mineral oil type fuel substitute as set out in the European Waste Catalogue'.

Waste oil arises from a number of sources and comprises of different oil types falling broadly into the following categories[2]:

- Post lubricating oils;
- Heavy Fuel Oil (HFO) washings landed from the large trans-continental ships (typically containing 30% water) and from ferries and local traffic (typically containing 50% water);
- Contaminated fuels (e.g. crossovers of diesel and petrol road fuels, off spec. jet fuel, time expired military fuels e.g. MOD, Customs & Excise returns etc.); and
- Fuel tank residues and sludges (often wet).

The following wastes have higher water content but contain some oil:

- Emulsions (e.g. from metal working or fire resistant hydraulic fluids); and
- Oil interceptors (e.g. from run off areas or storage/processing plant).

All waste oil regardless of composition or source is considered to be hazardous waste and as such producers, collectors and treatment sites have to comply with the Hazardous Waste (England and Wales) Regulations 2005 and other linked pieces of legislation.

Until the implementation of the Waste Incineration Directive on 28 December 2005 RFO was widely used as an alternative fuel in a range of applications. Approximately 50% of RFO was burnt in 7 power stations as start up fuel and 50% in around 125 roadstone coating plants. [1]

Arisings and Composition of Waste Oil

The majority of waste oil collected is waste lubricants. In the UK the sale of lubricants has remained relatively stable in the past, however in recent years it has shown a slow decline of 1-2% per annum[2]. This trend is expected to be exaggerated in the short term as the impact of recession leads to a decline in demand for lubricant products and the decline is expected to continue at the slower pace of 0.5% per annum from 2011 into the future as heavy industry e.g. steel manufacture, metal working etc. slowly decline. It is also the case that the demand from vehicles will also decrease as technology improves (e.g. fuel cell technology) and service intervals lengthen however this may be offset by the projected increase in vehicle numbers. Table 1 shows the trend in production of petroleum products in recent years.

Table 1: Petroleum Products: Commodity balances from 1998-2007 ('000 tonnes)

Year	Aviation Spirit	Motor Spirit	White Spirit & SBP	Aviation Turbine Fuel	Burning Oil	Gas/ Diesel Oil	Fuel Oils	Lubricant
2007	0	21,313	70	6,176	2,968	26,397	11,809	547
2006	26	21,443	107	6,261	3,374	26,080	12,277	617
2005	32	22,620	136	5,167	3,325	28,691	11,728	936
2004	31	24,589	100	5,615	3,613	28,839	12,988	1,136
2003	26	22,627	104	5,277	3,521	27,579	11,517	576
2002	28	22,944	121	5,365	3,506	28,393	10,551	509
2001	101	21,455	121	5,910	3,088	26,796	11,863	656
2000	30	23,445	122	6,484	3,078	28,398	11,523	702
1999	16	25,230	129	7,249	3,553	25,870	12,195	907
1998	-	27,166	135	7,876	3,442	27,704	13,365	1,125

Source: BERR Digest of United Kingdom Energy Statistics 2008

Information on the quantity of waste oil arising in the UK is available from a variety of sources. Some of these sources use differing definitions of waste oil. There are also differing opinions on the proportion of lubricants etc., which are lost in use and the proportion of the remainder which is recoverable. It should be noted that the primary source of data used in some of these documents is the Environment Agency's Hazardous Waste Database, or before 2005, their Special Waste recording system. Therefore variation is due to reporting years rather than differing sources of data. This is true for Waste Strategy 2007 and the UK Waste Oils Market (2005). Table 2 summarises the different sources, figures and units identified as part of this financial impact assessment and demonstrates the variation that was found.

Shipping produces a significant volume of oil contaminated waste. Before its use in marine engines, heavy fuel oil is given a hot wash with the contaminated wash water being stored in the 'slops tank'. These slops contain approximately 70% water and 30% emulsified hydrocarbon and account for 70,000 – 100,000 tonnes per annum of oil contaminated waste.

Table 2: Waste Arisings Data according to different sources

Source	Oil lost in use	Proportion available for collection post use	Proportion of available oil collected
Waste Strategy 2007			80% (350,000t)
DTI Waste Oil Recycling (2001)	45.4% (395,741t)	54.6%	48.4%(422,000t)
Hazardous Waste Forum (2005)		(550,000t)	
UK Waste Oils market (2001)[5]	49.4%		(390,646t)
Final Report, TAG for Waste Oil (2007 figures)	45-50%	85%	390,000t
OSS (2007)			330,000-350,000t
UKPIA & Europia		94-97% in the late 1990s	

Source: RPS Planning and Development Ltd
Please note that gaps in the table indicate that data source did not include this information or data.

Due to the wide range of petroleum products and their use, the composition of waste oil and its contaminants can vary significantly. Common contaminants include the following:

- Water;
- Performance enhancing additives;
- Degradation products;
- Additional contaminants resulting from use e.g. fuel dilution in engines, metals from engine wear, soot etc.); and
- Other waste liquids added to the waste oil for example, brake fluid, antifreeze etc.

The most problematic contaminants present in waste oil can be halogen and sulphated ash. The ash is created as a result of detergents added to lubricating oils and can clog burners and boiler tubes restricting the applications for which RFO and PFO can be used.

For the purpose of the Quality Protocol the term contaminant has been defined by the Technical Advisory Group as 'materials that are present in waste lubricating oils which would not be present in the comparator virgin fuel oil. This includes lubricant additives and materials present in waste lubricating oils as a result of their use and possible subsequent mixing with other solid or liquid waste.'

Collection

The market for waste oil is very mature and driven by market forces rather than environmental considerations. At present producers of waste oil are paid up to 5 pence for every litre collected and producers of high quality RFO can charge approximately 35-37 pence per litre to fuel users (consultation with TAG).

The price paid to producers depends on the charge the waste oil industry can make for its products therefore should the market value of PFO rise as a result of the Quality Protocol, the price producers receive may rise too. Should the Quality Protocol not be approved and the Environment Agency's interim position withdrawn, the value of RFO could fall due to a retraction of markets and waste oil producers may have to pay to have their waste oil removed.

Waste Oil Treatment in the UK

The Final Report of the Waste Oils Technical Advisory Group describes waste oil treatment as ranging from the very basic physical treatment of screening, filtering and de-watering to complicated, high tech physical, chemical and thermal systems although the majority operate at the most basic level.

Waste oil can be processed for one of two end uses, firstly as a regenerated lubricant or base oil and secondly for use as a fuel. The UK currently has an extremely limited ability to regenerate waste oil into lubricant and in 2001 it was estimated that only 3.7% of the total waste oil recovered was destined for this market[4]. The remaining proportion of the total was processed to make it suitable for use as a fuel in a number of specific applications where the characteristics of RFO e.g. ash content etc. did not prohibit its use.

According to the Environment Agency's REGIS database, 71 sites held an Environmental Permit to biologically, chemically and physically treat waste oil in 2006. The largest of these was Cottenham Treatment Works in Cambridgeshire which accepted approximately 23,000T of waste oil and oil containing materials in that year.

In 2007 Whelan Refining commissioned a re-refining plant in Stoke on Trent to produce base oil from waste oils. It is currently the only facility of its kind in the UK and has capacity to treat 50,000 tonnes of waste oil per annum. There are a number of high technology installations able to re-refine waste oil in other European countries, most notably Germany, Spain and Italy.

OSS operates 4 waste oil treatment plants in the UK including one in Stourport that produces material that they market under the brand name of 'Clean Fuel Oil' (CFO). They also operate 14 consolidation plants and transfer stations. Currently they have the capacity to produce 40,000 tpa but hope to increase this 100,000 tpa. Eco-oil also operates a number of transfer stations and three treatment plants including a sea fed import/export facility. Eco-oil were purchased by Puralube in 2005 with the express intent of using their business base as a platform for developing a 100,000 tonne re-refining plant in the UK however their plans are currently on hold due to uncertainty surrounding current legislation and in particular the status of the processed fuel oil as waste.

Waste Incineration Directive

Prior to the implementation of the Waste Incineration Directive (WID) in December 2005 the majority of waste oil was burnt at power stations, cement kilns and roadstone coating plants. Many of these installations either chose not to or were unable to upgrade to the requirements of WID and therefore these markets effectively ended. At present none of the UK power stations are WID compliant and have converted to alternative fuels. Cement kilns are generally WID compliant but only one is currently permitted to burn RFO. In addition, roadstone coating plants are using RFO if they are able to comply with the Environment Agency's interim position[8].

Waste Oil Directive

The Waste Oil Directive (75/439/EEC as amended) requires Member States to give priority to the re-generation of waste oil above its use as a fuel. The Directive will be repealed by the revised Waste Framework Directive (WFD) with effect from 12 December 2010. Article 4(1) of the revised WFD introduces a 5-step waste hierarchy which is substantially the same as that which already informs the England and Wales waste strategies. Article 4(1) of the revised WFD provides that:-

1. The following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy:

(a) prevention;
(b) preparing for re-use;
(c) recycling;
(d) other recovery, e.g. energy recovery; and
(e) disposal.

Article 4(2) of the revised WFD requires Member States, when applying the waste hierarchy, to take measures to encourage the options that deliver the best overall environmental outcome. The Directive acknowledges that this may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste. The transposition of the revised WFD in England and Wales is the subject of a first stage consultation published in July 2009 by Defra.

The UK currently has only a limited capacity to re-refine waste oil into lubricants due to a historically strong market demand for waste oil for combustion which has deterred investment in modern oil refining plant. A further factor is perceived to be the historic uncertainty regarding the status of fuels derived from waste oil as companies are unwilling to invest in high capital investment re-refining technology until the end-of-waste status is confirmed. The decision to introduce or reject the Quality Protocol will end this uncertainty. Some industry experts consider that the market certainty will increase the confidence of companies wishing to invest in re-refining in the UK, particularly if the Quality Protocol is rejected, and make it more profitable to re-refine waste oils into base oil rather than produce RFO for a limited market of WID compliant facilities. Some members of the waste oil sector also believe that waste oil collectors will be approached by UK or European re-refining companies to secure future supplies, either for re-refining in existing plants in Germany or for the development of new re-refining plant in the UK.

3.0 Current Markets for Waste Oil and RFO

3.1 End uses

This section refers to waste oils processed to produce fuels as RFO prior to the introduction of the Quality Protocol. Processed waste oil meeting the requirements of the Quality Protocol is termed Processed Fuel Oil (PFO) whilst processed waste oil that does not meet the standard continue to be referred to as RFO.

This section refers to current uses of RFO (i.e. before the introduction of a Quality Protocol) and therefore includes both RFO that is compliant with the Environment Agency's interim arrangements so can be burnt in plants that are not WID compliant and RFO falling outside these arrangements so limited to WID compliant plants with the relevant permits to accept and use waste.

The current and potential markets for waste oil are influenced by legislation and the level of contaminants present. The potential uses of waste oil currently fall into three main categories as described in Table 3.

Table 3: Categories of end use for Waste Oil

Category	Examples of uses
Non-fuel products	■ Base oil ■ Re-generated lubricants ■ Chemical reducing agent in steel making blast furnaces
Recovered Fuel Oil	■ Cement and lime kilns ■ Power stations ■ Roadstone coating plants ■ Various users of fuel oil
Exports	■ Exports for re-refining in Europe

It should be noted that whether the Quality Protocol is introduced or not, RFO is considered waste and therefore subject to waste management controls. Furthermore, whether or not the Quality Protocol is agreed and introduced the Environment Agency's interim arrangements will be withdrawn, and RFO would only be able to be burned in WID compliant plant. This will limit the market for RFO to cement and lime kilns that are WID compliant, steel manufacture and exports for re-refining. PFO (processed waste oil complying with the Quality Protocol) will not be considered a waste and therefore a wider range of markets will be available.

The end markets for processed waste oil are in all cases driven by commerciality and limited only by the legal restrictions on companies using it. If the UK market price of waste oil falls significantly it is likely that more waste oil will be exported to Europe where prices may be higher.

The price of waste oil and subsequent products is also linked to the price of virgin fuels of all kinds and the market price of PFO will be capped by the price of virgin fuels. The prices quoted in this FIA can be subject to significant variation as the price of virgin fuels fluctuate significantly over time.

It should be noted that the Quality Protocol will apply to PFO and not non-fuel products or waste oil that is exported to be re-refined in another country.

3.2 Non-fuel Products

Regenerated Lubricants & re-refined Base oils

As previously discussed, the volume of waste oil historically re-refined for use as base oil and lubricants was minimal at around 4% of the total waste oil collected. This is due to the very limited capacity in the UK to re-refine waste oils. Currently only one plant is capable of producing base oil from waste oil (Whelan Refining in Stoke on Trent) however it is not currently operational. The waste oil industry expects that there will be increased investment in the re-refining technology as the long-term uncertainty over the status of RFO will end with the rejection or introduction of the Quality Protocol. The market will be further encouraged by the revised Waste Framework Directive which sets out a preference towards re-refining rather than burning waste oil.

Chemical Reducing Agent

Waste oil is used as a chemical reducing agent (reductant) in blast furnaces used for steel manufacture. The oil is burnt creating carbon monoxide which acts as the reductant in the process. The WID does not apply to this process. The Corus facility at Redcar accepted around 150,000T per annum of RFO before closing due to the economic downturn in late 2008 (consultation with TAG). When operational, the facility has the capacity to burn up to 75% of all waste oil arising in the UK[1] however it is uncertain if the plant will re-open and at what level it will operate if it does. Corus compete for RFO with other users such as roadstone coating plants and cement kilns. There is no duty to pay on RFO used in this way as it is not burnt as a fuel.

3.3 Recovered Fuel Oil

RFO is manufactured by de-watering, filtering and blending recovered lubricants and higher flashpoint fuels. In most cases the waste oil is heated, water removed and then filtered through a 400 micron filter. Higher quality RFO can be manufactured by filtering to 1 micron as this removes heavy metals and flocculants (solids) and can have a calorific value of 44 MJ/Kg.

The applications for which RFO is suitable can be limited by its ash content as it can block burners and coat the inside of boiler tubes. RFO can substitute heavy fuel oil in applications with suitable combustion equipment. Other contaminants such as halide and chlorine are also of environmental concern.

For RFO to be used as a fuel in non-WID compliant plants it currently has to comply with the specification contained in the Environment Agency's interim position '*Regulation of Waste Oil: Interim Arrangements*'[8] updated and re-issued in August 2008.

The Financial Impact Assessment has not considered the cost of Customs and Excise duty applicable to RFO as it is not influenced by the introduction of a Quality Protocol. HM Revenue and Customs (HMRC) have issued guidance on the duty payable for the use of 'waste oil' which can be accessed at HM Revenue & Customs website.

The potential for RFO and PFO to maintain or increase its market share and open up new markets will depend upon the specification, price and consumer confidence in RFO and PFO as a fuel. Gauging levels of confidence was not within the scope of this FIA, but the Quality Protocol is expected to increase consumer confidence where there are concerns about the currently provided quality and consistency of the fuel.

Roadstone Coating Plants

The roadstone coating industry has used RFO for over 40 years in its asphalt plants. The RFO is used in combination with virgin fuel or alone to fire burners that heat the aggregate prior to it being mixed with bitumen. The high ash content of RFO can sometimes prohibit its use as it can choke equipment however, in its application in roadstone coating plants ash content is not a restriction regarding the product as it mixes with the aggregate in the drying drum.

Prior to the implementation of WID in December 2005, the roadstone coating industry used approximately 50% of all RFO in some 125 plants in small quarries. At this time the RFO producers received around 9 pence per litre for RFO[1].

Cement and Lime Kilns

RFO was used as a start up fuel and to power secondary systems in a number of WID compliant cement and lime kilns. Before the implementation of WID they represented a greater proportion of the market for RFO but this was reduced when some kilns were either unable or reluctant to upgrade to WID requirements. Lafarge operate 6 kilns in England and Wales in addition to one in Scotland and one in Northern Ireland. Other companies operating kilns include Cemex (4 kilns), Buxton Lime and Cement Company, Tarmac and Castle Cement.

WID compliant cement and lime kilns also use alternative waste derived fuels such as tyre shreds and refuse derived fuels (RDF). Therefore the price of RFO is capped by the value of these fuels, which are currently burnt at cost to the supplier. The traditional fuel of cement and lime kilns is coal or petroleum coke however, RFO has a higher calorific value. Cement and lime kilns are currently paying around 15-16 pence per litre for RFO (consultation with TAG).

Power stations

Until the end of 2005 approximately 50%[1] of all RFO produced in the UK was burnt as a start up fuel in seven power stations in the UK at a cost to the operator of around 9 pence per litre[1]. The implementation of WID completely closed this market as no power stations chose to upgrade to the requirement of WID and instead converted their equipment to use alternative fuels.

The closure of the Corus steel manufacturing facility at Redcar has led to a number of power stations accepting RFO meeting the requirements of the Environment Agency's Interim Standard[8]. This is not expected to continue past 2011 as the Interim Standard will be withdrawn whether or not the Quality Protocol is introduced and power stations are not WID compliant.

Commercial Users of Fuel Oil

The potential market for PFO is unlimited providing it is consistently of the quality required by users. At present the market for RFO meeting the Environment Agency's Interim Standard is dominated by the major users discussed above however, as the price of virgin fuels increase coupled with the desire of many companies and individuals to be more environmentally sustainable, the market for supplying PFO to small users is expected to grow.

A number of manufactures market high quality RFO which has been subject to greater processing to users of light, medium and heavy fuel oil and gas oil. Users currently pay around 30p pence per litre compared to 16-17 pence per litre for RFO produced by regular processing. High quality RFO is not suitable for use in diesel engines but has a wide range of other applications. Table 4 shows the specification of an example high quality RFO produced by one of the oil processing companies. The price of RFO complying with the Quality Protocol (PFO), and therefore classified as a non-waste, will be determined by the price of virgin fuel rather than comparator waste derived fuels.

Table 4: Example composition of a high quality RFO

Property	Units	Limits	
		Min	Max
Ash content	% m/m	0.01	0.15
Calorific Value - Gross	MJ/kg		44.7
- Net	MJ/kg		42.5
Conradson Carbon Residue	% m/m	1.0	5.0
Density at 15°C	kg/l	0.850	0.898
Flash Point	°C	66.0	>100
Sediment	% m/m	0.01	0.15
Strong Acid Number		zero	zero
Sulphur	% m/m	0.50	1.00
Viscosity at 40°C	cSt	28	45
Water	% m/m	0.10	1.00

Source: OSS Group

Export

If the price for RFO falls below 10 pence per litre it would become financially advantageous to export it for re-refining in Europe rather than to manufacture and sell RFO in the UK. This is not currently happening with the price of RFO at around 16-17 pence per litre. (consultation with TAG).

If use in the UK is not financially beneficial, waste oil would be collected and delivered to the dock side for transport to countries such as Germany or Holland where it can be 'cracked' to make gas oil, or re-refined in German oil regeneration plant. High virgin oil prices and the Waste Framework Directive's preference towards re-generation make re-refining more attractive.

4.0 Consultation

Initial consultation during the development of this FIA was confined to the Technical Advisory Group (TAG). TAG members (see Appendix 2) cover a cross-section of stakeholders who would be affected by the introduction of a Quality Protocol for Waste Oil including:

- industry representatives including the Oil Recycling Association (ORA), British Cement Association, UKPIA, EUROPIA;
- Environment Agency;
- Department for Business, Innovation and Skills (BIS) previously known as Department for Business, Enterprise and Regulatory Reform (BERR);
- Department for Environment, Food and Rural Affairs (Defra);
- Energy Institute; and
- The National Industrial Symbiosis Programme.

The TAG met regularly throughout the development of the Quality Protocol.

5.0 Options

5.1 Methodology

The development of the assessment followed HM Treasury Green Book[6] and Cabinet Office guidance. Two options were evaluated:

Option A: 'do nothing' or 'no introduction of a Quality Protocol' for waste oil together with the withdrawal of the Environment Agency interim standard (baseline); and

Option B: introduction of the Quality Protocol for waste oil.

Under Option B, the expected impact of the introduction of the Quality Protocol was determined by modelling a 'low' and a 'high' scenario for future market developments in order to capture a conservative and optimistic expectation. The modelling also includes a 'central' scenario which represents the most realistic impact of the Quality Protocol introduction between the low and high scenarios. The method used to assess the financial impact of the Quality Protocol for waste oil involved comparing Option A (baseline) with the central scenario in Option B.

There is a great deal of uncertainty related to the possible impacts of the Quality Protocol for waste oil. The figures for future trends in the volume and value of markets for RFO are based on a number of assumptions and simplifications for the modelling process. These assumptions and simplifications were derived in consultation with the TAG and Environment Agency and are based on the TAG's Final Report[3], publicly available reports, telephone discussions and meeting notes with industry and TAG members.

All scenarios have the same underlying growth rate for waste oil production as it is primarily a by-product of the lubricant use and its production will not be driven by its regulatory status or increased demand for RFO and/or PFO. There will be some moderate decrease in waste oil with time due to decreasing vehicle numbers and the use of more efficient engines.

The FIA assumes that 55% of lubricants used in the UK are recoverable with the remainder being lost to the environment. With increasing virgin oil prices and regulatory pressure to re-refine more, this might change, however for the purpose of this report and the fact that this market is not directly influenced by the Quality Protocol the above value will be applied in the modelling for comparing the economic scenarios. The recovery rate of waste oils remains static at the 2007 level of 85% of the total volume recoverable for both options during the assessment period.

It has been assumed that it will not be possible for fuel derived from waste oil to meet the specification for the Distillate Oil Equivalent (DOE) contained within the Quality Protocol without some form of distillation or re-refining. As this would require a large investment in distillation technology it has been assumed that operators are more likely to produce high value base oil with a small amount of gas oil equivalent PFO and RFO being produced as a by-product. In the case of the specification for Residual Oil Equivalent (ROE), it has been assumed that a relatively low technology process, including chemical treatment, would be sufficient.

The market value of PFO is closely linked to the price of the virgin heavy fuel oil and gas oil it can replace. For example, should the price of virgin fuels rise, the cost of PFO is expected to rise as well. The cost of virgin fuels rose significantly due to increased global demand. However, wholesale prices have recently declined sharply as a result of the global economic downturn. Future prices are difficult to predict. The FIA does not attempt to model future virgin fuel prices.

The period of assessment was 2011 to 2020 and the analysis used 2008 prices. It has been assumed that the Quality Protocol will be introduced in 2011 and its full effects will be seen in the markets in that year as the markets for PFO meeting both specifications in the Quality Protocol will have demand for the material if it is favourably priced compared to the virgin equivalent. The figures presented in the following chapters are rounded to improve the readability of the report.

The quantifiable benefits and costs of the Quality Protocol were calculated for each year over the 10-year period. They were then discounted at 3.5 per cent (following Green Book guidance) and summed to provide the total net present value (NPV) benefit or cost. Because the benefits could continue beyond the 10-year assessment period, the estimates may be an underestimate.

The assumptions used in the FIA modelling are detailed in Appendix 3.

Potential carbon impacts of introducing a Quality Protocol

The potential carbon impacts of the introduction of the Quality Protocol were assessed using Defra guidance on the Shadow Price of Carbon (SPC)[7]. Three scenarios were modelled for the potential value of carbon savings; the central scenario was based on the Defra figures for SPC per tonne of carbon dioxide (CO_2) and the others based on sensitivities of ±5 per cent of the SPC figure. The assessment uses the Shadow Price of Carbon rather than the Market Price of Carbon used in the European Union Greenhouse Gas Emission Trading Scheme (EU ETS) to be consistent with the approach used in FIAs for other Quality Protocol materials.

In 2005, the European Association of the re-refining industry, GEIR (Groupement Européen de l'Industrie de la Régénération), commissioned a project to carry out a Life Cycle Assessment comparing the benefits of re-refining waste lubricants against the burning of waste oils as fuel in large scale facilities such as cement kilns. The project published the report titled '*Ecological and energetic assessment of re-refining used oils to base oils: Substitution of primarily produced base oils including semi-synthetic and synthetic compounds*'[9] in February 2005. The report concluded that compared to burning in cement and power stations, re-refining is only beneficial from a global warming perspective when burning waste oil replaces certain virgin fuels. If the virgin fuels used in the applications are coal or pet coke, re-refining increases carbon emissions. However, if the applications use other fuels such as oil or gas, re-refining has the lowest global warming potential.

It has been assumed that an increase in the utilisation of PFO will not have an adverse effect on carbon emissions as it will replace the use of virgin fuels and therefore save the total carbon emissions associated with their production. Virgin Class D and Class G oil has a high embodied carbon (average 3.10 tCO_2/tonne) because of its nature and the energy-intensive processes by which it is produced. This figure represents the carbon emissions of the oils from extraction to delivery to the customer. It does not include the carbon emissions from their combustion. Waste oil will continue to be produced as a result of lubricant use and this will not be influenced by the introduction of a Quality Protocol.

The high degree of complexity involved in carrying out a detailed Life Cycle Assessment to assess the potential carbon impacts of introducing a Quality Protocol for PFO means that it is not within the scope of this analysis. This, coupled with the high level of uncertainty over the impact of the Quality Protocol on markets and other variables makes it extremely difficult to accurately estimate the potential carbon savings. Thus, the estimates provided later on in this report should be considered as indicative only.

5.2 Options

Option A: 'do nothing' or 'no introduction of Quality Protocol' and withdrawal of the Environment Agency's Interim Position

Under the baseline option, the Quality Protocol is not introduced and the Environment Agency withdraws its interim position on regulating the use of RFO in 2011. Therefore RFO is considered to be waste in all circumstances and can only be burnt in facilities compliant with WID requirements.

Current users of RFO that are not WID compliant will have to stop using the fuel thereby reducing the market for RFO significantly. This will result in a decrease in market value and lead to the export of waste oil for re-refining becoming more attractive to the waste oil sector. The ending of the legislative uncertainty over RFO will stimulate the market in the UK for re-refining as operators increase investment in re-refining technology to manufacture base oil. This option does not consider the costs associated with establishing re-refining capacity in the UK as it is outside the scope of the assessment.

Manufacturers and users of RFO have to comply with waste legislation to keep, transport and use it as a fuel.

Baseline outline

- The withdrawal of the Environment Agency's interim position results in the end of RFO use in roadstone coating plants and power stations. The UK market for RFO is limited to cement and lime kilns and steel manufacture (as a reductant).
- The restriction of the RFO market to WID compliant plants and non-fuel applications results in a fall in its market value stimulating the export of some waste oil to Europe for re-refining and the establishment of re-refining plant in the UK. In this scenario, one re-refining plant with a capacity to accept 75,000tpa is operational by 2011 and another two plants of the same size by 2017.
- Those producing, transporting and using RFO will have to comply with relevant legislation such as the WID and the Hazardous Waste Regulations 2005 and meet the associated costs of compliance which include fees payable to the Regulator and the administrative burden of achieving these registrations, permits etc.
- The proportion of waste oil and RFO going to each market over time is described in Table 5. The market breakdown is split into four periods to reflect the effect of current economic conditions, the introduction of the protocol and increasing capacity of the UK to re-refine waste oil over time. The reason for setting the proportion going to each market is included in the table. It is assumed that market prices stay constant throughout the assessment period.

Table 5: Assumed average annual per cent of RFO going to end markets under Option A*

Market	Year	%	Clarification
Power Stations	2006-08	0	No power stations in the UK were WID compliant during these years therefore no RFO was accepted
	2009-10	40	Environment Agency Interim standard allowed RFO that complied with interim standard to be used in non-compliant WID power stations
	2011-16	0	Environment Agency Interim standard is withdrawn and power stations are still not WID compliant therefore cannot accept RFO
	2017-20	0	As above
Cement and Lime Kilns	2006-08	26	Value of RFO reduced from 50% pre-2005 when WID came into force. Some cement and lime kilns converted to be WID compliant
	2009-10	40	Environment Agency Interim standard allowed RFO that complied with interim standard to be used in non-compliant WID cement and lime kilns
	2011-16	65	Environment Agency Interim standard is withdrawn restricting non-WID compliant markets. More goes to WID compliant cement & lime kilns than previously as much less RFO is being used as a reductant
	2017-20	12	Reduction in RFO to cement and lime kiln as re-refining to high value base oil increases
Steel Manufacture (as a reductant)	2006-08	64	Blast furnaces do not need to comply with WID and have capacity to use extremely large volumes of RFO
	2009-10	0	The Corus Redcar site closed autumn 2008
	2011-16	10	Assumption is that Redcar reopens as a result of improving economic conditions but at reduced production rates
	2017-20	13	As above
Roadstone costing plants	2006-08	0	After the introduction of WID, roadstone coating plants continued accepting good quality RFO
	2009-10	10	Volumes going to roadstone coating plants increase with the introduction of the Environment Agency's Interim Position in 2008
	2011-16	0	Environment Agency Interim standard is withdrawn
	2017-20	0	As above
Exported to Europe for re-refining	2006-08	10	Estimated level of exporting for waste oil
	2009-10	10	Level of export estimated to remain static, in practice it is dependant on the market price for RFO
	2011-16	0	As the rejection of the Quality Protocol, re-refining capacity increases in the UK taking waste oils that would previously be exported
	2017-20	0	As above
Re-refining in the UK to produce base oil	2006-08	0	No re-refining plants operating in the UK
	2009-10	0	As above
	2011-16	25	Investment in re-refining after QP rejection ends market uncertainty. ORA estimated that the UK could establish up to 80,000tpa re-refining capacity during this period
	2017-20	75	More re-refining plants become operational as investment continues

*The market breakdown has been simplified for modelling purposes. It does not reflect regular annual fluctuations.

Option B: 'Introduction of the Quality Protocol'

The low, central and high scenarios under option B assume the Quality Protocol will be introduced in 2011. As the Quality Protocol is a voluntary commitment, it will depend on the waste oil industry (i.e. manufacturers of PFO) ensuring the product complies with the Quality Protocol. Data for the 'central case' represents the estimated most likely scenario between the two extremes from the research that has been carried out.

The scenarios modelled for the low, central and high scenarios were developed and agreed in consultation with the TAG and Environment Agency.

In order to demonstrate compliance with the Quality Protocol there will be a requirement to sample and test each batch of PFO. For the purpose of the financial impact assessment it has been assumed that PFO is manufactured in batches of approximately 30 tonnes and that one sample will be required from each batch. The cost of testing includes the cost of testing against the BS2869 specification, the newly developed test for sulphated ash in waste oils and tests for inorganic and organic halides. This option does not consider the costs associated with establishing re-refining capacity in the UK as it is outside the scope of the assessment.

Introduction of the Quality Protocol – 'low case'

Under this scenario, the Quality Protocol for waste oil is introduced and the Environment Agency will consider PFO that complies with this Quality Protocol to be a product and not a waste.

In this scenario, one quarter of the total waste oil collected is processed to either be compliant with the Quality Protocol (PFO) or manufactured into base oil by re-refining. The remaining three quarters are manufactured into RFO which remains waste. The de-classification of PFO as a waste leads to a stimulation of the market as users no longer need to be WID compliant and the waste 'stigma' is lifted. The increasing market demand results in a rise in the price of PFO.

The market for RFO is split between WID compliant cement and lime kilns, sites that do not use RFO as a fuel (steel manufacture), and export for re-refining. Of the remaining 25% of waste oil collected, one quarter is distilled in lower technology refineries to produce PFO that meets the specification for residual fuel oil in the Quality Protocol and the remainder is re-refined to produce base oil although some PFO meeting the distillate oil specification and residue of generated as a by-product of the process. Producers of PFO have to meet additional costs for testing but, as the PFO is no longer considered to be waste, have no compliance costs associated with waste legislation.

Table 6 shows the changes in the market after 2011 when the Quality Protocol takes effect and compliant PFO is being produced and briefly describes the reasons for them.

Table 6: Assumed average annual percentage of RFO and PFO (including base oil) going to end markets in the low scenario*

Market	2011-2020	Clarification
Market for RFO	**% of total RFO produced**	
Cement and Lime Kilns	74	RFO is limited to WID compliant plant so the bulk goes to cement & lime kilns as an alternative fuel
Steel Manufacture (as a reductant)	16	Assumes that Corus re-opens
Exported to Europe for re-refining	10	A proportion of waste oil continues to be exported whilst the UK re-refining industry is established
Market for PFO	**% of total PFO and base oil produced**	
ROE users (from low technology distillation)	25	Some companies will choose to invest in lower technologies treatment processes to produce ROE
Base Oil Users	56	Investment in re-refining technology leads to the production of base oil
Various users of DOE	8	DOE will be produced as a by product of the re-refining process. It is not considered cost effective to re-refine waste oil to DOE standard as base oil is of higher value
Blast Furnaces (RFO by-products of distillation)	11	Re-refining and distillation will always result in by-products that do not meet QP standards

*The market breakdown has been simplified for modelling purposes. It does not reflect regular annual fluctuations.

Outline of the low scenario

- 75% of waste oil collected is manufactured into RFO and does not meet the Quality Protocol and therefore remains waste. The remaining 25% is re-refined in either high or low distillations plants to produce PFO meeting the specifications in the Quality Protocol or base oil with a small amount of residue which can be used as a reductant by the steel manufacturing industry.
- The Quality Protocol is expected to enhance consumer confidence for PFO meeting the specification. The status of PFO as a non-waste has opened up higher value end uses such as applications using low volumes of distillate oil equivalent and residual oil equivalent.
- For the purpose of this report and modelling exercise the scenario assumes that the proportions in Table 6 stay the same throughout the assessment period and that prices stay constant.

Introduction of the Quality Protocol – Central case (preferred scenario)

Under this scenario, the Quality Protocol for waste oil is introduced and the Environment Agency will consider PFO that complies with this Quality Protocol to be a product and not a waste. In this scenario, 40% of the total waste oil collected is processed to either be compliant with the Quality Protocol (PFO) or manufactured into base oil by re-refining. The remaining 60% is manufactured into RFO which remains waste. The de-classification of PFO as a waste leads to a stimulation of the market as users no longer need to be WID compliant and the waste 'stigma' is lifted. The increasing market demand results in a rise in the price of PFO. The market breakdown for RFO and PFO is the same as described in the 'low' scenario shown in Table 6.

Outline of the low scenario

- 60% of waste oil collected is manufactured into RFO and does not meet the Quality Protocol and therefore remains waste. The remaining 40% is re-refined in either high or low distillations plants to produce PFO meeting the specifications in the Quality Protocol or base oil with a small amount of residue which can be used as a reductant by the steel manufacturing industry.
- The Quality Protocol is expected to enhance consumer confidence for PFO meeting the specification. The status of PFO as a non-waste has opened up higher value end uses such as applications using low volumes of distillate oil equivalent and residual oil equivalent.
- For the purpose of this report and modelling exercise the scenario assumes that the proportions in Table 6 stay the same throughout the assessment period and that prices stay constant.

Introduction of the Quality Protocol – 'high case'

This scenario represents the most optimistic expectations for the impact of the Quality Protocol. In this scenario all waste collected is subject to some degree of re-refining to produce base oil, distillate oil equivalent PFO or residual oil equivalent PFO. The Quality Protocol is expected to enhance consumer confidence and this together with the status of PFO as a fuel and not waste has made the higher value recovery options fully established markets (see Table 7).

Table 7: Assumed average annual percentage of RFO going to end markets in the high scenario*

Market	2011-2020	Clarification
ROE users (from low technology distillation)	25%	Some companies will choose to invest in lower technologies treatment processes to produce ROE
Base Oil Users	56%	Investment in re-refining technology leads to the production of base oil
Various users of DOE	8%	DOE will be produced as a by product of the re-refining process. It is not considered cost effective to re-refine waste oil to DOE standard as base oil is of higher value
Blast Furnaces (RFO by-products of distillation)	11%	Re-refining and distillation will always result in by-products that do not meet QP standards

*The market breakdown has been simplified for modelling purposes. It does not reflect regular annual fluctuations

Outline of the High Scenario

- All producers of PFO manufacture their product in line with the Quality Protocol specification and therefore are no longer subject to waste regulations. They do have to meet the additional cost of sampling and testing against the specification.
- The value of PFO increases as additional, higher value markets can be accessed to reflect the status of PFO as an equivalent product for virgin heavy fuel oil and gas oil in a variety of markets. The increasing prices may also result in waste oil being imported into the UK.
- The scenario assumes that the proportions in Table 7 stay the same throughout the assessment period and that prices stay constant.

6.0 Costs and Benefits

6.1 Summary of Monetised Costs and Benefits

The costs and benefits associated with the introduction of the Quality Protocol for the low, central and high scenarios taken from the FIA model are summarised in Table 8.

Table 8: Summary of monetised costs and benefits of the options (£) over the assessment period (2011-2020)

	Option B1 – Low	Central	Option B2 – High
Benefits			
NPV of increased market value	-243,970,000	101,891,424	438,752,000
NPV of avoided waste regulation costs from fees and charges	9,200	10,700	12,200
NPV of avoided administrative burdens	2,100	2,500	2,900
NPV of carbon costs avoided (10 years using 3.5 per cent discount rate)	230,095,000	230,095,000	230,095,000
Costs			
NPV of Quality Protocol compliance costs	6,088,000	10,129,000	14,170,000
Overall Benefit (benefits minus costs not including carbon)			
Total benefit of option (10 years using 3.5 per cent discount rate)	-241,047,000	91,775,575	424,598,000

Table 8 shows the most pessimistic scenario (Option B1) occur after the Quality Protocol is introduced, a net loss of approximately £241M to the industry would result. This is due to the fall in market value when compared to the baseline scenario (Option A) in which the Quality Protocol is rejected. The baseline scenario assumes that companies will choose to invest in re-refining technology at a faster rate as the rejection of the Quality Protocol will end the historic uncertainty in the market. This faster increase in re-refining means that more waste oil is processed into high value base oil (£750 per tonne) in the baseline scenario than in the pessimistic scenario where the majority of waste oil is processed into much lower value products such as ROE (£250 per tonne) and non-Quality Protocol compliant RFO (£108 per tonne).

Table 9: Breakdown of revenue from markets (£) over the assessment period (2011-2020)

	Option B1 – Low	Central	Option B2 – High
RFO	128,949,580	140,664,597	0
Blast Furnaces (reductant)	43,562,146	44,353,702	34,849,337
ROE Users	82,497,665	88,003,376	256,676,514
DOE Users	40,654,849	44,119,026	129,071,619
Base Oil Users	554,384,309	492,818,907	1,232,047,268
European Export market	17,425,619	19,008,729	0
Total:	**867,474,168**	**828,968,337**	**1,652,664,738**

Table 9 shows a breakdown of the revenue that is expected from the markets into which processed waste oil will be sold. Unlike Table 8, the figures represent the total value of the markets in each scenario and not just the changes in value that result from the introduction of the Quality Protocol. This demonstrates the scale of the changes that may occur in each market should the Quality Protocol be introduced.

In the most optimistic scenario, no waste oil processors choose to produce RFO other than as a by-product of their operations. There is an increased investment in re-refining technology resulting in a significant increase in market revenue for the sale of high value base oil. This is demonstrated by the four fold increase in market revenue compared to the more realistic central scenario of Option B in which some RFO continues to be produced and the proportion of waste oil being re-refined is lower.

The avoided cost of regulation and the associated administrative burden on the industry is relatively small compared with the impact of market revenue ranging between approximately £11,000 - £15,000 over the assessment period.

The value of carbon savings remain constant across all scenarios in Option B as the assessment assumes that the total volume of waste oil collected, processed and sold remains the same in the pessimistic, central and optimistic scenarios.

6.2 Analysis of costs and benefits

Benefits for stakeholders from the introduction of a Quality Protocol for PFO

If the Quality Protocol leads to an increased demand in the end markets available for PFO and increase of re-refining into valuable base oil, then producers of PFO are expected to benefit in a number of ways.

- With Quality Protocol compliant PFO no longer considered to be waste, PFO manufacturers will no longer have to comply with all relevant waste legislation and meet the cost of fees and charges and administrative burdens. Manufacturers will no longer need to consign PFO leaving the site of production under the Hazardous Waste (England and Wales) Regulations 2005. Waste legislation will however remain relevant to the collection, management and processing of waste oils and RFO that is not compliant with the Quality Protocol.
- As users of Quality Protocol compliant PFO no longer have to be WID compliant, the range of potential customers is expected to increase as it will be used in applications where it was too costly or impractical to become WID compliant in the past. PFO will be able to compete with higher priced virgin fuels in markets where customers will pay higher prices.
- The Quality Protocol will become a recognised standard guaranteeing the quality and consistency of PFO therefore increasing demand, and therefore prices in end markets due to increased customer confidence in the fuel.

Users of PFO that currently need to hold an Environmental Permit and comply with WID if they are burning RFO will no longer need to meet these requirements if they use Quality Protocol compliant PFO. This should result in avoided costs such as subsistence fees, consultancy fees, training, providing technically competent management, etc. However, in reality, current users of RFO that are WID compliant also burn other waste derived fuels such as tyres and therefore will need to continue to meet these requirements for other waste fuels. The Quality Protocol would give the opportunity for PFO currently treated as a hazardous waste to be treated instead as a hazardous material without the associated waste controls.

Users of distillate oil equivalent and residual oil equivalent will benefit from the option of using PFO if it is suitable for their application. Not only will they benefit financially as PFO is expected to be cheaper than virgin fuel, but the 'recycled' nature of PFO will boost their environmental image with customers and might benefit their climate change agendas.

Wider benefits related to the introduction of a Quality Protocol for PFO

The FIA uses a crude approach to calculate the potential carbon savings associated with the introduction of the Quality Protocol. The assessment mirrors the approach taken in other FIAs and assumes that PFO will replace virgin fuels saving the carbon associated with their production. In this case it is estimated that the Quality Protocol could result in an annual saving of approximately 7.5 million tonnes of carbon emissions.

Costs related to the introduction of a Quality Protocol for PFO

The FIA assumes that there will be costs associated with complying with the Quality Protocol in respect to sampling and testing costs to demonstrate compliance with the specification however there may be wider and much more significant costs resulting from the introduction of the Quality Protocol. Research with the TAG resulted in the opinion that if the continuing legislative uncertainty was ended by the rejection and monitoring compliance with the Quality Protocol, they, companies involved in waste oil treatment would commit to investing in high technology processes such as re-distillation. This would result in a greater volume of waste oil being recycled into base oil rather than burnt as a fuel in line with the objectives of the Waste Framework Directive. This scenario results in a greater increase in benefits than the low scenario of the Quality Protocol introduction in which 75% of processed waste oil remains non-compliant RFO. The central and high scenarios result in a net benefit from the introduction of the Quality Protocol.

Current users of RFO will be affected by the rising price of PFO as competition from other markets increases. The advantage they had of holding an Environmental Permit and being WID compliant will no longer be relevant as Quality Protocol compliant RFO is no longer considered a waste. However, it is likely that RFO will continue to be manufactured, at least in the short term, as not all processers will be able to produce fuel oil that will meet the specifications in the Quality Protocol and re-refining capacity will take time to establish.

If PFO substitutes virgin distillate oil equivalent and residual oil equivalent, virgin fuel suppliers may be adversely affected by the introduction of the Quality Protocol as the use of PFO could potentially reduce demand. However, PFO will not be suitable for all applications due to the high ash content and therefore the demand for virgin fuels is not expected to be impacted significantly.

The Environment Agency and its partners would have to bear the costs of removing RFO from the regulatory regime, loss of income and the costs of the Quality Protocol process. But depending on the regulatory arrangement for introducing and monitoring the Quality Protocol, they could also have less work and therefore lower costs.

There would be costs associated with marketing and communicating the Quality Protocol to industry, the public and other regulatory and government bodies.

6.3 Conclusions

The financial impact assessment has shown that the introduction of a Quality Protocol for PFO could provide a range of benefits to the industry and to fuel users in the central and high scenarios however, this is not the case for the low scenario in which the potential for increased re-refining of waste oil is decreased by its introduction. Benefits would filter down to waste oil producers, collectors and the environment as waste oil increases in value.

The main benefit comes from the increase in market value associated with an increase in re-refining and the removal of the requirement on users of PFO to hold an Environmental Permit and be WID compliant. This opens up a wide range of markets with any users of distillate oil equivalent and residual oil equivalent becoming potential customers. The status of PFO as a fuel will further stimulate demand and help PFO reach its market potential. The Quality Protocol is also expected to increase customer confidence by providing guaranteed quality and consistency further supporting the utilisation of PFO.

As previously mentioned, the end of the legislative uncertainty and the introduction of the Quality Protocol is expected to stimulate the development of re-refining capacity in the UK. It is assumed that waste oil processors will need to invest in re-distillation technology in order to produce Quality Protocol compliant PFO. A relatively low level of technology will be required to produce PFO that meets the specification for a residual oil equivalent however, significantly more investment would be required to meet the specification for the distillate oil equivalent and therefore it is envisaged that processors would choose to manufacture higher value base oil at such facilities and PFO equivalent to the gas oil specification would be produced only as a by-product of this process.

The financial benefits associated with the stimulation of markets for PFO and base oil are expected to range from a net reduction of £241 million compared to Option A in the low case scenario to a benefit of £425 million in the more optimistic scenario over the 10 year period of the assessment. The central scenario results in a net benefit of £92 million over the 10 year assessment period. Most of these benefits accrue from the increase in market value of PFO and the manufacture of base oil.

In addition to the financial benefits, there are environmental benefits from:

- a potential reduction in carbon emissions;
- reduction in amount of virgin fuel and lubricants used; and
- a reduction in exports.

In contrast, the costs associated with implementing and complying with the Quality Protocol are limited. At present the arrangements for demonstrating compliance with the Quality Protocol have not been agreed and additional costs may result if, for example, a certification scheme is introduced.

The conclusion from the cost benefit analysis is therefore that, on the whole, introduction of a Quality Protocol for waste oil would be of benefit to the industry.

7.0 Small Firms Impact Test

The majority of the firms currently involved in the manufacture of RFO and current users are relatively large and cannot be considered to be SMEs.

Small firms selling products to markets that could be targeted by PFO manufacturers may be affected by the implementation of the Quality Protocol, e.g. virgin fuel suppliers.

Table 10 summarises the consultation on the impact of the Quality Protocol on small firms.

Table 10: Summary of small firms impact test consultation

Company name	Sector	Size	Contact method	Impact
TAG	Defra, Environment Agency, SEPA, WRAP and industry	Various	2 TAG meetings	
	RFO manufacturers	Various	2 TAG meetings	Positive impact upon its products
	RFO Users	Various	2 TAG meetings	Positive impact as regulatory burden removed

8.0 Competition Assessment

The markets that would be affected by the introduction of a Quality Protocol for waste oil include:

- Cement and lime manufacture;
- Power generation;
- Roadstone and Quarrying;
- Steel manufacture;
- Waste oil exporters; and
- Suppliers of virgin heavy fuel oil and gas oil.

The introduction of the Quality Protocol will enable PFO to be classed as a fuel rather than a waste and hence put the fuel on a more competitive position relative to alternatives and virgin fuels. This may displace the alternatives in the various markets.

The Quality Protocol may also stimulate competition between the different producers of PFO. In the event that the PFO producers were competing for the same markets, compliance with the Quality Protocol could be a deciding factor behind which fuel to use.

Compliance with the Quality Protocol is a voluntary issue and non-compliance may make the material less desirable to end users.

9.0 Enforcement, Sanctions and Monitoring

If the Quality Protocol is not complied with (e.g. the RFO is not produced to the approved standard), the processors/user will have to comply with waste regulations and may be committing an offence if they do not do so.

Even if the Quality Protocol is complied with, the fuel may become waste again and be subject to regulatory waste controls if, for example, it is at any stage:

- disposed of;
- stored indefinitely with little prospect of being used; or
- used in a way that poses a risk to human health or the environment.

The method of enforcement and/or compliance monitoring has not yet been agreed. However, companies will not sign up to the Quality Protocol unless they have confidence in its effectiveness.

There could be costs of removing RFO from the regulatory regime, loss of income and costs of the Quality Protocol process to the Environment Agency and its partners. But depending on the regulatory arrangement for introducing and monitoring the Quality Protocol, there could also be less work for the Environment Agency and therefore lower costs. The charges for waste regulation are set to cover the costs and it could be argued that there would not be any significant net costs to the Environment Agency.

10.0 Admin Burdens Calculations

Admin burdens are the costs to operators of complying with regulations and include the costs of:

- reporting information;
- familiarisation with forms;
- gathering and preparing data;
- inspections;
- meetings;
- form submission; and
- settlements.

The cost of these activities to operators is included in the estimate of the cost of compliance with regulations (see Table 8).

This evidence base uses the administrative burden associated with notifying a premise as a hazardous waste producer and applications for transfrontier shipments of waste as calculated under the 2005 Admin Burdens Measuring Exercise undertaken by all government departments.

11.0 Compensatory Simplification (offsetting)

Following the introduction of the Quality Protocol, it will not be necessary for companies to comply with existing waste regulations if the materials they are using meet the required standards. Compensatory simplification measures are not relevant to the analysis.

12.0 Race Equality Impact Assessment

The Quality Protocol is not expected to have an impact on race equality.

13.0 Gender Impact Assessment

The Quality Protocol is not expected to have an impact on gender equality.

14.0 Rural proofing

The Quality Protocol is not expected to have an impact on rural circumstances and needs.

Appendix 1: References

1. Waste Strategy 2007, Defra, 2007. Available from http://www.defra.gov.uk/environment/climatechange/research/carboncost/index.htm) [accessed 23/06/08]

2. DRAFT WASTE OILS: Arising and minimisation Group), Hazardous Waste Forum, pre June 2005. Available from http://www.defra.gov.uk/environment/waste/hazforum/pdf/hwf-3-5iii.pdf [Accessed 23/06/08] [accessed 23/06/08]

3. Final Report, Waste Oil Technical Advisory Group, February 2008

4. Waste Oil Recycling: Oil Waste Arisings and Recycling Rates, Department of Trade and Industry, January 2001. Available from http://www.environment-agency.gov.uk/commondata/acrobat/oil.pdf [accessed 23/06/08]

5. UK Waste Oils Market 2001, Oakdene Hollins Ltd for the DETR. Available from http://www.defra.gov.uk/environment/waste/topics/oils/pdf/wasteoils.pdf [accessed 03/07/08]

6. HM Treasury Green Book. Available from http://greenbook.treasury.gov.uk/chapter02.htm [accessed 03/07/08]

7. Defra guidance on the Shadow Price of Carbon (SPC). Available from http://www.defra.gov.uk/environment/climatechange/research/carboncost/index.htm) [accessed 03/07/08]

8. Regulation of Waste Oil. Interim Arrangements, August 2008, Environment Agency. Available from http://www.environment-agency.gov.uk/commondata/acrobat/version3_1865514.pdf

9. Ecological and energetic assessment of re-refining used oils to base oils: Substitution of primarily produced base oils including semi-synthetic and synthetic compounds, February 2005, Ifeu Ltd. Available from http://www.defra.gov.uk/environment/climatechange/research/carboncost/index.htm) [accessed 22/06/09]

Appendix 2: TAG Members

ORGANISATION	REPRESENTATIVE
Association of Electricity Providers	Andy Limbrick
British Cement Association	Murray Hislop
	David Pocklington
BVA	Detlev Bruhnke
Federation of Petroleum Supplies	Peter Bamber
	Geoff Shaw
BERR/BIS	Andy Roberts
Defra	Andy Howarth
	John Macintyre
EIC	Robert Oakley
	Richard Abel
Energy Institute	John Phipps
	Bob Hooks
Environment Agency	Amin Anjum
	Amanda Barratt
	Haydn Jones
	Richard Martin
	Paul Weston
EUROPIA	Howard Hayes
GEIR	Christian Hartmann
Joint Environment Programme	Richard Busby
LACORs	Neil Talbot
NISP	Adrian Murphy
Oil Recycling Association (ORA)	Roger Creswell
	Keith Roberts
OSS	Andy McNair
	Chris Williamson
Quarry Products Association (now known as the Mineral Products Association)	Sarah Baldry
	Malcolm Simms
UK Lubricants Association (UKLA)	Rod Parker
	Patrick Dyke
UKPIA	Ian MacPherson

Appendix 3: Assumptions used in the modelling

General assumptions

1. Lubricant production is assumed to fall by 2% per annum from 2006-2010 and 0.5% per annum thereafter.

2. The proportion of potentially recoverable oil (i.e. lubricants not lost to the environment) is assumed to be 55%.

3. Production losses from the manufacture of RFO and PFO are assumed to be 35% due to the removal of water and contaminants.

Waste regulation compliance costs assumptions

4. The number of RFO producers in the UK was estimated to be 64 (taken from the Environment Agency REGIS database) and it was assumed that they would notify the Environment Agency of their site being a hazardous waste producer via the internet (£18 per annum).

5. The cost of applying for transfrontier shipments was estimated by estimating the number of loads, based on a medium range tanker carrying 25,000T and the applicable application fee is for 1-5 loads per annum.

6. Current users of RFO that are WID compliant are assumed to burn other waste derived fuels and therefore will be required to maintain these standards when the Quality Protocol is introduced. The same has been assumed for registered waste carriers.

Costs of complying with the Quality Protocol

7. It has been assumed that PFO manufacturers will be required to take and analyse one sample per batch and that a batch will be 30T.

8. The tests required will be the standard for BS2869 IP163 (the new test for waste derived oils) in addition to tests for inorganic and organic halides.

9. No costs have been modelled for certification costs.

Carbon emissions and savings

10. The carbon savings attributed to using PFO were assumed to be 100 per cent of the carbon emitted during production of the virgin fuels they substitute. Although PFO production also produces CO_2, waste oil will continue to be produced as a result of lubricant use and this production will not be influenced by the Quality Protocol.

11. The cost savings from the reduction in carbon emissions were calculated using the Shadow Price of Carbon, which was assumed to increase by 2 per cent per year as per Defra guidance.

Breakdown of the scenarios

12. A detailed breakdown of the assumptions relating to the options is given in Table A1. Estimates of the current markets for RFO and the effects on these of the introduction of the Quality Protocol have been developed in consultation with the TAG.

Table A1: Detailed breakdown of assumptions

Assumptions	Option A – Baseline (No QP)	Option B – Low	Option B - Central	Option B2 – High
QP compliance rate	N/A	25%	40%	100%
Market breakdown projections	Without the Quality Protocol and with the withdrawal of the Environment Agency interim position, the market breakdown is assumed to be as follows for 2006-2008: 26% - cement & lime kilns 64% - blast furnaces 0% - roadstone coating plants 10% - export for re-refining From 2009-2010, the breakdown is assumed to be: 40% - power stations 40% – cement & lime kilns 10% - roadstone coating plants 10% - export for re-refining From 2011-2016, the breakdown is assumed to be: 65% – cement & lime kilns 10% - blast furnaces 25% - re-refined to base oil From 2017-2020, the breakdown is assumed to be: 12% - cement & lime kilns 13% - blast furnaces 75% - re-refined to base oil	The Quality Protocol is assumed to affect the markets from 2011 onwards. Before then, the market breakdown is assumed to be the same as Option A. From 2011, the markets for RFO (75% of the total) are expected to be as follows: 74% - cement & lime kilns 16% - blast furnaces 10% - exported for re-refining From 2011, the markets for PFO and base oil (25% of total) are expected to be as follows: 25% - users of residual oil equivalent 56% - base oil users 8% - users of distillate oil equivalent 11% - blast furnaces	The Quality Protocol is assumed to affect the markets from 2011 onwards. Before then the market breakdown is assumed to be the same as Option A. From then the markets for RFO (60% of the total) are expected to be as follows: 74% - cement & lime kilns 16% - blast furnaces 10% - exported for re-refining From 2011, the markets for PFO and base oil (40% of total) are expected to be as follows: 25% - users of residual oil equivalent 56% - base oil users 8% - users of distillate oil equivalent 11% - blast furnaces	The Quality Protocol is assumed to affect the markets from 2011. Before then, the market breakdown is assumed to be the same as Option A. From 2011, the markets are expected to be as follows: 25% - users of residual oil equivalent 56% - base oil users 8% - users of distillate oil equivalent 11% - blast furnaces

Waste & Resources
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