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Localised production and supply of biodiesel from used cooking oils

State of the Art in Europe

A report from WP 2 of the European Commission
Intelligent Energy Europe project EIE/06/090/S12.448899 "BioDieNet - Developing a network of actors to stimulate demand for locally produced biodiesel from used cooking oils"

By

Idun Husabø Anderssen[1], Crispin Webber[2], Roger Kelly[2] and Otto Andersen[1]

[1]Western Norway Research Institute
[2]Thames Energy Ltd., UK
[3] Energy Solutions (North West London), UK

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Summary:
This report presents the results from a pilot action project on developing a network of actors to stimulate demand for locally produced biodiesel from used cooking oils. The main subject of the project is the establishment of production, as well as the promotion, of biodiesel produced from used cooking oil (Used Cooking Oil Methyl Ester – UCOME).

This report deals specifically with Work Package 2 of the project, through which it is sought to establish the state of the art within the production of UCOME. This work has been led by Western Norway Research Institute. Forming the main basis of the report, surveys have been conducted among the project partners. The main objective of these surveys has been to establish the status quo on production of UCOME in the ten countries in question: Holland, Italy, Portugal, Spain, Germany, Hungary, Norway, Romania, Bulgaria and the United Kingdom. Subcontract works performed by Thames Energy have provided information on the financial, health and safety issues connected with biodiesel production in general and UCOME in particular. In addition, literature surveys have been conducted to obtain an overview of relevant projects and initiatives in Europe.

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Preface

This report has been produced for the BioDieNet project, funded by the European Commission's programme *Intelligent Energy Europe (IEE)*. BioDieNet is a 3-year project, starting in 2007, and includes partners in ten countries across Europe. The main focus of the project is the establishment of production, as well as the promotion, of biodiesel produced from used cooking oil (Used Cooking Oil Methyl Ester – UCOME).

This report deals specifically with the work of establishing the state of the art within the production of UCOME. This work has been led by Western Norway Research Institute. Forming the main basis of the report, two surveys have been conducted among the project partners. The main objective of these surveys has been to establish the status quo on production of UCOME in the ten countries in question: Holland, Italy, Portugal, Spain, Germany, Hungary, Norway, Romania, Bulgaria and the United Kingdom. In addition, literature surveys have been conducted to obtain an overview of relevant projects and initiatives in other parts of Europe.

Some of the work for WP2 has been subcontracted, but all results pertaining to this Work Package are presented in this report. A substantial subcontract work has been performed by Thames Energy on health and safety issues connected with biodiesel production in general and UCOME in particular. Another subcontract, on financial issues, has also been performed by Thames Energy. Finally, Energy Solutions (North East London) has contributed the chapter on legal issues related to the direct involvement of energy agencies in UCOME production.

Sogndal, 27 December 2007

Otto Andersen

Contents

1 SUMMARY 1

2 OVERVIEW AND BACKGROUND OF THE WORK 4

2.1 Overview of BioDieNet 4
2.1.1 The 4 phases 4
2.1.2 The BioDieNet Partners 4

2.2 Background for WP2 8

3 METHODOLOGY 10

4 TASKS 1-3 13

4.1 Introduction 13

4.2 Results 14
4.2.1 Availability and use of UCO 14
4.2.2 Production of UCOME 34
4.2.3 Supply of UCOME 45

4.3 Conclusions on UCO and UCOME amounts 52

4.4 Suppliers of equipment for localised UCOME production 53

5 TASK 4 - ASSESSMENT OF LOCAL MARKETS FOR BIODIESEL 58

5.1 Main customers for the local biodiesel production 58

5.2 Size of customer fleets and type of vehicles 58

5.3 Potential customers 58

5.4 Summary 59

6 TASK 5 – FINANCIAL, LEGAL & HEALTH AND SAFETY ISSUES 59

6.1 Financial 59
6.1.1 Biofuel Funding Options 59

6.2 Legal 63
6.2.1 Legal issues related to the direct involvement of energy agencies in UCOME production 63
6.2.2 The IPPC Directive and its implementation in the different EU member states 65

6.3 Health and Safety 67
6.3.1 Biodiesel production 67
6.3.2 Advantages of biodiesel 71
6.3.3 Disadvantages of biodiesel 72
6.3.4 Biodiesel storage and use 74
6.3.5 Hand held power tools and other work equipment 147
6.3.6 Oil storage regulations 149
6.3.7 Manual handling and lifting 152
6.3.8 Fire safety regulations 153

7 TASK 6 – OVERVIEW OF PROJECTS 156

7.1 Member States situation 156
7.1.1 Portugal 156

7.1.2 Hungary 157
7.1.3 United Kingdom 158
7.1.4 Norway 169
7.1.5 Germany 170

7.2 Other European projects and initiatives for localised biodiesel production 173
7.2.1 Mureck 173
7.2.2 EU projects 179

8 CONCLUSIONS 187

9 REFERENCES 187

10 APPENDIX 1: QUESTIONNAIRE 1 (TASKS 1- 3) 189

11 APPENDIX 2: QUESTIONNAIRE 2 (TASKS 4 AND 6) 193

List of figures

FIGURE 1 LOCATIONS OF ACORN COLLECTORS IN UK 19
FIGURE 2 SCHEMATICS OF A BIODIESEL PLANT 70
FIGURE 3 FROM THE MILVENN PRODUCTION FACILITIES 169
FIGURE 4 FUEL CONSUMPTION IN BUSES - UCOME COMPARED WITH FOSSIL DIESEL 175
FIGURE 5 CO EMISSIONS IN BUSES - UCOME COMPARED WITH FOSSIL DIESEL 176
FIGURE 6 NO_X EMISSIONS IN BUSES - UCOME COMPARED WITH FOSSIL DIESEL 177
FIGURE 7 PM EMISSIONS IN BUSES - UCOME COMPARED WITH FOSSIL DIESEL 178
FIGURE 8 HC EMISSIONS IN BUSES - UCOME COMPARED WITH FOSSIL DIESEL 179

List of tables

TABLE 1 DISTRIBUTION OF SOURCES OF USED COOKING OIL IN THE 10 COUNTRIES 15
TABLE 2 MAIN COLLECTORS OF UCO IN EACH COUNTRY 19
TABLE 3 TYPES OF OIL USED AS INPUT IN THE MAIN FORMS OF UCO IN EACH COUNTRY 21
TABLE 4 NATIONAL REGULATIONS APPLYING TO THE USE OR DISPOSAL OF UCO 24
TABLE 5 ESTIMATED AMOUNT OF UCO COLLECTED IN EACH COUNTRY 27
TABLE 6 ESTIMATED AMOUNT OF UCO UTILIZED IN EACH COUNTRY 27
TABLE 7 ESTIMATED AMOUNT OF UCO DUMPED IN EACH COUNTRY 27
TABLE 8 COSTS OF COLLECTING UCO 29
TABLE 9 COSTS OF DUMPING UCO 30
TABLE 10 MAIN ENVIRONMENTAL IMPACT OF UCO 32
TABLE 11 ENERGY USED FOR UCO COLLECTION AND DUMPING 34
TABLE 12 MAIN USES FOR UCO BESIDES BIODIESEL PRODUCTION 35
TABLE 13 PRODUCTION FACILITIES FOR UCOME 37
TABLE 14 TECHNOLOGIES USED IN THE MAIN PRODUCTION FACILITIES UCOME 39
TABLE 15 BIODIESEL QUALITY IN THE MAIN PRODUCTION FACILITIES FOR UCOME 41
TABLE 16 AMOUNT OF UCOME PRODUCED 42
TABLE 17 ENVIRONMENTAL IMPACT OF PRODUCING UCOME 44
TABLE 18 MAIN DISTRIBUTORS OF UCOME 47
TABLE 19 TYPE OF LOGISTICS USED BY DISTRIBUTORS OF UCOME 49
TABLE 20 USES FOR UCOME (IN % OF TOTAL AMOUNT OF UCOME IN THAT COUNTRY) 50
TABLE 21 MAIN ENVIRONMENTAL IMPACTS OF UCOME DISTRIBUTION 52
TABLE 22 UCO COLLECTED, UTILIZED AND DUMPED. UCOME PRODUCED 53
TABLE 23 SUPPLIERS OF EQUIPMENT FOR LOCALISED UCOME PRODUCTION 54
TABLE 24 CHANGES IN REGULATED EMISSIONS WITH BIODIESEL 72
TABLE 25 DEGRADABILITY OF BIODIESEL COMPARED WITH FOSSIL DIESEL 174

1 Summary

This report presents the results from the project BioDieNet - Developing a network of actors to stimulate demand for locally produced biodiesel from used cooking oils. This is a pilot action project in the European Commission's programme *Intelligent Energy Europe (IEE)*. BioDieNet is a 3-year project, which started in 2007, and includes partners in ten countries across Europe. The main purpose of the project is establishing and promoting biodiesel produced from used cooking oil (Used Cooking Oil Methyl Ester – UCOME) in the various European countries included in this study.

This report presents an overview and background of BioDieNet and describes its four main phases:

1. Information gathering and synthesis (WP2)
2. The development of tools and resources (WP3)
3. The set up of demonstration activities (WP 4-6)
4. Dissemination (WP 7/8) and Project Coordination (WP1)

The report gives a background for the work, which deals specifically with Work Package 2 of the project. Through this work, it has been sought to establish the state of the art within the production of UCOME. The methodology used in the various tasks of the Work Package is then presented. Tasks 1-3 encompassed:

1. Assessment of UCO availability, quality and logistics of collection for each country together with common data across all regions
2. Overview of technology, standards and economics
3. Assessment of local markets for fuel distribution, with a particular focus on learning from best practices and frontrunners of localised biodiesel fuel distribution

Forming the main basis of the report, surveys have been conducted among the project partners for these three tasks. The main objective of these surveys has been to establish the status quo on production of UCOME in the ten countries in question: Holland, Italy, Portugal, Spain, Germany, Hungary, Norway, Romania, Bulgaria and the United Kingdom.

The results indicate that restaurants represent s the primary UCO source for most of the BioDieNet countries, although the domestic sector and food processing industry are also of importance. Most of the Western European BioDieNet countries have well established collection systems for UCO, but this is not the situation in Bulgaria, Romania and Hungary. There are substantial variations between the countries in terms of what type of virgin oil is used as cooking oil. Sunflower, palm and soy are the most common types of oil, while rape, olive and peanut oil occurs. Eastern European countries rely rather heavily on sunflower oil. Most of the western European countries have regulations preventing UCO dumping. The main environmental impacts of UCO appear to be water pollution from dumping. Clogging of sewer pipes also constitutes a problem. In addition to biodiesel production, several uses of UCO are found, including heating oil, presswood industry, lubricating oil, soap production, chemical industry, animal feed, and asphalt processing.

Production facilities for UCOME exist in Portugal, Spain, Germany, Norway, UK, and Bulgaria. There are specific distributors of UCOME in the UK, Spain and Germany. The main environmental impacts from the UCOME production appears to be 1) waste water from cleaning the UCO containers, 2) impact from the transport of UCO to production facility, 3) waste from UCO filtration, 4) disposal / use of low grade glycerine, 5) packaging waste, and 6) upstream impacts from electricity consumption.

A rather extensive list of suppliers of equipment for localised UCOME production has been compiled. This is, however, to a large extent based on suppliers who were represented at the Biodiesel Expo 15 & 16 October 2007 in Nottinghamshire, UK, causing dominance by UK suppliers.

The local markets most likely to be utilised for localised UCOME encompass average size transport fleets with 50-100 vehicles. These could be municipal fleets of cars and small lorries, waste collection fleets, buses as well as car rental enterprises.

The total annual amount collected UCO in the BioDieNet countries has been estimated to about 772 thousand m^3. The amount biodiesel that is produced from this source is about 533 thousand m^3. Total fatty acid methyl ester (FAME) production in the EU-25 in 2005 has earlier been estimated to 3.2 million tonnes. The total amount of 533 thousand m^3 UCOME corresponds to 0.43 million tonnes, when applying an average density of 0.8. The UCOME production in the ten BioDieNet countries thus constitutes about 13 % of the FAME produced in EU-25.

Throughout the European countries, a variety of funding options exist for establishing UCOME production. These vary in range from business grants, financial incentives, community grants and loans. The assistance varies from countries having a wide range of alternatives to having different sources but limited financial options.

The legal status of Energy Agencies varies considerably between Member States, as does the national legislation relating to the establishment and management of biodiesel production from used cooking oils. There is in principle no barrier to the involvement of Energy Agencies in biodiesel production. The precise legal structure of any production company, however, will have to be tailored to the particularities of each agency's legal status and the company law in force in the relevant Member State. The nature of the business under consideration by the BioDieNet project – small scale, localised biodiesel production – means that each enterprise is unlikely to provide employment for more than 3 or 4 staff. The turnover of such an enterprise however, because of the high value of the end product, is unlikely to be less than €350,000 a year and could be several times higher. A business of this scale lends itself to the following possible company structures:

- A simple partnership where all the individuals involved share risks and profits equally
- A limited company where all the individuals involved are directors
- A non-profit company or social enterprise with defined community benefit as its primary aim
- A worker co-operative, which can be either profit-making or non-profit

Legal aspects covered in the report also include the implementation of the integrated pollution prevention and control, the so-called IPPC Directive 96/61/EC. The directive and its implementation in the EU member states have been described.

Extensive information has been gathered on the health and safety issues associated with biodiesel production in general and UCOME in particular. This includes 1) description of biodiesel production, 2) advantages and disadvantages of biodiesel, 3) biodiesel storage and use, 4) relevant tools, 5) oil storage regulations, 6) manual handling and lifting, as well as 7) fire safety regulations.

Literature surveys have been conducted to obtain an overview of BioDieNet relevant projects and initiatives in Europe.

Finally, the main conclusions from the work carried out in the project are presented.

2 Overview and background of the work

2.1 Overview of BioDieNet

2.1.1 The 4 phases

There are essentially four phases to the BioDieNet project:

1. Information gathering and synthesis (WP2)
This phase recognises the existence of multiple sources of information and experience from across Europe concerning the supply chain of biodiesel UCOME. It aims to make the first comprehensive analysis of this state of the art to form the basis of the later project phases.

2. The development of tools and resources (WP3)
The second phase takes the results of the first and develops from them a set of tools and resources which provide concise and comprehensible guidance to market actors in any Member State. With this guidance new biodiesel production facilities can be initiated and vehicle fleets converted to biodiesel.

3. The set up of demonstration activities (WP 4-6)
Using the tools and resources developed in WP3, Work packages 4-6 focus on bringing collected knowledge and tools into practice. The three work packages reflect three major focal points (and target groups) within the supply chain for establishing successful biodiesel demonstrations on local scale: production of local biodiesel plants (WP4), distribution facilities for biodiesel (WP5), and demand development for fleets (WP6).

The demonstration phase forms the heart of the BioDieNet action; WP 2 and 3 are focused on providing deliverables (e.g. tools) that enable successful and efficient demonstration activities.

4. Dissemination (WP 7/8) and Project Coordination (WP1)
During the full duration of the project, dissemination activities (WP 7/8) are carried out in which results from the individual work packages are disseminated to relevant target groups including project partners, BioDieNet supporters, EC delegates as well as relevant target groups. This phase covers a wide range of dissemination techniques, from printed and electronic handbooks to workshops and training sessions, ongoing networks, all having the ultimate goal of increasing the uptake of biodiesel among public and private transport fleets across the EU.

An overarching work package is concerned with the management of the project from start to finish, ensuring proper coordination, quality assurance and budgetary control (WP1).

2.1.2 The BioDieNet Partners

Most of the partners are energy agencies, but a research institute and a biodiesel producer are also represented. The Partners are:

Coordinator:

Energy Solutions (North West London) - ESNWL
UK
Energy Agency
Contact: Roger Kelly
Address:
Unit 4.15 Wembley Commercial Centre
East Lane
Wembley
HA9 7XX
Tel: +44 20 8904 2444
Email: roger@energysolutions.org.uk

Co-beneficiaries:

Ecofys b.v. - ECOFYS
Netherlands
Research & consultancy company
Contact: Menno Chang
Address:
Kanaalweg 16-G
3526 KL
Utrecht
Tel: +31 30 2808 449
Email: M.F.Chang@ecofys.nl

North East London Energy Efficiency Advice Centre - NELEEAC
UK
Energy Agency
Contact: Dr Crispin Webber
Address:
Energy Centre
31 Church Hill
London
E17 3RU
Tel: +44 20 8509 4365
Email: dcwebber@aol.com

Agência Municipal de Energia e Ambiente de Oeiras - OEINERGE
Portugal
Energy Agency
Contact: Tiago Gaio
Address:
Taguspark, Edifício Inovação I
Sala 212 D, Porto Salvo
2740-257
Oeiras
Tel: +351 214 214 010
Email: tiago.gaio@oeinerge.pt

Agência Municipal de Energia de Sintra - AMES
Portugal
Energy Agency
Contact: João Barroso
Address:
Avenida Coronel Linhares de Lima
2705-351
Colares - Sintra
Tel: +351 21 928 12 41
Email : jbarroso@ames.pt

Western Norway Research Institute - WNRI
Norway
Research Institute
Contact: Otto Andersen
Address:
Sognahallen, P.Box 163
6851
Sogndal
Tel: +47 57 67 61 71
Email: otto.andersen@vestforsk.no

Milvenn
Norway
Biodiesel producer/supplier
Contact: Karsten Aubert
Address:
Eidsvaagvn.150
5105 Bergen
Tel: +47 4114 6666
Email: ka@daimyo.no

Sofia Energy Centre - SEC
Bulgaria
Energy Agency
Contact: Ivanka Pandelieva
Address:
37 Galitchitsa Str.
1164 Sofia
Tel: +359 (2) 962 8447
Email: ivankap@sec.bg

Innoterm
Hungary
Engineering Office & Consultancy
Contact: Miklós Fráter
Városligeti fasor 47-49
H-1071

Budapest
Tel: +36 / 1 / 343 12 80
Email: miklos.frater@innoterm.hu

Agència Energètica de la Ribera - AER
Spain
Energy Agency
Contact: Mª Pilar Pérez
Address:
Plaça Argentina, 1
46680
Algemesí
Tel: +34 96 242 46 41
Email: aer@aer-ribera.com

Agency of Brasov for the Management of Energy & Environment - ABMEE
Romania
Energy Agency
Contact: Radu Gaspar
Address:
Eroilor Bdv., No. 8
Brasov
500 007
Tel: +40 268 474 209
Email: office@abmee.ro

Brent Community Transport - BCT
UK
Community Transport operator
Contact: Newy Nottingham
Address:
Unit 29/30 Bridge Park
Brentfield
Harrow Road
London
NW10 0RG
Tel: +44 20 8838 1353
Email: newy@brentct.org.uk

Agenzia Veneziana per l'Energia - AGIRE
Italy
Energy Agency
Contact: Cristian Carraretto
Address:
c/o VEGA
via delle Industrie 17/a
I - 30175 Venezia Marghera
Tel: +39 41 5094251
Email: carraretto@veneziaenergia.it

ENERGIA E TERRITORIO SPA - ET
Italy
Contact: Adriano Pessina
Consultancy company
Address:
Lungo Tanaro Magenta, 7/A
15100
Alessandria
Tel: +39 393 9060260
Email: info@spesconsulting.com

Bundesverband freier Tankstellen e.V. - BFT
Germany
Association
Contact: Axel Graf Buelow
Address:
Ippendorfer Allee 1d
D-53127 Bonn
Tel: +49 173 5353020
Email: Axel.Graf.Buelow@bft.de

Federation of Scientific & Technical Associations -FAST
Italy
Association
Contact: Marieke Reijalt
Address:
Piazzale R. Morandi 2
20121 Milan
Tel: +39 340 791 4751
Email: marieke@h2it.org

Province of Fryslân - FRYSLAN
Netherlands
Local Authority
Contact: Geert Knobbe
Address:
Tweebaksmarkt 52
8900 HM
Leeuwarden
Tel: +31 58 2925147
Email: g.knobbe@fryslan.nl

2.2 Background for WP2

There is much debate as to the viability and potential for smaller scale biodiesel production. For the BioDieNet project, with the focus on UCOME, the first point of contention is to the availability and irretrievability of the used cooking oil resource itself. There is still very little data available on this issue. In the document 'Recycled Cooking Oils: Assessment of risk for public health', by STOA Panel (European

Commission - Directorate General of Research, 2000), it is argued that there is a specific need for more information on the extent of used cooking oil production and disposal. It states: “At the moment there are no figures on the volume of these oils collected from catering or restaurant chains. Such lack of data does not permit to make decisions nor draw conclusions on the magnitude of the issue in question.”

There have been many projects funded through ALTENER and STEER as well as through the LIFE programme which have addressed a varying range of issues concerned with the supply chain of biodiesel, some of which have focused specifically on UCOME and/or on local supply/demand issues. There is, however, no comprehensive and catalogued body of information which brings together the findings of all these projects and others which have not been funded through European Commission programmes. The purpose of BioDieNet Work Package 2 has therefore been to create a definitive synthesis of information from across Europe concerning the state of the art in localised production and supply of UCOME. The WP builds on data accumulated by other ALTENER projects relating to localised biodiesel production and supply.

There is evidence in some cities that the amount of available local UCO is much higher than official statistics suggest. In London recent other studies have shown a possible 50 million litres plus of retrievable UCO within the city, which would allow for two or three local plants producing 10 to 20 million litres per annum, or several producing less. WP2 in BioDieNet has sought to answer the question as to what degree this may be the case in other European towns and cities. The viability of such a scheme in cities such as London has never before been proved. One of the main aims of this project has therefore been to establish the real potential for smaller scale biodiesel production from UCO and its viability within the various partner countries. The results are important for demonstrating what scales of production are the most suitable for which regions.

This status overview should thus provide insight into readily available knowledge concerning localised biodiesel production (e.g. from other EU projects) as well as assessing knowledge gaps relevant for developing useful handbooks and tools in WP3 of BioDieNet. Furthermore, more insight into the particular knowledge gaps and information requirements of supply chain actors needs to be collected as an input to develop dedicated BioDieNet tools which address these issues.

3 Methodology

WP 2 of the project has been divided into six main tasks:

Task 1- Assessment of UCO availability, quality and logistics of collection for each country together with common data across all regions:

- UCO availability assessment:

This encompasses looking at not just the quantity of UCO being generated within the target area, but also the type of oil being generated, as to its appropriateness for biodiesel production.

- Current UCO collection methods:

This varies from country to country and the consortium has endeavoured to analyse the various different practices that exist in each partner country for UCO collection. Traceability and quality control are essential if a successful supply chain is the ultimate aim.

- UCO collection logistics & costs:

The costs and logistics of the various methods will be examined to reach conclusions as to what methods are most appropriate for the production of biodiesel. This may differ from region to region.

- Impacts of UCO on sewage systems:

The consequences of illegal disposal of UCO into the sewage system have been investigated in collaboration with the water authorities in each partner country. It has been important to discover how much is being illegally disposed of and how much it costs to alleviate this. Such costs can then be included in the business case in favour of biodiesel production.

Task 2-Overview of technology, standards and economics:

- Technology & Capital costs:

There are a number of suppliers of small and medium scale biodiesel plants. It has therefore been of vital importance to evaluate the various different companies and systems to decide which are the best value for money and will meet the requirements within the partner regions for satisfactory production of biodiesel from UCO.

- Quality control:

Of critical importance to any biodiesel supply chain is a quality assurance of EN14214. The equipment supplier must be able to guarantee this. This includes a degree of quality control of the UCO raw material, requiring a well managed collection system, as prescribed by the results Task 1.

- Location of plant:

The location of a plant is important for the logistics for transfer of waste to and product from the site, as well as the relevant planning and legislative requirements for the installation of facilities.

- Production costs:

The market for both UCO and biodiesel may be significantly different from country to country and the relative costs per litre have been examined and compared.

Economies of scale in relation to equipment, consumables & labour:
The various scales of production have been examined in this task to evaluate the merits of various scales of production and their potential profitability within their respective countries.

- Incentives:

Assessment of information requirements and incentives for potential biodiesel producers: Access to information, capital allowances and other potential incentives in each partner country for local biodiesel production have been examined.

Task 3-Assessment of local markets for fuel distribution.
This has had a particular focus on learning from best practices and frontrunners of localised biodiesel fuel distribution. It has included:

- Economics:

The issues of public/private filling stations, franchise, ownership and profit are looked at. Any biodiesel producer must be able to access his market through an effective form of distribution. Therefore there needs to be sufficient potential for the filling stations and other distributors to sell the fuel to customers and users. The experiences of BFT in Germany are of particular focus here. This biodiesel market is relatively mature and has been important for the understanding of how existing biodiesel distributors and suppliers have financed and managed their operations. This has enabled a transfer of best practice.

- Fuel supply:

This looks at markets, distribution channels and storage. The logistics of storage and distribution is essential for the successful transfer of the fuel from producer to distributor and to end users.

- Incentives:

This is an assessment of information requirements and incentives for distributors. Incentives for fuel distributors are crucial if they are to sell the fuel to their users. These are in the nature of public profile, financial benefit, distribution of income streams or other incentives. The incentives available and their efficacy have been evaluated on a country to country basis.

Task 4-Assessment of local markets for biodiesel

- Types of customer:

Potential customers for local biodiesel production are identified. This has drawn on previous studies with current users and existing interested customers in each country listed and compared. For this project the main target has been the fleets to be audited in Work Package 6 and local authority fleets working with the Energy Agencies. But the whole scope of potential customers has been looked at for each partner country.

- Incentives:

This has included assessment of information requirements and incentives for fleet operators and public authorities. Incentives for the use of biodiesel will depend on the end users. Public Authorities will most likely set different criteria than a private fleet operator. It is the aim of this task to explain the various incentives that currently exist in partner countries, and where possible, their relative successes expounded.

- Price:

This includes the price of biodiesel in partner countries. The absolute and relative price of biodiesel compared to diesel has been monitored. The price of biodiesel is critical to the success of any project. Prices will obviously vary according to the price of diesel and raw material. This task has, however, attempted to identify the critical price levels at which the prospects for biodiesel will no longer be financially viable.

- Specific issues:

This includes: vehicle warranties; effects on engine wear/maintenance; NO_x emissions; cold ambient temperature performance of fuel; second-hand vehicle market. Fuel performance is essential to winning the confidence of the end user. Important EC studies and from academic and scientific institutions have been consulted and their findings included to give input of the advantages and risks of the use of biodiesel in vehicles.

- Supply/demand balance:

Matching of the supply of UCO with the demand generated for the end product of biodiesel. The demand levels need to be controlled, and there is a need for a reliable and consistent supply chain. Artificially increasing demand that cannot be matched by supply will only lead to disappointed customers and give biodiesel a bad reputation. At the other extreme, oversupply not matched by demand will damage the sustainability of a biodiesel production facility.

Task 5-Financial, legal & Health and Safety issues relating to small scale biodiesel production

- Financial:

This has been an assessment of financial findings from previous tasks looking at the potential advantages of national/regional networks in relation to purchasing power and supply/demand balance. Financial consultants with expertise in capital investment have investigated and advised on the sources of capital, loan finance for SMEs & Community Businesses capital requirement (from Task 2).

- Legal:

This entails an overview of existing legal structures of Local Energy Agencies & constraints imposed advantages/disadvantages of trading subsidiaries:

  - Advantages/disadvantages of setting up independent Community Businesses
  - Advantages/disadvantages of creating a network of independent enterprises or a single enterprise with local autonomous branches.

Included are also the relevant national laws implementing Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control (IPPC Directive), Taxation regimes for biodiesel and bio-blends, Planning regulations and Required Licences.

- Health & Safety Requirements:

This has been the subcontracted work of Thames Energy, an expert in the field of Health and Safety Law and Compliance. It has covered setting out the responsibilities and procedures for the employers in relation to health and safety management at biodiesel production sites, including:

- Use and storage of methanol (flammable and toxic)
- Use of sodium hydroxide (corrosive and toxic)
- Use and storage of UCO and biodiesel (flammable)
- Manual handling of containers
- Occupational exposure to noise and fumes
- Use of vehicles off-site (UCO collection vehicles) and on-site (forklift trucks used for lifting IBCs and other large containers)
- Risks associated with construction and installation activities, including working from heights, manual handling, use of hand and power tools, and use of lifting equipment
- Oil Storage Regulations
- Fire prevention and control.

Task 6- Case Studies of existing and planned projects

This final but critical task in the WP has involved gathering information about all known localised biodiesel from UCO projects across all Member States, through regional networks and individual Energy Agencies. Learning experiences and ‘dos and don’ts’ from these initiatives have been gathered to be disseminated to relevant stakeholders in this project.

4 Tasks 1-3

4.1 Introduction

This chapter covers Task 1-3. The 3 tasks were as follows:

1. Assessment of UCO availability, quality and logistics of collection for each country together with common data across all regions
2. Overview of technology, standards and economics
3. Assessment of local markets for fuel distribution, with a particular focus on learning from best practices and frontrunners of localised biodiesel fuel distribution

A survey has been carried out in ten countries across Europe: Romania, Hungary, Spain, Portugal, Italy, Holland, Germany, Norway, Bulgaria and the United Kingdom.

In terms of methodology, the survey has been carried out by the use of a questionnaire distributed to the project partners in each of the ten countries (see appendix 1-2). The questionnaire was divided into three main parts. Part 1, with nine questions, focused on various issues related to UCO in each country. Part 2 contained eight questions, dealing with biodiesel production. Finally, part 3, with four questions, focused on matters related to the supply of UCOME.

Throughout the analysis, each question has been handled separately, according to a standard formula (described in the next paragraph). The partners have attempted to gather the requested information, and returned the completed forms to Western Norway Research Institute, following which the results have been summarized in this report. In cases where the respondents had not completed the questionnaires, or where the information stated by the respondent appeared to be erroneous, a second round of contact was made with the respondent, and the questionnaires were amended accordingly. For those questions where responses still were lacking, the information about this is not included in this report.

The structure of this part of the report is as follows: First, the objective for each question is stated. Second, the ten questionnaire responses are listed. Third, the information is summarised in the form of a table to bring attention to the most important results. Fourth, the main conclusions pertaining to that question are drawn. In this part, relevant methodological points are also discussed, where necessary. Finally, the main conclusions for the entire survey are drawn in the final section of the report.

In addition to the questionnaire survey, we have conducted a literature survey of the suppliers of equipment for localised UCOME production. This is limited to European suppliers.

4.2 Results

4.2.1 Availability and use of UCO

4.2.1.1 Main sources of UCO

Objective: Mapping the main sources of UCO in each country.

Questionnaire Responses:

Holland:
Main sources are restaurants and snack bars (about 40.000 in total). UCO from food processing industry is limited.

Italy:
1. families, 2. restoration – food industry

Portugal:
The UCOs in Portugal are produced mainly in the Domestic Sector (54%) and in Restaurants (45%). Food processing industry may be responsible for something like 1% of the total produced UCO in the county.

Spain:
Restaurants

Germany:
Restaurants, food processing industry, private customers (smaller quantity)

Hungary:
Restaurants

Norway:
1. Industrial frying processes:
Potato chips – Maarud, KIMS, Sørlandschips
Meatballs etc. – Gilde at Rudshøgda (smoked hickory tasted products),
Pre-processed food for heating up in microwave ovens)
Deep fried products (fish bits) Fonn, Egersund
Plentymat, processed meat products
Deep fried chicken, Prior,
Frozen "Pommes Frittes" Norsk Potetindustri
2. Restaurants and municipal waste

Romania:
There is no centralised data regarding UCO. We can only estimate that the domestic sector is the primary source for UCO, followed by the restaurants and food processing industry, but we cannot determine the percentage of each sector.

United Kingdom:
Approximately 65,000 tonnes of the 80,000 tonnes of used cooking oil collected in the UK from commercial and industrial sources originates from commercial catering establishments (81%), with the remaining 15,000 tonnes (19%) arising from the food processing industry.

Bulgaria:
Restaurants

Summary

The numbers 1-3 in the table below indicate primary source of UCO in the country* in question (1), secondary source (2), and tertiary source (3).

Table 1 Distribution of sources of used cooking oil in the 10 countries

Country	**Restaurants**	**Domestic sector**	**Food processing industry**
Holland	1		
Italy	2	1	2**
Portugal	2	1	3
Spain	1		
Germany	1	3	2
Hungary	1		
Norway	2		1
Romania	2	1	3
United Kingdom	1		2
Bulgaria	1		

* The questionnaire did not ask the respondents to rank the different sources of UCO. This was, however, done by several of the respondents, and thus the numbers 1-3 appear

in the table. In cases where no ranking was done, the numbers have still been used to indicate what is the primary, secondary and tertiary source.
** Shared second place between restaurants and food processing industry

Conclusions

- Restaurants constitute the main or primary source of UCO in six countries (Holland, Spain, Germany, Hungary, the UK and Bulgaria), and the secondary source in four countries.
- The domestic sector is the main source of UCO in three countries, Italy, Portugal and Romania.
- The food processing industry is only the primary source of UCO in one of the countries, Norway.

4.2.1.2 Main collectors of UCO in each country

Objective: Obtaining names of UCO collectors for each country.

Questionnaire responses:

Holland:
Main collectors are waste companies as Sita and some specialised companies as Rotie BV, Vierhouten Vet BV. In total about 60 companies are active in collecting and 7 companies in processing [2].

Italy:
A.N.CO –Associazione Nazionale Concessionari Consorzi-
(Association of the main companies of used oil collecting - vegetal and mineral)
The main collectors in the low Pindemont area are:
DOGNAZZI RENZO E ROBERTO S.N.C.
STR. VALENZA S. MARIA 4/M - 15033 - Casale Monferrato (AL)
ALSO SRL VIA ISOVERDE 1
16010 Isoverde – GE

Portugal:
In the whole county there might exist more than 20 private companies collecting UCO at the a.m. sources. Most of them collect the UCOs from Restaurants and/or Industry, while some are also involved in pilot-projects for Domestic Sector UCO collection. The “Waste Management Companies’ List”, published by the National Institute for Wastes (INR) in January 2007, specify the following 11 companies licensed for “vegetable oils and fats management” collection:
Biological
Dieselbase
Fabrióleo
IMBAL
Manuel Augusto Serra Ferreira
Oleotorres
Recinve
Reciol

Socipole
Space Ecocombustíveis
Tatris
Thus, from an extensive questionnaire made in 2005-2006 to more than half of Oeiras' county restaurants, it was possible to acknowledge the existence of at least 19 different companies collecting UCO in this sector.

Spain:
REAGRA, RAVUSA, CAVISA, ROCSA, RAFRINOR, ECOGRAS

Germany:
NKF Kalkar GmbH; Petrotec, Saria, Gerlicher Lesch; unknown Number of smaller collectors.

Hungary:
BIOFILTER Co.

Norway:
Municipal waste collectors
Waste energy traders (veg. oils, glycerine) e.g. Modern By-Products, Daimyo
Biodiesel producers (Milvenn)
Animal feed makers, Norsk Protein

Romania:
The Ministry of Economy and Trade is in charge of the UCO sector. They have do not have any information about companies that collect UCO in Romania. However, we managed to find and contact two private companies that do collect UCO.
SC RIAL CONSULT SRL
SC STOHER MINERAL&VEGETAL OIL SRL
However, when we approached these companies they were reluctant to disclose any information regarding their collecting of UCO and production of Biodiesel. They argued that this data is company property and could be used by the possible competitors on this emerging market.

UK:
A.R.R.O.W is the biggest Vegetable Oil Management team in the UK, consisting of 16 nationwide locations and four recycling plants. With over 100 vehicles which are responsible for the collection of over 200,000 Litres of cooking oil per week. All our locations are accredited by the relevant legislation and operated by trained personnel. We believe that we offer the best all-round service relating to oil and fat management.

ACORN (Affiliated Cooking Oil Reclaimers Nationwide) has 14 Collectors strategically placed in the UK, offering a collection service no matter where your outlets happen to be (Including Northern Ireland). Well in excess of 100 collection vehicles giving tremendous flexibility to the operation. ACORN use the biggest and longest established companies in the UK. ACORN is confident that the service we offer is second to none.

ACORN carries out regular review of performance levels. This can be done on a regular basis, showing all deliveries / collections made in a given period.

All collections of UCO are fully documented, and a Waste Transfer Note is being raised. All the necessary information, including date and quantities collected. The Waste Transfer Note is then signed by both parties and kept to show to the 'Environment Agency when requested. If collections fall below the agreed estimated UCO output on a regular basis, the unit is contacted in order to ensure that all UCO is being collected by ACORN, and not an unlicensed collector – thus protecting both parties.

ACORN complies with recent European legislation which state that all collections must be totally traceable back to source at any time in the collection chain. For this purpose, we have devised a system that attains this traceability by way of "ID" labels. This system will be explained to your outlet by the ACORN member in question. ACORN evaluates and audits national cooking oil collection organisations. All national used cooking oil collection organisations field collections out to a variety of independent operators throughout the UK. Each operator or collector typically coves a 70 to 80 mile radius, sometimes less. The number of collectors involved are usually somewhere between 12 and 20 (refer to ACORN map as an example). Individual collectors may, in turn, subcontract collections out to other operators, in which case the total number of collectors involved will be more. ACORN does not subcontract collections to any undeclared collectors. There are good reasons why the product should be certified to same standard. Product Authentication International (PAI, http://www.thepaigroup.com/default.aspx?P=Home) certification means that the collector concerned has passed a stringent audit and PAI have checked the following:

- The HACCP and traceability system to manage the risks involved in the production of safe animal feed products.
- Licences, insurances and compliance with the 'duty of care' provisions in the Environmental Protection Act 1990.
- The general competence and hygiene standards of the collector concerned. All ACORN members have been approved by PAI.

Annual PAI audits give indication of the competence, reliability, legality and safety of collectors, but national caterers should not exclusively rely on these audits. PAI's focus is primarily on animal feed safety. Caterers concerns regarding used oil collectors will be centred on the duty of care, reputability, health and safety, and adequate insurance. ACORN recommends strongly that the caterer audit each collector. This is done by correspondence and inspection of documents, but it is also recommended that the caterer visits at least one collector.

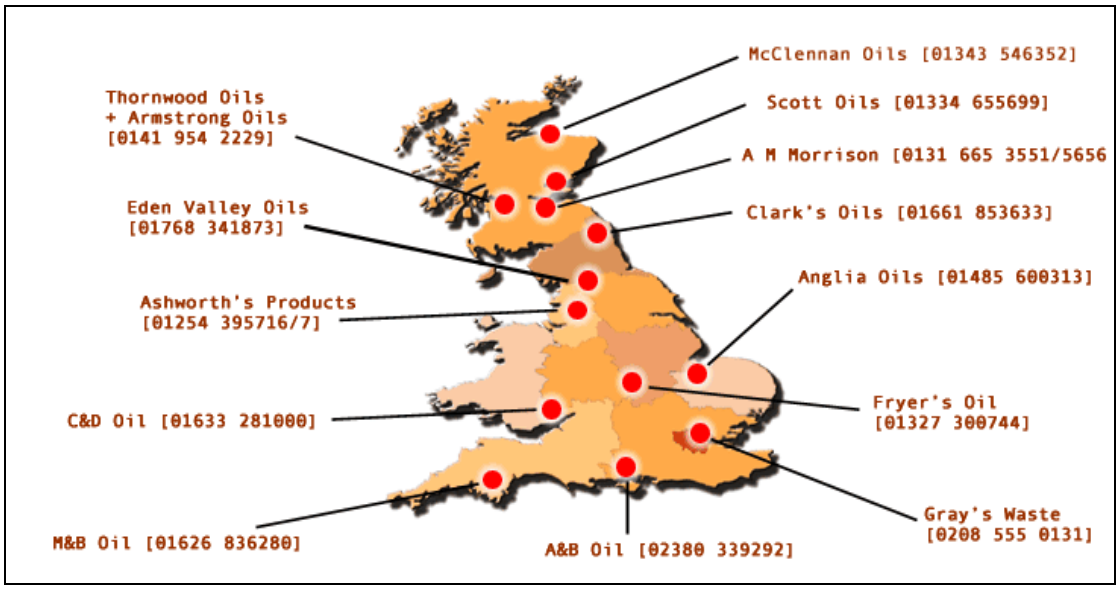

Figure 1 Locations of ACORN collectors in UK

Bulgaria

No system for collection UCO

Summary

Table 2 Main collectors of UCO in each country

Country	Main collectors of UCO
Holland	Sita (waste company) Rotie BV, Vierhouten Vet BV (specialised) App. 60 companies active in collecting, 7 in processing.
Italy	A.N.CO (Associazione Nazionale Concessionari Consorzi), an association of the main companies of used oil collecting - vegetal and mineral Dognazzi Renzo e Roberto S.N.C., Also SRL
Portugal	Probably more than 20 private companies collecting UCO. 11 companies licensed for "vegetable oils and fats management" collection: Biological, Dieselbase, Fabrióleo, IMBAL, Manuel Augusto Serra Ferreira, Oleotorres, Recinve, Reciol, Socipole, Space Ecocombustíveis, Tatris From an extensive questionnaire made in 2005-2006 to more than half of Oeiras' county restaurants, it was possible to acknowledge the existence of at least 19 different companies collecting UCO in this

	sector.
Spain	REAGRA, RAVUSA, CAVISA, ROCSA, RAFRINOR, ECOGRAS
Germany	NKF Kalkar GmbH, Petrotec, Saria, Gerlicher Lesch + unknown number of smaller collectors
Hungary	BIOFILTER Co.
Norway	Municipal waste collectors, waste energy traders (veg. oils, glycerine) (e.g. Modern By-Products, Daimyo), biodiesel producers (Milvenn), animal feed makers, Norsk Protein
Romania	Ministry of Economy and Trade in charge, but has no information about companies that collect UCO. Managed to find and contact two private companies that do collect UCO: SC RIAL CONSULT SRL and SC STOHER MINERAL&VEGETAL OIL SRL
UK	A.R.R.O.W., ACORN (Affiliated Cooking Oil Reclaimers Nationwide)
Bulgaria	No system for collecting UCO

Conclusions

- Nine countries have collectors of UCO, and one or several have been named for each country. Bulgaria has no collection system.
- The information from Eastern Europe (i.e. Romania, Bulgaria and Hungary) is scarcer than the information on countries in Western Europe. This *could* indicate some of the following: that UCO collection is either less widespread in the countries in Eastern Europe, that collection is carried out in less formalised ways or that the information is simply less readily available than in the Western European countries.
- The data on the countries located in Western Europe (Holland, Italy, Portugal, Spain, Germany, Norway and the UK) generally seems to indicate that UCO collection is becoming an institutionalised activity (i.e. no longer sporadic and unusual).
- Moreover, in some countries (e.g. the UK), UCO collection seems to be highly centralised, as opposed to a country like Norway, where collection seems more sporadic, small-scale and local.

4.2.1.3 Types of virgin oil used as input in the main forms of UCO in each country

Objective: Establish the types of virgin oil that are used as input in the main forms of UCO in each country.

Questionnaire responses:

Holland:
In The Netherland about 80% frying fat (solid at room temperature) and 20% oils are used (date from 2003). There is a trend towards oils. The used oils are a mixture of rapeseed, sunflower, palm and other oils. The average composition is unknown.
Source (Dutch): *http://www.infomil.nl/contents/pages/23497/e17def.pdf*

Italy:
Seed oil 60-63%
Olive oil 30-33%

Portugal: Sunflower, palm, peanut, corn and soybean.

Spain: OLIVE (53%) AND SUNFLOWER OIL (40%)

Germany: Rape seed, sunflower, palm oil, soy

Hungary: sunflower

Norway:
Palm (60-70%), Soy, Rape / canola, Sunflower, Others <5%

Romania:
Sunflower, palm.

UK: Data not available Seed oil with the following (rough) breakdown:
Rape, corn, soy oil - 90%, Palm oil – 10%

Bulgaria:
Sunflower

Summary

Table 3 Types of oil used as input in the main forms of UCO in each country
Where available, the table displays the occurrence of this type of oil out of the total amount of UCO collected in that country. If only the types of oil have been listed in the questionnaire, this is indicated by an 'x' in the table. If no data is available, this is indicated by a hyphen (-).

Country	Olive	Sunflower	Palm	Soy	Rape	Peanut	Corn	Seed	Frying fat	Mixed oils	Other
Holland									80	20	
Italy	30-33							60-63			
Portugal		X	X	X		X	X				
Spain	53	40									
Germany		X	X	X	X						
Hungary		X									
Norway		X	X (60-70)	X	X						<5
Romania		X	X								
UK	-	-	X	X	X	-	X	X	-	-	-
Bulgaria		X									

Conclusions

- The type of oil that constitutes the main source of UCO varies greatly between the countries
- According to the collected data, the most commonly occurring oil types are: sunflower oil (7/10 countries), palm oil (5/10 countries), and soy oil (4/10). Rape seed oil was listed for three countries. Olive oil was listed for two countries, as was corn oil and seed oil. Peanut oil, frying fat, mixed oils and other oils were only listed once. (A clear weakness in this part of the data is that "mixed oils", "other", "seed" and "frying fat" may refer to some of the aforementioned types of oil, blurring the overall profile somewhat).
- All of the Eastern European countries (Romania, Bulgaria and Hungary) have listed sunflower oil, and Romania has in addition listed palm oil. The three Southern European countries (Spain, Portugal and Italy) have different profiles, but all of them have listed sunflower oil, and two have listed olive oil. Germany and Norway seem to have very similar profiles, with a main reliance on sunflower, palm, soy, and rape.

4.2.1.4 National regulations applying to the use or disposal of UCO

Objective: Establishing what national regulations apply to the use or disposal of UCO in the ten countries.

Questionnaire responses:

Holland:
Leading in the Netherlands is the EU regulation regarding transport of waste. Per 12 July 2007 this will be EG1013/2006

Italy:
The law about exhaust oils refers to different decrees: in fact, after the Government decree number 95 published in 1992, there is also the number 22 published in 1997 and the latest number 152 came out last year (2006). The CODE for cooking oils is CER 20.21.25 which identifies not dangerous waste and that classification makes the collection *voluntary*.
For the other kinds of oils there is a threshold of 500 litres/year above which collection is mandatory, and the one of 300 which states that there must be a registration of the amount of oils incoming and outcoming.
Decree law: 152/2006, 3 April, "Environmental laws". It sets criteria to evaluate environmental impact, water resources management and waste handling. It covers all the range from gathering, transportation, storing, treatment and elimination.

Portugal:
The Decree-Law 178/2006, 5 September, sets the necessary criteria to waste management, covering all the range from gathering, transportation, storing, treatment,

valorisation and elimination thus avoiding any hazards concerning human health and environment.
In 2004, the *Portaria* 209/2004, 3 March, transposed to the national legislation the Decision 2000/532/EC, from 3 May, which identifies the UCO as a waste with the reference "20 01 25".
Actually, in Portugal, legislation for the treatment or valorisation of UCO does not really exist. However, as a lack of information including, for example, the production and/or availability of UCO per year and per sector was identified, an Agreement for the establishment of a voluntary system for UCO management, specifically, for restaurants and industry sectors, was signed in October 2005, involving the most relevant entities on/for this issue, namely:
INR (National Institute for Wastes);
APOGOM (Portuguese association for vegetable oils and fats);
ARESP (Portuguese restaurants' association);
ANCIPA (national association of food processing industrial and commercial companies);
APED (Portuguese association of logistic companies);
RECIOLEO (national association of UCO collection companies);
BDP (national association of biodiesel production from UCO' companies).
One of the main objectives of this Agreement was the creation of an integrated system for UCO's management, acting as a "start-up push". Thus, the Agreement states the biodiesel production as one of the priority destinations for the UCOs, aiming to contribute to the accomplishment of Directive 2003/30/EC, from 8 May, objectives'.
On this field, we may point the Decree-Law 62/2006, 22 March, transposing the Biofuels' Directive, and the Decree-Law 66/2006, 22 March, defining the partial exemption on Biofuels' taxation.

Spain:
Framework waste management Law 10/1998
Law on Packaging and Packaging waste 11/1997

Germany:
There are up to now no special regulations. As UCO is to be used in the car sector, there is a biodiesel standard (German Standard DIN/EN 14214) which cannot be fulfilled by UCO. There is another standard draft, given out by "Arbeitsgemeinschaft Altfettmethylester", which is following this questionnaire.
There is no possibility to bring UCO into animal food production since BSE discussion.

Hungary:
102/1996. (VII. 12.) Administration Order concerning dangerous waste materials

Norway:
The national regulation in Norway puts the responsibility of collection on the local *kommune* to collect Used Cooking Oil. A *kommune* can, of course, contract out the work to private companies.
The regulation applying to Bergen commune is available on:
http://www.lovdata.no/cgi-wift/wiztldles?doc=/usr/www/lovdata/for/lf/ov/ov-19970922-1187.html&emne=frityrolje&

Romania:

Governmental Decree no.1844/2005 on promoting the use of Biofuels and other renewable fules for transport.

UK:
EU Animal By-Products Regulations (1774/2002)
Landfill Directive (99/31/EC)
Waste Incineration Directive (2000/76/EC)

Bulgaria:
No such regulations

Summary

Table 4 National regulations applying to the use or disposal of UCO

Country	**National regulations**
Holland	The EU regulation regarding transport of waste, EG1013/2006
Italy	Government decree number 95 (1992), number 22 (1997), number 152 (2006). UCOs defined as harmless, i.e. voluntary collection.
Portugal	The Decree-Law 178/2006, 5 September Decree-Law 62/2006, 22 March Decree-Law 66/2006, 22 March *Portaria* 209/2004, 3 March Directive 2003/30/EC, from 8 May Decision 2000/532/EC, 3 May (+ Agreement for the establishment of a voluntary system for UCO management - restaurants and industry - signed in October 2005)
Spain	Framework Waste Management Law 10/1998 Law on Packaging and Packaging Waste 11/1997
Germany	No special regulations
Hungary	102/1996. (VII. 12.) Administration Order concerning dangerous waste materials
Norway	Decided by each local municipality (*kommune*)
Romania	Governmental Decree no.1844/2005 on promoting the use of Biofuels and other renewable fules for transport.
UK	EU Animal By-Products Regulations

	(1774/2002) Landfill Directive (99/31/EC) Waste Incineration Directive (2000/76/EC)
Bulgaria	No such regulations

Conclusions

- Most of the countries have national regulations that apply to the use or disposal of UCO. The relevance is merely indirect in some cases. Some countries stated supranational/EU regulations, e.g. Holland.
- Bulgaria may be lacking regulations that apply to this field.
- Norway's situation is special in the sense that each municipality decides how to regulate this field.
- Interestingly, Italian government decrees defines UCOs as harmless to the environment, making collection voluntary, as opposed to mandatory for oils defined as harmful.

4.2.1.5 Amount of UCO being collected, utilized and dumped

Objective: Achieving estimates of the amount of UCO (in m^3) being collected, utilized for various purposes, and dumped in each country each year.

Questionnaire responses:

Holland:
Collected: Frying oil/fat from catering: 60 ktonne/year [2]. Total processing (Dutch + import) is 120 ktonne/year.
Utilized for various purposes: Same amounts as above mentioned. No information found on different uses
Dumped: None

Italy:
Collected: 60 000 m^3
Utilized for various purposes: 60 000 m^3 (the amount of oil used is more or less unknown)
Dumped: Negligible

Portugal:
Produced: 96 000 m^3 (52 500 m^3 in domestic sector, 43 000 m^3 in restaurants and 550 m^3 in industry)
Collected: approx. 28 600 m^3 (50 m^3 in domestic sector, 28 000 m^3 in restaurants and 550 m^3 in industry)
Utilized: 16 000 m^3
Dumped: 67 400 m^3

Spain:
Collected: 270 000 m^3
Utilized for various purposes: Unknown
Dumped: 1 080 000 m^3

Germany:
Collected: 115 000 – 140 000 m^3 (in 2001), in 2006 estimated 250 000 m^3
Utilized for various purposes: Chemical Industries, biodiesel plants (small quantities)
Dumped: Not done in Germany

Hungary:
Collected: 5 500 m^3
Utilized for various purposes: 5 000 m^3
Dumped: 500 m^3

Norway:
Collected: 1 000 m^3
Utilized for various purposes:
1. Burned for energy
2. Composted
3. Biodiesel production: 300 m^3
4. Exported (Modern By-Products, Danish company exports to Denmark)
Dumped: 1 000 m^3, by restaurants and organisers of large events (tournaments, ski resorts, remote areas without risk of being caught by municipal authorities.

NB! Western Norway Research Institute has determined the amount of waste animal fat trapped in grease traps in restaurants and food processing industry in Norway. The amount is in the range of 9 000-13 000 m^3, which could be utilized for biodiesel production.

Romania:
Collected: No data
Utilized for various purposes: No data
Dumped: No data

UK:
Collected: 99 000 m^3
Utilized for purposes: Most is used for biodiesel production. Some is still used for animal feed (if it has only been used for cooking vegetable, not meat or fish products)
Dumped: Dumping is illegal in the UK, so no data available

Bulgaria:
Collected: No data
Utilized for various purposes: No data
Dumped: No data

Summary

Table 5 Estimated amount of UCO collected in each country

Country	m^3/year
Holland*	67 000
Italy	60 000
Portugal	28 600
Spain	270 000
Germany	250 000
Hungary	5 500
Norway	1 000
Romania	No data
UK	90 000
Bulgaria	No data

* The respondent stated *60 000 ktonnes*, i.e. 60 000 000 kg. If we employ a specific weight of 0.9 kg per litre, the amount is 66 666 667 litres. With 1 000 litres per m^3 the amount is 66 667, i.e. 67 000 m^3 a year.

Table 6 Estimated amount of UCO utilized in each country

Country	m^3/year
Holland	67 000
Italy	60 000
Portugal	16 000
Spain	No data
Germany	limited
Hungary	5 000
Norway	> 300
Romania	No data
UK	99 000
Bulgaria	No data

Table 7 Estimated amount of UCO dumped in each country

Country	m^3/year
Holland	0
Italy	negligible
Portugal	67 400
Spain	1 080 000
Germany	0
Hungary	500
Norway	1 000
Romania	No data
UK	No data (illegal)
Bulgaria	No data

Conclusions

- Estimates for amounts of UCO collected, utilized, and dumped are not available for all of the countries in question. This naturally affects the quality and reliability of the results. However, a vague outline of the situation in the different countries and differences between countries may be discerned.
- The estimated amounts of UCO *collected* each year vary greatly between the countries, with a maximum of 270 000 m^3 a year in Germany and 250 000 m^3 a year in Spain. The lowest amounts are the ones stated for Norway (1 000 m^3) and Hungary (5 500 m^3) of UCO a year.
- The estimates of UCO *utilized* each year also vary considerably. The highest figure is the one stated for the UK, 99 000 m^3 a year, with Hungary (5 000 m^3) a year at the bottom. However, this table suffers from a lack of data, as several respondents may possibly have misunderstood the second of the three sub-questions which inquires into the *amount of UCO utilized for various purposes*. Here, the desired information is an estimate of the amount of UCO utilized for various purposes in that country in one year. Instead, some respondents have listed the various purposes that UCO is used for in that country, excluding an estimated amount.
- According to the respondents, *dumping* of UCO is not done in Holland, Italy (negligible), Germany and the UK (illegal). However, dumping does seem to take place on a rather large scale in Spain in particular, but also in Portugal, whereas Norway and Hungary seem to have a more moderate problem. It should be noted that the reliability of the figures is questionable, due to the sensitive nature of the issue in question.

4.2.1.6 Cost of collecting UCO

Objective: Establish the cost of collecting UCO in each country, and compare results.

Questionnaire responses:

Holland:
The system of collecting is known to be efficient in the Netherlands [2]. Latest information about the price collectors pay for frying fat/oil is from 2001 is 90 €/m^3 [4]. This number is probably outdated and significantly higher nowadays.

Italy:
250.00 €/m^3 (average estimated cost)

Portugal:
It is known that the valorisation companies may pay to collection companies something like 0,35 €/litre of UCO.
Our local acknowledgment is that a collection cost of up to 300 €/m^3 may be used as an indicator.

Spain:
0.24 €/ litre (for an average route of 250 km recovering 1 000 litre)

Germany:
250 €/m³ average

Hungary:
Free of charge

Norway:
140 €/m^3

Romania:
No data available.

UK:
320 €/m^3
(22 pence per litre)

Bulgaria:
No data

Summary

Table 8 Costs of collecting UCO

Country	**€/m^3**
Holland*	90
Italy	250
Portugal	350
Spain	240
Germany	250
Hungary	0
Norway	140
Romania	No data
UK	320
Bulgaria	No data

* The figure provided dates back to 2001, indicating that the cost is higher now.

Conclusions

- The UCO collection cost is similar in Portugal (350 €/m^3), the UK (320€/m^3), Italy (250 €/m^3), Germany (250 €/m^3), and Spain (240 €/m^3). Collection is cheaper in Norway (140 €/m^3) and Holland (90 €/m^3).
- UCO collection is claimed to be free in one country, Hungary. It could be noted that there is definitely a *cost* involved in operating collection vehicles and driving around to collect UCO, although there is no collection fee.
- No applicable data from the Eastern European countries

4.2.1.7 Cost of dumping UCO

Objective: Establish the cost of dumping UCO in each country, as well as the variations between different countries in this field.

Questionnaire responses:

Holland:
Private persons can remove it for free. Companies have to pay to the collector. Costs of dumping UCO in the Netherlands vary from 0 to 200 € per ton.

Italy:
Dumping is residual, i.e. data not available, because there is almost no dumping.

Portugal:
As far as we know the producers that don't give an adequate destination to their UCO are dumping them directly to the sewage or to rubbish, having no costs and/or control on that.
However, if a "well intentioned" producer intends to dump his UCO in a landfill, the cost may be around 55 €/m^3 for citizens or enterprises, and 26 €/m^3 for municipalities.

Spain:
0.0575 €/m^3 (approximately an increase of 25% of water treatment costs)

Germany:
Is not done in Germany

Hungary:
20 – 40 €/m^3

Norway:
Hard to quantify, but large. Approximately 800 €/m^3. There is no official data available.

Romania:
No data available.

UK:
Dumping is illegal so no cost available

Bulgaria:
The UCO is dumped in the sewerage system, so the costs are included in the overall costs

Summary

Table 9 Costs of dumping UCO

Country	**€/m^3**
Holland	From 0 to 200 per ton (for companies)
Italy	No data (illegal)
Portugal	App. 55 for citizens or enterprises, and 26 for municipalities

Spain	0.0575
Germany	Not done
Hungary	20 – 40
Norway	No official data. Approx. 800
Romania	No data
UK	No data (illegal)
Bulgaria	Dumped in the sewage system, so the costs are included in the overall costs

Conclusions

- Great uncertainty, large variations.

4.2.1.8 Main environmental impacts of UCO

Objective: Achieve a basic understanding of the main environmental impacts of UCO in the ten countries.

Questionnaire responses:

Holland: Situation not different from other countries.

Italy: Drainage through waters - pollution stratums and rivers

Portugal: From a questionnaire made in 2006 to the citizens (at national level), on a total of over 11 000 answers, 56% of the UCO produced by the domestic sector is being dumped to the sewage while the remaining 44% are placed on the garbage. At restaurants, 22% are dumped into sewage and 13% into garbage.
So, the management costs of Waste Water Treatment Plants may be pointed as the most relevant environmental impact of UCO disposal.

Spain: Increasing water treatment costs, UCO forms a film on the water surface that prevent oxygenating aquatic life.

Germany: Sediments in domestic sewage pipes, illegal dumps, water pollution

Hungary: 78% of UCO is not collected. Main source is household. A certain part is put to garbage with household waste, which is collected and mainly dumped partially fired.

Norway:
Clogging of waste water pipes in cities.
Transport emissions from the export.
Dumping harms wildlife and contaminate soil.
Contamination of drinking water reservoirs.
Rodent population increase in urban areas.

Romania:
Waste Water Treatment costs are high because the vast majority of the population and companies dump the UCO into the sewage system.

UK:
The disposal of used cooking oil can be problematic when disposed, incorrectly, down kitchen sinks, where it can quickly cause blockages of sewer pipes when the oil solidifies. Thus used cooking oil is a potentially problematic waste stream which requires proper management.

Bulgaria:
Pollution of sewerage system and problems for waste water treatment plants

Summary

Table 10 Main environmental impact of UCO

Country	**Main environmental impact**
Holland	Same as in other countries
Italy	Drainage through waters - pollution stratums and rivers
Portugal	Management costs of waste water treatment plants
Spain	Film on water surface prevents oxygenating aquatic life. =Increasing water treatment costs.
Germany	Sediments in domestic sewage pipes, illegal dumps, water pollution
Hungary	Garbage/dumping, i.e. pollution
Norway	Clogging of waste water pipes in cities. Transport emissions from the export. Dumping harms wildlife and contaminated soil. Contamination of drinking water reservoirs. Rodent population increase in urban areas.
Romania	Increasing waste water treatment costs due to dumping of UCO into the sewage system.
UK	Disposal through kitchen sinks causes blockages of sewer pipes. Potentially problematic waste stream which requires proper management.
Bulgaria	Pollution of sewerage system and problems for waste water treatment plants

Conclusions

- Though some of the respondents have focused on indirect and economical costs rather than on the actual environmental impact, it seems clear that the most commonly listed environmental impact of UCO dumping is *water pollution (and concomitant problems) resulting from UCO dumping in water pipes in private households and restaurants*.
- Other types of environmental impact include damage to aquatic life, soil contamination, drinking water reservoir contamination, rising rodent populations in urban areas, and transport emissions resulting from UCO export.
- It appears that the type of environmental impact of UCO is similar in all of the countries in question, in the sense that where dumping occurs, it happens in much the same way. The extent of this impact is, however, assumed to be different depending on whether dumping takes place, what amounts are dumped, and how this is done.

4.2.1.9 Amount of energy used for UCO collection and dumping

Objective: Achieve an estimate of the amount of energy used for UCO collection and dumping in each country.

Questionnaire responses:

Holland:
Collection: Unknown
Dumping: Unknown

Italy: Unavailable

Portugal:
Collection: 0,4 kWh/litre
Dumping: -

Spain:
Collection:
Dumping: 0.0125 €/m3 (energy consumption for water treatment)

Germany:
Collection: Nobody knows
Dumping: " "

Hungary: Not known

Norway:
Collection: 1 000 liters biodiesel per year, for local collection
Dumped: (dominating). In addition burning for energy, compost, export, processing of wet organic waste.

Romania:
Collection: No data
Dumping: No data

UK:
Collection: 33miles /gallon of fossil fuel
Cumping: No data available in the UK

Bulgaria:
Collection: Not known
Dumping: Not known

Summary

Table 11 Energy used for UCO collection and dumping

Country	Energy for collection (kWh)	Energy for dumping (kWh)
Holland	Not known	Not known
Italy	Not known	Not known
Portugal	0.4 kWh/litre	Not known
Spain	Not known	0.0125 €/m^3 (Energy consumption for water treatment)*
Germany	Not known	Not known
Hungary	Not known	Not known
Norway	1000 litres of biodiesel per year for local collection. In addition burning for energy, compost, export, processing of wet organic waste	Not known
Romania	Not known	Not known
UK	32 miles per gallon of fossil fuels	Not known
Bulgaria	Not known	Not known

*The respondent has stated the cost, not the amount of energy used for UCO collection and dumping.

Conclusions

- Only three of the ten respondents were able to provide estimates of the amount of energy expended on UCO collection and dumping in their countries, which suggests that the quality and reliability of the data is extremely uncertain.
- The Portuguese respondent has estimated that the energy use for collection is about 0.4 kWh/litre. Spain has estimated that the energy use associated with dumping is about 0.0125 €/m^3, in the sense that this is the estimated amount of energy used in connection with water treatment. The UK respondent has stated the figures assumed for fuel consumption (32 miles per gallon of fossil fuel).

4.2.2 Production of UCOME

4.2.2.1 Other main uses of UCO (than for UCOME production)

Objective: Establish the main uses of UCO besides biodiesel production

Questionnaire responses:

Holland:
No information on national scale is known. For individual companies limited information is available. Vierhouten Vet BV e.g. uses 80% for Biodiesel, 10% as Biofuel and 10% is used in the presswood industry. The main use in The Netherlands is biodiesel production.

Italy:
heat recovery
use in lubricating oils

Portugal:
Soap production.

Spain:
As a fuel for solid boilers

Germany:
Chemical Industries, biodiesel plants (small quantities), plus Biogas plants (since a couple of years). 90 % biodiesel production

Hungary:
Fodder, chemical industry and asphalt processing

Norway:
Incineration for heat recovery: Tiny. Have burnt 20m^3 at Hurum Paper factory as fuel to make steam.

Romania:
The Ministry of Economy and Trade did not have any data regarding biodiesel or UCO. However there is one company that has produced UCOME – using imported collected UCO from Hungary. It was a demonstrative project and has now stopped producing Biodiesel.

UK:
None

Bulgaria:
No use, dumped in the sewerage systems

Summary

Table 12 Main uses for UCO besides biodiesel production

Country	**Use**
Holland	Biofuel, presswood industry
Italy	Heat recovery, lubricating oils
Portugal	Soap production
Spain	Fuel for solid boilers
Germany	Chemical industries, biodiesel plants (small quantities), Biogas plants
Hungary	Fodder, chemical industry and asphalt processing
Norway	Incineration for heat recovery (very limited)
Romania	None (demo project in the past)
UK	None
Bulgaria	None

Conclusions

- Most of the respondents are able to list alternative uses, but most of them also specify that these uses are peripheral and minor in comparison to the main use, which seems to be biodiesel production in most cases.
- The responses include the following: Biofuel, presswood industry (Holland), heat recovery (Norway), lubricating oils (Italy), soap production (Portugal), fuel for solid boilers (Spain), chemical industries, biodiesel plants, Biogas plants (Germany), fodder, and finally, chemical industry and asphalt processing (Hungary).
- Romania, Bulgaria and the UK have listed no alternative current uses.

4.2.2.2 Production facilities for UCOME

Objective: Achieve an overview of the main production facilities for UCOME existing today

Questionnaire responses:
Holland:
No large scale facilities are in operation. There are few initiatives in The Netherlands. The first is in construction in Rotterdam (by BeWa). The facility will produce 20 million litres of biodiesel per year. Other initiatives are still in the feasibility phase.

Italy:
In the past Novaol produced UCOME (5000 ton/year) but it stopped for quality reasons (the production process did not meet the required biodiesel standards by using UCO).
No data are available for the others production facilities.
Current biodiesel production in Italy (virgin oil):
D.P Lubrificanti: 155000 ton/y
Novaol – Livorno: 250000 ton/y
Comlube – Brescia: 120000 ton/y
Fox Petroli – Pesaro:121000 ton/y
Oil B. – Varese: 200000 ton/y
Mythen: 200000 ton/y

Portugal:
Setúbal, DIESELBASE, 1 000 ton/year (working)
Porto, SOCIPOLE, 5 250 ton/year (working)
Vila Nova de Famalicão, SPACE-ECO, 3 000 ton/year (working)
Torres Novas, OLEOTORRES, 3 000 ton/year (under development)
Torres Vedras, ARES LUSITANI, 300 ton/year (working)
Oeiras, CMO, 300 ton/year (under development)

Spain:

Location	Company	Production (tonn)	% of UCO
Fuentes de Andalucía	Biodiesel Andalucía 2004	36 000	20
Santa Olalla	Biodiesel CLM SL	45 000	100
Reus	Bionet Europa	50 000	80
Barcelona	Stock del Vallés	31 000	100
Berantevilla	Bionor Transformación	30 000	100

Germany:
Petrotec: 85 000 ton in Borken, 100 000 ton in Emden under construction
Saria: 12 000 ton in Malchin, 50 000 t in Lünen (just online)
Others: 30 000 ton small plants (decreasing quantity)

Hungary:
There is not any.

Norway:
Milvenn in Bergen, 300 ton / year

Romania: No data

UK:
Argent Energy Ltd has opened the largest biodiesel refinery in Europe, based in Motherwell (Scotland). The refinery is capable of producing 50 million litres of biodiesel annually. http://www.argentenergy.com/
Greenergy - currently building a biodiesel plant at Immingham on the east coast of England. The plant will initially process 100 000 tonnes/114 million litres of biodiesel per year and is expected to begin by the end of 2006. Already completed preliminary planning and design work for a second phase to double biodiesel production capacity at Immingham to 200 000 tonnes/228 million litres per year. Also planning to build another biodiesel plant in the Liverpool area (North West England_ and feasibility studies for this plant are currently underway. http://www.greenergy.com/1024_768.html
Rix biodiesel – produce biodiesel in Hull (North East England), output not published. http://www.rixBiodiesel.co.uk/
There are a few small local biodiesel producers in the London area.

Bulgaria:
There is only one local company producing biodiesel from UCO: "SAMPO" SC in Sofia, 56 Gladstone Str., 3 floor. Phone: 02/ 981 18 90; 980 45 31
email: sampo@netel.bg
The production facility is located in the town of Brusarci, Bulgaria

Summary

Table 13 Production facilities for UCOME

Country	**Facilities**
Holland	None
Italy	Production facilities from previous production exist (Novaol), but are not in current use.
Portugal	Setúbal, *Dieselbase* (working) Porto, *Socipole* (working) Vila Nova de Famalicão, *Space-Eco* (working) Torres Novas, *Oleotorres* (under development)

	Torres Vedras, *Ares Lusitani* (working) Oeiras, *CMO* (under development)
Spain	Fuentes de Andalucía, biodiesel *Andalucía 2004* Santa Olalla, biodiesel *CLM SL* Reus, Bionet Europa, *Stock del Vallés* Barcelona, Stock del Vallés Berantevilla, Bionor Transformación
Germany	*Petrotec* in Borken and Emden (under construction) *Saria* in Malchin and Lünen (just online) Other small plants
Hungary	None
Norway	*Milvenn* in Bergen
Romania	None (No data)
UK	*Argent Energy Ltd* (Motherwell in Scotland), *Greenergy* (Immingham in East England + plant in Liverpool being planned). Rix biodiesel (Hull in North East England) Small local biodiesel producers in London area
Bulgaria	*SAMPO SC* in Brusarci

Conclusions

- Six respondents have listed facilities for UCOME production. Two of these report that more plants are under construction (Portugal and the UK).
- Holland, Italy, Hungary and Romania have responded that these countries have no biodiesel facilities.

4.2.2.3 Technologies used in the main production facilities for UCOME

Objective: Identifying the technologies used in the main production facilities for UCOME.

Questionnaire responses:

Holland:
Unknown, but most likely a very limited amount due to the lack of large scale production facilities.

Italy:
No plants

Portugal:
Transesterification.

Spain:
Continuous process system

Germany:
Petrotec has its own technology
Others: Transesterification, greasoline method (trade mark of Fraunhofer Institute Oberhausen)

Hungary:
There is not any

Norway:
Simple 1st generation transesterification process.

Romania: No data

UK:
No technical data available
Transesterification

Bulgaria:
The initial production of biodiesel in Bulgaria started by ”SAMPO” company in 2000 when they create their own technology and reconstruct their refinery for vegetable oils into biodiesel refinery.

Summary

Table 14 Technologies used in the main production facilities UCOME

Country	**Facilities**
Holland	Unknown
Italy	None
Portugal	Transesterification
Spain	Continous process system
Germany	Petrotec has its own technology. Others: Transesterification, greasoline method (trade mark of Fraunhofer Institute Oberhausen)
Hungary	None
Norway	Simple 1st generation transesterification process
Romania	No data
UK	Transesterification
Bulgaria	SAMPO has own technology constructed for vegetable oils into biodiesel.

Conclusions

- The technologies mentioned are transesterification (Portugal, UK, Norway), continuous process system (Spain), Petrotec's technology, SAMPO's technology and the greasoline method (trade mark of Fraunhofer Institute Oberhausen) (Germany).
- No current production in Holland, Italy, Hungary and Romania.

4.2.2.4 Biodiesel quality obtained in the main production facilities for UCOME in each country

Objective: Identify the biodiesel quality obtained in the main production facilities for UCOME in each country.

Questionnaire responses:

Holland:
Not standard EN 14214 but only for direct use by fleet owners

Italy:
No data

Portugal:
As far as we know, the produced biodiesel in the a.m. facilities complies with the majority of EN 14214 parameters.

Spain:
European standard EN14214, as applied to Spanish law in decreeRD 177/2003 and RD 61/2006, ULSD 50 PPM (UNE 590) and RD 1700/2003

Germany:
The AME draft standard (look annex) or better nearly DIN/EN 14214 by greasoline method

Hungary:
There is not any

Norway:
Inconsistent EN 14214. Unknown how much. Testing is too expensive. 500 €/test

Romania:
No data available.

UK:
BS EN 14214

Bulgaria:
No tests performed

Summary

Table 15 Biodiesel quality in the main production facilities for UCOME

Country	Biodiesel quality
Holland	Not standard EN 14214 but only for direct use by fleet owners
Italy	Not applicable
Portugal	EN14214
Spain	EN14214, Spanish law in Decree RD 177/2003 and RD 61/2006 ULSD 50 PPM (UNE 590) and RD 1700/2003
Germany	The AME draft standard or better, nearly DIN/EN 14214 by greasoline method
Hungary	None
Norway	Inconsistent EN 14214
Romania	No data available
UK	BS EN 14214
Bulgaria	No tests performed

Conclusions

- There is a great degree of variation between the different countries, with the majority of the ten responding that EN 14214 is the biodiesel quality obtained in the main production facilities. This is true of Spain, Portugal, Norway (although the respondent added "inconsistent") and the UK.
- The exceptions to the rule are Holland (not standard EN 14214 but only for direct use by fleet owners) and Germany (UCOME draft standard or better, nearly DIN/EN 14214 by greasoline method).

4.2.2.5 Amount of UCOME produced

Objective: Establish the amount of UCOME produced in the different countries

Questionnaire responses:

Holland:
Unknown, but most likely a very limited amount due to the lack of large scale production facilities.

Italy: Nothing

Portugal:
16.000 m^3/year

Spain:
216,346,154 m^3 (180,000 ton)

Germany:

Between 110.000 m³ in 2006 in 2007 estimated 250.000 t

Hungary: None

Norway:
300 tons / year

Romania:
No data available

UK:
According to HM Revenue and Customs data published in February 2007, sales of biodiesel in 2006 were around 169 million litres, compared to around 33 million litres in 2005 - an increase of some 500 %. Total diesel sales in 2006 amounted to around 25 billion litres. These figures show that biodiesel still only makes up just 0.7 % of total diesel sales. There is no breakdown between UCOME and from virgin oils, but the entire Argent production of 4.2 million litres/month is from UCO.

Bulgaria:
The capacity of installation is 300 tons biodiesel/month and the production started in 2001.

Summary

Table 16 Amount of UCOME produced

Country	**m^3/year**
Holland	0
Italy	0
Portugal	16 000
Spain	216 346
Germany	277 000
Hungary	0
Norway	333
Romania	0
UK*	50 400
Bulgaria	3 600

*The stated amount was “At least 4.2 million litres/month”, which gives 50.4 million litres/year. This equals 50 400 m^3/year.

Conclusions

So far, the reliability of the data concerning the amount of UCOME produced per year in each country is uncertain.

4.2.2.6 Environmental impacts of producing UCOME

Objective: Determining the environmental impacts of producing UCOME in each country, in the form of discharges, emissions, waste, energy use and other impacts.

Questionnaire responses:

Holland: No data

Italy: not applicable

Portugal:
Discharges: waste water from UCO containers washing, contaminated UCO non-suitable for biodiesel production
Emissions: related to the transportation of UCO and biodiesel to/from facilities
Wastes: wastes from UCO filtration, low quality glycerine
Energy use: electricity and/or fuel usage for process machinery and equipments, such as heat for trans-esterification process, fuel for UCO and biodiesel transportation to/from installations
Other: -

Spain:
The same as in the rest of Europe

Germany:
Discharges: Producers use energy. There will be some reasonable CO_2 emission, depending of the used energy-source.
Emissions: No answer
Waste: No answer
Energy use: No answer
Other: No answer

Hungary: None

Norway:
Discharges: Alkaline water (to drain)
Emissions: MeOH vapors
Waste: Packaging waste
Energy use: Approximately 26W per litre of biodiesel produced
Other: Washing water

Romania:
No data available

UK:
No data available, but biodiesel production is controlled under the Pollution Prevention and Control (England and Wales) Regulations 2000 by the UK government's Environment Agency to ensure minimal environmental impacts.
However glycerol, one of the by-products, currently cannot be valorised as fuels under the UK legislation and is thus a waste. It is presently either dumped or mixed with animal food.

Bulgaria:
Discharges: No answer
Emissions: No answer

Waste: No answer
Energy use: No answer
Other: No answer

Summary

Table 17 Environmental impact of producing UCOME

Country	Environmental impact
Holland	Not applicable
Italy	Not applicable
Portugal	Discharges: waste water from UCO containers washing, contaminated UCO non-suitable for biodiesel production Emissions: related to the transportation of UCO and biodiesel to/from facilities Wastes: wastes from UCO filtration, low quality glycerine Energy use: electricity and/or fuel usage for process machinery and equipments, such as heat for transesterification process, fuel for UCO and biodiesel transportation to/from installations
Spain	Same as the rest of Europe
Germany	Discharges: Producers use energy. Some CO_2 emissions, depending on energy source.
Hungary	None
Norway	Discharges: Alkaline water (to drain) Emissions: MeOH vapors Waste: Packaging waste Energy use: app. 26W per litre of biodiesel produced
Romania	No data
UK	Glycerol issue
Bulgaria	Not known

Conclusions

- The *discharges* mentioned are waste water from UCO containers washing, contaminated UCO non-suitable for biodiesel production (Portugal), energy use, CO_2 emissions (Germany), alkaline water to drain and washing water (Norway).
- The *emissions* listed by the respondents are related to the transportation of UCO and biodiesel to/from facilities (Portugal) and MeOH vapours (Norway).
- The relevant *wastes* include wastes from UCO filtration, low quality glycerine (Portugal, UK), and packaging waste (Norway).
- The *energy use* mentioned includes electricity and/or fuel usage for process machinery and equipments, such as heat for transesterification process, fuel for UCO and biodiesel transportation to/from installations (Portugal). The Norwegian respondent estimated that biodiesel production requires 26W for every litre produced.
- No data was available for Holland, Italy, and Romania.

4.2.3 Supply of UCOME

4.2.3.1 Main distributors of UCOME

Objective: Identify the main distributors of UCOME in each country.

Questionnaire responses:

Holland: There is no significant use of biodiesel in The Netherlands.

Italy: Is used as biodiesel from crops in % in the other fuels and for heating
No info of existing distributors of UCOME

Portugal: Most of the companies mentioned in 2.1 distribute biodiesel among captive fleet and/or private users. Thus, some companies are providing biodiesel (from virgin oil) to GALP-Energia, the main fuel supplier of the county (95% of total), which distributes it mixed into diesel up to 5% (in 2006, something like 3% were accomplished). GALP-Energia is not yet "accepting" UCOME.

Spain: BIONOR, BIONET, NORPETROL, VIA OIL

Germany: Look Point 1.2. (NKF Kalkar GmbH; Petrotec, Saria, Gerlicher Lesch; unknown number of smaller collectors).

Hungary: There is not any

Norway: Milvenn

Romania: No data available.

UK:

Nicholl (Fuel Oils) Ltd
176 Clooney Road
Greysteel
Co Londonderry
Northern Ireland
BT47 3DY
T: 02871 810471
F: 02871 811057
Contact: Garry Nicholl
Area covered:
Northern Ireland

Rix Petroleum Ltd (Scotland)
5 Meridian Street
Montrose
Angus
DD10 8DS
T: 01674 673562
F: 01674 676135
Contact: Ian Macgregor
Area covered:
Scotland

Rix Petroleum Ltd
Witham House
45 Spyvee Street
Hull
HU8 7JR
T: 01482 838383
F: 01482 338591
Contact: Duncan Lambert
Areas covered:
Yorkshire, Lincolnshire

Par Petroleum
Woodstone Village Ind. Est.
Fenceshouses
Houghton Le Spring
Tyne and Wear

DH4 6DU
T: 0191 385 8001
F: 0191 385 8055
Areas covered:
Northumberland, County Durham

Swan Petroleum
Wood Lane
Ellesmere
Shropshire
SY12 0HY
T: 01691 626262
F: 01691 626211
Ian McMillan
www.tggroup.co.uk
Areas covered:
Shropshire, Cheshire

Caldo Oils Ltd
Worsely Brow,
Sutton,
St.Helens,
Merseyside,
WA8 3EZ
T: 0800 318437
F: 01744 816031
Contact: Garry Pennington
www.caldo.co.uk
Areas covered:
North Wales, Cheshire, Lancashire and Merseyside

Peak Oil
Foxwood Road
Sheepbridge
Chesterfield
Derbyshire
S41 9RF
T: 01246 450242
Area covered:
Derbyshire

Aid Fuel Oils Ltd
Cocksparrow Lane
Huntington
Cannock
WS12 4PB
T: 01543 506117
F: 01543 465736
Contact: Ian Richards
Area covered:
Staffordshire

Countrywide Energy
Defford Mill
Earls Croome
Worchester
WR8 9BF
T: 01386 757349
Area covered:
Worchester

Caldo Oils Ltd
Worsely Brow,
Sutton,
St.Helens,
Merseyside,
WA8 3EZ
T: 0800 318437
F: 01744 816031
Contact: Garry Pennington
www.caldo.co.uk
Areas covered:
North Wales, Cheshire, Lancashire and Merseyside

Rix Petroleum Ltd
Witham House
45 Spyvee Street
Hull
HU8 7JR
T: 01482 838383
F: 01482 338591
Contact: Duncan Lambert
Areas covered:
Lincolnshire, Yorkshire

CPS Fuels Ltd
The Old Sale Yard
Forncett St. Peter
Norwich
Norfolk
NR16 1BB
T: 01508 530342
F: 01508 532661
Contact: Chris Trenerry
www.cpsfuels.co.uk
Areas Covered:
Norfolk, Suffolk, Cambridgeshire

Ford Fuels Ltd
The Oil Depot
Farrington Fields Trading Estate
Farrington Surney
Bristol
BS18 5UU
T: 01761 452222
F: 01761 453977
Contact: Mike Ford
www.fordfueloils.co.uk
Areas covered:
Somerset, Dorset

Mitchell and Webber Ltd
The Fuel Depot
Scorrier
Redruth
Cornwall
TR16 5UT
T: 01209 821676
F: 01209 821750
Contact: Robert Weedon
www.mitweb.co.uk
Area covered:
Cornwall

THE SOUTH EAST
British Benzol
Douglas House
71 Brox Road
Ottershaw
Surrey
KT16 0LD
T: 01932 454262
F: 01932 454264
Contact: Ian Smith
www.britishbenzol.co.uk
Areas covered:
Gloucestershire, Hampshire, Surrey, Essex, Sussex

Wessex Petroleum Ltd
Wessex House
Cadland Road
Hardley
Hythe
Southampton
SO45 3NY
T: 023 8089 7841
F: 023 8089 8876
Areas covered:
Gloucestershire, Hampshire, Surrey, Essex, Sussex

Green*ergy* International Limited main fuels storage facility is at West Thurrock, Thames where a full range of fuels is stocked. Also have product availability from the following locations:
Grays, Thames; Dagenham, Essex; Immingham near Grimsby; Eastham and Stanlow, on the Mersey estuary; and Kingsbury in the West Midlands.

Bulgaria:
Biodiesel is only distributed as 5 % mix in mineral diesel without special marking

Summary

Table 18 Main distributors of UCOME

Country	**Main distributors**
Holland	-
Italy	No data
Portugal	- (No UCOME)
Spain	Bionor, Bionet, Norpetrol, Via Oil
Germany	NKF Kalkar GmbH; Petrotec, Saria, Gerlicher Lesch; unknown number of

	smaller collectors
Hungary	-
Norway	Milvenn
Romania	-
UK	Nicholl (Fuel Oils) Ltd, Rix Petroleum Ltd (Scotland), Rix Petroleum Ltd, Par Petroleum, Swan Petroleum, Caldo Oils Ltd, Peak Oil, Aid Fuel Oils Ltd, Countrywide Energy, Caldo Oils Ltd , Rix Petroleum Ltd , CPS Fuels Ltd, Ford Fuels Ltd , Mitchell and Webber Ltd , British Benzol, Wessex Petroleum Ltd , Green*ergy* International Limited
Bulgaria	No special distributors, only as B5.

Conclusions

- The respondents representing countries where UCOME exists, each listed several distribution companies. The most detailed response came from the UK. The results for Spain and Portugal are also relatively extensive.
- Norway has one distributor, i.e. Milvenn, whereas no distributors were named for the remaining countries (Holland, Italy, Portugal, Hungary, Bulgaria and Romania).

4.2.3.2 Type of logistics used by the main distributors of UCOME

Objective: Establish the type of logistics used by the main distributors of UCOME in each country.

Questionnaire responses:

Holland:
No data

Italy:
No data available

Portugal:
Some of the companies mentioned in 2.1. use trucks for biodiesel distribution. Some are using the biodiesel into their fleets (no distribution). GALP-Energia uses the same logistics as for fossil fuel distribution for road vehicles: trucks and, in some cases, train.

Spain:
Road transport

Germany:
Tank lorry, Ship, Tank container

Hungary:
There is not any

Norway:

Direct sales from factory outlet. 2-3 customers pick up 1000+ litres by trailer. 100-200 km away.

Romania:
No data available.

UK:
Road transport in fuel tankers

Bulgaria:
Existing mineral diesel fuel stations

Summary

Table 19 Type of logistics used by distributors of UCOME

Country	Type of logistics
Holland	Not applicable
Italy	No data available
Portugal	Road and train
Spain	Road transport
Germany	Tank lorry, ship, tank container
Hungary	Not applicable
Norway	Direct sales from factory outlet
Romania	Not applicable
UK	Road transport in fuel tankers
Bulgaria	As B5 in mineral diesel transport

Conclusions

- The data is sparse, but the obtained information shows relatively great differences in the type of logistics used by distributors of UCOME. The most environmentally beneficial distribution form is evidenced by Milvenn in Norway, which sells directly from the factory outlet (insofar as this is not an obstacle to the amount sold).
- Spanish, Portuguese, German, and British biodiesel distributors depend on road transport. In addition, German distributors rely on ship transport, and Portuguese use trains to some extent.

4.2.3.3 Uses for UCOME

Objective: Establish the amount of UCOME used as transport fuel, stationary fuel for heating, stationary fuel for electricity production, and other.

Questionnaire responses:

Holland:

Transport fuel: Very limited amount (see 2.3)
Stationary fuel for heating: unknown
Stationary fuel for electricity production: unknown
Other: unknown

Italy: No data available

Portugal:
Transport fuel: 16.000m^3 (from which 36m^3 are consumed by Sintra's waste collection trucks)
Stationary fuel for heating: probably none
Stationary fuel for electricity production: probably none
Other: don't know

Spain:
Transport fuel: 99%
Stationary fuel for heating:
Stationary fuel for electricity production:
Other: No answer

Germany:
Transport fuel: 100 %

Hungary:
There is none

Norway:
Transport fuel: all

Romania:
No data available.

UK:
Almost all is used for transport – maybe 0.1% for other uses

Bulgaria:
Transport: 100%

Summary

Table 20 Uses for UCOME (in % of total amount of UCOME in that country)

Country	Transport fuel	Stationary fuel for heating	Stationary fuel for electricity production	Other
Holland	Limited amount	-	-	-
Italy	-	-	-	-
Portugal	100.0	Probably none	Probably none	
Spain	99.0	-	-	-
Germany	100.0	-	-	-
Hungary	-	-	-	-

Norway	100.0	-	-	-
Romania	-	-	-	-
UK	99.9	-	-	~0.1
Bulgaria	100.0			

Conclusions

- The results are highly conclusive for Portugal, Spain, Germany, Norway, Bulgaria and the UK, in that more or less all the UCOME produced is used for *transport fuel*. It is indicated for Holland that a very limited amount may be used for the same purpose.
- The only indication of other uses originates from the respondent in the UK, where it is indicated that the amount of biodiesel used for alternative purposes is probably less than 0.1 per cent of the total amount of UCOME used in that country.

4.2.3.4 Environmental impacts of the supply of UCOME

Objective: Establish the main environmental impacts associated with the supply of UCOME in each country.

Questionnaire responses:

Holland:
No data

Italy:
No data available

Portugal:
Fuel consumption and GHG emissions due to transport.

Spain:
The same as in the other countries

Germany:
Tank lorries use UCOME, therefore there are only the impacts of traffic (Noise etc.) and some impacts of constructing the transportation units.

Hungary:
There is none

Norway:
Vehicle emission from the few customers collecting 1000+ litre tanks.

Romania:
No data available.

UK:
Emissions from distribution vehicles.

Bulgaria:
The supply is in a very initial stage so no impact can be assessed

Summary

Table 21 Main environmental impacts of UCOME distribution

Country	Main environmental impact
Holland	-
Italy	No data available
Portugal	Vehicle emissions
Spain	Same as elsewhere
Germany	Limited emissions, as vehicles use UCOME. Noise. Impact of construction distribution vehicles.
Hungary	-
Norway	Vehicle emissions
Romania	-
UK	Vehicle emissions
Bulgaria	No impact can be assessed

Conclusions

- The main environmental impact listed by the respondents stems from the emissions of the distribution vehicles that distribute the UCOME. In Germany, and possibly elsewhere, these emissions are limited by the fact that the vehicles use UCOME, which contains less harmful substances.
- Other possible impacts, as listed by Germany, include noise and the impact of the actual construction of the distribution vehicles.

4.3 Conclusions on UCO and UCOME amounts

The amounts of UCO collected, utilized and dumped, as well as the amounts of UCOME produced in the ten European countries are shown in Table 22.

Table 22 UCO collected, utilized and dumped. UCOME produced

		m^3/year		
		UCO		UCOME
	collected	utilized	dumped	produced
Holland	67 000	67 000	n/a	n/a
Italy	60 000	60 000	n/a	n/a
Portugal	28 600	16 000	67 400	16 000
Spain	270 000	n/a	1 080 000	216 346
Germany	250 000	n/a	n/a	277 000
Hungary	5 500	5 000	500	n/a
Norway	1 000	300	1 000	333
Romania	n/a	n/a	n/a	n/a
UK	90 000	99 000	n/a	20 400
Bulgaria	n/a	n/a	n/a	3 600
Sum	**772 100**	**247 300**	**1 148 900**	**533 679**

n/a: No data available

It is clear from Table 22 that the total amount per year of collected UCO in the ten countries (772 thousand m^3) is not dramatically higher than the amount biodiesel that is produced from this source (533 thousand m^3). From this we can conclude that there is not a large surplus of collected UCO available that could be utilized for producing more biodiesel. One country (Germany) is even producing more UCOME than is being collected, which could be explained by its import of UCO from UK.

It appears that UK has the largest potential for increasing its local UCOME production, since very little of the collected UCO is used for biodiesel production.

Total FAME production in the EU-25 in 2005 has been estimated to 3.2 million tonnes (EBB, 2006). The total amount of 533 thousand m^3 UCOME in Table 22 corresponds to 0.43 million tonnes, when applying an average density of 0.8. It can thus be concluded that the UCOME production in the ten BioDieNet countries constitutes about 13 % of the FAME produced in EU-25.

4.4 Suppliers of equipment for localised UCOME production

In addition to the questionnaire survey, a literature survey has been conducted of the suppliers of equipment for localised UCOME production. This is limited to European suppliers. It is not an exhaustive list of all European suppliers, but mainly suppliers who were represented at the Biodiesel Expo 15&16 October 2007 in Nottinghamshire (www.biodiesel-expo.co.uk/index_2007.php). The list in Table 23 is thus dominated by UK suppliers.

Table 23 Suppliers of equipment for localised UCOME production

Type	Supplier	Telephone	Internet site	E-mail contact
Analytical instruments & test equipment	Anton Paar	+44 (0) 1992 514 730	www.anton-paar.com	info.gb@anton-paar.com
	Methrom	+44 (0) 1280 824824	www.metrohm.co.uk	enquiry@mwtrohm.co.uk
	Mettler Toledo	+44 (0) 1162 234400	www.mt.com	enquire.mtuk@mt.com
	GR Scientific	+44 (0) 1525 404747	www.grscientific.com	info@grscientific.com
	Hartridge	01280 825600	www.hartridge.com	sales@hartridge.com
	Foss	+44 (0) 1925 287700	www.foss.co.uk	info@foss.co.uk
	PerkinElmer	0800 896046	www.perkinelmer.com	productinfo@perkinelmer.com
	Shimadzu	0870 8675200	www.schimadzu.co.uk	info@schimadzu.co.uk
	Stanhope Seta	+44 (0) 1932 564391	www.stanhope-seta.co.uk	sales@stanhope-seta.co.uk
	Labplant - Zematra	+31 1047 22080	www.zematra.com	info@zematra.com
	Tracerco	+44 (0)1642 375500	www.tracerco.com	tracerco@matthey.com
	Sartec	01233 758157	www.sartec.co.uk	sales@sartec.co.uk
	ASG (Analytik-Service Gesellschaft)	+49 821 450 423 0	www.asg-analytik.de	info@asg-analytik.de
	Analytik Ltd Analytical Solutions	0870 991 4044	www.analytik.co.uk	info@analytik.co.uk
Automation	Emerson Process Management	+44 (0) 161 4065150	www.emersonprocess.co.uk	uksales@emersonprocess.co.uk
Equipment – fuel station	PFS	+44 (0) 1708 252960	www.pfsfueltec.com	sales@pfsfueltec.com
Equipment – general	Thermo Fischer Scientific	+44 (0) 1442 233555	www.thermofisher.com	analyze.uk@thermo.com
	Flowquip	+44(0) 1422 829920	www.flowquip.co.uk	info@flowquip.co.uk
	Hytek	+44 (0) 1279 815600	www.hytekgb.com	info@hytekgb.com
	Oxford Instruments	+44 (0) 1865 393200	www.oxisnt.com	molecularbiotools@oxisnt.com
	North East Biodiesel	+44 (0) 1388 779328	www.northeastbiodiesel.co.uk	admin@northeastbiodiesel.co.uk
	AJK Biofuels	+44 (0) 1384 348885	www.ajkbiofuels.co.uk	enquiries@ajkbiofuels.co.uk
	Flowquip	+44 (0) 1422 829920	www.flowquip.co.uk	info@flowquip.co.uk
Filtration	Filtertechnik	0800 068 4134	www.tiltertechnik.co.uk/biodiesel	sales@filtertechnik.co.uk
	CC Jensen	+44 (0) 1388 420	www.ccjensen.co.u	filtration@cjcuk.co.uk

	Ltd., CJC	721	k, www.cjc.dk	
	Separ	+44 (0) 1923 276007	www.separ.co.uk	sales@separ.co.uk
	AquaSolAer	+44 (0) 78857 06400		ctaquasolaer@btinternet.com
	Parker Hannifin	+44 (0) 1924 487000	www.parker.com	filtrationinfo@parker.com
	Filtertechnik	0800 068 4134	www.tiltertechnik.co.uk/biodiesel	sales@filtertechnik.co.uk
Fuel equipment	Fuel Installation Services	+44 (0) 1727 867547	www.fuelinstallations.co.uk	Fuelinsserve@btclick.com
Fuel management	Timeplan	+44 (0) 1483 769766	www.timeplan.ltd.uk	info@timeplan.ltd.uk
	EuroTank Environmental	0800 3112146	www.eurotank.eu.com	info@eurotank.eu.com
Grease interceptor	FM Environmental	+44 (0) 2830 66616	www.fmenvironmental.com	sales@fmenvironmental.com
Handling systems	OPW Fluid Transfer Group	+31 2526 60300	www.opw-ftg.nl	info@opw-ftg.nl
Heat exchangers	Tranter	+44 (0) 161 4295680	www.tranter.com	sales@uk.tranter.com
Hoses	Elaflex	+44 (0) 1992 452950	www.elaflex.co.uk	elaflex@aol.com
Mixers – high shear	Silverson Machines	+44 (0) 1494 786331	www.silverson.co.uk	sales@silverson.co.uk
Nozzles	Elaflex	+44 (0) 1992 452950	www.elaflex.co.uk	elaflex@aol.com
Plants	BDI (BioDiesel International AG)	+43 316 4009 100	www.bdi-biodiesel.com	bdi@bdi-biodiesel.com
	Ageratec	+46 1133 5270	www.ageratec.com	info@ageratec.com
	Desmet Ballestra		www.desmetballestra.com	
	Incalculavel	+351 91 343 5454	www.incalculavel.com	info@incalculavel.com
Pumps	MSE Hiller	+44 (0) 1246 861166	www.mandse.com	mail@mandse.com
	Debem SRL	+39 0331 074034	www.debem.it	info@debem.it
	Atkinson Equipment Ltd	+44 (0) 1373 822220	www.atkinsonequipment.com	sales@atkinsonequipment.com
	Axflow	+44 (0) 20 8579 2111	www.axflow.co.uk	info@axflow.co.uk
	Michael Smith Engineers	0800 316 7891	www.michael-smith-engineers.co.uk	info@micheal-smith-engineers.co.uk
	CDR Pumps	0870 7561428	www.cdrpumps.co.uk	sales@cdrpumps.co.uk
	Tapflo	+44 (0) 2380 252325	www.tapflopumps.co.uk	sales@tapflopumps.co.uk
	Anchor Pumps	0870 7779844	www.anchorpumps.com	info@anchorpumps.com
	Essex	+44 (0) 114	www.essespumps.c	essexpumping@aol.com

	Pumping Systems	2420836	om	
	The Pump Company	+44 (0) 1293 533665	www.thepumpco.co.uk	sales@thepumpco.co.uk
Purification	Filtertechnik	0800 068 4134	www.tiltertechnik.co.uk/biodiesel	sales@filtertechnik.co.uk
	Rohm & Haas	+33 1400 25000	www.rohmhaas.com	
Reactors	NiTech Solutions	+44 (0) 1355 245993	www.nitechsolutions.co.uk	sales@nitechsolutions.co.uk
	Master Farm Services	+44 (0) 1787 229083	www.masterfarm.co.uk	enquiries@masterfarm.co.uk
	Simply Biofuels	+44 (0) 1603 654094	www.simplybiofuels.com	info@simplybiofuels.com
	Applikon	0845 3373306	www.applikon.co.uk	info@applikon.co.uk
	BHR Biofuels	+44 (0) 1243 750422	www.bhrbiofuels.co.uk	rjackson@bhrbiofuels.co.uk
	Elux Biodiesel	+44 (0) 7973 292 244		visontronic@hotmail.com
	Green Fuels	+44 (0) 1453 828003	www.greenfuels.co.uk	info@greenfuels.co.uk
	Ecotec Resources	+44 (0) 1772 627745	www.etruk.co.uk	sales@etruk.com
	BioDiesel Technologies	+43 1876 0895	www.biodieseltechnologies.com	info@bdt.co.at
	FM Environmental	+44 (0) 2830 66616	www.fmenvironmental.com	sales@fmenvironmental.com
	JC Fuels	+44 (0) 1206 242355	www.jcfuels.co.uk	djcatrell@hotmail.com
	EuroFuelTech	+44 (0) 1908 766124	www.eurofueltech.com	website@eurofueltech.com
	Incalculavel	+351 91 343 5454	www.incalculavel.com	info@incalculavel.com
Tanks	Titan Environmental	+44 (0) 2840 62660	www.environmental-containers.com	sales@titanenv.com
	Simon Storage	+44 (0) 1737 778108	www.simonstorage.com	info@simonstorage.com
	Protectoseal	01453 521439	www.protectoseal.com	saleseurope@protectoseal.com
	Francis Ward	+44 (0) 1274 707030	www.franciswardcom	info@franciswardcom
	Cookson & Zinn	+44 (0) 1473 825200	www.czltd.com	sales@czltd.com
	VTF	+44 (0) 1522 704865	www.vtfl.co.uk	enquiries@vtfl.co.uk
	Clarehill Plastics	+44 (0) 28 92611077	www.harlequiplastics.co.uk	info@clarehill.com
	Schoeller Arca Systems	+44 (0) 1235 822423	www.schoellerarca.com	info.abingdon@schoellerarca.com
	Ledbury Welding	+44 (0) 1531 632222	www.lweltd.co.uk	sales@lweltd.co.uk
	Tuffa	08707 567700	www.tuffa.co.uk	sales@tuffa.co.uk
	Regal Tanks	+44 (0) 1502 710100	www.regaltanks.co.uk	info@regaltanks.co.uk

Valves	Protego	01543 420660	www.protego.com	uk-office@protego.com
	Tyco Flow Control	+44 (0) 1858 467281	www.tyco-valves.com	uk_sales@tyco-valves.com
	Fort Vale	+44 (0) 1282440000	www.fortvale.com	sales@fortvale.com
	Burkert Fluid Control Systems	+44 (0) 1453 731353	www.burkert.com	sales.uk@burkert.com

5 Task 4 - Assessment of local markets for biodiesel

5.1 Main customers for the local biodiesel production

Objective: Identify the main customers for the local biodiesel production.

Questionnaire response:

Portugal:
In Portugal the main customers for the UCOME are the average logistic fleets (50 to 100 vehicles), municipal fleets, such as waste collection fleets and urban clean services' fleets – these fleets are composed by heavy vehicles running on B5, B20 or B50.

Spain: Public transport fleets, private transport means

Hungary:
MOL (the national oil company) is the only customer for the Hungarian biodiesel production since it is the only oil company which has refinery capacities in Hungary (the biodiesel must be blended into to conventional diesel fuel in order to get a tax reduction).

5.2 Size of customer fleets and type of vehicles

Objective: Establish the size of customer fleets and the types of vehicles involved.

Questionnaire response:

Portugal:
The fleets running on biodiesel in Portugal are, in average, composed by 50 to 100 heavy vehicles. In *Sintra*'s case-study the use of biofuels is being promoted in the municipal fleet. At the moment, only the waste collection trucks are running on B5 (52 heavy vehicles). However, the goal is to increase this number to the whole municipal fleet (plus 91 heavy vehicles). In *Oeiras*' case-study the use of UCOME is under preparation in the scope of OILPRODIESEL project (www.oilprodiesel.com). On a first stage, due to the fact that the biodiesel to be used will be locally produced from the collected UCOs in Oeiras (less quantity during the first months), only 10 vehicles will use B5, B10 and B30. On a next stage, the goal is to increase the number of vehicles according to the availability of biodiesel.

Spain: Buses: 5-50
Municipal vehicles (cars and small lorries): 10-60

5.3 Potential customers

Objective: Identify the potential customers in each country

Questionnaire response:

Portugal:
In what concerns potential costumers, in our opinion, and considering the environmental friendly action such are biodiesel usage and/or UCOs collection, the local authorities fleets are probably the most obvious. Indeed, also other average and/or large logistic fleets may demonstrate its interest for the use of biodiesel on their vehicles.

Spain: Road goods transport fleets, car rental enterprises

Hungary: Due to the taxation system there are no potential customers.

5.4 Summary

The local markets most likely to be utilised for localised UCOME encompass average size transport fleets with 50-100 vehicles. These could be municipal fleets of cars and small lorries, waste collection fleets, buses as well as car rental enterprises.

6 Task 5 – Financial, legal & Health and Safety issues

6.1 Financial

6.1.1 Biofuel Funding Options

Throughout the European countries assessed there are a variety of funding options. These vary in range from business grants, financial incentives, community grants and loan finance. The assistance varies from countries having a large variety of alternative to having different sources but limited financial options.

In Italy the main source of finance is through loan finance and financial incentives, both of these schemes provide funding locally, regionally and nationally. There are no special grants for biofuel production plants on an industrial level. The production of biofuels is comparable to any other industrial production thus unspecific.

At a local and regional level there is public funding available for biogas plants within specific programs that have been arranged to support the multifunctional role of agriculture. There are local schemes based on rural development policy within the region, for example the European Agricultural Fund for Rural Development (EAFRD).

According to the regional public funding schemes, there is a special guarantee fund performed by local and national banks in order to support the construction of biogas plants. Local authorities sign special agreements with local and national banks in order to support the construction of the plants. The banks offer loans with special low interest rates. There is however no specific loans for biodiesel or bioethanol production plants.

There are a variety of financial incentives at a national level mainly through the reduction of excise duty. There is a 45 €/ha supplement to energy crops. At a national level there is an excise duty reduction (20% of diesel excise duty on a biodiesel content base only for biodiesel blends with diesel fuel B5 to B25 and up to a total amount of 250,000 ton/yr of biodiesel production/import. A proportion of this however must be

produced within local chains. There is currently no excise duty on pure vegetable oil for electricity production, however not for vehicles. It is currently forbidden to use pure vegetable oil for vehicles.

The excise duty for bioethanol is 289.22 €/m^3 and 298.92 €/m^3 for Bio-ETBE. The production of bioenergy performed by a farmer is considered to be 'agricultural activity' therefore its management (VAT, taxes, administrative costs) is similar to other agricultural activities.

There are currently no sources of private capital available.

There are various business grants in Ireland depending on the nature of the proposed business or project. For new businesses there are grants available from the country enterprise boards depending on the number of people that will be employed, the support available is provided through feasibility studies, marketing and capital costs. For larger projects there are a variety of development authorities such as the Industrial Development Authority, Enterprise Ireland and Shannon Development that can provide support to developing projects towards set up costs for both the plant and the business.

At a local and regional level there is community funding available from leader groups that are designed to assist on developing rural based enterprises which support the local economy. These leader groups are available in each county who support local rural based initiatives in their respective areas.

Investors can be attracted under the Business Expansion Scheme for new businesses. The scheme offers investors tax incentives to invest money in start up businesses.

There are various national financial incentives available through the Irish Government. There is support to energy plantations of €45/ha plus €80/ha from the Government. Companies that were approved under the Mineral Oil Tax Relief Programmes in 2005 and 2006 receive excise relief on biofuels.

The Finance Act 2005 allows for a 50% VRT reduction on flexible fuel vehicles which can achieve blends of bioethanol with petrol of up to 85%. This relief is in place until 31st December 2007, when it is subject to review with the possibility of further extension to other vehicles. The biofuels obligation announced by government intends for Irelands biofuels to represent 5.75% of Irelands transport fuel market by 2009. There is support for Research and Development in biofuels particularly second generation biofuels.

The Department of Transport is currently running a pilot programme offering 75% grant aid for public authorities and haulers converting their vehicles to run on pure plant oil. All of these financial incentives are available nationally.

In Poland there are a variety of different funding opportunities available.

There are grants available for businesses investing in the production of bio-components, which are selectively based on competitive procedures. The projects must be over €5million and the total value of these various grants is €180 million. There is support to

the development of rural areas and SMS investments in biofuel chains, these grants are for a minimum of €30 000 and maximum €6 million per project.

At a local and regional level there have been special zones created in town centres and environmentally important areas for public ecological transport. Parking fees have been either reduced or removed for biofuel cars and there is also a reduction in environmental fees (at present applied to each company vehicle). The lost incomes of the municipalities are covered by the National Environmental Funds.

On a national level there is a special guarantee fund of the Bank of National Economy (BGK) in place in order to support EU Grants.

There are various national incentives similar to those in Ireland available to assist in the research, development, production and usage of biofuels. There is support for energy plantations; 50% of plantation cost, supplement to energy plantations 45 €/ha. There is no excise duty on pure biofuels, excise duty on fuels with bio-components reduced is equal to the level of applied tax, and this is under EU notification procedure. There is no fuel tax for pure biofuels and for fuels with bio-components this is proportionally reduced. There is also a 19% reduction of Corporate Income Tax for biofuel producers.

The National Environmental Funds provides support for awareness and educational campaigns and also supports the use of vehicles using biofuels, especially fleet vehicles using high-bio component fuels. There is also support at a national level for research and development into biofuels.

In Greece there is a subsidy of 45 €/ha of energy plantation granted to farmers. This aid is awarded in respect of areas whose production is covered by a contract between the farmer and the processing industry, except where the processing is undertaken by the farmer on the holding. An additional subsidy of 60 €/ha is granted to farmers for seed processing facilities. This is presided by the Ministry of Agriculture Development and Food Security, who are responsible for energy crop subsidiaries.

The Ministry of Development, Directorate of Energy administers an annual program of untaxed biofuel quantity distribution. Certain quantities of pure biodiesel are exempt from Special Consumption Tax.

The National Development Plan is an open type - without time constraints - financing tool for the support of investments, with biofuel production an eligible sector of investment. There are various types of incentives for investments; Cash Grants that cover part of the investment cost, Leasing Subsidy and Wage Subsidy for employment created by the investment of up to 35% or tax allowance up to 100%.

The amount of incentive is dependent on the geographic region. In the Region of Central Macedonia 30% is foreseen for Cash grant, Leasing and Wage subsidies and 100% for tax allowance. However, incentives for investment in Prefecture of Thessaloniki are much lower: 15% for Cash grant, Leasing and Wage subsidies and 50% for tax allowance.

Additional incentives up to 10% and up to 20% are envisaged for small and medium enterprises respectively. The amount of additional incentive depends on the geographic region within the country and the type of investment.

The Ministry of Development Operational Program comes under the 4th Community Support Framework 2007-2013. This program incorporates a package of actions and subsidies designed to improve the competitiveness of the Greek economy within the framework. The operational program includes 5 priority axes, which in turn comprise further actions. The 4th priority axe supports actions for RES utilization and energy saving, including investments in biofuels production. The operational competitiveness program for the period 2007-2013 has not yet started and the amount of incentive granted for investments in biofuels has not yet been determined.

In England there are a variety of local, regional and national grants and financing options for businesses and biofuel projects.

There are various regional grants of up to GBP 500,000 or 60% for research and development of technologically innovative products or processes. The grants available vary in their eligibility options however generally there are grants that accommodate most situations. Funding can be used for launching, modernizing, expanding or reorganizing a business and taking a new product form the development stage to production, and to set up research and development facilities.

There are various venture capital funds that provide financial support to businesses. The support offered is available at a variety of different levels depending on the nature and size of the business, and there are loans available of up to £7.5 million. These funds are all available through private companies.

The government has set aside GBP 100 million for UK business to research and develop new technologies from environmentally friendly low carbon projects to leading edge manufacturing.
Over the period 2005-2008, GBP 320 million is available to businesses in the form of grants to support research and development in the technology areas identified by the Technology Strategy Board.

The Carbon trust Venture Capital Fund is available for technology that has commercial potential, can demonstrate its feasibility and have potential co-investors.

Low Carbon Venture Capital will typically invest between GBP 250k-GBP 1.5m in a low carbon business as a minority stakeholder alongside private sector investors on the same terms. The proposal will need to demonstrate innovation either through a step change in technology design or in the application of a technology process.

The government funded Carbon Trust launched its Low Carbon Incubator programme in April 2004. The Carbon Trust provides up to GBP 60K of advisory support per accepted start-up/spin-out company, paid directly to our incubator partners for services provided to the company being incubated.

There are also criteria for exit from the incubator, and companies are expected to make continual progress whilst in the incubator, and to work with the incubator partner to meet agreed milestones.
Priority is given to novel solutions that fall into the 'focus' and 'consider' areas of the Low Carbon Technology Assessment (LCTA). For enabling technologies a case must be made based on the emissions reduction which they make possible, for instance if electrical energy storage enables additional generation from renewable energy sources.

Two short descriptions of case studies regarding financing are included. The first (Appendix 3) is for Tom Lasica of Pure Fuels and the second (Appendix 4) from the Essex Lion Grain company The latter is an evaluation explaining that there have been regional grants available in Wales but not London.

6.2 Legal

6.2.1 Legal issues related to the direct involvement of energy agencies in UCOME production

The legal status of Energy Agencies varies considerably between Member States, as does the national legislation relating to the establishment and management of biodiesel production from used cooking oils.

A DG TREN Study on outputs, performances and future perspectives of SAVE energy agencies carried out by a team of experts composed of Catrin Maby (Severn-Wye Energy Agency, UK), Reinhard Six (Rhonalpénergieenvironnement, Lyon, FR), Jiri Zeman (Seven, Prague, CZ) and coordinated by Marcello Antinucci (Ecuba srl, Bologna, IT), published in 2005, included a question about the legal status of the agencies contacted.

The answers to the question on legal status show, as expected, a predominant percentage of non-profit and public organizations:

Totally public organisation, or part of a local authority	32 %
Non public (or non-totally public) body having a non-profit status	45 %
Profit-making organisation	11 %
Others	7 %

About one fifth of the agencies have a more general mission, for example a development agency, where energy represents only a part time activity. This situation is therefore not rare and has to be accepted as a possible evolutionary trend, at least in some countries or regions.

A question was also asked about the Management Board - the body which formulates the policies to be followed by the agency, adopts the strategies and decides on the instruments for their implementation. It was found that the Board is made up of partners and participants in the field of energy management, such as regional or local authorities, chambers of commerce, consumers organisations, energy suppliers, other competent authorities in the energy sector, etc.. The management board is largely composed of widely differentiated categories, with a net prevalence in voting power of the Local Authorities (55%).

The implications of these findings for Energy Agencies considering involvement in biodiesel production are:

- Local authorities and other public bodies are generally constrained from carrying out directly commercial activities.
- Local authorities could however incorporate biodiesel production into their overall activities if it was for the purpose of supplying their own transport fleets with biofuel.
- Local authorities also have the power to set up 'arms length' organisations (such as many Energy Agencies are) which can carry out commercial activities and be profit-making. Such organisations will generally be partly but not wholly controlled by and answerable to the local authority.
- The constitution of non-profit organizations will vary from one Member State to another, and even within states. In the UK for instance there are many different types of non-profit status, some of which are able to carry out commercial activities directly, others (e.g. registered charities) which would have to set up a separate trading subsidiary company and gift the profits back to the parent charity.

There is in principle therefore no barrier to the involvement of Energy Agencies in biodiesel production. The precise legal structure of any production company however will have to be tailored to the particularities of each agency's legal status and the company law in force in the relevant Member State.

The nature of the business under consideration by the BioDieNet project – small scale, localised biodiesel production – means that each enterprise is unlikely to provide employment for more than 3 or 4 staff. The turnover of such an enterprise however, because of the high value of the end product, is unlikely to be less than €350,000 a year and could be several times higher. A business of this scale lends itself to the following possible company structures:

- A simple partnership where all the individuals involved share risks and profits equally.
- A limited company where all the individuals involved are directors.
- A non-profit company or social enterprise with defined community benefit as its primary aim.
- A worker co-operative, which can be either profit-making or non-profit.

There is a long tradition of worker co-operatives in many European countries (see Appendix 1) and the structure is in many ways ideally suited to the ethical and environmental basis of small scale localised biodiesel production. A further benefit of worker co-operatives is that, by their nature, they tend to favour co-operation with other similar enterprises. Because small scale biodiesel production is unlikely to be a highly profitable business, and because its aims are predominantly for the benefit of local communities, co-operation between producers within a city or region could play an important part in the long term viability of the enterprises involved. The options for such co-operation include:

1. A single enterprise with a number of production plants across a city or region. This would have the advantage of better buying power, more scope for marketing and the

ability to balance supply and demand across a wider area. The main disadvantage would be that if one production plant were to experience financial difficulties it could threaten the whole enterprise.

2. A network of independent enterprises. This would have some but not all the advantages of the single enterprise and without the accompanying disadvantage. There would be no real incentive to share experience and expertise however unless it was a specific aim of the network, and there is a danger that in a difficult marketplace the individual enterprises could end up as direct competitors.

3. A co-operative of co-operatives. This would be similar to (2) above, but with a stronger incentive to share and a similarly weaker incentive to compete. Such a network is in the process of being established in the UK with the aim "to raise investment, offer nationwide services, share information, resources and experience, and support new social businesses." Co-ops currently involved include Sundance Renewables (see chapter 7.1.3.1 or http://www.sundancerenewables.org.uk/), Goldenfuels (http://www.goldenfuels.co.uk/), biofuels.org.uk (http://www.bio-diesel.co.uk/) and Bolton Alternative Fuels Co-op (see chapter 7.1.3.2 or http://www.allcommunity.co.uk/bafc/1.html).

6.2.2 The IPPC Directive and its implementation in the different EU member states

6.2.2.1 Description of the Directive

The Council Directive 96/61/EC, concerning integrated pollution prevention and control, the so-called IPPC Directive, is central in the environmental legislation for combating emissions from stationary sources1. It aims at: *"....preventing, reducing and as far as possible eliminating pollution by giving priority to intervention at source and ensuring prudent management of natural resources, in compliance with the 'polluter pays' principle and the principle of pollution prevention"*.

The Directive is based on the view that integrated pollution control is an important part of the move towards a more sustainable balance between human activity and socio-economic development, on the one hand, and the resources and regenerative capacity of nature, on the other. The objective is protecting the environment as a whole, through simultaneous prevention of the three main forms of pollution;

- Air pollution
- Discharge of dangerous substances into water
- Emissions into soil

The Directive addresses a number of issues necessary for ensuring the effectiveness of the system for giving permits to facilities for achieving the objective of the Directive. The issues include:

1. Complete coverage of all IPPC installations by the permitting system
2. Adequacy of information supplied by permit applicants

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1 The IPPC Directive is available at http://ec.europa.eu/environment/air/legis.htm#stationary

3. Co-ordination between authorities involved in the permitting process
4. Completeness of permit conditions to cover all significant environmental impacts
5. Use of Best Available Technique (BAT) as a basis for permit conditions
6. Compliance with environmental quality standards
7. Adequate compliance monitoring
8. Regular review of permits
9. Public participation in the permit procedure and access to documents

6.2.2.2 Implementation in the EU member states

The Directive was adopted in September 1996. The EU member states were required to bring it into effect by 30 October 1999. In May 1999, the Commission published a Communication on how the member states were obliged to report on the implementation of the Directive (EC, 1999). Through a questionnaire input was to be given on changes to national legislation and the licensing system, permit conditions and their compliance, environmental quality standards and BAT information necessary to meet the aim of IPPC. The questionnaire also asked the member states to report on the number of installations covered by IPPC and what measures had been taken to provide that the authorities ensure that the installations operate according to IPPC. In addition, member states were to report on information to the public, transboundary cooperation and relationship with other Community instruments.

The first study of the implementation of the Directive was reported in May 2002 (AEA, 2002). This established the status and scope of national IPPC legislation. In addition it identified and assessed the rules of best available techniques (BAT) guidance as well as the scope of the permitting process. The findings of the study provided knowledge of how the permitting system was working in practice and highlighted the similarities and differences between the approaches of different member states.

The progress of the IPPC implementation was further reported in June 2003 in a Communication from the Commission (EC, 2003). In that report, the Commission expressed concerns about the progress in the implementation: "*The Commission has a clear message to send to Member States and Candidate Countries: a high level of protection of the environment, which is the overriding objective of the Directive, can only be achieved if the authorities in charge of implementation make the efforts necessary for correct implementation and engage in constructive interaction with plant operators and other stakeholders. A large number of Member States need to accelerate progress towards this objective and the majority of the Acceding Countries must continue to significantly enhance their efforts, as agreed in the accession negotiations. The final deadline for existing installations to apply the best available techniques and meet all other requirements is October 2007.*

In October 2003, the Institute for European Environmental Policy published a Policy Brief for the European Parliament Environment Committee (IEEP, 2003). In that report, it was stated that there are approximately 50,000 IPPC installations in the EU member

states and accession countries[2] combined, varying from around 10,000 in Italy to 20 in Malta. However, this was not considered to be a complete count, and this was sometimes better known for the new EU member states, as a result of the accession negotiations.

The concerns of the lacking implementation of IPPC were confirmed by the first implementation reports from the EU member states[3], and in 2005 the Commission formulated two questions arising from these concerns (EC, 2005):

1. Quantitatively, how many installations in the EU operate according to an IPPC permit?
2. Qualitatively, have existing permits been issued or updated in accordance with the IPPC Directive?

A new assessment was to be conducted, with two main objectives:
"1. To determine through a questionnaire and interviews with competent authorities of the Member States, and from other sources as appropriate, the number of permits already issued for new and existing (including "substantially changed") installations in terms of the IPPC Directive, and the number that remain to be issued
2. To select and analyse specific permits granted in Member States in order to assess whether these permits have been issued in accordance with the IPPC Directive."

The IPPC reporting for the second reporting period (2003-2005) is available on http://ec.europa.eu/environment/ippc/ippc_ms_implementation.htm#ImplementationReps. The reports by the individual EU member states are found on EIONET Central Data Repository[4] and are being analysed during 2007. This source for the IPPC implementation in individual EU member states is useful for BioDieNet members in updating on the situation in their own country.

6.3 Health and Safety

The material in this chapter is based on the work carried out as a BioDieNet subcontract by Thames Energy. It is written by Crispin Webber.

6.3.1 Biodiesel production

6.3.1.1 Introduction

Biodiesel consists of the mono alkyl esters of fatty acids derived from vegetable oils or animal fats. It is most commonly produced through a process known as trans-esterification, which is a chemical reaction where an alkoxy group of an ester is exchanged with that of another alcohol to form the new ester product.

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2 This covers the 10 acceding countries, 2 accession countries (Bulgaria and Romania) and 1 Candidate Country (Turkey)
3 http://europa.eu.int/comm/environment/ippc/ippc_ms_implementation.htm#ImplementationReps
4 http://cdr.eionet.europa.eu/resultsdataflow?dataflow_uris=http%3A%2F%2Frod.eionet.eu.int%2Fobligations%2F523&years%3Aint%3Aignore_empty=&partofyear=&country=&sort_on=reportingdate&sort_order=reverse

This reaction is reversible, so to force the equilibrium in the direction of the products from 60% to 200%, excess methanol is added. The reaction requires a catalyst and strong bases such as potassium hydroxide and sodium hydroxide.

The alkali catalysts usually result in the reaction proceeding to completion in 4 to 8 hours at ambient conditions and in 1 hour at 60^{o}C. In general, the catalyst is dissolved in the methanol before addition to the oil to prevent direct contact between the concentrated catalyst and the oil. Since the methanol is only slightly soluble in the soybean oil, agitation is required during the early part of the reaction. The reaction proceeds through a sequence of steps involving the removal of fatty acid chains from the triglyceride to produce diglycerides, monogylcerides, and, ultimately, free glycerol. When the reaction has proceeded to the point where substantial amounts of di- and monoglycerides have been produced, agitation is less important. To further drive the equilibrium to products, the reaction is often conducted in steps. During the first step, only a portion, say 80%, of the methanol and catalyst are added. The reaction proceeds substantially to equilibrium and then the reactants are allowed to settle so the resulting glycerol can be removed.

Then, the remaining methanol and catalyst are added and the reaction continued. Removal of the glycerol forces the reaction to the product side and since the alkali catalyst is selectively attracted to the glycerol, the presence of the glycerol can limit the speed of the reaction.

Excessive levels of saturated fatty acid chains can produce biodiesel with a high pour point making it difficult to use at low temperatures. High levels of poly unsaturated fatty acid can provide poor oxidative stability requiring the resulting fuel to be treated with an antioxidant.

While most biodiesel is made using methanol, because of its low price (and quick conversion), other alcohols, such as ethanol and iso-propanol, can also be used. Higher alcohols provide superior cold flow properties but are generally more difficult to produce, requiring higher temperatures, lower levels of water contamination, and more complex alcohol recycling due to the formation of azeotropes.

As mentioned earlier, strong alkalis such as sodium hydroxide and potassium hydroxide are common catalysts. These bases form the corresponding methoxides when dissolved is methanol. Water is also formed in this reaction and is probably responsible or some soap formation although not enough to inhibit the trans-esterification reaction.
Oil enters the reactor where it is mixed with methanol and catalyst. Usually, the catalyst has been mixed with the methanol before contacting the oil to prevent direct contact of the concentrated catalyst and the oil to minimise soap formation. The reactor can be either a batch process or, as is more common with larger plants, a continuously stirred tank reactor (CSTR) or plug flow reactor. When a CSTR is used, it is common to use more than one stage to ensure complete reaction. After the reaction is complete, the glycerol is separated from the biodiesel. This separation can be accomplished with a gravity decanter or using a centrifuge.

The un-reacted methanol will split between the biodiesel and glycerol giving about 1 to 3% methanol in the biodiesel and 30 to 50% in the glycerol. The methanol in the biodiesel should be recovered for reuse. It may be as much as half of the excess

methanol. This is usually accomplished by a vacuum flash process, but other devices such as falling film evaporator have also been used. The methanol-free biodiesel is then washed with water to remove residual methanol, catalyst, soap, and free glycerol. If the biodiesel contains excessive soap, this washing process can be problematic, as the soap will cause an emulsion to form between the water and the biodiesel. To minimise the formation of emulsions, a strong acid is sometimes added to the biodiesel to split the soap into free fatty acids (FFA) and salt. Without the soap, water consumption is greatly reduced and the salt, methanol, catalyst and glycerol are removed with as little as 3 to 10% water. The water should be heated to 60^{o}C to assist in the removal of free glycerol and should be softened to minimise the transfer of calcium and magnesium salts to the biodiesel. The final step in the process is to heat the biodiesel to remove water that may be dissolved in the biodiesel or entrained as small droplets. This is accomplished with a flash process.

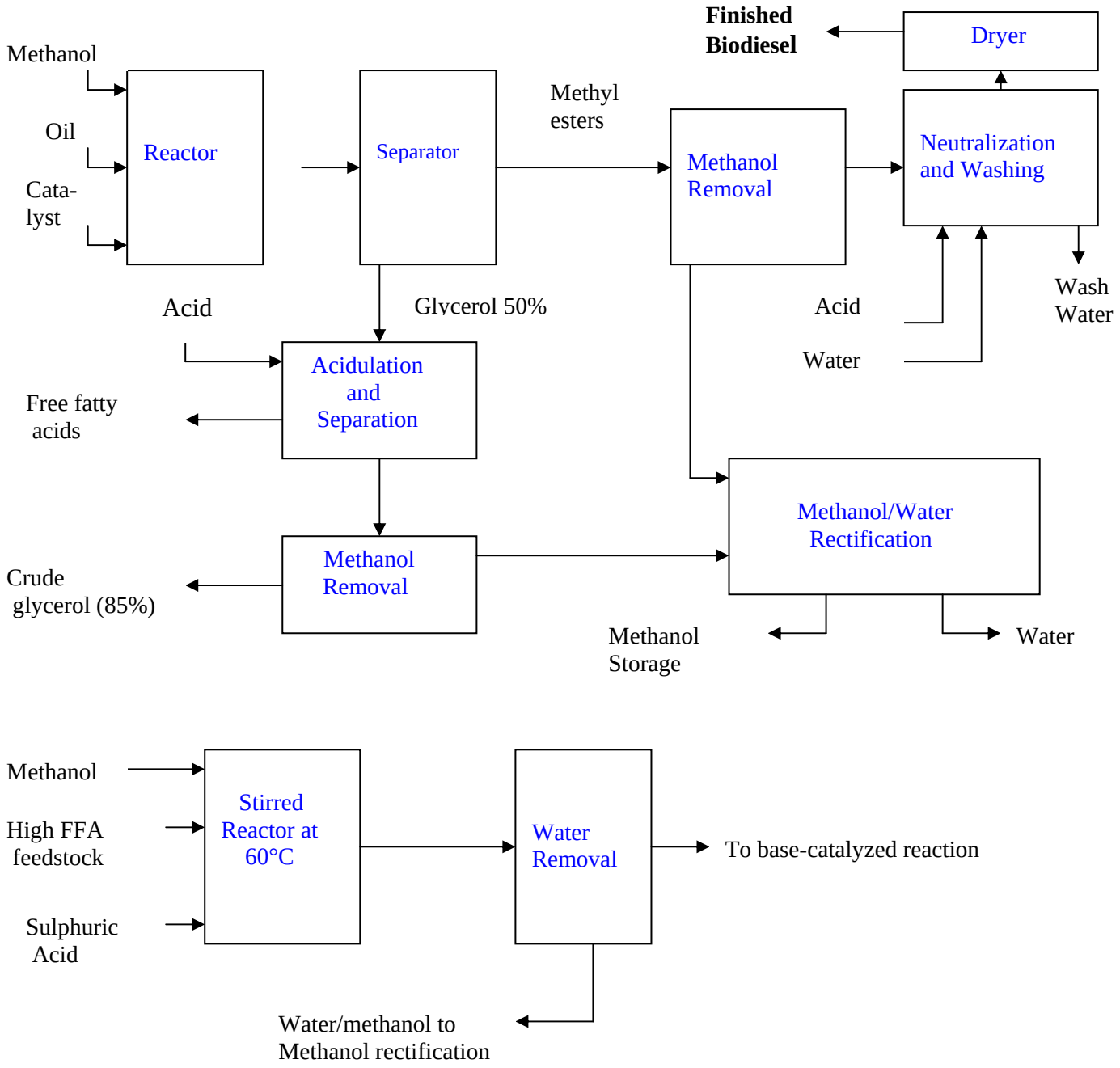
Also shown in the diagram is the preliminary processing of the co-product glycerol. This glycerol contains virtually all of the catalyst and a considerable amount of soap and un-reacted methanol. Usually the glycerol will be acidulated to split the soaps into FFA and salt. The FFAs are not soluble in the glycerol and rise to the top where they can be decanted and returned to the biodiesel process after pre-treatment. After FFA removal, the methanol is removed by a flash process or by a thin-film evaporator leaving a crude glycerol product that is 80 to 90% pure. The balance will be salts, residual FFAs, water and phosphotides, colour-bodies, and other contaminants from the oil.

Although water is not deliberately added to the process until after the methanol has been removed, small amounts of water will enter the system as a contaminant in the oil, alcohol and catalyst. This water will tend to accumulate in the methanol, so before it can be returned to the process, the methanol should undergo fractional distillation.

Biodiesel plants can use either batch or continuous flow processing. Batch processing is most common in small plants of less than 4 million litres/year. Batch processing provides the ability to modify the process for variations in feedstock quality.

Continuous flow requires greater uniformity in the feedstock quality, generally requires 24 hour operation, 7 days per week, increase labour costs, and is most suitable for larger operations of greater than 40 million litres/year. The schematic of a biodiesel plant is shown in Figure 2.

Figure 2 Schematics of a biodiesel plant



6.3.1.2 Product Quality

Modern diesel engines require high-quality fuels. The fuel injection system which is often the most expensive element of the engine can be damaged by fuel contaminants. Water and solid particles are the largest problem.

The contaminants most frequently found in biodiesel are the products of incomplete reaction and residual alcohol, catalyst and free glycerol. Incompletely reacted biodiesel will contain monoglycerides, diglycerides and triglycerides. These compounds are usually detected using a gas chromatograph and then the glycerol portion is summed to yield a total glycerol quantity for the fuel. ASTM standards require that the total glycerol be less than 0.24%. This means that more than 98% of the original glycerol portion of the triglycerides feedstock must be removed. Excessive amounts of monoglycerides, especially for saturated compounds, may precipitate from the fuel and plug fuel filters.

If the biodiesel is not washed with water, it may contain some un-reacted alcohol. The amount will usually be small enough that it does not adversely affect the operation of the engine, but it can lower the flash point of the fuel to where it must be considered flammable and accorded the same safety requirements as gasoline. The residual catalyst can cause excessive ash formation in the engine. Free glycerol can separate from the fuel and collect in the bottom of storage tanks. This glycerol layer can extract mono- and diglycerides from the biodiesel and produce a sludge layer that may plug filters and small passages in the fuel system.

6.3.2 Advantages of biodiesel

Table 24 shows the changes that were observed in the regulated exhaust emissions of three diesel engines that were tested to produce emissions characterisation data for the US Environmental Protection Agency's Fuels and Fuel Additives registration program. The reductions in unburned hydrocarbons (HC) and carbon monoxide (CO) are dramatic although these specific pollutants are not generally a concern with diesel engines. The particulate matter (PM) reductions are also quite striking. Oxides of nitrogen (NO_x) were found to increase with the use of biodiesel. The increase varied depending on the engine tested, but it is clear that biodiesel may produce a NO_x increase of 5 to 23%. The reasons for this increase are still under investigation but appear to be a combination of several effects, including biodiesel's higher speed of sound and isentropic bulk modulus and the tendency of many engine fuel injection systems to advance the injection timing when greater volumes of fuel are injected. Due to biodiesel's lower energy content, a typical test protocol may demand a higher fuel flow rate when biodiesel is used, causing an inadvertent timing advance and resulting NO_x increase.

A comprehensive Life-Cycle Inventory of biodiesel conducted by the National Renewable Energy Laboratory showed that biodiesel provided 3.2 units of fuel energy for every unit of fossil energy consumed in its life cycle. Further, although some fossil-based CO_2 is released during biodiesel production, mainly from the methanol consumed, the net production of CO_2 is reduced by 70%.

6.3.3 Disadvantages of biodiesel

6.3.3.1 Economics

One of the largest factors preventing the adoption of biodiesel is cost. The feedstock for biodiesel tend to be high in comparison to the cost of petroleum diesel fuel. The end result is that the cost of biodiesel is higher than that of petroleum diesel fuel. In addition, transportation costs are significantly greater for biodiesel due to the fact that transportation infrastructure for biodiesel is in its infancy.

Table 24 Changes in Regulated Emissions with biodiesel

Engine	HC	CO	PM	NO_x
Cummins N-14	-95.6	-45.3	-28.3	+13.1
DDC S-50	-83.3	-38.3	-49.0	+11.3
Cummins B5.9	-74.2	-38.0	-36.7	+4.3

6.3.3.2 NOx and Other Exhaust Emissions

Biodiesel produces more NO_x emissions than diesel fuel. If B100 is used, NO_x production may be increased by 13%. If a B20 blend is used, NO_x production is only increased by 2%, and the engine will typically satisfy the EPA engine exhaust emissions requirements under the Clean Air Act. To meet the EPA emissions requirements in 2006, engine manufacturers will likely use exhaust after-treatment technology that will reduce NO_x emissions. The low sulphur levels in biodiesel fuels make them a good candidate for use with the exhaust after-treatment technologies that are available. Even though biodiesel fuels produce more NO_x emissions, they have been shown to reduce carbon monoxide, particulate matter, unburned hydrocarbons, and other pollutants.

6.3.3.3 Fuel Quality

Many problems associated with biodiesel stem from poor fuel quality from the supplier. Most often this is related to the completeness of the production reaction. The ASTM has developed a quality standard for biodiesel. At this point in time, fuel manufacturer compliance with the standard is voluntary. Generally, it is a good idea to ensure that the biodiesel manufacturer sells biodiesel that meets or exceeds the ASTM specifications.

6.3.3.4 Energy Content

Biodiesel fuels contain about 12.5% less energy per unit of weight than petroleum diesel fuel (37,215 kJ/kg vs. 42,565 kJ/kg). However since biodiesel has a higher density, the energy content per unit of volume is only 8% less. As a result, the fuel economy of the diesel engine that is powered with biodiesel tends to be slightly less than when powered with petroleum diesel fuel.

6.3.3.5 Cold Weather behaviour

The cloud point and cold filter plugging point are much higher for biodiesel than diesel fuel. This means that the fuel will not work in the engine as well as diesel fuel at lower temperatures. Additives can be used to reduce the cloud point and CFPP of biodiesel fuel. The cold weather properties of biodiesel can also be improved by using a lower level blend of biodiesel fuel (i.e. B5 instead of B20). Additionally, the fuel may be blended with number 1 diesel instead of number 2 diesel to improve the cold weather properties.

6.3.3.6 Material Compatibility

Biodiesel fuel will react with some plastics and some metals in a negative manner. The plastics that seem to be compatible with biodiesel include Nylon, Teflon, and Viton. When in contact with nonferrous metals, such as copper and zinc, biodiesel fuel can cause precipitates to form. Some of these materials can be found in fuel tank liners, fuel lines, transfer pump diaphragms, injector seals and injection pump seals (among others).

6.3.3.7 Solvency

Biodiesel can also act as a solvent. This creates some problems when used in existing systems. The biodiesel can dissolve existing residues in fuel tanks and lines and carry them to the fuel system. Generally, after a few tanks of fuel have been used, the problems tend to be reduced.

6.3.3.8 Stability

The oxidative stability of biodiesel fuel is a major factor in determining the allowable storage time for biodiesel fuel. The iodine number can be used to estimate the oxidative stability of the fuel before any stabilisers are added. Typically biodiesel fuels can be stored for use up to 6 months without problems. If biodiesel fuel needs to be stored longer, antioxidants can be added to the fuel to improve the stability. If the fuel is not stabilised, biodiesel can form gums and sediments that clog filters or form deposits on fuel system components, including fuel pumps and injectors.

Additionally, as with diesel fuel, some climatic conditions promote biological growth (such as algae), in the fuel. If this occurs, the problem can be treated with a biocide. Reduction in water contamination also reduces the amount of biological growth in the fuel since the algae grows on the water.

6.3.3.9 Warranties

Most engine manufacturers do not warranty their engines for use with a specific fuel. Consumers with engine problems that can be traced to the fuel are directed to their fuel supplier. Many engine manufacturers have developed policy statements for biodiesel that allow the use of up to 5% biodiesel but indicate that more experience is needed before fuelling with higher level blends. Most require that biodiesel meet the ASTM

standard. The best practice is to check with the engine and vehicle manufacturer before using biodiesel.

6.3.4 Biodiesel storage and use

6.3.4.1 General

Personnel engaged in operation of storage tanks should be thoroughly conversant with the type of tanks for which they are responsible their gauging, safe operating capacities, their fittings, connections and high and low level alarm settings.

All valves from which product may be drawn and all inlet valves should be closed when not in use. For additional security, locking of all valves from which product may be drawn and inlet valves in the closed position may be considered desirable when the installation is closed, or when any tank is only operated infrequently. All valves should be operated as frequently as necessary to ensure ease of operation when needed.

No person should go on to a tank roof during an electrical storm.

6.3.4.2 Procedures

Clear procedures should be established for receipt of product into the installation's tanks; these will vary in accordance with the method of receipt to be employed, i.e. cross country pipelines or road. The procedure will include:

- Quantities and grades of product to be delivered
- The rate of delivery, the numbers and capacities of the tanks to which deliveries are to be made.
- The method of controlling the operation of the inlet valves to the tanks.

Procedures should be clearly set out and followed:

- To avoid tank overfilling.
- For the changeover of tank and product grade, to ensure segregation of grades and to avoid risk of contamination.

There should be an efficient system and communication established between all personnel concerned in the operations, in order that the procedures referred to above are properly carried out and immediate action can be taken in an emergency.

6.3.4.3 Tank gauging and sampling

The reference height used for manual gauging should be clearly marked near dip hatches.

Dip hatches for manual gauging of tanks should remain fully closed unless gauging is being carried out.

If a tank is fitted with more than one dip hatch, only one should be open at a time.

To avoid the possibility of electrostatic discharge, no manual gauging or sampling should take place while tank filling operations are proceeding or for 30 min afterwards.

Movement of product(s) and manual gauging should not be carried out when atmospheric conditions are liable to cause a static or other hazard to personnel engaged in operations e.g. an electric storm or flying sand.

Gauging and sampling should be carried out. If any object is dropped accidentally into a tank, it should be reported immediately.

Automatic level and temperature gauging equipment should be checked against manual methods at regular intervals.

6.3.4.4 Drainage of water from tanks

Water bottoms should not be retained in storage tanks, since water can cause internal corrosion of tank bottoms and lower shell plates, and encourage microbial growth. The only exception may be in the event that a tank bottom is leaking, or suspected of leaking, in which case water may be temporarily introduced to prevent loss of product; special procedures should be established for operation of the tank.

6.3.4.5 Blending

Blending of biodiesel is not recommended if the temperature of either fuel is below 4.4^{o}C. Low temperatures impact how easily the biodiesel mixes with petroleum diesel fuel. In most situations, splash blending works effectively (i.e. splashing or pouring the biodiesel into the diesel fuel), as biodiesel mixes readily with petroleum diesel fuel. Once mixed, the biodiesel tends to remain blended.

If splash blending biodiesel in a large tank, the biodiesel should be introduced after the diesel fuel has been placed in the tank or the blend should be prepared before placing the blended fuel into storage. This is due to the fact that the biodiesel is heavier than diesel fuel and will essentially rest at the bottom of the tank until some type of agitation is provided. Bulk plants or terminals may also use pumps but will most likely rely on electronic injection or in-line blending to prepare the required blend.

6.3.4.6 Additive injection

General

Additives may be added for several reasons such as safety, quality improvement, tax law (to distinguish products to deter their illicit use) and most commonly, product differentiation. Additive injection at terminals has evolved as follows:

a) Injectors actuated by meters mechanically or pneumatically.
b) Hand-dosing typically from the top of tank truck compartments.
c) Metering pumps.

d) Piston-based injectors, pressurised system.
e) Electronic-controlled injectors, pressurised system.

Product additives are a complex mixture of amines and solvent components. Precautions should be exercised in handling and when working on additive systems.

Certain cetane improvers, commonly used in diesel fuel additives, decompose exothermically at elevated temperatures. It is therefore necessary to assure all equipment is suitable for use and that the safety level of the system is adequate. The design and location of adjacent equipment where an exothermic additive could leak out spray should also be considered.

Point of injection

There are many factors that influence the point at which additive is added to the base product, including the type of facilities available, whether these are shared or owned by third parties, and the extent of product exchange agreements. Before it is decided to inject at the loading gantry, the advantages and disadvantages of other locations should be considered.

Where product is required both with and without additive, or where third parties require different additives, the additive will normally be injected at the gantry, just upstream of the product flow meter. For injecting additives when loading tankers various systems are available.

The most suitable type of equipment for any particular application will depend on the physical properties of the additive to be injected and on the injection rate.

For injection of additives while loading, pulse signals taken from the product flow meters can be used to control the injection operation. Provision for such control should be incorporated in the electronic control equipment (if available) or the installation of an electrical pulse transmitter to the loading meter.

To avoid cross-contamination between loads, the injection system should be designed to stop injecting additive prior to the end of the load thus leaving the loading meter stream and loading arm purged of all additivated product. This normally requires the use of an electronic control system that recognizes the load size prior to the start of the load and that subsequently initiates additive injection at rates slightly above proportionality to compensate for the fact that the last part of the load should receive no additive.

The injection of additive requires the additive system to operate above the product line pressure. The interaction of two pressure systems (products and additive) creates a number of significant challenges, principally the need to prevent the migration of product/additive to and from each system.

Experience has shown that the additive system should be designed robustly such that the forward/back flow of product is prevented, both during operation and during periods when the additive system is not operational; monitoring equipment and control interlocks for such events are recommended.

Additive systems should be kept completely segregated with separate product line connections. Thermal relief arrangements should be given careful consideration in the design of systems.

Blending

Additive injection is not considered a part of the blending process but a separate function; blending systems generally consist of combining greater volumes of components. Blending is generally required to form an intermediate grade, and can offer both cost and product availability advantages by reducing the number of product storage tanks required.

The design of the system should recognise restrictions imposed by the point at which duty is paid for the blended product and the components thereof. Sequential blending allows tailoring of the loading metering (where each blend component is loaded one at a time and product mixing occurs on the tanker compartment). This process is not suitable for heavy products since sufficient mixing is unlikely to occur.

In-line blending is the process where all components used in the blend are individually metered and controlled simultaneously to precise ratios, and in which mixing occurs in the blend discharge pipe resulting in blended product being loaded into the tanker compartment from start to finish.

Thermal relief arrangements should be given careful consideration in the design of blending systems.

6.3.4.7 Package filling and package storage buildings

General construction

Materials used for the construction of package filling and storage buildings should be fire-resistant and materials for the construction of equipment should be non-combustible.

Floors may be tiled, paved or concrete, but where drums are filled and loaded, steel or other oil- and wear- resistant impervious flooring is recommended, and consideration should be given to the containing and cleaning of spills.

Heating

Buildings in which petroleum is stored or handled should preferably be unheated, but where heating is required it should be provided by means not constituting a source of ignition.

Ventilation

Buildings should be adequately ventilated by natural or mechanical means. Those for storage and handling of biodiesel should have, as a minimum, natural openings in opposite sides near to the floor and the roof, or they may be constructed with open sides,

in which case entry of unauthorised persons may be prevented by means of metallic open mesh material.

Biodiesel should not be stored or handled in any part of a building below ground level unless that part of the building is provided with ventilation sufficient to prevent the accumulation of flammable or toxic vapour. Consideration may be needed to be given to the installation of a gas monitoring system.

Service doors, windows and skylights

Doors should be placed and constructed so as to provide a ready means of escape in the event of fire; they should be not less than 900 mm wide and should open outwards.

Wired glass should be used in the glazing of windows and skylights.

Escape routes should be in accordance with the local fire precaution regulations but it is recommended that at least two protected means of escape are provided.

Packaging machinery

Packaging systems should be designed to minimise manual handling by providing suitable conveyers and trolleys as appropriate.

All exposed gears, chains and similar dangerous moving parts should be provided with safety guards to prevent accidental injury; the guards may be fixed or automatic.

Adequate spacing should be provided around machines to allow safe operation and maintenance.

Where required, exhaust extraction suctions should be located close to the filling points. Fumes/vapour should be discharged into an external safe area at points where recirculation or collection in a confined space is avoided.

To prevent overfilling, containers should preferably be filled using a preset batch meter or similar arrangement.

Due to the possibility of generating electrostatic discharges during the filling of plastic containers, the filling of containers greater than 5 litres capacity should be avoided where possible, particularly where particles, water or vapour may be entrained.

When larger containers are filled, the flow rate should be limited and a bonded metal fill pipe extending to the bottom of the container should be used to minimise the generation of electrostatic charges.

Fine filtration can increase the generation of electrostatic charges; where they cannot be avoided in the filling system, alternative controls for flow rate and relaxation time to minimise electrostatic charge generation should be considered. These restrictions do not apply where containers are used only for unclassified products.

Transportation

Biodiesel, due to its high flash point, is not considered flammable. The fuel is considered combustible, just as is vegetable oil (feedstock). As such, the transportation of "neat" biodiesel may be handled in the same manner as vegetable oil (Code of Federal Regulations 49 CFR 171-173). This is not the case for a low-level blend or a B20 blend. These blends exhibit flash point tendencies that essentially mirror diesel fuel. Blends of biodiesel should be handled in the same manner as petroleum diesel fuel.

Storage Tanks

Storage tanks for biodiesel can be constructed from mild steel, stainless steel, fluorinated polyethylene, fluorinated polypropylene and Teflon. Biodiesel, like petroleum diesel fuel, should be stored in a clean, dry, dark environment. In the event that the container selected is made from polyethylene or polypropylene, the container should be protected from sunlight.

Some authors suggest that aluminium is suitable for use as a storage tank. However, nonferrous metals, such as aluminium, tend to react unfavourably with biodiesel by shortening the shelf life of the fuel. Much is the same for tin and zinc. Concrete lined tanks, varnish lined tanks, or tanks lined with PVC cannot be used to store biodiesel. Biodiesel reacts with each of these products, breaking down the chemical structure of each.

As with any fuel, steps must be taken to prevent water from entering the tank. Algae can grow in biodiesel just as it does with petroleum diesel fuel.

Measures should be taken to ensure that the biodiesel will flow in cold weather. This is often accomplished by mixing the fuel with either number 1 or number 2 diesel fuel. Cold flow improvers (CFI) can also be added to enhance the cold flow characteristics of biodiesel.

Material Compatibility

Essentially the same materials that are used to construct a biodiesel storage tank can be used with biodiesel (stainless steel, mild steel, viton, some forms of Teflon and fluorinated polyethylene/polypropylene). Rubber elastomers cannot be used, as pure biodiesel will dissolve the rubber. The effect is lessened with lower percentage blends, but little research has been conducted to determine the long term material compatibility of biodiesel blends.

Safety

Biodiesel is non-toxic, biodegradable and much less irritating to the skin than petroleum diesel. However, the same safety rules that pertain to petroleum diesel fuel also apply to the use of biodiesel. The following list summarises several of these issues:

- Store in closed, vented containers between 10oC and 50oC.
- Keep away from oxidising agents, excessive heat, and ignition sources.
- Store, fill and use in well-vented areas.

- Do not store or use near heat, sparks or flames; store out of the sun.
- Do not puncture, drag or slide the storage tank.
- A drum is not a pressure vessel; never use pressure to empty.
- Wear appropriate eye protection when filling the storage tank.

6.3.4.8 Vapour collection and recovery systems

Vapour collection system checks

Vapour collection systems should be visually checked periodically for signs of damage:

- Knock out pots should be drained regularly.
- Flame arresters should be checked regularly as part of an inspection system to ensure that there is no mechanical damage and that they are not becoming blocked.
- Isolation, non-return and relief valves, if fitted, should be checked for correct operation.

Vapour Recovery Units (VRU)

A VRU should be controlled by existing emergency shut down systems on the terminal. In addition the unit should have its own separate emergency shut down facility which does not impact on the remainder of the terminal.

A procedure is needed for resetting after an emergency shut down or fire alarm in order to make the process unit operational again. It is recommended that this is not implemented remotely, but involves attendance at the unit to check the status of all the process equipment and utility supplies in order to ensure a safe restart.

A record of all operational activities and alarm conditions should be kept to facilitate problem solving by maintenance personnel.

Precautions to be taken with tanks connected to vapour balancing systems

Tanks connected to a vapour balanced system can be operated normally with the exception that sampling and dipping operations require revised procedures as the tank may be pressurised.

Pressure/vacuum valves should be checked and set carefully to avoid unnecessary vapour loss.

Care should be taken during repair and maintenance to ensure that means of isolation are in place to minimise emissions to atmosphere.

6.3.4.9 Hazardous areas

Introduction and Principles of Area Classification

Hazardous areas may develop where products are handled or stored.

The concept of considering the risk of fire and explosion by classification of areas is given in various national regulations and in oil industry codes.

Object

The object is to define the classification of hazardous areas according to the probability of the existence of an explosive gas-air mixture, in order to relate the selection of electrical apparatus for use in the area to the degree of hazard.

Definition of Hazardous Areas

An area in which explosive gas-air mixtures are, or may be expected to be present in quantities such as to require special precautions for the construction and use of electrical apparatus.

Non-Hazardous Area

An area in which explosives gas-air mixtures are not expected to be present in quantities such as to require special precautions for the construction and use of electrical apparatus.

General

For an explosion to occur the following conditions must co-exist:

a) A flammable gas or vapour mixed with air in the proportions required to produce gas-air mixture.
b) A means of ignition

Only means of ignition related to electrical apparatus are taken into consideration. There are arcs or sparks or surfaces at a temperature sufficient to ignite the mixture.

In order to facilitate the selection of appropriate electrical apparatus, hazardous areas may be divided into Zones,

Classification of Hazardous Areas

A Hazardous Area is divided into Zones as follows:

- Zone 0 In which an explosive gas-air mixture is continuously present or present for long periods.
    - NOTE: The vapour space of a closed process vessel or storage tank is an example of this zone.

- Zone 1 In which an explosive gas-air mixture is likely to occur in normal operation.

- Zone 2 In which an explosive gas-air mixture is not likely to occur and if it occurs it will only exist for a short time.

Factors to be considered for Classification and Extent of Zones

Various factors must be taken into consideration when classifying an area. The main are:-

- Source of hazard
- Ventilation
- Nature of hazard

Source of Hazard

The source of hazard is a point (from which a flammable substance may be released into the atmosphere. Two grades (of release) are considered, termed primary grade and secondary grade, but these do not necessarily imply that areas containing primary or secondary grade hazards should be classified respectively as Zone 1 and Zone 2.

Primary grade Source of Hazard

a) Machinery and plant which can release a flammable substance into the atmosphere during normal operation.

b) Equipment containing a flammable substance and constructed of material liable to easy breakage.

Secondary grade Source of Hazard

Machinery or plant which can release a flammable substance into the atmosphere during abnormal (leakage or bursting) or infrequent operations.

Ventilation

The dilution of a flammable gas with air will depend upon the degree of ventilation and upon the amount of ignitable gas or vapour available to replace the gas being diluted.

It follows from the above that there are two extreme conditions. A hazardous Zone 0 in which an explosive gas-air mixture can be present either continuously or for an appreciable time in an enclosed space, hence a source of ignition must be completely avoided; and a non-hazardous zone where a source of ignition is permissible because an explosive gas-air mixture is not expected to be present.

There are two intermediate hazardous zones:-

- Zone 1 in which an explosive gas-air mixture may be present under normal operating conditions (although every effort would normally be made to minimise such a likelihood). This situation requires the installation of protected-type electrical equipment which will not give rise to a source of ignition (for a free flammable atmosphere) under normal or fault conditions.

- Zone 2 in which an explosive gas-air mixture would only be present under abnormal conditions for a short time.

This situation requires the installation of protected-type electrical equipment which will not give rise to a source of ignition for a free flammable atmosphere in normal operation but which could do so in electrical fault conditions despite precautions to minimise the likelihood. In this case the probability of a flammable atmosphere and an electrical source of ignition being present simultaneously are very low.

This section deals only with the classification of areas and not with the selection/installation of electrical equipment and installation for each of the areas concerned. Examples of primary and secondary grade sources of release are given together with a brief description of how they can occur under normal and abnormal operation.

Examination of the circumstances and total environment surrounding each possible source of release will indicate how quickly the flammable vapour can be expected to disperse.

For example, if ventilation is good a hazardous situation may remain for only the duration of the release and in this case a secondary grade source of release would give rise to a Zone 2 area, since the period of release would be short and infrequent.

Factors in Considering the Extent of a Hazardous Zone

A release of flammable substance may occur as liquid, vapour or a combination of both. It is necessary to decide at what distance from the source the vapour will have diffused in air to a mixture that cannot be ignited i.e. the distance at which it passes the lower explosive limit.

Consideration must therefore be given to:-

I. The quantity of material released, if over a short period, or the rate of release.

II. The conditions of the release, namely temperature and properties of the product, local ambient temperatures and ventilation rate.

III. The rate of evaporation and the distance the vapour cloud will travel before dilution to below the lower explosion limit.

IV. The nature of release i.e. liquid or vapour.

An indication of the evaporation rate can be obtained from the vapour pressure of the product released as the evaporation rate – including that for a mixture of hydrocarbons – depends upon its volatility. It will also depend upon the temperature of the substance released and the temperature of the atmosphere into which it is released.

Dilution of the vapour from the flammable substance can occur due to:-

- Wind, which is the most significant

- Turbulence caused by the velocity of the release

- Effect of gravity and thermal air currents on heavier-than-air material.

The dispersion of gases by wind is through the mechanism of turbulent diffusion. When the wind flows around obstructions turbulent eddy currents are generated which interact, intermingle and reform with each other. Gas released into the wind is passed from eddy current to eddy current, and as such spread transversely across and with the general direction of air flow. The random motions of the eddy currents are proportional to the mean wind speed, so the stronger the wind the more rapidly will gas be dispersed. The distance required to dilute a given gas discharge rate to a particular concentration is approximately inversely proportional to the square root of the wind speed. The gas-air mixture will be drawn into an elongated plume at the higher wind speeds but, since the direction of the wind may vary, the hazardous zone should be assessed as a circle around the source of release having a radius equal to the length of the plume at which the flammable vapour has been diluted in air to below the lower explosive limit. Information available at present indicates that for a given type and rate of release a critical wind speed occurs which gives a maximum plume length and that wind speeds above the critical result in a shorter plume. With lower wind speeds, near but above 2 metres per second, the gas-air mixtures does not travel in any particular direction but spreads more transversely across the direction of air flow. Hence the hazardous zone will not be greatly different from that for the higher wind speeds down to the minimum wind speed at which its direction is still evident.

When classifying an area, using analytical methods, equipment and layout details of the area must be known, so that vapour-evolution rates can be derived. For example, the rate of vapour escape from a storage tank vent can be calculated from knowledge of the product and tank filling rates. The points from which spillages may occur can be predicted and the amount of likely spillage assessed according to flow rates and duration.

There will probably be areas outside those finally defined as hazardous which will therefore be classified non-hazardous. These non-hazardous areas will still form part of the installation, terminal or depot “restricted area” or which all work and operations should be under general administration control requiring “permits-to-work” – particularly where naked lights or are concerned.

Requirements for Electrical Equipment in Hazardous Areas

All electrical equipment to be used in Zones 0, 1 and 2 must comply with the relevant national standards for these Zones.

Requirements for Ignition Sources other than Electrical

Whilst on classification described is for the selection of the correct electrical equipment and installation for each hazardous zone, the same classification will apply when ignition sources arising from other than electrical equipment are considered.

In Zone 0 and Zone 1 areas all items of equipment should be considered very carefully to establish if they could form an ignition source and if so they must be omitted. Building materials should be of the fire-resistant type.

In Zone 2 areas it is recommended that no plant, equipment or facilities should be used giving rise to fire, capable of producing sparks or generating temperatures higher than the auto-ignition temperature of the gas-air mixture present.

Full consideration must be given to all other factors which may influence the final classification for the purpose concerned.

Other Considerations

This code does not cater for catastrophic situations. However, if careful analysis of the type of 'Area Classification' is carried out following the procedures detailed herein then high risk points can be highlighted and plant design reconsidered to lessen any risk.

Sources of Risk – General

All equipment forming part of a plant or area handling flammable material should be examined to decide whether any part of it could give rise to a release of flammable material. The following should be included:-

- The mechanical construction – to determine the points from which leakage of flammable material could occur.

- The types of operation being carried out.

- The likelihood and frequency of a release of flammable material during normal operation, routine servicing and maintenance periods.

Precautions to avoid static charges

To avoid the build-up of static charges when filling a tank with biodiesel under conditions which may create a flammable atmosphere in the tank ullage space by vaporization or formation of mist, the inlet velocity should not exceed 1 m/s until the inlet of the tanks is completely submerged, and until the feed pipeline is free of any water or air. Subsequent inlet velocities should ensure smooth flow into the tank without causing turbulence, breaking of the surface of the product or disturbing bottom sediment. A maximum velocity of 7 m/s is recommended.

Drainage of tank compounds

Water which accumulates in the tank compound may be drained by normal gravity drainage. In this case the compound should be isolated from any outside drainage system by an externally sited valve, kept closed, and preferably locked except when the area is being drained of water under the control of the duty supervisor.

Alternatively, the compound may be drained by means of a manually controlled pump, or by a siphon drain, which passes over the top of the wall of the compound and which has to be primed by means of a small manually controlled pump.

Personnel should remain in attendance throughout all compound draining operations.

Water from tank compounds should be passed through an oil/water separator before being discharged to any outside drainage system or surface waters.

Oil/water separators

Oil/water separators should be inspected regularly, preferably daily, and any free oil removed from the surface of the main chambers. The surfaces of these chambers should be cleaned as required to ensure efficient operation of the separator. A log should be kept of all inspections and cleaning operations. Where water is removed during cleaning operations it needs to be replaced by clean water prior to the separator continuing in use.

Samples of the effluent should be drawn and tested regularly to monitor compliance with discharge consents.

Additive injection equipment

Additive injection facilities should be checked regularly to verify that correct injection rates are maintained and there are no leaks.

Additives can be hazardous and extreme care should be taken when handling them. Manufacturers' procedures and health and safety data sheets should be strictly adhered to.

Where more than one additive is being injected or more than one operating company is involved, care should be taken to avoid cross-contamination of additives.

The roof-to-tank seal is normally vapour tight but vapour may accumulate above the roof within the tank shell when the tank is being emptied because the roof, when travelling downward, leaves a wetted area of shell so giving rise to a primary grade soured of release.

Normally there is sufficient wind to disperse such vapour but the source of release is nevertheless classed as primary.

Valves, Flanges, Pump Glands and Seals

In plants and installation where products are handled below their boiling point the above do not normally give rise to primary grade sources of release.

A secondary grade source of release could occur where the valve stem or spindle passes through the packing gland or seal or where a flange gasket fails.

Loading Arms

The external surface of the immersed length of the arm will be wet as it is withdrawn from the vessel which has been filled. The internal surface of the arm will also be wet. The wetted surfaces will drain so giving rise to other small wetted areas as the arm is returned to the "at rest" position.

Relief Valves

Relief valves do not create sources of release unless they vent to atmosphere.

Filters, Sample Points, Air Bleed Points and Pig Traps

When filters are opened for cleaning, a wetted surface will be exposed and spillage may occur.

Sample points should be designed to prevent loss of constituents of the sample. The flow should, where practical, be restricted in order to limit the rate of loss if the sample point is accidentally left open. Samples should be small and delivered if possible into a closed system. Release of flammable vapour should consequently be small and infrequent.

Air bleed points are only fitted at high positions in piping systems and are normally in well-ventilated situations. Their use is infrequent, usually during commissioning and re-commissioning and they should be plugged or blanked off when not required.

Leakage can occur if a valve is not properly re-seated. Flow rate during operation of such valves should be restricted but even so consideration should be given to the possible release of liquid and a consequent wetted area.

Pig traps give rise to three possible sources of releases: the air vent, the drain line to a sump and the exposed wetted area of the internal surface of the trap, when opened. This includes the pig and any discharged debris.

All of the above are secondary grade sources of release.

Slop Facilities, Interceptors and Sumps, Drainage Channels

In combination, the above can form an oil/water effluent system and therefore require very careful consideration both separately and jointly since spillage in one area can be transmitted through to other areas.

Slop facilities usually comprise a funnel-type entry to a closed piped system, leading in turn to a storage tank. Spillage may occur which gives rise to a secondary grade source of release.

Ground Spillage

The initial rate of evaporation from ground spillage will be high with low flash point material and will then decrease assuming no replenishment by continued spillage. The

area affected by the above secondary grade source of release will extend above and beyond the total surface area of the spillage.

Loading and Discharge Facilities - Road Tank Vehicles

If a loading bay is occupied, a tanker approaching that bay should not come closer than 6 metres from the loading position and the engine should be stopped. This distance may be controlled by a warning line on the ground. Loaded tankers should be parked greater than 6 metres clear of the loading gallery.

While loading or unloading is in progress, tankers should not be left unattended and the parking brake should be applied.

While loading biodiesel, the engine of the tanker being loaded and the battery master switch should be switched off. The engine should not be restarted until all caps, valves or covers on the tanker have been closed and securely fastened and the loading arms placed in the parked position.

Electrical continuity (bonding) and grounding is always necessary when handling biodiesel and particularly when switch loading.

Note: The bonding connection is normally an intrinsic part of an overfill prevention system.

Where vapour recovery is practised, the vapour recovery hose should be connected to the tanker before any liquid loading hose.

When tankers are top loaded with biodiesel, or when switch loading occurs, the drop pipe of the loading arm should be lowered to the bottom of the tank compartment before loading commences to avoid splash loading.

Any tanker dip rods for measuring tank contents should be securely stowed after use.

Managers of installations should make sure, for example by arranging spot examinations, that tankers using the loading facilities, whether their company's own or operated by third parties, comply with minimum safety standards and, where bottom loading is operated:

- Are leak proof to avoid loss of vapour
- Have overfill prevention sensors that are regularly checked to ensure that the ullage setting remains as designed.
- The operation of all pressure/vacuum valves is checked on a regular basis in accordance with any local regulations.

Only authorised and trained drivers should be allowed to load their tankers. All other drivers should load under direct supervision.

Procedures

When switch loading tankers, vapour in the tank may remain for a significant period within the explosive range. In order to minimise the risk of ignition, loading should start at a reduced rate until the outlets of the fill pipe are submerged. This assists in minimising the build-up of electrostatic charge within the tank. Thereafter loading rates may be increased. Under such conditions it is emphasised that top loading fill pipes should reach the bottom of the tank and should be in a vertical position.

Filling of Vehicles

At all times whilst a vehicle is in service the internal spaces of the compartments should be classified Zone 0.

A primary grade source of release occurs whilst the vehicle is being loaded due to vapour emission from the open or venting manlids. It has been established that the hazardous area from open manlids – at a filling rate of 2.5 m3 per minute – extends in all directions to a distance of 1.5 metre from the edge of the opening of each manlid with a vertical drop to ground level, be classified Zone 1 so allowing for the adjacent manlids and any spillage from the loading arm whilst being removed.

The above distances allow for the possible release of product from draw-off valves when used for adjustment of load.

Spillages

All installation personnel should be given instructions on the sound operating practices to avoid the risk of spillage and of subsequent fire. If however any spillage or leakage occurs, the methods of preventing ignition, of preventing product entering drains, sewers or water courses and of cleaning up the spillage should be clearly understood.

Spillage, a secondary grade source of release, can occur from filters during routine servicing, from the components of pipe work systems, and due to overfilling of vehicle compartments. Spillage can therefore occur at a rate up to the maximum loading rate. The extent of a spillage should be assessed according to the expected duration of such an occurrence, with due regard to surface grading and drainage systems.

6.3.4.10 Container filling and storage

Open Building

A primary grade source of release occurs as the container is being filled. This is because flammable vapour and air will be emitted from the filling/venting point, in greater or less volumes, according to the rate of filling. The heavier-than-air vapour emitted from the filling/venting point could roll across the top surface of the container and travel over the edge and down to ground level. Spillage may occur due to overfilling and from drainage of the filling nozzle, giving rise to secondary grade sources of release.

It is recommended that an area extending 1 metre in all directions from the edges of the filling/venting opening projected to ground level should be classified Zone 1. This area should further be extended all around at a height of 0.5 metre above ground level to a horizontal distance to 2.5 metres from the vertical centre line of the container.

Closed Building

Container filling in a closed building is not recommended. When unavoidable the whole of the closed building should be classified as Zone 1 since the continuous dilution of any flammable vapours cannot be guaranteed. Openings in the building to outside atmosphere should be considered as secondary grade sources of release. An area extending 3 metres in all directions and down to ground level, from the edges of the opening, should be classified Zone 2.

Other Areas – Open and Closed Buildings

Product storage, distribution systems, meters, valves, pipe work flanges, etc. upstream of the filling points should be considered. The individual hazardous areas associated with each possible source of release should be derived from all the pertinent facts, as demonstrated, and a final practical classification determined. The area affected by spillage, due to overfilling, should be derived with appropriate consideration for provision of the means of containment, drainage and slop facilities.

Storage Areas

The storage and handling of sealed containers will not normally give rise to a hazardous area. If such are stored, and consequently handled, within enclosed premises or bunded areas (or perimeter of the compound formed by a wall) then it is recommended that the whole area to a height of at least 1 metre, above the highest container be classified Zone 2.

6.3.4.11 Planning of installations

Legislative requirements - general

Statutory requirements, both national and local, including any petroleum licensing conditions, planning, building regulations and local by-laws should be considered. Early discussions should be held with all authorities, including the fire officer, who are

responsible for these and any other requirements. Formal approvals should be obtained on conclusion of such discussions before starting construction.

Within the European Union, compliance with national legislation implementing EC Council Directive 96/82/EC and Directive 2003/105/EC *Control of major accident hazards involving dangerous substances* (the so-called SEVESO II Directive) is mandatory dependent on the nature and quantity of dangerous substances stored on site.

Layout and design

The recommendations given in this Code are intended for guidance on sites in the low-to-medium risk category, capable of straightforward development such as a site on reasonably level ground in an urban, but not heavily built-up area. Sites in high risk areas may require more stringent conditions.

The layout and general design should take account of relevant Intellectual Property Publications with respect to health, safety, operational efficiency and environmental considerations.
Installations which handle only biodiesel may present less risk, but in these cases safety distances from boundaries for storage and handling facilities should have regard for the location and surroundings of the installation.

Hazardous area classification

The storage, transferring, loading and unloading of biodiesel, create hazardous areas where a flammable atmosphere may be present or may arise. The planning, layout and design of the installation and equipment should take account of this, particularly in the selection of electrical equipment.

Prevention of leakage and containment

Leakage of product should be prevented, or otherwise safely contained, in order to avoid the creation of hazardous situations or damage to third party property, drainage systems, waterways, local groundwater and water sources.

Consideration should be given to providing secondary containment systems for handling fire fighting water. In the United Kingdom reference should be made to Environment Agency Publication PPG18 *Control of spillages and fire fighting run-off, and to Guidance Note, EH70: The control of fire water run-off from CIMAH sites to prevent environmental damage*, published by the Health and Safety Executive.

Risk assessment

During the planning phase of the installation a risk assessment should be carried out to ascertain the likely risks to the health and safety of employees and anyone who may be affected by the work activity. Reference should be made to HSE publications HS(G)176, HS(G)186 and INDG163 *Five steps to risk assessment*.

6.3.4.12 Boundaries and security

Boundary security

Installations should be surrounded by a suitable security fence or wall of a minimum height of 2 metres. The form of construction may be chain link fencing, weld mesh, steel paling, brick, mass concrete or post and slab concrete construction. It will often be found that more that one type of enclosure can usefully be employed at the same installation, such as chain link or other open style fencing for tank compounds, and brick or concrete walling for busy operational areas, particularly where these adjoin a public thoroughfare.

Additional security measures

In conjunction with any applicable legislation or associated guidance, a risk assessment should be carried out to determine what further level of security is required. This might include closed-circuit television (CCTV) incorporating a recording / playback feature, an automatic alarm system on unmanned sites and remote site surveillance by means of telecommunications to a main control room or independent security company.

6.3.4.13 Tankage layout and safety distances

General

Storage tanks should be laid out in such a way as to minimise the impact of their operation on neighbouring properties and to enable effective containment of fire or spilt product. The disposition of tanks should take account of how emergency incidents would be handled.

Even where tanks containing volatile products are fitted with external or internal floating roofs, it is not possible to prevent the escape of some petroleum vapour during refilling.
In respect of biodiesel stored in fixed roof tanks, consideration should be given to the installation of internal floating roofs or to linking the tanks to a vapour recovery system in order to minimise the emission of vapour to atmosphere, to reduce product losses, and to conform to any statutory controls.

Tanks should be placed so that any vapour emissions will have diffused in the atmosphere to a concentration below the lower flammable limit before reaching a non-hazardous area. IP Model Code of Safe Practice Part 15 *Area classification code for installations handling flammable fluids*, (IP 15) gives guidance on determining the extent of hazardous areas.

Method of determining minimum separation distance

Recommended minimum separation distances refer to the horizontal distances in plan between the nearest points of the specified features, e.g. storage tanks, filling points, openings in buildings, boundaries etc.
Special consideration should be given to sites on sloping ground.

6.3.4.14 Arrangement of tanks and stacks of packed products in the open air

General

The arrangement of tanks and stacks of packed products should be planned in accordance with good operating and engineering practice with the aim of eliminating fire and explosion hazards to the greatest possible extent.

It is important to realise that safety requirements dictate the disposition of storage tanks relative to adjacent equipment and to each other. Whereas drum filling facilities can, in the event of a fire emergency, be relatively isolated by closing down product supply the problem is clearly of a different significance and magnitude concerning a potential fire within a tank compound.

For this reason tank design, tankage arrangements, tank distances and the provision of protection belts are governed by special requirements.

Tanks in Compounds

Above ground tanks for biodiesel should be completely surrounded by a bund wall unless the topography of the surrounding areas is such, either naturally or by construction, that spillage or any leakage from the tanks is directed quickly and safely by gravity drainage to a depression or impounding basin located at an appropriate situation within the boundary of the installation.

Bund walls biodiesel tanks are not necessary unless spillage could otherwise escape from the installation and cause damage to third party property or pollute drainage systems, rivers or waterways. Where such damage could occur a low bund wall should be constructed around the tankage not less than 0.5 metre in height.

When planning tank compounds consideration should be given to the necessity of safeguarding ground water resources against pollution from spillage or leakage.

Arrangement of Tanks

Tanks for the storage of biodiesel should be arranged and disposed so that, irrespective of whether they are erected within one or several compounds, any fires in nearby tanks in the same or adjacent compounds or in nearby equipment or buildings will have a minimal effect. As a further safety factor, consideration can be given to ensuring that they may be further protected against fire by mobile or stationary fire-fighting equipment (in the event of such an emergency). Furthermore, tanks should be arranged, so that, if a fire does break out, then fire-fighting may be carried out effectively with mobile and stationary fire-fighting equipment. Access and operating availability for such equipment is therefore of prime importance.

Tanks for the storage of biodiesel should be arranged so that each tank is adjacent to a (fire) road or place accessible to mobile fire-fighting equipment. They may be arranged in up to three rows adjacent to a (fire) road or open place.

Distances between above-ground tanks

Safety distances between above-ground tanks are, in most European countries, stipulated by authority regulations or by negotiations between operator/owner and local authorities. In the course of years requirements governing these distances have been changed and modified to take into account current environmental problems and the updating of technological procedures. A consequence of the is that safety distances vary in European countries:

Fixed Roof Tanks	-	Between 0.25/0.50 x diameter
Floating Roof Tanks	-	Between 0.25/0.30 x diameter

For example:

In Switzerland

The topography may influence the layout of an installation and may require a reduction of these distances. The possible higher risk being compensated for by additional fire-fighting support measures installed.

In France

Each tank greater than 5,000 m3 capacity must be equipped with a floating roof or an inert gas blanket. Reduced distances are only acceptable between tanks with a diameter below 24 metres and tanks erected in the same compound.

Tanks for biodiesel Products

The tanks should, for safety reasons, be arranged at the following minimum distances from one another, the distances being measured horizontally between the tank shells and being calculated on the basis of the diameter of the largest tank present. The distances between any two should be:

Fixed roof tanks	0.5	Diameter
Floating roof tanks	0.3	Diameter
Fixed roof and floating Roof tank	0.5	Diameter of the fixed roof tank or 0.3 Diameter of the floating roof tank – whichever is larger.

Fixed roof tanks with floating blankets or inert gas blankets must be considered as fixed roof tanks but where there is a rigid internal floating roof and a properly ventilated vapour space then they may be considered as floating roof tanks.

Tanks for biodiesel Product

No special safety factors governing distances between tanks for the exclusive storage of biodiesel products are required and these may be set according to constructional and operational convenience.

The requirements in respect of distances should however be observed between tanks holding biodiesel products if these are set up adjacent to each other, whether in the same bund or not. Calculation of distance is then based on the diameter of biodiesel tanks.

Reduced distances between tanks

The distance recommended may be reduced if measured as a result of accepted and implemented observations such as additional fire fighting support measures.

If two adjacent tanks are separated by a fire resistant wall of a height 4/5ths of the highest tank and of a length equalling the diameter of the largest tank, or if one of two tanks is surrounded by a fire resistant wall of a height of 4/5ths tank height, then the normally calculated separation distances may be reduced by 50 % (but not less than 3 metres). It may be observed that such fire resistance walls could at the same time serve as a bund wall for retaining oil spillages or leakages.

Distance Between Tanks and Hazardous Area and Between Tanks and Installation Boundary - Tanks for biodiesel

For fixed roof above ground tanks the distance between a tank and any loading/unloading point, filling shed or a building should be not less than 15 metres.

For floating roof tanks storing biodiesel the distance between the tank and any loading/unloading pint, filling shed or a building not containing a possible source of ignition should be not less than 10 metres.

The distance between a tank and outer boundary of the installation, any designated non-hazardous area or any fixed source of ignition should be not less than 15 metres. Similarly the distance between the outer boundary of the installation or the protection belt and the perimeter limit of a hazardous area associated with a facility should not be less than 10 metres.

Tanks for biodiesel

It is recommended that tanks for the storage of biodiesel should be not less than 10 metres from the outer boundary of the installation.

Small Groups of Tanks

Deviating from the above requirements small tanks of a diameter not exceeding 10 metres may be regarded as one tank with a nominal height of 15 metres. Such small tanks (of any height) may be placed together in one group with a distance between the tanks determined only by operation/constructional requirements. No such group should have an aggregate capacity of more than 8,000 m^3.

The distances between the nearest tank of a group and other tanks are:

3,000 m^3 - 8 metres
3,000 m^3 to 8,000 m^3 - 13 metres

Small tanks up to a diameter of 10 metres will normally be built as fixed roof tanks.

Distances between Horizontal Cylindrical Tanks for biodiesel Products

The calculation of minimum distances for such tanks is based on their respective diameters – as with cylindrical, vertical floating-roof tanks. For horizontal cylindrical tanks with diameters not exceeding 4 metres, placed adjacent to each other at the same level, no safety distances are stipulated. If tanks of such diameters are placed adjacent and above each other, adequate fire protecting measures may have to be provided and supports should be fire-resistant (2 hours).

Arrangement of Stacks of Packed Products

Stacks containing packed biodiesel should be placed in one or several compounds if the total volume of the packed products exceeds 200 m3 to ensure containment in the event of leaking packages of fire.

Cleaning and gas-freeing

Cleaning of packages should be carried out in a well ventilated building or in the open air. The appropriate safety precautions should be observed, e.g. no smoking or sources of ignition. Steam is the normal medium for cleaning and gas-freeing packages.

Repairs

All work should be controlled by a permit-to-work system. No hot work repairs should be carried out on any package until it has been cleaned and certified gas-free; closures should first be removed. Such repairs should be carried out within an area designated as non-hazardous.

Containers which have held heavy oil can appear gas-free when tested, but when heat is applied, traces of product remaining in the container can vaporise to form a flammable atmosphere. No hot work should therefore be permitted on any container, including those which have held a heavy product, unless all traces of product have been removed, the container certified gas-free, and procedures are in place to verify that this condition is maintained.

Filling

The filling of packages with biodiesel should only be carried out in a building designed for that purpose. Arrangements should be made for the packages and the filling installation to be maintained at the same electrical potential, and the filling installation should be electrically bonded and grounded.

Adequate ventilation of the filling area should be maintained throughout filling operations.

The filling of packages with biodiesel may be carried out in any building except where a source of ignition could endanger the operations.

Any spillage which occurs during filling should be isolated, kept from spreading and cleaned up without delay. If the spillage is of biodiesel all operations in the immediate vicinity should be suspended. Filling should not be resumed until the area has been declared safe and authority is given by the supervisor in charge.

After filling, all packages should be marked or labelled as required by legislation to indicate the contents and related hazards.

Storage

Packages should be stored only in the buildings or other space specifically allocated for the purpose. Floors of buildings should be of level construction and all access ways to outdoor storage should be free of holes or other tripping hazards. Walkways should be kept clear and should preferably be marked with white lines.

From the time packages are received, whether empty or full, from a source outside the installation, a regular cycle of operations should be arranged to eliminate any unnecessary handling.

When full packages are stacked, they should be so arranged that leakage from any package can be readily detected. They should be regularly inspected, and the contents of any package found to be leaking should be immediately transferred to a sound container.

Barrels and large drums, of 205 litres nominal capacity or greater, stored horizontally, should be provided with adequate and safe means of restraining movement at both ends of the stack. Scrap metal, stones or other makeshift materials are not suitable for use as chocks. Full barrels stored horizontally should not be stacked higher than the loading on the bottom of the row will permit. This will normally be four high, but will depend on the wall thickness and construction of the barrels. Consideration should be given to providing weather protection.

Barrels stored vertically should be arranged so that the stacks are stable and safe. This may be done by using pallets or similar devices between the tiers to prevent tipping or by cross bonding the stacks by placing each successive tier half a barrel to the left and right alternately. Stacks of full barrels should not be higher than loading on the bottom tier permits; again consideration should be given to providing weather protection.

Other packages should be stacked in a neat and stable manner. Cartons of small packages which have insufficient mechanical strength in them should not be stacked without racking.

All stacks of packages should be confined to properly marked areas. Adequate width of aisles should be provided between stacks for normal movement, including the use of mechanical handling equipment, fork lift trucks and power trolleys, and to provide breaks in the event of fire. There should be clearance between the stacks and building or boundary walls so that in no circumstances will stacks lean or exert pressure on walls.

Empty packages of any size may be stored to suit operational requirements and package design limitations. Packages which have held petroleum should be treated as a potential fire hazard and the appropriate safety precautions observed.

Empty packages which are to be disposed of should be cleaned and made gas-free unless they are to be delivered to a competent person who has been notified of their condition and to any precaution to be taken prior to subsequent use.

Handling

Care is necessary in handling packages in and out of stacks to avoid injury both to those engaged in the work and other persons in the vicinity.

When packages are handled in a hazardous area, adequate precautions should be taken to avoid the risk of sparks from the movement of packages or from ancillary handling equipment.

6.3.4.15 Layout – arrangement of plants and facilities

General

The layout of all other plants and facilities pertaining to installations and depots should be planned in accordance with good engineering practice and with the aim of eliminating fire and explosion hazards to the greatest possible extent. The hazards will, on the one hand, depend on the types of product to be handled, the total capacity of the tanks involved and the total volume of products handled and, on the other hand, on the local conditions, the size and configuration of the area and the types of other plant and equipment in the vicinity. Therefore, the following guidelines and observations can only be of a general nature.

Safety Distances

Operational buildings such as workshops, boilers, transformers, switch rooms, etc. should be separated from the perimeter limit of a hazardous area by a distance not less than 10 metres. Similarly this minimum distance should apply between the perimeter limit of a hazardous area and the site boundary.

Fence and Entrance

Restricted areas should be completely or separately – if located at distances from one another – enclosed by wire mesh fence or walls of adequate height (approx. 2 metres). No separate fencing around individual installation parts themselves is necessary if the whole area of the installation depot is so fenced in and closed to general traffic, except in the case of special products.

Self-service filling equipment for biodiesel may be located outside such fencing and needs no separate fencing, provided it is safeguarded against unauthorised use.

Gates in perimeter fencing to allow the passage of road traffic should be for

One way traffic – 4 metres wide minimum
Two way traffic – 7 metres wide minimum

Consideration may be given to installation – within such fence works – of strategically located "easy-access" positions for use in the event of an emergency such as a fire.

Loading and Unloading Points – Road Vehicles

The immediate loading or unloading area should be constructed so as to restrict any spread of product following a spillage. The drainage system should ensure that any product spillage at the loading or discharge area is collected by drains (fitted with water traps) and carried to an oil interceptor located at least 15m from any uncontrolled source of ignition.

The interceptor will create its own hazardous area which will determine the type of location of equipment in its vicinity.

Under no circumstances should underground oil interceptors be placed under vehicle loading bays.

The area where product spills could occur should be surfaced in concrete or similar material resistant to the product. Islands between or at the side of loading bays should be higher than road level to ensure that product spillage cannot accumulate.

Vehicle loading or unloading points should be operationally grouped together with ease of access for vehicles and protected against accidental physical damage by vehicles using the facilities. Entry and exit roads should avoid crossing of main traffic flow.

The grouping of facilities on islands parallel to one another and spaced to permit the simultaneous use of both sides of any such islands and the height of roofs, loading arms, pipe work etc. should allow sufficient clearance for the largest vehicles in use and for anticipated development of larger vehicles. Weighbridges, kerbside fuelling stations, maintenance and washing facilities, should be located outside the normal traffic flow, if possible, and remote from loading/unloading areas. Waiting areas immediately adjacent to the loading/unloading area should be site so that there is a minimum distances of 6 metres from the front of any waiting vehicle and the outside of the loading bays.

Above Ground Tanks

For small horizontal tanks less than 10 metres long one manhole is recommended in the top centre of the tank. For larger horizontal tanks two manholes, one at each end of the tank upper surface are recommended.

Above ground horizontal tanks should be anchored to their foundations if there is the possibility of instability due to high winds or flooding.

Buried or Semi-Buried Tanks

Buried or semi-buried horizontal cylindrical tanks should be designed, fabricated, erected and tested in accordance with a recognised standard e.g.

British Standard \Institution: BS2594
Deutsche Industrie Norm: DIN 6608 6624

Where such tanks are constructed in locations with a high water table then anchorage should be provided to prevent tanks being lifted from their bases.

Tank Fittings and Fixtures – Gauging Equipment

Automatic or remote gauging equipment together with temperature recorders, high/low level alarms should be electrically bonded to the main tank structure.

Pipe Nozzles

All connections to tank shells or tank bottoms should be steel, welded and, where necessary, reinforced. Inlet connections should be located as low as possible in tank shells compatible with normal operating practice, so as to reduce potential electrostatic hazards which might arise during filling, as a result of product spraying from the inlet nozzle when it is above liquid level.

Valves fitted to tank connections should be of steel and should indicate clearly when in the open or closed position. All gaskets should be fireproof and resistant to attack by the product stored.

The installation of remotely-operated valves – particularly in unmanned depots – is desirable.

Testing of pipe work

Vapour hose connections should be made before loading commences.

Insulating flanges or hoses should be visually checked before loading to ensure that they are not short-circuited.

Tank Security and Safety – Ullage (space left unfilled in a tank) Requirements

The design capacity of tanks should provide sufficient ullage (a minimum of 2%) below the upper curb angle (for vertical tanks) to permit thermal expansion of the product to be accommodated.

The net capacity of tanks utilising floating roofs should be limited to the permitted safe movement of the roof.

Venting

Venting should be designed to meet the requirements of an accepted code of practice – e.g. American Petroleum Institute, API Standard 2000, Venting, atmospheric and low-pressure storage tanks.

Open vents or pressure/vacuum valves should be of sufficient air/vapour flow capacity to suit normal conditions of tank filling and discharging so that no increase in pressure or vacuum outside the limits of the tank design criteria can occur.

Fixed roof tanks for biodiesel, whether they are equipped with or without a blanket, should be fitted with pressure/vacuum valves or open vents with flame arrestors or adequate cross-ventilation designed to prevent the tanks vapour space entering the flammable range.

Pressure/vacuum valves or open vents should not be fitted with fine mesh gauze which is liable to become clogged with dust, dirt or ice so impairing venting capacity. If valves or vents are equipped with screens – to prevent the entry of birds – the mesh of the screen should not be finer than 10 millimetres.

Emergency Venting

Every above ground tank should have a form of 'emergency venting' which will relieve internal pressure in the event of exposure to fire.

For vertical tanks such venting may be provided by a floating roof or in a fixed roof tank by a weak weld between roof and shell which will fail sooner than any other weld or plate of the tank shell or curb angle.

Grounding

Shells of tanks which are used to store products in which a flammable atmosphere can develop or which are located in a hazardous area should have a resistance to earth not exceeding 10 ohms when all external pipe connections are isolated from the shell. If above 10 ohms a minimum of 2 earth electrodes should be installed to meet this requirement so that the electrode system has a resistance to earth not exceeding 10 ohms.

A group of tanks within a single bund wall may employ a common system of electrodes and grounding. In such cases each tank should be provided with two paths to earth.

If any one path/electrode is isolated the resistance to earth of the tank should not exceed 20 ohms.

Floating roof tanks should be provided with multiple contact scraping devices (shunts) between roof and tank shell positioned at 3 metres intervals around the circumference over the roof seal. With a mechanical linkage metal seal shunts should bond the roof to the seal which is in contact with the shell.

Rolling ladders should be bonded to the tank shell and roof by means of flexible cable.

Corrosion Protection

Tank shells, roof fittings and other fixtures should be protected against external corrosion, special consideration being given to protection of tank surfaces covered by insulation materials.

Buried tanks should be protected, having due regard to soil properties, water table and other conditions prevailing in the area.

Internal surfaces of tanks, particularly tank bottoms, tank roofs and the top strakes of tanks with floating roofs should be protected against corrosion after consideration of the properties of the intended contents.

With buried or semi-buried tanks it is important that the possibility of corrosion occurring be reduced to the point where the risk becomes negligible (internally or externally). This may be achieved by the use of non-corroding materials such as glass, reinforced plastic or by the application of protective coatings to steel or by cathodic protection.

Identification of Tanks

Tanks should be assigned numbers and visibly marked with any other specific operational information required. Thus, leaded storage-tanks should be labelled and identified so that this information will be permanently visible and be retained even after a change of service.

Detailed records should be kept of design criteria, manufacture, date of construction, capacity etc. and should always be readily accessible.

Cavern Storage

Caverns are fully accepted as a method of storage of oil. They are particularly advantageous where land availability is restricted.

Design procedures vary. A cavern wall may be lined with a skin of thin steel plate and the space between the cavern wall and the steel plate packed with concrete. In such cases special provisions must be made to relieve pressure build-up by ground water between the concrete and the steel liner which could otherwise cause its collapse. Problems have been experienced with this arrangement as, generally, heavy corrosion at the interface steel/concrete sets in. This may be minimised if millscale (ferric oxide deposit is adequately removed in advance.

Alternatively, concrete may be set against the rock as a tank wall. It has lately been shown that a concrete lining is impervious to petroleum products only when the pores of concrete are filled with water.

A generally accepted method is to store oil in underground caverns (or old mines) where crude oils, liquid-gas or petroleum products are kept in place of impermeable surrounding rock and by external water pressure. Such a cavern must be located below the lowest possible water-table level. The cavern surface must be adequately homogeneous with no excessive fissuring, so as to avoid leakage of ground water into the cavern, exceeding the capacity of the installed water drainage system.

Attention must be paid to the need for product and water level alarms and systems for gauging both product and water levels continuously.

Special provision must be made to ensure that duplicate standby water removal pumps are available and provision of emergency power generators must be considered.

Where necessary cavern storage should be fitted with vents or pressure/vacuum relief valves releasing to outside the complex.

Two alternative systems of storage may be used, one with fixed low water-bed (e.g. 0.2 metres) and variable product level, and the other with fixed high product level, with product stored on fluctuating water-bed.

All such storage must be designed to rigid safety standards by experienced geologists and engineers and approved by local authorities. Heated products (e.g. fuel oils) at 50 ºC or liquefied, refrigerated products (-40 ºC) can be successfully stored in caverns but care should be taken to allow for differential expansion if steel linings are present.

In granites and gneisses, caverns have been constructed up to 20-25 metres in span and up to 35 metres in height. In sandstone, caverns have been constructed with spans up to 15 metres and heights up to 25 metres.

Salt Dome Cavern Storage

Such storage is excavated in a natural underground salt dome formation by leaching out a cavern in the salt using water.

Since salt dome caverns are impervious to the oil stored within them and are not affected by seepage of ground water no special alarm or gauging systems are necessary to meet safety requirements. However, owing to the plastic behaviour of the salt dome, precautions must be taken to avoid build-up of excessive pressure. Further, it is necessary to keep the cavern volume filled at all times, to prevent collapse of the walls. Therefore, when products are withdrawn, replacement water must be pumped in. Since this leads to further leaching of the salt from the base of the cavern, recalibration at regular intervals is required. For this reason, salt dome caverns are not normally recommended for product storage when the product is continually being turned over, but rather for the provision of reserve or strategic storage which will be static by nature.

6.3.4.16 Building

Administrative buildings

Administrative buildings (including the control room) should be located in a non-hazardous area preferably near the main gates. Visitors should have access to the administrative building without having to enter the operational area.

Operational buildings

Any operational building in which biodiesel is handled or stored should not be less than 15 metres from the boundary; the construction of any wall without openings located on the boundary may justify a reduction in this distance to not less than 10 metres.

Where the wall of the operational building closest to the boundary has no openings and there are no openings in the side walls of the building within 10 metres of the boundary, these distances may be disregarded.

Similar distances should be observed between these operational buildings and any buildings in which hot work is carried out or which contain any source of ignition.

In the case of a building where biodiesel is handled or stored, the distance from the boundary to openings in the side walls can be reduced to 6 metres.

Service buildings

Service buildings which may constitute a fire risk due to the nature of the work carried out or equipment used in them should be situated in non-hazardous areas.

Boiler house, power plant and fire pump houses

Boiler houses, power plant and fire pump houses should be located in non-hazardous areas, and where the equipment can continue to be safely operated in the event of fire or spillage elsewhere in the installation.

Road tanker workshops

Road tanker workshops should preferably be located outside the main security fence of the installation; in any case they should be located in non-hazardous area.

There should be adequate vehicle standing and access areas, and consideration should be given to the turning circles of the largest vehicles likely to use the workshop, especially when reversing out. Reference should be made to IP Road tanker workshop code when planning new workshops and extensions.

Consideration should be given to access for vehicle maintenance contractors' vehicles, such as parts delivery vans.

6.3.4.17 Storage of packed products in the open

Layout

Recommended minimum separation distances are given in Annex B. Further guidance is available in HSE publication HS(G) 51 (www.hse.gov.uk/pubns/) .

Storage

Consideration should be given in planning and constructing package storage areas (whether outside or within buildings) to the safe height to which packages of various sizes can be stacked, the method of stacking (whether with or without pallets or racking) and to any type of mechanical handling equipment to be used. If forklift trucks are used, the area should be sufficient to allow adequate aisle width for safe manoeuvring.

Spillage containment

Stacks containing packed petroleum products should be placed in one or several bundled compounds if the total volume of packed products exceeds 200 000 litres, to ensure containment in the event of leaking packages or fire.

For stacks between 5 000 and 200 000 litres, small walls within compounds are recommended to prevent operational spillages or fire from spreading.

Containment volume

Compounds for stacked petroleum products should be capable of retaining 30 % of the volume of the stored packed products. The capacity of a compound should be calculated by its geometrical dimension, disregarding the space taken up by the packed products staked in the compound.

6.3.4.18 Drainage

General

Drainage should be planned in accordance with national practice and with the approval of the authorities concerned.

Guidance on minimising pollution of site effluents is given in IP *Environmental guidelines for petroleum distribution installations*.

All areas in the installation should be classified as follows:

- Areas where surface water may be contaminated with oil, e.g. within the tank compound or a filling area.
- Areas where surface water cannot normally be contaminated with oil, e.g. offices, roofs and car parks.

Areas where surface water may be contaminated with oil

For areas where surface water may be contaminated with oil, e.g. tank bunds, loading area and pump rafts, methods should be considered for controlling and recovering both planned and unplanned releases of product as described in IP *Environmental guidelines for petroleum distribution installations*.

Where product can mix with rainwater in containment areas, sumps with outlet valve should be provided to enable controlled run-off through the site oil/water separators. Road, rail and drum filling areas should be paved with concrete or other material impervious to product, so that all surface water can be directed to the main site oil/water separators.

Discharges requiring special treatment (e.g. run-off from wash bays and other areas where detergent is used) should either be passed to an on-site treatment plant designed for the specific duty or to a foul water sewer for treatment elsewhere.

Areas where surface water cannot be contaminated with oil

In these areas drainage should be provided for rainwater, domestic waste water and sewage without special precautions. Every advantage should be taken of natural seepage for disposal of uncontaminated surface water. Existing drains, sewers and watercourses may be used in agreement with the regulatory authority.

Oil/water separators (including interceptors)

Oil/water separators should be sited in accordance with the general guidance in IP 15, away from boundaries and, where possible, away from other hazardous areas and with easy access for inspection, cleaning and maintenance. The separator should be designed to give an oil separation performance adequate to ensure that the quality of effluent water discharged from the site meets the consent levels imposed by regulatory authorities.

Fire water

Allowances should be made in the design of drainage and separator systems to accommodate increased flows during fire-fighting operations. Most fire-fighting foams inhibit gravity separation oils. Consideration should be given to providing holding capability to permit subsequent disposal other than to surface waters.

Foul sewage

Where local foul sewage exists adjacent to the installation, foul sewer outlets should be connected to them. Where this is impracticable, septic tanks or other suitable foul sewage disposal means should be provided.

6.3.4.19 Design, construction and operation of biodiesel distribution installations

General

The planning, design and construction of an installation should be entrusted to appropriately qualified and experienced engineers. The design process should be carried out in a methodical way, starting with a design brief which identifies the operational objectives and ending with the provision of as-built documentation. The design brief should be sufficiently detailed to enable the level of automation and in-built safety systems to be determined.

A plan should be produced early in the project to identify the flow, review and approval steps which each generic type of project document will undergo, including production of as-built drawings and retention of records.

A Hazard and Operability study (HAZOP) of the installation should be considered during the design stage to ensure that all operational conditions, both normal and abnormal, are identified and taken into account. Other more general safety reviews may be appropriate to ensure that the plant can be constructed, operated, maintained and decommissioned safely.

An Initial Risk Assessment should be carried out during the planning phase of the project and should be reviewed during the design stage and revised where necessary.

Consideration should be given to all statutory requirements, local environmental conditions and to gaining any necessary consents for construction and operation of the installation. Local regulations such as the UK's Construction (Design and Management) Regulations 1994 (CDM) and Control of Major Accident Hazards Regulations 1999 (COMAH) may influence the project's management. It is recommended that the fire officer, safety and environment agencies be involved in all studies.

6.3.4.20 Electrical

General

Electrical apparatus, electrical installations, electrical grounding and bonding, cathodic protection, telecommunications and instrumentation should comply with the recommendations of IP Model Code of Safe Practice Part 1 *Electrical safety code*, BS EN 60079 and BS 7671 (the Institute of Electrical Engineers' (IEE) Regulations (latest edition)) and, in the UK, the Electricity at Work Regulations 1989 (SI 635).

Power distribution

At the design stage and during any subsequent modification, it should be ensured that electrical cables –both overhead and underground- are not taken across any areas where they could interfere with the petroleum storage of handling operations, either in the immediate or long term future.

Data transmission cables

IP HM 23 *Fidelity and security of measurements data transmission systems.* Section 1: *Electric and/or electronic pulsed data cabled transmission for fluid metering systems* gives advice on data cable transmission for fluid metering systems.

Area classification

IP 15 gives recommendations for the classification of areas in which a hazardous atmosphere, which could be ignited by an ignition source, may be present.

The hazardous areas detailed include the following Zone Classifications, which are dependent on the probability of a hazardous atmosphere being present, i.e. an atmosphere containing a flammable gas or vapour in a concentration that is capable of ignition:

Zone 0 That part of a hazardous area in which a flammable atmosphere is continuously present or present for long periods.

Zone1 That part of a hazardous area in which a flammable atmosphere is likely to occur in normal operation.

Zone 2 That part of a hazardous area in which a flammable atmosphere is

not likely to occur in normal operation and, if it occurs, will exist only for a short period.

The areas outside these zones are defined as non-hazardous.

Electrical equipment

All electrical equipment should be certified as suitable for the zone applicable to its intended location of operation.

Equipment should be maintained in accordance with manufacturers' recommendations to ensure continued operability and compliance with the hazardous area certification. Maintenance records should be retained for the lifetime of equipment.

Circuits in hazardous areas

Independent of their location, isolating switches controlling circuits on Zone 1 or Zone 2 areas should isolate all live and neutral conductors to ensure complete isolation before electrical equipment in hazardous areas is opened.

All isolating switches should be lockable in the open position.
There should be no connection between neutral and earth conductors of AC circuits after isolating switches.

6.3.4.21 Tanks

Standards

Above-ground tanks should be designed, fabricated and erected in accordance with a recognised tank standard, e.g. BS EN 14015, API Standard 620 or API Standard 650. Smaller shop-fabricated horizontal tanks should be designed and fabricated in accordance with recognised standards, e.g. BS 2594. Tanks for operation at higher pressures than covered by these standards are not considered in this Code but should be designed and fabricated in accordance with a recognised pressure vessel code, e.g. PD 5500, or ASME Section VIII.

Attention should be given to roof loading, tank stability and rate of corrosion in areas where climatic conditions are severe.

Special consideration is required if a tank is to contain liquids at temperatures below -18ºC, and reference should be made to the low temperature requirements of the standards referred to above.

The standards referred to above cover tanks made of carbon steel; tanks made from other materials should be designed to an appropriate standard and in accordance with good engineering practice.

In particular, if the use of glass-reinforced plastic (GRP) tanks above ground is proposed, reference to BS 4994 or an equivalent standard is essential. For GRP tanks below ground, reference should be made to BS EN 976-1 *Underground tanks of glass-reinforced plastics (GRP). Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels part 1 Requirements and test methods for single wall tanks.* Particular attention should be paid to ensuring correct design and installation and the importance of regular and adequate examination.

Operating procedures should take account of the likelihood of the generation of static electricity, and its safe dissipation.

If the use of a second-hand tank is proposed, or the change of use of an existing GRP tank, the new user should be aware of the purpose for which the tank was initially designed, what materials have been stored in it, whether repairs have taken place (and their adequacy) and what examinations have been carried out.

Design pressure

The maximum design pressure to which tanks may be built is specified in the selected tank standard. The design pressure should take into account current and possible future product densities. Where the required design pressure exceeds those allowed within the tank standards, a suitable pressure vessel code should be applied.

Where there is a change in use of a tank, the design pressure should be checked to ensure it is sufficient for the density and vapour pressure of the new product.

Where tanks are used in conjunction with vapour recovery units (VRUs) design standards should be reviewed to ensure pressures required in the vapour collection systems do not exceed those permitted in the tanks.

Tank fittings

Tanks should be provided with appropriate fittings for filling, emptying, drawing off water and draining, sampling, temperature monitoring, venting, inspection and fire-fighting. Additionally each tank should be fitted with a tank gauging system and consideration should be given to installing an independent high level alarm which can be manually tested.

Tank fittings below the highest liquid level should be liquid and vapour tight and fittings above the highest liquid level should be vapour tight when closed for biodiesel tanks.

Tank connections

Connections to tanks should be designed in accordance with the selected tank standard. Connections to steel tank shells or bottoms should be steel throughout. Connections to tanks other than steel should take account of the guidance outlined in the appropriate standard. Each tank connection through which liquid can normally flow should be fitted with a cast of steel valve immediately adjacent to the shell of bottom of the tank.

Inlet pipes of tanks should terminate internally near the bottom of the tank; this helps ensure smooth and efficient flow, the minimisation of the generation of static electricity through turbulence, and the avoidance of disturbance of bottom sediment. Where internal floating roofs are installed in fixed roof tanks, a diffuser should be fitted to minimise surface disturbance. A maximum flow velocity of 7 m/s is recommended.

Normal venting for fixed roof tanks

Tanks should be adequately vented to prevent the development of pressure or vacuum exceeding the design limits of the tank. Venting should allow for changes in pressure due to filling or withdrawal of product and due to tank breathing caused by changes in atmospheric conditions.

Vents for normal venting of atmospheric and low pressure tanks should be sized in accordance with a recognised venting guide, e.g. API Standard 2000.

Tanks for biodiesel should normally be fitted with internal floating roofs to comply with local environmental legislation. Where tanks are fitted with pressure vacuum valves they should be sized in accordance with API Standard 650 or an equivalent standard. Tanks for biodiesel may be fitted with open vents

Pressure and vacuum valves and open vents should not be fitted with gauze of less than 6 millimetres mesh to reduce the risk of clogging with dust, dirt or ice which would impair the venting capacity. Additional measures should be taken to avoid the possibility of tank collapse cause by clogged mesh in a vent, e.g. the mesh may be designed to collapse, such as by using non-corroding metal wire of approximately 0.4 millimetre diameter.

Emergency venting

Every above-ground tank should have some form of emergency venting which will relieve excessive internal pressure. For vertical fixed roof tanks emergency venting may be provided by a weak roof-to-shell seam, which will fail preferentially to any other seam or plate of the tank shell or bottom.

(Note: emergency venting is an inherent feature of floating roof tanks).

Where emergency venting is provided by means of pressure-relieving vents, the venting capacity if normal and emergency vents together should be designed to be sufficient to prevent failure of the shell of floor of vertical tanks, or of the shell or ends of horizontal tanks.

The emergency venting capacity provided should be in accordance with a recognised venting guide, e.g. API Standard 2000.

Consideration should be given to preventing liquid overfills by the use of gauge mounted 'Hi-level' and independent 'Hi-Hi-level' alarms. The latter may provide a signal to initiate an automatic shutdown.

Emissions control

Where local legislation requires control of hydrocarbon emissions it may be necessary to install secondary seals on floating roof tanks and internal floating roofs in fixed roof tanks. Guidance on appropriate control measures is given in IP *Guidelines for the design and operation of gasoline vapour emission controls.*

It may also be necessary to ensure that the tank external paint is selected to reflect solar radiation adequately.

In the UK reference should be made to the Secretary of State's Guidance PG1/13 – *Processes for the storage, loading and unloading of petrol at terminals.*

Capacity and high level alarms

The rated capacity of a tank should provide sufficient ullage to permit expansion of product due to a rise in temperature during storage. Capacity levels should allow for operational limitations of any internal or external floating roofs.

Where tank filling operations are complex, such as with tanks fed by cross-country pipelines, consideration should be given to the fitting of high level alarms and devices for automatically cutting off the supply. Ideally automatic cut-off devices should be of high integrity and independent of any normal measuring or alarm system.

As the operation of an automatic shut-off valve could be sudden, care should be taken to alleviate or relieve shock loading or general over-pressurisation. Surges can often be avoided by increasing the valve closure time.

Where internal floating roofs are fitted within tanks of fixed roof design, care should be taken to set alarms and automatic cut-offs at such a level as to prevent physical contact between the floating roof and the tank roof support structure, instrumentation or foam pourers.

Manholes

Manholes (in accordance with the selected tank standard) should be provided to permit entry to the tanks and facilitate gas-freeing and tank cleaning operations. They should be large enough, typically 600 millimetres inside diameter, to permit entry when full personal protective equipment is worn, including breathing apparatus.

For vertical tanks above ground, at least one manhole should be provided in the lowest shell strake and one in the tank roof. Wherever possible, two manholes –installed as far apart as possible- should be provided in each of these areas to provide adequate means of emergency escape and to facilitate tank ventilation for access and cleaning purposes.

Stairways, gangways and ladders

Means of operational access to, and escape from tank roofs should be provided for personnel in the form of permanent stairways or ladders leading directly from ground to individual tank roofs, or to bridges between tanks. Where possible, more than one means of escape should be provided.

If access to the roofs or adjacent tanks is provided by means of bridges or gangways between tanks, there should be more than one stairway giving access to the group. The connections of bridges or gangways to the tanks should take account of differential settlement and expansion of the tanks.

For tanks not more than 4,5 metres high, vertical ladders terminating in a landing platform may be provided for access to roofs. Such ladders or any other fixed vertical ladders exceeding 2,3 metres in height should be provided with safety cages. Provision of fall arrest equipment may also be considered.

Safe walking surfaces should be provided at all points where operational attendance or regular maintenance is required, e.g. dipping and sampling points and vents. All means of access should non-slip surfaces and be of adequate width to provide free and safe movement of personnel.

Stairways, gangways, bridges, ladders, platforms, landings and points on tank roofs to which access is required, should be provided with handrails in accordance with the selected tank standard and should take into account relevant regulations governing working at height.

It is preferable that all stair treads and platforms be of the galvanised open mesh type.

Gauging, sampling and temperature measurement

Gauging, sampling and temperature measurement are key factors in maintaining effective loss control systems at installations. Means should be provided to ensure that

stock and delivery measurements are taken accurately and routinely through the provision of:

- facilities for sampling and for level and temperature gauging;
- accurate tank calibration;
- gantry meter systems for road and rail loading;
- metering systems for marine loading (otherwise use gauging of shore tanks);
- weighbridge for weighed deliveries/receipts;
- computerising petroleum measurement tables and stock control systems;
- simple laboratory equipment to support, where necessary, gauging measurements e.g. density measuring equipment.

Guidance on the selection and use of such facilities and equipment and on stock control procedures is provided in the IP Hydrocarbon Management series.

The complexity and range of measurement equipment installed at a particular installation will, firstly, be governed by regulatory requirements for measurement and reporting, and, secondly, based on a cost-benefit approach.

In general it will tend to be a function of the throughput, with larger installations meriting better equipment. In the case of gauging equipment, both manual and automatic systems are available; the additional capital and maintenance costs of automatic measuring equipment should be compared with the operating costs of manual methods.

Hatches for gauging, sampling and temperature measurement should be such that they can be closed to exclude moisture. Tanks for biodiesel should be vapour-tight when closed. Installation of a strike plate on the tank bottom is recommended where dipping manually.

Automatic level and temperature gauging equipment may be fitted to reduce the risk to personnel when carrying out gauging operations. All level and gauging equipment should be installed in accordance with BS ISO 4266 or equivalent standard. For all tanks in petroleum service, the equipment should be adequately bonded to the tank structure, in accordance with IP Mode Code of Safe Practice Part 1 Electrical safety code.

External floating roof tanks

The total pontoon volumes of external floating roofs should give sufficient buoyancy to meet all operating conditions, including abnormal loading conditions such as heavy rain or snow covering, with an adequate factor of safety. Pressure relief vents should be installed to avoid pressure rising under the rim seal and to release vapour from under the roof during the initial filling. Vacuum breakers should also be provided.

Provision should be made to drain rainwater from the roof the means of closing the outlet. Where the drain passes through the stored product the closure should be at the bottom end of the pipe and should be kept closed except when water is being drained under controlled conditions. Product-sensing automatic shutoff valves may also be considered.

If permanent access to the roof is required, one or more stairways should be provided that are hinged to the top curb angle of the shell and equipped with rollers at the lower extremity, handrails and self-levelling flat treads.

Roofs should be provided with adjustable support legs which can be set for sufficient roof height to permit maintenance and tank cleaning work to be carried out. They should be designed to be set also for a lower roof height, in order to ensure that the roof floats on the product under all normal operational conditions. These supports should be provided with drain holes so that they can be cleared of product when the tank is gas-freed for repairs. It is recommended that wear plates are fitted to the tank floor at each roof support leg and the roof vent leg.

In order to provide adequate means of escape in an emergency, roofs should be provided with two manways diametrically opposed.

Internal floating roofs

Guidance on the design, construction, operation and maintenance of internal floating roof is given in API Standard 650 and API Standard 653.

The roof at its lowest level should not obstruct flow through the shell or bottom connections, or entry through shell manholes. At its highest level the roof should not come into contact with members of the roof structure, nor at any point with items of gauging equipment, automatic level limits or foam pourers.

In order to provide adequate means of escape in an emergency, roofs should be provided with two manways diametrically opposed.

Grounding and bonding

Electrical grounding of tanks and electrical bonding of internal and external floating roofs for the reduction of electrostatic charges and protection against lightning discharge should be in accordance with IP Model Code of Safe Practice Part 1 Electrical safety code.

Buried and mounded tanks

Unless special considerations dictate otherwise the use of buried tanks should be avoided, because of the lack of access for external inspection. Where buried tanks cannot be avoided consideration should be given to the prevention and detection of leaks, e.g. double skinned with interstitial monitoring.

The design standards for vertical tank cover above-ground tanks only. A vertical steel tank for installation as a buried or mounded tank may be designed and constructed in accordance with these standards, but special consideration will have to be given to surrounding the steel tank with concrete or other means of protection against earth or water pressure, and to the design of the tank to cater for superimposed loading.

Horizontal tanks may be installed as buried or mounded tanks, but precautions should be taken against the possibility of flotation.

The filling point of a buried or mounded tank should be located at, or carried down internally to a point near the bottom of the tank.

Shafts or tunnels should be incorporated to allow compliance with venting and access requirements.

Foundations and supports

The design standards for vertical tanks give recommendations for the construction of foundations for tanks built to those standards. The foundation design will depend generally on site conditions and consideration should be given to incorporating an impermeable barrier such that continuity of the tank compound containment system is achieved. The design should provide drainage, prevent external corrosion of the tank bottom, and give stability to the tank under test and under all service, wind and other climatic conditions likely to be encountered.

A thorough knowledge of the ground conditions should be obtained with particular reference to establishing the allowable bearing pressure, total and differential settlement expected, risk of flotation and possible deterioration of original conditions. Settlement, in particular differential settlement, should be limited to prevent excessive stresses in the tank structure and connected pipe work. Areas having weak subsoil conditions require special consideration.

Where the tank site may be subject to flooding, protection should be given to the foundation to avoid erosion and the tanks may be anchored.

The design of foundations and supporting structures for tanks designed and constructed to pressure vessel codes need special consideration.

Saddles for horizontal tanks should be shaped to conform to the tank shell. The minimum number of supports should be provided, preferably two, located to give minimum bending moments and deflections. They should be designed to prevent any accumulation of water.

Where there is likely to be severe corrosion between the tank shell and supports, steel sacrificial corrosion plates should be welded to the shell or, as an alternative, waterproof resilient pads should be used.

The tank should be securely anchored or weighted against hazards from high winds or if there is risk of flotation due to flood water.

Supports for elevated tanks should be given fire protection to meet local regulatory requirements unless the risk of collapse during a fire is considered unlikely.

Inspection and testing

Shop and site inspection of tanks should be carried out in accordance with the selected tank standard.

Vertical tanks should be tested on site in accordance with the selected tank standard. This may include testing of the tank floor for leaks by vacuum box or other suitable method, testing of the tank shell for tightness and security by filling with water followed by visual inspection, and testing for vapour tightness of the roof and roof fittings. Controlled water loading of new tanks during testing may be necessary to avoid over-stressing the supporting ground. The total and the differential settlement should be carefully measured and recorded throughout testing.

Buried or mounded tanks should be tested before backfilling or mounding.

Corrosion protection

Tanks, tank fittings and supports should be adequately coated externally to prevent corrosion. The reflectivity of the coating system may need to be selected to comply with national environmental legislative to minimise VOC emissions. The need for internal coating is largely dependent on the product to be stored.

Buried and mounded tanks should be given an external protective coating system adequate to resist expected corrosion conditions arising from contact with the soil and groundwater.

Cathodic protection should be considered where severe corrosion by aggressive sub oils may be expected. Where applied, cathodic protection should be in accordance with BS 7361-1 *Cathodic protection, Code of practice for land and marine applications, with due regard being paid to BS EN 14161 Petroleum and natural gas industries. Pipeline transportation systems and IP Model Code of Safe Practice Part 1 Electrical safety code.*

Tank compounds

Compound walls should be fire-resistant and substantially impervious.

Every main compound wall should be impervious to liquid and of sufficient strength to withstand the pressure to which it would be subjected if the space between the tank compound walls were filled with water. Consideration may also be given to the forces that may be generated by a sudden release of tank contents. All expansion and construction joints should be similar impervious and be fire-resistant.

Compound floors should be substantially impervious to the liquid to be stored and where necessary should be sloped to prevent rainwater remaining around any tanks and to enable effective recovery of any minor spillage of product. Existing facilities may be constructed from non-impervious materials. In this case a risk assessment should be undertaken to determine whether upgrading is justified taking into account the possible risks of retrofitting impervious flooring in operating areas.

Change in use

Design of tankage and associated systems should be reviewed whenever change in use or modifications are planned such as product composition, temperature or flow rate. In particular, design pressure and venting should be checked together with any change in

height between connected tanks or equipment to prevent gravity transfer causing overflow.

Geodesic domes

Consideration is sometimes given to the conversion of a floating roof tank to a fixed roof tank for a variety of reasons, such as:

- climate conditions;
- water ingress around peripheral seals; or
- reduction of fumes from odorous products.

Geodesic domes usually consist of a self-supporting lightweight tubular construction carrying a thin metal cover. Justification for their use is largely dependent on economics.

6.3.4.22 Piping, valves and fitting

General

Following identification of the product flow requirements, hydraulic studies should be carried out to establish the required line sizes. The hydraulic study should consider, and in some cases determine, required flow rates, the available pressure drop and possible pressure variations.

Once the line sizing and routing have been established, the piping systems should be reviewed with the requirements of the selected piping code to ensure that excessive pipe stresses are not induced by thermal expansion, settlement, or other means.

In the European Union references should be made to 97/23/EC *The approximation of laws of Member States concerning pressure equipment* when determining that full requirements of the piping system installation.

Piping code

The design, including the selection of materials, fabrication, assembly, inspection and testing of piping systems, should be suitable for the working pressures, temperatures and stresses to which the system will be subjected in service. It should conform to the appropriate sections of a recognised piping code.

Materials

All materials, including non-metallic parts for valves, seals, gaskets and diaphragms, should be resistant to the action of petroleum products (including additives) under the service conditions to which they are subjected.

Cast iron should not be used for valves or piping containing petroleum products; where it is used for items such as flow meters, nodular cast iron should be used; grey cast iron is not considered suitable.

Copper, brass, aluminium or non-metallic pipe or tubing should not be used for main piping system.

Steel pipe should conform to API Standard 5L or equivalent.

Pipe thickness

Pipe thickness should be calculated in accordance with the selected piping code. However, it will generally be necessary to use pipe of a greater thickness than calculated to give rigidity and to provide a corrosion allowance. Guidance should be taken from the relevant piping code.

Pipe joints

Joints on piping, particularly below ground, should preferably be welded. Welding should be carried out in accordance with the selected piping code. Where practical considerations require a joint to be disconnected, at equipment or for maintenance, flanged joints should be used. If below ground flanged joints cannot be avoided they should be installed in an impervious chamber.

Screwed joints should be preferably not be used. Where their use is unavoidable they should only be applied to piping 50 mm nominal size and smaller and should be made in accordance with API Spec. 5B or ASME/ANSI B1.20.1.

Flexible-type joints incorporating non-metallic sealing rings are not recommended.

Valves

Piping systems should contain a sufficient number of suitable valves to enable the system to be operated efficiently, to protect the installation and to enable the system to be shut down quickly without damage in the event of an emergency.

Valves should comply with the selected piping code, be of steel construction, of the correct design rating, to a fire safe design and include adequate electrical continuity.

Glands should be designed to permit repacking without removing the valve from service.
Indication of the actual valve position (open or closed) should be clear, i.e. rising spindle gate or ball valves. It should be physically impossible to assemble a valve (for example after stripping for maintenance) such that indications of its position are reversed.

All open-ended valves should have blind flanges or screwed plugs fitted.

Adequate access stairways or ladders and operating platforms should be provided to enable the safe and convenient operation of valves.

Flanges and fittings

Steel flanges and flanged fittings should be to BS 1560, ANSI B16.5 or equivalent standard.

Steel butt weld fittings should be to BS 1640, ANSI B16.9 or equivalent standard.

Steel socket welding and screwed fittings should be to BS 3799, ANSI B16.11 or equivalent standard.

Bolting should be to BS 4882 or equivalent standard.

The required integrity of the piping system will determine the most suitable gasket for the service conditions. Non-asbestos gaskets should be used with dimensions to ASME/ANSI B16.21.

Installation and flexibility

Piping systems should have adequate flexibility to accommodate any settlement of tanks or other equipment, thermal expansion and contraction and other stresses which may occur in the piping system. Reference should be made to the sections on design and installation in the selected piping code for detailed considerations to be taken into account to ensure the satisfactory installation and flexibility of piping systems.

Flexibility should preferably be provided by changes in direction or piping, through the use of bends, loops or offsets. Where lack of space prohibits the use if these methods, suitable expansion joints of the stainless steel bellows type may be used provided the pipe work either side is properly anchored or guided.

Bellows joints should be protected from torsional loads and should be designed in accordance from the manufacturers. Bellows and associated restraints should be routinely inspected against agreed retirement criteria following installation. Bellows should not be used to overcome misalignment at the installation stage.

Pipe supports should be adequately designed and spaced to suit the pipe work configuration and to withstand anchorage and guide friction forces or forces arising from pigging operations. Direct contact between the supports and the pipe wall should be avoided by utilising slip feet or friction pads.

Pipe bridges or other support structures may be required in certain circumstances.

Piping systems should preferably be above-ground. Those which are placed below ground should be protected against corrosion, and against uneven ground settlement, particularly when passing under railways, roads or other points where severe local loading may be experienced.

Accurate as-built drawings should be maintained for quick reference and lines should be marked at ground level shortly after entry to ground and at all changes of direction.

Open trenches and ducting in which wipes are run are not recommended as they can allow flammable vapour to collect, but where they are unavoidable they should have fire

stops at suitable intervals. Short lengths of duct without fire stops are acceptable for road crossings.

Water lines, or lines in which water may accumulate, should either have provision for complete evacuation or be protected, with an adequate safety margin, against the lowest anticipated ambient temperature.

Sufficient drain and vents points for testing, commissioning, future alterations and maintenance operations should be considered. These should be blanked or plugged when not use.

Thermal pressure relief

Any section of a piping system in which liquid may be trapped, e.g. between shut-off valves, should be protected against excessive pressure caused by thermal expansion of the contents. The discharge of any relief valve provided for this purpose should preferably be directed to a storage tank. This however is often not practicable and therefore thermal pressure relieves may have to be arranged in series along a line containing several valves with only one final relief into tankage. In designing such systems it should be recognised that the pressures at which relief occurs are cumulative at each subsequent isolation point progressing away from the tank.

Relief valves should preferably be of the enclosed bonnet type.

Where isolating valves are installed either side of a relief valve, a locking system should be provided to prevent inadvertent closure.

Inspection and testing

Reference should be made to the appropriate sections in the selected piping code for recommendations on inspection and testing.

Before they are commissioned, and in the case of buried pipe work before closing the trenches in which the lines are laid, completed piping systems should be tested hydrostatically to one and a half times their maximum operating pressure.

In cases where it is not desirable to test hydrostatically, it is recommended that a test for leaks with air be carried out at a pressure not exceeding 1 bar, followed by a pressure test with product to one and a half times the maximum operating pressure; in such cases consideration should be given to increasing the level of inspection.

Facilities should be incorporated to assist routine inspection and testing of underground pipelines and pipelines running above or near water courses.

Piping systems above or below ambient temperatures

Protection should be provided to prevent personnel coming into contact with heated surfaces over 50 ºC.

Energy conservation should be considered in all situations where pipe work is designed to carry liquids at temperatures significantly above or below ambient.

Pipe insulation should be in accordance with the selected piping code. Consideration should be given to the prevention of corrosion under insulation.

Hoses

Hoses should be in accordance with a recognised standard applicable to the duty they are to perform:

BS 1435 for hoses for ship discharge and loading.
BS 3492 for hoses for road tank vehicle and rail tank car loading and unloading.

Articulated pipe connections

The design, materials and construction of articulated pipe connections should be suitable for the product which they are to handle. They should be capable of withstanding a test pressure of one and a half times the maximum pressure they will carry in service.

Corrosion protection

Above-ground piping systems should be adequately coated externally to prevent corrosion.

Buried piping should be protected externally by suitable corrosion-preventing materials. Prior to backfilling, the pipe coating should be tested for integrity, i.e. holiday detection. Care should be taken not to damage such protection during backfilling, which should be carried out using fine granular material immediately adjacent to the pipe.

Cathodic protection should be considered where severe corrosion by aggressive sub-oil could be expected or where piping crosses, or is adjacent to, other services, e.g. electrical cables and metallic water mains. Where applied, cathodic protection should be in accordance with BS 7361-1 and with reference to IP Model Code of Safe Practice Part 1 Electrical safety code.

Surge suppression

The design of piping systems should avoid pressure surges, but where this is not practicable accumulators of adequate strength and capacity may be fitted when service conditions give rise to high surge pressures.

Segregation

Where isolating flanges, blanks and spades are used to segregate sections of a piping system, they should be of adequate strength and embody a means or clearly indicating their setting. At the design stage, provision should be made to permit safely clearing the lines and relieving line pressure before removing segregating flanges, blanks or spades.

Gravitational flow between tanks may be minimised by incorporating of non-return valves at suitable points but consideration should be given to more positive separation, e.g. double valve separation.

Identification

Means of identification and direction of flow should be applied to pipe work to show the product or service. Where there is an approved and standardised colour code in use (e.g. IP *Code of practice for a product identification system for petroleum products*), it should be incorporated in the identification scheme.

Pumps - location

Pumps should preferably be situated in open air, unless severe climate conditions may be experienced. They should preferably not be installed below ground level. Pumps and pump manifolds should not be located within tank compounds.

Pumps may be grouped together in one area or individually sited to suit operational and constructional convenience.

Pump type and seal design

The type of pump to be used will be determined by product characteristics and pumping duties, in particular the suction conditions. Pressure retaining parts of pumps in hydrocarbon service should not be made of grey cast iron; cast steel is preferred but nodular cast iron may be used where pumps can be readily isolated in the event of fire.

The service conditions for the pump will determine the most suitable seal arrangement. It should be noted that some standard type mechanical seals may not offer the necessary integrity when they fail.

Pump installation

Ideally pumps and manifolds should be dedicated to single products.

Pumps should be protected by a coarse strainer on the inlet side of the pump.

Pumps should be fitted with non-return valves:
on the discharge side;

- where two or more pumps operate in parallel, and
- where gravity flow back from the discharge line through the pump could take place when it is not operating.

Positive displacement pumps should have an integral bypass valve or other suitable protection against over-pressure or overloading if the pump is operated against a closed discharge.

Pumps should be fitted with non-sparking guards for moving parts.

Connections for pressure gauges to aid pump commissioning should be fitted on both the suction and discharge of each pump.

Driving units for pumps

The driving units of pumps should be sized for continuous duty at maximum load in the prevailing climatic conditions. They should be suitable for operation in hazardous area in which they are located. Consideration should also be given to the likely number and frequency of pump starts.

Gasoline engine driven pumps should not be operated in hazardous areas. Diesel engine driven pumps, when operated in an area in which there is risk of flammable vapour being present.

Diesel engines should be installed above ground level and, if enclosed, should be well ventilated.

Driving units should be fitted with non-sparking guards for moving parts.

There should be a means for rapid shut-down of the driving unit in an emergency; as a minimum a local stop and a means of isolating and locking off the power supply from the driving unit.

6.3.4.23 Compressors

Location

Compressors should, where possible, be located in non-hazardous areas in thoroughly ventilated buildings. They should preferably not be installed below ground level or inside road tanker workshops.

The type of compressor to be used will largely be determined by the system characteristics and its location, particularly in relation to noise. In the UK, The Control of Noise at Work Regulations 2005 give further guidance on monitoring noise levels in conjunction with rotating machinery and manufacturers should provide noise data on their equipment.

In the UK, the Pressure Systems Safety Regulations 2000 require that a written scheme of examination should be prepared.

6.3.4.24 Fire protection

General

The protection of installations from the hazard of fire should be achieved primarily by the use of sound design, construction and operational methods. These should ensure that the possibility of an outbreak of fire is remote and therefore permit the provision of fire fighting equipment to be limited to the means for rapid extinguishing of any fire in its initial stages.

The flammable nature of petroleum products is discussed and advice is given on fire protection and detection, on extinguishing systems and on application rates for fire extinguishing media. Preparation of a comprehensive Fire Plan for a petroleum site is also considered. This covers the selection of equipment, the provision of water and foam, development of emergency procedures and training of staff.

Where there is no statutory obligation for the local fire authority to provide fire fighting capability within an acceptably short period of time, it is recommended that provision of facilities is made in accordance with the guidance Code of Safe Practice Fire precautions at petroleum refineries and bulk storage installations.

6.3.4.25 Design of fire fighting equipment

General

Provision of fire fighting facilities need to be considered in the light of all local circumstances. For installations exceeding 7000m3 storage capacity handling biodiesel mobile or fixed fire fighting equipment or a combination of both should be provided in addition to portable fire extinguishers. The latter alone may be sufficient for small distribution depots.

The general philosophy of a fire fighting operation is embodied in:

- Control
- Containment
- Extinction

Escalation is prevented by isolating the source of fuel to the fire and by maintaining the integrity of adjacent equipment containing flammable products. The latter is achieved primarily by an efficient application of cooling water.

Although a conflagration should be extinguished as rapidly as possible it must always be remembered that if this is achieved before all the fuel feeding the fire has been exhausted or cut off, it may reignite. This is particularly true of a vapour or volatile liquid fire, where re-ignition (which may not necessarily occur locally) may take place with explosive force.

Area drainage or alternative disposal systems for the large volumes of water which may be used must be adequate to avoid flooding which can, in turn, introduce fresh hazards.

The efficient and rapid extinction of a fire relies on the selection of correct equipment and its ready availability.

Mobile fire-fighting equipment and appliances are an integral part of the protective equipment of an installation. The effectiveness, with which such equipment can be used, particularly in the early stages of a fire, depends primarily on the speed with which it can be brought actively into use. Thus, access for fire-fighting equipment must always be adequate to enable the fire to be approached and tackled from alternative positions.

Fire fighting equipment, associated systems, and their operation should be planned in co-operation with local fire authorities and any practical assistance which can be provided by such authorities should be taken into account in the overall arrangement. If the layout and equipment of the fire fighting systems or an agreement to provide co-ordinated help is based on assistance from outside then a formal agreement should be drawn up and ratified.

As there are many conceivable combinations of an installation's own effort and fire fighting assistance from outside, recommendations in this Code can only be of a broad and general nature and aimed at stating minimum requirements for the total effort.

Requirements in respect of fire fighting equipment and the appropriate emergency plans are based on the following considerations:

a) Classification of products stored or handled.

b) Capacity of tanks or volumes handled.

c) Number of available personnel and external support.

d) Location, extent and operating patter of the oil installation.

e) Availability of mutual aid and third party assistance.

It is essential that the systems/equipment used in an installation are compatible with the standard equipment of the local firer authorities.

Hand Operated/Portable Fire Fighting Equipment

Every endeavour must be made to extinguish a fire in its initial stage pending the arrival of the fire brigade. Therefore hand operated, portable fire fighting equipment should be included in the overall fire fighting system and should be accessible at strategic points throughout a location.

Fire Fighting Equipment at Product Handling and Storage Installations

In general foam and powder are used as extinguishing media and water, preferably in the form of fog/mist rather than as jets, is used for cooling and isolating adjacent tankage etc. Therefore as sufficient supply of water, powder and foam compound should be readily available with planned back-up supplies accessible.

Types of Foam

The following types of foam may be considered for fighting petroleum fires:

- Protein

- Fluoro-Protein

- Fluoro-Chemical including AFFF (Aqueous Film-forming Foam)

- Synthetic and Detergent – Medium and High Expansion

Finished foam for fire fighting is produced by introducing the foam component into water, usually art a rate of approximately 2-7%. The mixture is then converted to finished foam by expansion with air. The degree of expansion has an important effect on its fire fighting properties
Expansion ratios may be classified as follows:

Low expansion foam	up to 25
Medium expansion foam	25 to 500
High expansion foam	500 to 1000

Protein, fluoro-protein and fluoro-chemical foams are normally used at low expansion ratios. Medium and high expansion foams can only be achieved by using synthetic or detergent bases.

A precise knowledge of the compatibility of foam compounds with each other and with "dry chemicals" – when used simultaneously in fire fighting – is essential. Co-ordination with outside bodies such as companies in the area with similar interest and with the local authority brigade should be made to ensure a compatibility of foam compounds.

Finally, consideration should be given to the problems associated with the storing of foam compounds (e.g. sludging, oxidation etc.)

Fire Fighting at Loading Racks/Discharging Facilities for Vehicles

Hand operated portable fire extinguishers should be supplemented either with a water supply for the purpose of making foam or the number of 50kg dry powder extinguishers should be a minimum of two when the number of loading racks are from 3 to 6 and of three when the number of loading racks is above 6.

When the foam making alternative is chosen water supplies should be sufficient to combat a fire of 30 minutes minimum duration.

Water Supply Rate for Foam-making in Product Storage Installations

The quantities of water required for fighting fires in tanks and compounds are dependant on the type and size of tankage under consideration.

Fixed Roof Tanks

Additional to the employment of mobile jet monitors to project foam on to the top of a tank the following systems may be considered:

Top Supply

Where a top supply system is employed the foam is injected into the tank at the upper edge of the shell – but never through the roof. An internally located pipe-bend ensures that the flow of the foam is directed towards the tank shell.

It should be noted that this system is vulnerable to damage an may be rendered inoperative by an initial explosion.

Bottom Supply direct injection system:

Bottom supply direct injection has proved effective for tanks up to 25 metres diameter and is considered more effective than foam monitors or top supply systems for any sized tank.

Only fluoro protein foam or AFFF should be used for this application.

The following minimum figures for water supply are recommended: (30 more than for top supply should be allowed for use of mobile monitors)

	Top Supply L/min/m^2	Bottom Supply L/min/m^2
Protein foam		4*
Fluoro protein	4.5	4.5 (minimum)

*only applicable for semi-subsurface systems as under Bottom supply.

Floating Roof Tanks (rim section)	L/min/m of Circumference
All types of foam	15

Other approved systems such as BCF

(bromochlorodifluoromethane) systems, may be employed.

C. Bunded Areas (net surfaces)

	L/min/m^2
Protein foam	1.6
Fluoro-protein foam	1.0
AFFF	1.0

Such an applied concentration can be used to extinguish or prevent a fire in a bunded area in which a spillage has occurred. In such a case medium or high expansion foam may also be used.

Stocks of Foam Compound

Stocks of foam compound should be sufficient for 30 minutes fire fighting against the highest single fire hazard.

Water Supply for Cooling of Tanks

Cooling is required for biodiesel tanks which become immediately endangered by a fire in adjacent tanks holding biodiesel, if these are within 20 metres.

Every advantage should be taken of locally available water sources, such as public mains, river, lakes or canals. If the water source is anticipated to be of insufficient capacity, a supplementary storage reservoir providing for two hours supply should be installed.

Cooling water supply valves should be located in accessible situations to permit operation following outbreak of a tank fire.

Tanks should be cooled by flooding the shell on the side facing the fire.

The maximum quantity of water required should be calculated on the basis of the number of adjacent tanks which would have to be cooled in case of fire in one tank.

Fixed Equipment – Fire Station

A fire station should always be located outside a hazardous area and should include facilities for the parking/storage of mobile equipment.

At large installations and other facilities requiring fire pumps at least two portable or fixed pumps should be available either located in the installation or with an independent authority where suitable arrangement can be made. Such pumps should preferably have independent, alternative sources of power e.g. diesel and electric power. If, however, all pumps are electrically driven they should be fed through separate supply circuits.

If more than two pumps are installed, the individual capacity of each may be reduced so that two in service together achieve a delivered capacity equal to 100% of water required.

Detailed and legibly printed instructions for starting and for operating all pumps should be available at the relevant pump stations or in association with portable equipment.

Fire Alarm System

A fire alarm system which is clearly audible must be installed. The alarm may be activated from one or more selected locations and where the energy source is electrical an independent back up supply (e.g. battery) should be installed to guarantee operation in the event of a power failure.

It may also be necessary to have localised alarms to provide warning of fire within buildings. These may be activated by heat or smoke detectors, break-glass alarm, fusible links or manual action.

Location of Fire Fighting Equipment
Fire fighting equipment should be kept in strategic, safe and easily accessible locations. Each extinguisher should be painted a distinctive code colour to characterise its contents and the type of fire on which it can be used.

For ready reference in an emergency situation a skeleton layout plan of the installation or depot should be displayed on notice boards in suitable locations. It should indicate the positions and content of all product tanks, water and foam fighting appliances, fire mains, hydrants, sprinklers and of the fire station.

Pipe for Water

Where a pipe for water with hydrants is necessary, either "wet" or "dry", it should be of sufficient supply capacity to suit local requirements and be so located as to pass all strategic points. The pipe should be large enough to ensure that there is sufficient water pressure at all hydrants to operate the available fire equipment under full flow conditions. It should preferably be a ring pipe and be provided with valves to ensure continuity of supply of water in the event of damage to any action. A wet pipe should either be buried or protected against frost or fire.

The pipe of water must be provided with hydrants sufficient in number and location to supply the required water rate in each area. Spacing and detailed location of hydrants may vary with the plant and tankage to be protected but, in general, they must be sited near the roadway and be readily accessible.

Hydrant spacing is typically 50/100 metres. The general philosophy of keeping hose runs as short as possible should always be applied e.g. fixed foam laterals to tankage should have hydrants in close proximity. Hydrants should be suitably and easily identified and protected from frost and mechanical damage. The provision of separate valves for each hydrant off-take gives added flexibility in a fire situation.

Monitors

Mobile monitors and under certain circumstances – fixed monitors can be used to direct cooling water or foam to facilities such as loading racks, pump area structures. The valve controlling the monitor supply can be remotely operated and the monitor pre-directed to the high risk area. In some cases the monitor itself can be remotely controlled. For a monitor situated in an elevated position an emergency booster pump may be required to achieve the desired operating pressure. Monitors should be located so as to avoid obstruction by pipe work, steelwork etc.

Mobile monitors can speedily be brought into operation, adjusted and left unattended to allow operators to carry out other essential duties. Such monitors can be brought very close to the scene of a fire under protection of a water curtain and then left unattended. Capacities are typically 135 m^3/hr but can extend up to 550 m^3/hr and adaptations are

available for foam applications. High capacity hand-operated foam cannons have proved valuable for blanketing major fire areas.

Sprays, Drenchers and Sprinklers

Water sprinkler systems suffer from the disadvantage that they may become unreliable due to corrosion and/or plugging. In addition they cannot always be tested while the equipment is in commission due to the detrimental effect of a water deluge. However, there are certain instances where special and immediate protection is required (e.g. high risk equipment in areas with restricted access for normal fire-fighting) and the installation of such a system provides an effective answer.

It is important that spray nozzles be of adequate diameter and piping systems be short and direct. It is also important to ensure complete water coverage of the equipment to be protected. The water supply valve to the spray system should be in an accessible and protected location.
In some instances, particularly in unattended areas, it may be desirable to operate the spray system automatically (e.g. by fire detection devices).

In regions where frost occurs, only dry systems can be used.

6.3.4.26 Emergency procedures

General

In the event of an emergency situation the shift supervisor or other nominated person should be responsible for initiating emergency procedures.

All personnel, including drivers and office personnel, should have regular instruction in what actions they are expected to take in an emergency.

Fire

Appropriate personnel should be trained in the action to be taken in the event of fire and in the use of first-aid and fire-fighting equipment. They should be familiar with all types of fire extinguishers likely to be encountered in the course of operations. This aspect of their training should include the theory and in particular practice in extinguishing all types of fires.

Training should include the correct use and response to fire alarms, practical experience in summoning the fire and rescue service and other emergency services.

Accidents involving road tankers

Drivers should receive regular instruction in handling emergency situations involving road tankers within petroleum installations.

6.3.4.27 Operatons

General Compliance

The operation of a petroleum storage installation should take account of all relevant legislation, and in particular health, safety and environmental considerations. Where there is no applicable legislation, recommended industry practices should be adopted.

To demonstrate compliance, it is recommended that:

Approved written procedures are provided for all activities including maintenance. Detailed procedures are available for effective response to emergency incidents. Records are kept identifying everything that happens within the installation and anything outside that affects the operation of the installation.

Note: These should be retained for a sufficient period to comply with local legislation or internal organizational standards.

All operational procedures, as well as being checked for compliance with industry practices, should be the subject of a risk assessment; earlier risk assessments carried out in conjunction with the planning and design of the installation may form the basis of these assessments.

Security

Security of installations should be consistent with safeguarding the general public, operating personnel, products handled and plant and equipment. Access gates should be monitored continuously while the installation is open and it is recommended that inspections be made of the perimeter fence at least once during every shift.

Staff

To ensure that the operation of the installation is conducted in a proper manner, protecting both safety and product quality, only appropriately qualified and experienced staff should be employed. Effective training is required and personnel should not be allowed to use equipment or plant for which they have not received comprehensive instruction. All operating personnel should be familiar with the general layout of the installation.

A location plan, product flow diagram and an emergency facilities plan should be readily available to staff for reference in an emergency.

Facilities

All areas should be maintained in a clean and tidy state with regular inspections carried out. Any equipment found not to be functioning as intended, or to be defective, should be reported in writing and, where appropriate, isolated.

Where there is an approved and standard colour code in use this should be incorporated in the identification scheme related to the product flow diagram.

Pipelines should be adequately identified throughout their length. Where manifold or branch connections exist they should be appropriately marked.

Particular attention should be given to pipeline termination points by marking the pipe immediately adjacent to all valves at loading/off-loading facilities, pumps and tank connections.

For equipment such as valves, fittings etc. an alternative method of identification may be required, e.g. embossed tags or stenciled numbers related to the product flow diagram on display at the installation.

Each tank should be clearly marked with the tank number, preferably near the inlet valve and dip hatch. Consideration should be given to marking the grade of product stored.

Supervisory Controls

All activities on the installation should be subject to the control of a duty supervisor. No work involving maintenance or alterations and additions to the existing facilities should start until the duty supervisor has given approval. Where appropriate, work permits should be issued and rigidly enforced. It is recommended that a display and record system be established and spot audits be carried out to check the effectiveness of the permit system and the results recorded.

There should be an approved procedure for hand over between supervisors; this should include signed acceptance of a status report at the end of shift by both supervisors.

6.3.4.28 Maintenance and modifications

Introduction

This section provides guidance on planning and execution of routine and non-routine maintenance of plant and equipment on the installation. It also covers modification and construction works.

Maintenance, planning and control

The appropriate level of maintenance should be established for all plant and equipment, taking into account operating experience and statutory obligations. This should be incorporated into a maintenance management system and will range from planned routine tests and inspections to unplanned breakdown repair. In each case the maintenance management system should ensure that work is carried out as required and adequate records kept demonstrating adherence to the plan. It also should provide sufficient information for periodic review to ascertain the appropriate level of maintenance.

In addition to routine operational checks, planned routine maintenance should, as a minimum, include the periodic inspection and testing of:

- Safety systems and alarms;

- Electrical equipment and cables;
- Grounding and bonding;
- Storage tanks and pressure vessels;
- Boilers;
- Pumps and pipe work;
- Relief valves;
- Loading equipment;
- Lifting and mechanical handling equipment.

Management of changes

A system should be in place which ensures that changes to the plant, process equipment, process control software, mechanical integrity and procedures are authorised before implementation. All changes should be properly reviewed by adequately qualified person(s) to ensure that operational integrity is not jeopardised.

Drawings, documentation and procedures should be updated to incorporate any changes.

Safe systems of work

The safe system of work established by management of an installation should include all construction, maintenance, repair, modification and demolition works. Control of all work should be by standing instructions, maintenance procedures, appropriate complementary method statements or a work permit system.

All tasks and the location of the work should be clearly defined, and the precarious explained and understood by all concerned. Particular attention should be given to work which will continue beyond shift changes.

The procedure for the use of work permits should be rigorously enforced and records kept. Work permits should be regularly monitored during the course of the work.

6.3.4.29 Safety at work on site

Assessment of extent of hazard

When it is necessary to carry out work of maintenance, repair or plant modification in an operating installation a careful assessment of the extent of any likely hazard and the risk it presents should be made considering:

- The effect of the work itself and the extent of any source of ignition under normal and possible abnormal or accident conditions.
- The petroleum handling operations being carried out and the possibility of an accident unrelated to the work resulting in movement of product or product vapour into the area of the work.
- The weather, humidity, direction of the wind, topographical features of the site and availability of assistance in the event of an emergency.

The safety conditions to be included on the permit should reflect the conclusion of the risk assessment.

Safety precautions

The safety precautions to be included on a work permit will depend on the extent of hot work, sources of ignition or other potentially hazardous work, possible release of flammable liquid or vapour, proximity to hazardous areas and operations being carried out in the installation. Consideration should be given to all conditions that might prevail during any period of the works.

The following typical precautions cannot cover all conditions that may arise and circumstances may require further actions to be considered and entered on the permit:

- Erection of temporary fencing or moveable barriers around construction works, plant and equipment to prevent unauthorised access and to protect personnel working within the area.
- Display of warning notices in advance of the work and on the temporary fencing or barriers, such as speed limits, no smoking, wearing of PPE, services and cable marking.
- Depressurising, emptying, disconnecting and blanking off tanks, vessels, equipment and pipelines.
- Safe collection and disposal of all products collected.
- Isolation from mechanical power.
- Isolation from electrical power.
- Isolation from sources of flammable, hot or dangerous liquids, gases or pressurised systems. Isolation may be disconnection and blanking of pipelines or by insertion of spades etc; no reliance should be placed on closed valves.
- Isolation from radiation sources.
- Ensure freedom from toxic hazards.
- Gas-freeing of equipment after emptying.
- Checks for gas-free conditions appropriate to the class of work to be carried out.
- Transfer of equipment which has been in service to workshops or outside the installation.
- Provision of an adequate supply of oxygen.

- Wearing of protective clothing and breathing apparatus and specifying type to be used.
- Cleaning away of combustible materials, removal or wetting down of wooden floors, decks, platforms, scaffolds etc.
- Safe disposition of welding or other equipment to be used in carrying out the work.
- Grounding/bonding of electrical or welding equipment and steam, air and water lines and nozzles to be used in the work.
- Location of overhead or buried electric power lines or product lines, particularly if digging or using cranes and other mechanical equipment.
- Provision of fire-fighting facilities and standby fireguards if necessary.

Safety distances

It is not possible to lay down exact safety distances, since these will depend on the assessment of the extent of the hazard and the availability of means to deal with any emergency.

Hot work in or near hazardous areas

When it is necessary to carry out hot work in or near hazardous areas and petroleum handling facilities, the following special checks and precautions may be necessary.

No hot work should be permitted in a hazardous area until the likelihood of a hazardous atmosphere occurring has been removed. This may be achieved by temporarily suspending the movement of products by stopping operations, or sealing off or diverting possible sources of flammable liquids and vapour. The action taken should be appropriate to the particular situation in each case considered.

When hot work is being carried out within a hazardous area there is always the possibility of a serious accident occurring on plant or equipment in use nearby which may give rise to a flammable atmosphere or hazardous situation in the work area. A risk assessment should be made to evaluate the likelihood and consequences of this occurring and a contingency plan should be put in place appropriate to the level of risk. The contingency plan should be explained to all personnel concerned and their understanding checked.

Fire precautions

Whenever non-routine or hot work is to be carried out in a hazardous area, special precautions for fire protection should be taken. These will be specified on the special or hot work permit and could include the provision of:

- A wind-sock erected on top of an adjacent tank or building.
- Continuous gas monitoring equipment.
- Additional fire-fighting equipment.
- Cooling for adjacent tanks.
- Clearance or wetting down of combustible materials.
- A fire watcher to monitor the area where hot work is to take place.

The fire watcher should be trained in basic fire-fighting and his duties should include:

- Ensuring that adequate fire-fighting equipment is available in the area.
- Ensuring compliance with all the conditions specified on the work permit.
- Noting any changes in surrounding conditions which will affect the work permit.
- Stopping the work if he suspects the presence of any uncontained flammable liquid or vapour in the vicinity.
- Bringing first aid fire-fighting equipment into immediate use in the event of a fire.
- Ensuring that there is coverage by another trained fire watcher or stopping the work when he has to leave his post.

Where necessary, liquid-retaining walls, fire walls or screens may be erected to reduce the risk of flammable liquids or vapour approaching the area where work is being carried out. Where hot work is to take place above other equipment or plant this should be adequately protected by means of fireproof blankets or equivalent.

Any sewers, drains, ducts or other surface entries within 15 metres of the work should be checked and sealed off.

Before the work takes place brief but explicit instructions on how the alarm is raised, sound of the alarm and the action to be taken in the event of a fire or the alarm sounding should be given to all personnel engaged on work covered by the work permit. Where available such briefings should be complemented by a short safety video presentation outlining the installation's fire and emergency procedures together with safety aspects whilst working in a hazardous area.

6.3.4.30 Repairs, alterations tests

Detailed instructions

When repairs or alterations necessitate the dismantling on site of important items of equipment, such as valves, pumps or pipelines, or entry into tanks or vessels, specific notice should be conveyed to all concerned and acknowledgement of receipt confirmed.

Tanks and vessels

Special precautions are required when gas-freeing and cleaning tanks which have held hydrocarbon products.

Tanks which previously contained leaded product should be tested by qualified personnel for the presence of lead and a certificate issued stating the vessel is safe for entry of personnel.

Tanks and vessels which have not previously been gas-freed and tested for sufficiency of oxygen should not normally be entered even when wearing breathing apparatus.

When entry under such conditions has to be made for exceptional reasons, special management authorisation should be obtained. An observer should be stationed at the manhole throughout the operation to take immediate action or summon assistance in case of collapse or danger to any person or persons inside the tank or vessel. Observers and rescue personnel should also be suitably equipped so that they do not become casualties during rescue operations.

Hot work or other hazardous work should not commence on or inside a tank or vessel which has stored petroleum until it has been emptied, isolated, cleaned and gas-freed. Before the application of heat, written certification should be obtained stating tests carried out have revealed no product vapour to be present.

If repair work involving hot work from the inside of the tank is necessary on welded seams or plates of buried or mounded tanks, or on the bottom plates of above-ground vertical tanks, holes should be carefully drilled under cold work conditions; gas tests

should be carried out to ensure that product or gas is not trapped between the tank plates and the tank foundations and surrounds.

When tanks contain hard deposits which have to be removed by chipping, the work permit should specify that the surface should be kept thoroughly wetted during the operation.

Cylinders of oxygen or flammable gas should not be taken into a tank. Blowpipes and hoses should be removed from a tank when not in use, since a small leak of oxygen or flammable gas over a period can make the atmosphere in a confined space hazardous.

If welding is to be done, there should be adequate ventilation so that welding fumes are collected and carried away from the breathing zone of the welder. If this cannot be provided a face mask supplied with fresh air should be used.

Special attention should be given to providing safe entry and exit through the manholes.

Pipelines, pumps, valves

Prior to breaking connections, systems should be adequately isolated, depressurised, drained as far as practicable and facilities put in place to collect any residual product.

Where hot work is to be undertaken, gas-freeing and thorough cleaning of the unit or units to be repaired or altered should be carried out.

All openings or equipment left in place should be closed by blank flanges or equivalent; reliance should not be placed on closed valves. Any product drainings should be captured in suitable containers and disposed of safely and not be allowed to soak into the ground or enter drainage systems.

Electrical

A competent person should satisfy himself that the equipment is isolated from live electrical circuits and should issue an electrical isolation certificate before any work on tests, adjustments, maintenance or extensions is commenced.

Where possible, main switches or circuit breakers should be mechanically locked in the open position while work is in progress, but if there is no provision for locking the switchgear, fuses should be withdrawn and locked away.

A warning notice that work is in progress should be attached to the switchgear or fuse board to prevent accidental operation of the switchgear or replacement of the fuses.

After the work has been completed, a competent person should certify that the apparatus is mechanically and electrically in order before it is brought back into use.

Records

Records should be maintained of all items of plant and equipment which are required by law to be regularly inspected or tested. Such records should be kept for the life of the equipment.

Records should be maintained of all other items of plant and equipment including the name of the manufacturer, design conditions and any other relevant information, details of any cleaning, inspections, repairs, maintenance and modifications. Each piece of plant and equipment should have a unique identifier (or tag number).

Work on equipment in operation

Repairs or modifications to plant and equipment in operation should not be permitted.

Where unavoidable, the following work may be carried out on equipment in operation; in both cases the work should be carried out under rigorously controlled conditions:

- Non-hazardous cold work.
  (Note: repairs or alterations to floating suction, pressure and vacuum vents, float gauges etc. should not be undertaken when tanks or vessels are being filled or emptied).
- Hot tap connections may be permitted if no alternative is practicable. These should be carried out in accordance with local regulatory requirements. The approval of the local safety inspector should be obtained.

Removal of equipment to workshops or outside the installation

If equipment has to be removed to a workshop, contractors' premises or other location outside the installation, a work permit should specify the cleaning or gas-freeing to be done before transport, storage or starting work so that no hazard will arise in subsequent handling.

When equipment is so removed, the supervisor responsible for the moving or dispatching should ensure that it is cleaned and gas-freed in accordance with the work permit and is safe to handle in transit. He should attach instructions to it indicating the service that it was in and further precautions necessary to ensure that no flammable or toxic hazards will arise when hot work is carried out.

The workshop or other premises receiving the equipment should not accept it without such instructions, which should bear the signature of the dispatching supervisor and the date of dispatch.

6.3.4.31 Personnel

Planning and supervision

Inspection, maintenance or new works should be planned and progressed by experienced and responsible staff; they should ensure that those engaged in the work observe all relevant precautions.

Management of installations should ensure that persons carrying out maintenance or construction have received appropriate training (including appropriate safety induction) and are fully acquainted with all relevant safety legislation and site procedures.

Temporary personnel

Temporary personnel are frequently used for maintenance and plant modifications. They may not be familiar with the normal precautions adopted in premises storing petroleum, and should be given:

- A safety induction course when first reporting for work, such as in the form of a video.
- Safety instruction, both general and specific, before starting work.
- Adequate supervision to ensure that relevant precautions are observed.

A register of all training of personnel, including safety induction, should be held on site.

As visitors to site all temporary personnel should be required to sign the visitors register including times of entry and exit so that management have a detailed record of visitors and personnel on site at all times.

6.3.4.32 Equipment

Contractors' equipment should only be brought into use with written authority of the installation manager or his authorised representative. The equipment should be inspected by a competent person before this authority is given to ensure safety features are fitted and working, and to confirm an adequate state of mind.

Vehicles or equipment fitted with petrol or spark ignition engines should not be allowed into the installation.

Use of vehicles or equipment should be defined and controlled particularly in hazardous areas. Routes to or from the place of work for pedestrians and vehicles should be clearly indicated.

Mobile equipment located in a hazardous area should be constructed and maintained so that it is not a source of ignition. In general such equipment should be diesel-powered, fitted with a spark arrester on the exhaust system and with an over-speed cut-out in the induction system.

6.3.4.33 Health, welfare and protection of personnel

General responsibilities

The main hazards associated with storage and handling of petroleum products are fire, explosion and risk to health through exposure to the products or contact with them.

Management and employees have individual and joint responsibilities for the safeguarding of health and safety at work, which may be embodied in national legislation.

Management responsibilities

It is the responsibility of management to ensure that all reasonable precautions are taken for the safety and welfare of personnel employed at the installation.

Management has a duty to ensure that risks at the workplace are minimized as far as is reasonably practicable. This includes the setting up of safe working procedures and adoption of customary industry practices to minimize the risks associated with the storage and handling of petroleum products.

Management should supply employees with PPE.

All employees should be instructed and trained in their duties and in regard to foreseeable emergencies.

A written statement setting out general safety procedures and the employees' duties and responsibilities should be prepared, communicated to all staff and displayed in a prominent position.

Employers should provide employees and other people at the workplace who might be at risk with suitable information, instruction and training on precautions and actions they need to take to safeguard themselves and others, including:

- Names of the substances in use and risks they present.
- Access to any relevant safety data sheets.
- Details of legislation that applies to the hazardous properties of those substances.
- The significant findings of the risk assessment.

Employers should also make information available to employee representatives.

Information, instruction and training may only need to be provided to non-employees where it is required to ensure their safety; where it is provided, it should be in proportion to the level and type of risk.

Employees' responsibilities

Employees have a duty to take all reasonable steps to observe correct working practices in order to ensure that neither they nor their colleagues, nor anyone who may be affected by their work, are exposed to hazard.

Employees should wear the personal protective equipment issued to them, as required.

It is the employees' responsibility to report any incident, activity or procedure which may have contributed to an infringement of regulations.

6.3.4.34 Specific responsibilities

Health and safety policy statement

Employers should produce a health and safety statement which should be made available to all personnel and displayed at all installations. In the UK this is required under the Health and Safety at Work etc., Act 1974.

Protection of employees and others

Management should carry out an assessment of the risks to health and safety of employees and of anyone who may be affected by the work activity. This is a requirement under the Management of Health and Safety at Work Regulations 1999.

Control of Substances Hazardous to Health (COSHH)

A risk assessment of activities involving the handling and use of hazardous substances such as petroleum products and additives should be carried out to determine the specific issues relating to their intended use and relevant to the work environment. In the UK, this is required by the Control of Substances Hazardous to Health Regulations.

The risk assessment should guide the identification of adequate control programmes in order to minimize:

- Potential exposure of workers to hazardous substances.
- The identification of any personal protective equipment (PPE) that should be worn.
- The development of training programmes to avoid or mitigate exposure.

Exposure of workers to hazardous substances is controlled by national occupational exposure limits (OELs). These limits are set at a level which would not be expected to cause adverse health effects on repeated daily exposure over a working life time.

Protection of workers from the risk of explosive atmosphere

The European Council Directive 1999/92/EC (ATEX 137, The Workplace Directive'), which is also known as the 'ATEX Use' Directive, is implemented in the UK by the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR). It came into force on 1st July 2003 to coincide with the end of transition of the ATEX 'Equipment' Directive (94/EC).

Employers are required to protect workers from the risk of explosive atmospheres. An explosive atmosphere is defined as a mixture with air, under atmospheric conditions, of dangerous substances in the form of gases, vapours, mist or dust in which after ignition has occurred, combustion spreads to the entire unburned mixture.

The end user should risk assess their workplace and zone and mark hazardous areas according to their level of risk for gases and dusts.

Responsibilities

Employers and self-employed should:

- Carry out a risk assessment of any work activities involving dangerous substances.
- Provide technical and organisational measures to eliminate or reduce as far is reasonably practicable the identified risks.
- Provide equipment and procedures to deal with accident and emergencies.
- Provide information and training to employees.
- Classify places where explosive atmospheres may occur into zones, and mark the zones where necessary.

Scope

DSEAR applies whenever the following conditions have been satisfied:

- There is work being carried out by an employer or self-employed person.
- A dangerous substance is present or is liable to be present at the workplace.
- The dangerous substance presents a risk to the safety of persons (as opposed to a risk to health).

Persons protected

In addition to employees at the workplace, any other person whether at work or not who may be put at risk by dangerous substances should be considered; this includes employees working for other employers, visitors to the site, members of the public, etc.

However when considering arrangements to deal with accidents, incidents and emergencies and the provision of information, instruction and training, employers only have duties to persons who are at their workplace

Risk assessment

Employers (or self-employed persons) should:

a) Carry out a risk assessment before commencing any new work activity involving dangerous substances.
b) In the case of an employer with five or more employees, record the significant findings of the assessment as soon as is practicable after the assessment is made, including:

    - The measures (technical and organizational) taken to eliminate and/or reduce risk.
    - Sufficient information to show that the workplace and work equipment will be safe during operation and maintenance including details of any hazardous zones and any special measures to ensure co-ordination of safety measures and procedures when employers share a workplace.
    - Arrangements to deal with accidents, incidents and emergencies.
    - Measures taken to inform, instruct and train employees.

Scope of the risk assessment

The risk assessment should be an identification and careful examination of the dangerous substances present in the workplace, the work activities involving those substances and how they might fail dangerously so as to give rise to fire, explosion and similar events with the potential to harm employees and the public. Its purpose is to enable employers to decide what the need to do to eliminate, or reduce to as far as is reasonably practicable, the safety risks from dangerous substances.

The risk assessment should be carried out before commencing any new work activity, and the measures identified as necessary by the risk assessment should be implemented before the work commences.

Safety measures

Employers should ensure that the safety risks from dangerous substances are either eliminated or reduced to as far as is reasonably practicable.

Where it is not reasonably practicable to eliminate risks, employers should take, so far as is reasonably practicable, measures to control risks and measures to mitigate the detrimental effects of a fire or explosion or similar event.

Control measures

The following control measures should be applied in the following priority order consistent with the risk assessment and appropriate to the nature of the activity or operation:

- Reduce the quantity of dangerous substances to a minimum.
- Avoid or minimise releases.
- Control releases at source.
- Prevent the formation of an explosive atmosphere.
- Collect, contain and remove any releases to a safe place (e.g. by ventilation).
- Avoid ignition sources.
- Avoid adverse conditions (e.g. exceeding the limits of temperature or control settings) that could lead to danger.
- Keep incompatible substances apart.

Mitigation

Mitigation measures should be applied that are consistent with the risk assessment and appropriate to the nature of the activity or operation including:

- Reducing the numbers of employees exposed.
- Providing plant which is explosion-resistant.
- Providing explosion-suppression or explosion-relief equipment.
- Taking measures to control or minimise the spread of fires or explosions.
- Providing suitable personal protective equipment (PPE).

Elimination and reduction

The measures taken to achieve the elimination or the reduction of risk should include:

- Design, construction and maintenance of the workplace (e.g. fire-resistance, explosion relief).
- Design, assembly, construction, installation, provision, use and maintenance of suitable work processes, including all relevant plant, equipment, control and protection systems.
- The application of appropriate systems of work including written instructions, permits-to-work and other procedural systems of organising work.

Identification of contents

The hazardous contents of containers and pipes should be identified. 'Identification' may include training, information or verbal instruction, but some may require labeling, marking or warning signs.

Places where flammable atmospheres can occur

In workplaces where flammable atmospheres may occur, it should be ensured that:

- The areas where flammable atmospheres may occur are classified into zones based on their likelihood and persistence.
- The areas classified into zones are protected from sources of ignition by selecting equipment and protective systems. In the UK, they should meet the requirements of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulation 1996, although equipment already in use before 1 July 2003 can continue to be used indefinitely provided the risk assessment shows it is safe to do so; where necessary, areas classified into zones are marked with a specified 'Ex' sign at their points of entry.
- Where employees work in hazardous areas they are provided with appropriate clothing that does not create a risk of an electrostatic discharge igniting the flammable atmosphere.
- Before coming into operation for the first time, the areas where flammable atmospheres may be present are confirmed as being safe (verified) by a person (or organization) competent in the field of explosion protection. The person carrying out the verification should be competent to consider the particular risks at the workplace and the adequacy of control and other measures put in place.

Arrangements to deal with accidents, incidents and emergencies

Employers should make arrangements to protect employees (and others who are at the workplace) in the event of accidents. In the UK, the provisions should build on existing requirements and requires employers to make arrangements including:

- Suitable warning (including visual and audible alarms) and communication systems.
- Escape facilities – if required by the risk assessment.
- Emergency procedures to be followed in the event of an emergency.
- Equipment and clothing for essential personnel dealing with the incident.

- Practice drills.
- Making information on the emergency procedures available to employees.
- Contacting the emergency services to advise them that information on emergency procedures is available (and providing them with any information they consider necessary).
- The scale and nature of the emergency arrangements should be proportionate to the risks.
- These requirements clarify what already needs to be done in relation to the safety management of dangerous substances and will not require any duties in addition to those already present in existing legislation.

Guidance

In countries where there are existing statutory requirements pertaining to the petroleum industry, these should be considered as being complementary to such requirements.

6.3.4.35 Training and competence

Training requirements

Good training for all personnel including supervisory staff, installation operators, road tanker drivers and all contractors is essential if work is to be carried out efficiently and safely. On-the-job training alone, in most cases, is not sufficient and should be supplemented by a properly co-ordinated programme of formal training.

While all newcomers should be properly trained, the necessity for periodic refresher training of existing staff should not be neglected.

It is recommended that a senior member of staff should have direct responsibility for putting training programmes into effect and for keeping full records.

Training should be based upon the procedures set out in the operating manual for the installation. It is recommended that the following are provided:

- A concise instructional guide on basic information common to all installations operated by the owner.
- Operating manuals for particular items of plant and equipment specific to each installation, both fixed and mobile, that possesses any degree of complexity.

If road vehicle drivers employed by agents, distributors or transport contractors load or unload their vehicles at the installation, it is important that they should have undergone a similar training programme to ensure that they are also competent and that they understand the proper use of the installation's facilities. Full record of their training should be kept.

Consideration should be given to providing basic training for visitors supplying services to the installation; this should cover, as a minimum, emergency evacuation procedures.

Training subjects

Operations personnel should be thoroughly trained in all aspects of their duties including all the products handled at the installation concerned. During the course of this training, as well as theoretical content, a period of practical work under supervision is recommended.

To achieve maximum benefit it is desirable that personnel be given an understanding of the reasons behind the various procedures. In order to ensure the effectiveness of the training, some form of competence assessment should be performed at the end of the training. The results of this assessment should be recorded.

Safe practices in relation to specific operations are covered in detail in other sections of this Code.

As appropriate the following specific points – provided as a guide and not exhaustive – should be included in training programmes:

- The properties of the products handled including their flammability and toxicity.
- Static electricity and switch loading, and how these hazards can be avoided or minimized.
- Legislation, so far as it relates to and affects the individuals' duties and responsibilities.
- Statutory and other regulations relating to the storage and handling of petroleum products at the installation.
- The techniques of loading/discharging road tankers.
- The precautions to be adopted when dipping, gauging or sampling tanks and when filling and emptying them.
- The techniques of gas-freeing and cleaning, even when this work is performed by specialist contractors.
- The value of personal protective equipment, including clothing, safety helmets, gloves, goggles, safety footwear, high visibility clothing and the use of barrier creams, hand cleansers and skin conditioning products.
- Instruction in the correct methods of lifting and handling heavy and irregular objects.
- Regular instruction in handling emergency situations and using the emergency procedures in force at the installation; the training should include dealing with fires, accidents to road tankers, spillages, product contamination, personal injury and security incidents.

Emergency exercises based on simulated incidents, carried out with the participation of the public services, will familiarize all concerned with the equipment and techniques required to deal with emergency conditions.

Training records

Records of raining should bee maintained showing dates when personnel are adjudged proficient in their various tasks, when certification expirers and when retraining is required. The records should show training in new techniques and in the operation of new equipment when introduced.

The following forms of records are useful:

- A record in the individual file of each person.
- An overall chart showing training of all personnel employed at the installation.
- Records of rotational training of staff to ensure flexibility.
- Records of refresher training.
- Competence assessment records.

6.3.5 Hand held power tools and other work equipment

6.3.5.1 Risks

Hand held power tools present particular risks to the operator and, with certain types of tools, to other persons in the close vicinity. The general duties to provide safe plant and systems of work under the Health and Safety at Work Act 1974 encompasses hand held tools within its requirements and these broad duties have been expanded upon by the Provision and Use of Work Equipment Regulations (PUWER) 1998. The client will ensure compliance with these requirements at all times.

A risk assessment will be carried out to determine the hazards presented by the use of power tools and to ensure that these hazards are eliminated, minimised or controlled.

All users will receive sufficient instruction, information and training in the use of tools to enable safe use. This will include identification of faults, procedures to follow for their reporting and the nature of risks involved in the use of power tools.

6.3.5.2 Safe Use

Power tools can present risks in normal use. To ensure health and safety when using power tools the following procedures should be observed:

. Use tools in accordance with training and instruction
. Use the correct tool for the job
. Visually inspect tools prior to use each day-check condition of cables and plugs, hoses and couplings, mechanical soundness of tool
. Route cables and hoses so as not to present a tripping hazard and minimise the chance of damage
. Isolate from power supply before making adjustments
. Use any required safety devices, including PPE
. Report any problems immediately

An inventory of work equipment will be held to record maintenance, tests, checks, etc., to ensure safety.

6.3.5.3 Inspection and Maintenance - Servicing

Routine servicing and maintenance will be carried out by trained personnel in accordance with manufacturers' guidelines.

6.3.5.4 Safety

All electrical equipment will be routinely examined and tested in accordance with the PAT requirements (see also Section 16). Other safeguards (such as protection from hot surfaces or sharp surfaces) will be regularly inspected to ensure all instruments are safe to use.

6.3.5.5 Instruments from an External Source

All instruments hired by the client from an external source shall be supplied with certificates of calibration or conformity, together with maintenance and safety certification.

All documentation relating to equipment hired by the client will be filed in the trained project file along with the specific instrument requisition form.

6.3.5.6 Noise

It is the client's policy to tackle noise at source where possible and as such will consider noise emissions as an important criterion when evaluating new plant or systems of work. For existing plant all protective measures (enclosures, exhausts) will be properly maintained.

Where noise emissions rise above as defined in the Noise at Work Regulations 1989, The client will supply, renew and provide instruction in the use of suitable ear protection.

All employees will receive such information, instruction and training as is commensurate with their degree of exposure.

Noise is a form of pollution which can cause irreparable damage to hearing. Levels of noise that do not damage hearing may still cause distraction, discomfort, irritation and stress.

To minimise these effects the following precautions will be applied:

. Use ear protection in noisy areas
. Ensure ear protection is suitable to the job
. Any problems concerned with noise at work should be reported immediately

6.3.5.7 Workplace safety checklist

No workplace can be expected to be totally free from hazards. However, risk assessment and minimisation should reduce risks and accidents in the workplace.

6.3.5.8 Ladders (and other means of access)

Very many people are disabled, some very seriously, every week while using ladders.

Check points:-

. Is the ladder secured at the top?
. If not, is it firmly fixed at the bottom or footed by a second person?
. Is the ladder in good condition, no missing, cracked or improvised rungs?
. Is the ladder varnished and not painted?
. How frequently are the ladders inspected?
. Is a written record of inspection kept?

Access Towers (Portable)

. Are they erected on flat and level ground?
. Are the brakes to the wheels “on”?
. Are they moved only from the bottom?
. How frequently are the towers inspected?

6.3.5.9 Lifting tackle

Chains, ropes, slings, hooks, eye bolts, shackles and chain blocks.

. Is the lifting tackle being used correctly?
. Is the safe working load clearly marked?
.Is the equipment being examined every six months for defects, and a record kept?
. Is there a certificate of test showing the safe working load?

6.3.5.10 Electricity

Electricity is perfectly safe if the equipment is well made, installed by competent people, properly used and properly maintained. If these basic rules are not followed, electricity can kill.

Check points:

. Signs of damage to apparatus – especially portable equipment
. Signs of damage to and exposure of wires. Also damage to plugs, sockets
. Interference with equipment, damaged or otherwise, by unskilled persons

6.3.6 Oil storage regulations

The Control of Pollution (Oil Storage) (England) Regulations 2001: For many years oil was the most common pollutant reported to us. Before 2003, we were told about over 5000 incidents every year. For the last five years the numbers have dropped and in 2006 there were about 3500 oil pollution incidents. That's still over 9 incidents a day that could have been avoided. We are working with the oil industry, oil tank manufacturers,

oil delivery companies, businesses and the public to make sure this downward trend continues.

Most problems are caused by poorly maintained oil stores and bad delivery practices. That's why we have The Control of Pollution (Oil Storage) (England) Regulations 2001, which require tank owners to provide a secondary containment facility, such as a bund or drip tray, to prevent oil getting into the water environment.

The regulations apply in England and affect you if you store oil in containers greater than 200 litres, above ground at an industrial, commercial or institutional site, or if you store more than 3500 litres of oil at a domestic property. The Water Environment (Oil Storage) (Scotland) Regulations 2006 apply in Scotland. The Scottish regulations are different from the England regulations and you should check them for oil storage in Scotland. There is currently no consultation date for regulations in Wales or Northern Ireland.

6.3.6.1 How do we enforce the regulations ?

The Environment Agency is responsible for enforcing these regulations in England. We can give you advice and guidance to help you get your storage facilities up to scratch. However, if you don't act, we may take legal action for non-compliance and could serve a notice to make you bring the facilities up to standard. Failure to comply with this notice would be a criminal offence and may result in prosecution.

The Oil Storage Regulations apply to oil stored in **tanks**, **intermediate bulk containers**, **oil drums** and **mobile bowsers**. They are designed to ensure that you store oil safely and minimise the risk of pollution incidents.

The regulations cover oil storage at many types of site. If you are responsible for oil storage at a factory, shop, office, hotel, pub, restaurant, school, church, village hall, public sector building, community centre or hospital in England, the regulations are likely to apply.

The regulations do ***not*** apply:

- at premises used for refining or distributing oil;
- for oil stored in a building or entirely underground;
- to the agricultural use of oil on farms for the production of heat and power. The storage of agricultural fuel oil is covered by the Control of Pollution (Silage, Slurry and Agricultural Fuel Oil) Regulations, 1991;
- to waste mineral oil;
- at premises used mainly as a single private dwelling where less than 3500 litres of oil is stored. However, Building Regulations do apply for new and replacement domestic tanks.

6.3.6.2 Dealing with oil spills

You **should** introduce measures to control any oil spills that occur on your site. Have a pollution incident response procedure for dealing with spills. Make sure that all your staff is familiar with this procedure and how to implement it.

6.3.6.3 PPG 21 Pollution incident response planning

Try to prevent spills from entering drains or watercourses. For example, use earth to block the flow of spills, or sand or commercial absorbents to soak them up.

Keep a spill kit and absorbent materials near to your oil store so that you can access them easily when they are needed.

Train all staff in what to do in the event of a spill and how to use any spill equipment. You must never hose a spill down or use detergents to disperse it.

6.3.6.4 Oil storage - General requirements of the Oil Storage Regulations

If you store oil in England or Scotland, you must comply with the general requirements of the Oil Storage Regulations. These regulations do not apply in Northern Ireland and Wales. However, you should still consider meeting the requirements of the regulations, as they aim to prevent water pollution.

6.3.6.5 Containers, bunds and drip trays

You must use oil containers that are strong enough and that are unlikely to burst or leak during ordinary use.

You must store containers within a secondary containment system (SCS), such as a drip tray, bund, or any other suitable system, which will contain any oil that escapes from its container.

Your SCS must be able to hold:

- at least **110%** of the volume of any single container in the storage area, or
- if there is more than one container, at least **110%** of the largest container's storage volume, or at least **25%** of their total volume (whichever is greater).

Any drip tray you use must be able to hold at least 25% of the total storage capacity of the drums.

Position the SCS to minimise the risk of damage, e.g. from vehicles. You must ensure that the base and walls of your bunds are impermeable to water and oil. The base and walls must not be penetrated by any valve, pipe or opening which is used for draining the system. Check the base and walls regularly for leaks.

If any fill pipe or draw-off pipe goes through the base or walls, you must seal the junction of the pipe with the base or walls to prevent oil escaping from the system.

You must locate all valves, filters, sight gauges, vent pipes and other equipment, other than fill pipes, draw-off pipes or pumps, within the SCS. Note: in England if the oil has a flashpoint of more than 32 ºC, the pump must also be located within the SCS.
Where a fill pipe is not within the SCS, you must use a drip tray to catch any oil spilled when the container is being filled.

6.3.7 Manual handling and lifting

NELEEAC will as far as is reasonably practicable provide machineries such as lifting accessories and systems of work that are safe and without risk to health. This will ensure fulfilment of HASAW Act and subsidiary regulations, principally the Provision and Use of Work Equipment Regulations1998 (PUWER) and Lifting Operations and Lifting Equipment Regulations 1998 (LOLER).

Manual handling is any form of activity that entails pushing, pulling, lifting and carrying.

NELEEAC' policy on manual handling is to prevent foreseeable injury to staff which is the result of poor handling of objects.

Prior to manual handling tasks will be risk assessed in accordance with The Manual handling Operators Regulations 1992.

Manual handling risks will be assessed by considering –

. Task
. Load
. Posture
. Frequency
. Mechanical Aids
. Individual Capability
. Environment
. Awareness and Training

Continuous handling of objects in a fixed position will be minimised; repetitive manual handling should be avoided. Mechanical aids to assist in manual handling will be provided where required. Staff involved in manual handling will receive appropriate training and instruction.

6.3.7.1 Lifting Techniques

Whilst the weight of anything that has to be lifted or carried is obviously important, it has to be recognised that a common cause of injury is the use of the wrong lifting methods. It is therefore important that anyone who is required to lift and carry should have some knowledge of lifting techniques.

There are certain basic principles in lifting. The most important of these is that the nearer the body is to the upright position the less the effort required by the muscles and the less the strain imparted on the discs.

The arms should be kept close to the body, with the chin tucked in as this protects the top of the spine; the feet should be placed a hip-breadth apart to give a strong base and balance.

However, the most important thing is to keep a straight back when lifting; this prevents uneven stress on the discs and back muscles.

6.3.7.2 Five golden rules of lifting

. Keep upright
. Distribute the weight evenly
. Support the weight on the bone structure of the body
. Hold the weight close to the body
. Use any devices provided for assistance

6.3.7.3 Precautions

The weight of an object which can be safely lifted decreases as the awkwardness of its shape increases. The following precautions should always be observed when handling or lifting:

. Wear protective gloves for loads with sharp edges
. Wear safety boots when lifting hazardous loads
. Obtain assistance if the load is too heavy or large
. Do not carry a load which may obscure vision
. Loads should not be lifted above chest height

6.3.7.4 Assistance

Ask someone to help of there is doubt that the object to be moved is too heavy for one person. It is better still to use mechanical assistance.

It is invariably more sensible to use mechanical aids where these are available, (e.g. cranes, derricks, block and tackle, yokes, slings, chocks, rollers, skates or the overhead crane). If in doubt, do not lift or move an object on your own.

No work to premises will be allowed to proceed until asbestos risks have been assessed and necessary safeguards put in place.

6.3.8 Fire safety regulations

A Fire Emergency Plan for all premises will be held by the Local Director and will be displayed on notice boards and implemented. The plan must show assembly points, system of roll calls, summoning emergency services etc.

6.3.8.1 Fire Prevention

The following arrangements should be implemented in each premise:

a) Seek guidance if required, to assess fire hazard situation and to advice on type and number of fire extinguishers required.

b) Arrange for the recommended type and number of extinguishers to be ordered and located as advised. Fire equipment to be regularly inspected and approved.

c) Ensure all personnel are trained and can use the various types of extinguishers and are aware of all fire alarms.

d) Ensure periodical fire drill is arranged.

e) Ensure all staff are aware of the importance of fire prevention, particularly with regard to electrical apparatus, smoking etc.

In the event that a member of staff discovers a fire, any attempt to extinguish should only be made if the fire-fighting equipment is to hand. The alarm should be raised immediately and the laze should only be tackled if by doing so there is no risk to him/her.

The client will take all reasonably practicable measures to prevent fire in providing a safe working environment as required by the Health and Safety at Work Act 1974. In addition, procedures will be in place to ensure the safe evacuation of persons and to provide facilities for fire fighting.

Should a fire occur the safety of persons will take priority over all other considerations.

The client does not require any employee to combat a fire, but this may be done if it is safe to do so. Fire fighting equipment should be used as necessary to ensure safe evacuation.

An assessment of possible fire risks will be undertaken to ensure that effective measures are put into place for their control. The procedure for Fire Risk Assessment will be that prescribed by HSE Guidance as follows:

- Identify potential fire hazards in the workplace
- Decide who might be in danger in the event of a fire, in the workplace or while trying to escape from it, and note their location
- Evaluate the risks arising from the hazards and decide whether existing fire precautions are adequate or whether more should be done to eliminate the hazard or to control the risks (e.g. by improving the fire precautions)
- Record the findings and details of the action taken as a result. Inform employees of the findings
- Keep the assessment under review and revise it when necessary

Fire precautionary systems will be regularly checked and will include: ensuring all escape routes are unimpeded and clearly identified, examination of fire fighting equipment, tests of fire alarms and evacuation drills. All employees will be given instruction and training in these systems both on induction and at appropriate intervals thereafter.

Adequate standards of housekeeping will be maintained with regular clearance of combustible waste materials and correct use and storage of flammable liquids.

Electrical faults are a major cause of fires and accordingly all apparatus will be inspected and maintained in accordance with IEE Regulations.

Hot working, burning and welding, will normally take place within designated areas. In other areas proper regard must be given to additional precautions that may be required for this type of work.

All offices must display action to be taken in the event of a fire.

6.3.8.2 Fire Control

Before a fire:

1. Know the fire procedure and your tasks within it

2. Familiarise yourself with fire exits, escape routes and muster point locations

3. Know where the fire points are, how to use the equipment and what types of fires the extinguishers are safe to use on

4. Be advised that all employees have full authority to trigger the fire alarm upon suspicion or discovery of a fire.

6.3.8.3 Suspicion or Discovery of a Fire

1. Immediately raise the alarm. Do not delay by trying to confirm if the fire actually exists.

2. Fight fire if safe to do so.

3. Switch off any equipment that may be a hazard to fire fighters.

4. Evacuate immediately if signal is given, closing all doors behind you.

6.3.8.4 Reduce the Risk of Fire by:

1. Immediately reporting any defect in electrical equipment

2. Keep area tidy and free from wastes

3. No smoking except in designated areas

7 Task 6 – Overview of projects

7.1 Member States situation

Objective: Establish an overview of all known localized UCOME projects in the BioDieNet Member States. This will form the basis of learning experiences and do's and don'ts', to be disseminated to relevant stakeholders.

For each case of existing and planned projects the following information was provided:
1. Year built
2. Location
3. Sources of financing
4. Scale of production
5. Type of customers
6. Regional network utilized
7. Barriers encountered
8. Strategies applied for overcoming the barriers

Response: A few case studies have been included below, describing cases in Portugal, Hungary, and the United Kingdom.

7.1.1 Portugal

7.1.1.1 Sintra

Built in 2009. Located in Vila Verde (Sintra). Auto-financed. Scale of production: under development. Type of customers: municipal fleet. No regional network utilized.

Barriers:
We think that the main barrier for the small-scale production is the amount of UCO collected to satisfy the needs. Also, the initial investment (material, human and financial resources), the automotive-industry scepticism and the biodiesel quality control must be taken in account.

Strategies to overcome barriers:
The main actions that should be taken are: a) create specific legislation for the collection of UCO in every sector of production; b) create business plans to demonstrate the economic feasibility of biodiesel small-scale production/use; c) force the automotive-industry to accept more than B5 to accomplish the directive.

7.1.1.2 Oeiras

Establisheded by the end of 2007. Located in Vila Fria in Porto Salvo (Oeiras). Funded by the LIFE-Environment Programme. Scale of production: up to 1.000 litres per day. Type of customers: municipal fleet. No regional network utilized.

Barriers:

Availability of UCO, auto-investment, vehicles' brand permission for biodiesel usage in B>5, legal procedures (innovative project).

Strategies to overcome barriers:
Disseminate project objectives in order to increase citizens' participation and increase amount of UCO, force the automotive-industry to "accept" biodiesel usage over B5.

7.1.2 Hungary

7.1.2.1 Mátészalka

1. Year built: 2006
2. Location: Mátészalka
3. Sources of financing: private financing
4. Scale of production: biodiesel production
5. Type of customers: MOL (national oil company)
6. Regional network utilized: no
7. Barriers encountered: changes in the price of raw material
8. Strategies applied for overcoming the barriers: -

7.1.2.2 Kunhegyes

1. Year built: 2007
2. Location: Kunhegyes
3. Sources of financing: private financing
4. Scale of production: biodiesel production
5. Type of customers: MOL
6. Regional network utilized: no
7. Barriers encountered: changes in the price of raw material
8. Strategies applied for overcoming the barriers: long term contracts with the suppliers

7.1.2.3 Gyöngyösvisonta

1. Year built: under construction
2. Location: Gyöngyösvisonta
3. Sources of financing: private financing
4. Scale of production: crude biodiesel
5. Type of customers: MOL
6. Regional network utilized: no
7. Barriers encountered: changes in the price of raw material
8. Strategies applied for overcoming the barriers: long term contracts with the suppliers

7.1.2.4 Komárom

1. Year built: under construction
2. Location: Komárom
3. Sources of financing: private financing by MOL

4. Scale of production: only refinery
5. Type of customers: MOL
6. Regional network utilized: no
7. Barriers encountered: changes in the price of raw material
8. Strategies applied for overcoming the barriers: long term contracts with the suppliers

In general it must be mentioned that all of the above biodiesel plants are not based on used fried oil at all. The raw materials are enough for these plants but further developments can be obstructed by the lack of raw materials and financing of the developments. The lack of raw material can be solved by importing from Ukraine, Slovakia and Romania.

7.1.3 United Kingdom

7.1.3.1 Sundance Renewables

Sundance Renewables[5] is a community-based biodiesel production plant. The plant was initiated after the founding member and current director conducted a feasibility study, as part of a Masters Research degree, on small scale production of biodiesel. 5 of the members have attended the celebrated LILI (low-impact living initiative, www.lowimpact.org) biodiesel training course. As a co-operative, the members decided to pursue a biodiesel venture and try to build their own plant, recycling useful equipment owned by one of the founding members.

Meanwhile, they applied for a grant with the local community enterprise group, Foothold (www.thefootholdgroup.org), to help with the purchase of equipment and running costs. They were offered the grant on condition that they also got the CleanStream grant as match funding.

Obtaining the CleanStream grant was problematic, as after submission and tentative approval of the application it was decided that projects involving energy from waste eg. biodiesel, were no longer eligible for this grant.

When the director with the useful equipment left the Co-op, the people left decided to draw a line under the do-it-yourself idea which wasn't going anywhere, despite the investment of over GBP 20,000 which had practically left them bankrupt. They had to resubmit the Foothold grant to suit the revised equipment plan and seek out additional match funding to cover the costs of a containerised packaged unit that Eurodiesel sell. However, rocketed in price overnight from GBP 40 000 to over GBP 60 000 they had to abandon this as a plan.

The industrial unit where they planned to locate the biodiesel was by now overflowing with UVO that they had been collecting. It was evident that the unit was too small - they needed new premises as well as different equipment. This decision didn't go down well with the Environment Agency. Despite heroic efforts by their local EA officer, the legal

[5] This description is mainly base don information found at www.sundancerenewables.org.uk

judgment from London resulted in that they had to apply again for a new permit, at the cost of GBP 2,500. They continued collecting UVO and with the help of Biofuels (www.biofuels.org) based in Cambridge and Goat Industries, they eventually completed their biodiesel plant.

They had received grant funding for some of the equipment from CREATE Enterprise, Foothold, Enfys (www.wcva.org.uk/grants) and Naturesave (www.naturesave.co.uk). The rest, approx. GBP 40,000, was raised with loans, including members' contributions.

When Sundance Renewables had the official launch of their plant they were also awarded an Action Earth prize from the UK Environment Agency. They have also won a EuroSolar award for their renewable energy services. The sales of biodiesel started on November 1st 2004. They have produced biodiesel that fulfil the criteria in the European Quality standard EN 14214 for biodiesel. In addition to the biodiesel production, they are running training courses to help others replicate their work and are sharing the secrets of their success.

At present they have produced biodiesel for driving approximately half a million miles, with customers choosing to blend our 100% biodiesel from 5% mixtures up to 100%. They are planning to make modifications to their plant to improve its efficiency and increase production to meet growing demand.

Contact: Sundance Renewables, Excal House, Capel Hendre Industrial Estate, Ammaford, Wales, UK, SA18 3SJ, Tel: 01269 842401. Email: INFO@SUNDANCERENEWABLES.ORG.UK

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7.1.3.2 The Bolton Greenhouse Project

The start of a small scale biodiesel plant, later to become the Greenhouse Project in Bolton operated by Bolton Alternative Fuels Coop (http://www.allcommunity.co.uk/bafc/1.html) occurred in September 2005, when a contact was made to the UK Environment Agency and registration was done with HM Revenue and Customs (www.hmrc.gov.uk). The basis of the operation is a reactor from Goldenfuels (http://www.goldenfuels.com/).

One of the key advantages of the Goldenfuels system is the introduction of methoxides (formed when the bases is dissolved in methanol) via a venturi. This implies that the mixture is sucked into the reactor by the use of a vacuum. It is therefore not necessary to place the methoxide container elevated, but rather safely at ground level.

The preparation tank for the UCO at the Bolton Greenhouse Project allows heating to separate oil/water and heavy fats. In addition, it delivers measured, pre-heated batches of UCO to the reactor.

Contact: Andrew Boardman, +44 7851936640, Brian Rylance, +44 7749838362, boltongreenhouse1@hotmail.co.uk, http://www.allcommunity.co.uk/bafc/1.html, THE GREENHOUSE PROJECT, 2 Northwood Crescent, Deane, Bolton, BL3 5SE.

7.1.3.3 Pure Fuels

Pure Fuels in Enfield (North East London) was established in 2006 and started producing and selling biodiesel at the beginning of 2007, reaching its full production during the second half of 2007. The production is financed through private funds from the involved entrepreneurs themselves. Its scale of production is small/medium scale, with a production of 20,000 litres per month on average. The type of customers is mainly haulage companies. No regional network is utilized, as Pure Fuels operates only locally.

The barriers encountered are essentially connected to the economics of the operation. The UCO tends to be pricey. There are many other buyers in the market who push the prices up.

Taxes on biodiesel are a problem for Pure fuels. They are perceived as too high by the company. There is a cost associated with the by-product glycerol. This is considered as a waste in the UK legislation and therefore cannot be valorised by Pure Fuels. It has to be taken away, which is a cost for the company.

The strategies applied for overcoming the main barriers are mainly that Pure Fuels undertakes UCO collection itself to reduce the cost of obtaining this material. In addition, Pure Fuels has reported to its Member of Parliament about the taxes level on biodiesel and has urged him / her to work on lowering the taxes (*is that the case?*). Pure Fuels is in contact with NELEEAC to have their problems exposed on a European level through the BioDieNet and Bio-NETT projects, especially the glycerol issue. Pure Fuels has developed a solid and informative website that provides the company with good marketing.

Summary of biodiesel distribution in the UK

The availability of biodiesel for end users in the UK has the following characteristics –
Virtually all biodiesel is supplied from independent filling stations or direct from producers; none of the major fuel station chains is yet supplying biodiesel.
B5 is most widely available, with one company – Rix biodiesel – having by far the biggest share of the market, followed by Greenergy.

B100 is almost all produced and distributed by small independent producers and filling stations. No blends between B5 and B100 are available at the pump.
Geographical distribution is in almost inverse proportion to population – Greater London with 15% of the UK population has only 1 outlet, Greater Manchester, the 2nd biggest conurbation has none and the West Midlands, the 3rd biggest has 1. Some rural counties with low population densities such as Lincolnshire, North Yorkshire or Perthshire in Scotland are very well supplied with biodiesel.

List of biodiesel outlets in the UK:

ALL COUNTIES

Biodiesel By Mail Order, Pure biodiesel Ltd, The Green Shed, Station Road Industrial Estate, South Woodchester, Stroud,GL5 5EQ, tel: 01453 872266, Pure Biodiesel, 100% blend

Aberdeenshire

Crossroads Filling Station, Old Meldrum Road, Newmachar, Aberdeen, Aberdeenshire, AB21 0QD, tel: 01651 862698, Rix biodiesel Ltd, 5% blend

Angus

Crosshills Filling Station, Montrose Road, Brechin, Angus, DD9 7PL, tel: 01356 624939, Rix biodiesel Ltd, 5% blend

Pitairlie Garage, Pitairlie Road, Newbigging, Dundee, Angus, DD5 3RH, tel: 01382 370224, Rix biodiesel Ltd, 5% blend

Avon

Wrington Motors Limited, School Road, Wrington, Bristol, BS40 5NA, tel: 01934 862297, Ford Fuel Oils, 5% blend

Berkshire

Enfuels, Unit 2, Pipers Industrial Estate, Pipers Way, Thatcham, Berkshire, RG19 4NA, tel: 01635 865013, Enfuels, 100%

Reading Biodiesel, Unit D6, Acre Road Business Park, Acre Road, Reading, Berkshire, RG2 0SA, tel: 0845 330 8272, True Food Co-op, 100% - fill up by arrangement only

Cambridgeshire

Cambridge Biodiesel, The Green Box, Station Garage, Wilbraham Road, Fulbourn, Cambridgeshire, CB21 5ET, tel: 07801 042504, Cambridge Biodiesel, 100% & blends by appointment

Cleveland

Safari Garage, Scaling Dam, Easington, Saltburn-By-The-Sea, Cleveland, TS13 4TP, tel: 01287 640710, Rix biodiesel Ltd, 5% blend

Cornwall

Ecomag Limited, 28 Beeching Park, Station Road, Kelly Bray, Callington, Cornwall, PL17 8QS, tel: 0845 0940 761, Ecomag Ltd,, 100%

Esterco Biofuels Ltd, 33 Trevarthian Road, St Austell, Cornwall, PL25 4BT, tel: 01726 66763, Or 07950612766, NB – 20-1000 litres available,, 100% biodiesel at, martin@biofuel.freeserve.co.uk, EN 14214 standard

Gwinear & District Farmers Ltd, 20 Cathebedron Road, Carnhell Green, Camborne, Cornwall, TR14 0NB, tel: 01209 831320, 5% blend

Hawkins Motors Ltd, 57 Gwindra Road, St Austell, Cornwall, PL26 7LB, tel: 01726 828100, Rix biodiesel Ltd, 5% blend

Newbridge Garage, Newbridge, Penzance, Cornwall, TR20 8QH, tel: 01736 364786, Rix biodiesel Ltd, 5% blend

North Country Filling Station, North Country, Redruth, Cornwall, TR16 4AA, tel: 01209 215877, Mitchell & Webber, 5% blend

County Antrim (NI)

Rathcoole Filling Station Ltd, 42 Doagh Road, Newtownabbey, County Antrim, BT37 9NY, tel: 02890 864684, Nicholl Oils, 10% blend

Tannaghmore Fillingstation, 157 Lisnevenagh Road, County Antrim, BT41 2JU, tel: 02825 891309, Nicholl Oils

The Mill Biofuels, Conway Mill, 5-7 Conway Street, Belfast, BT13 2DE, tel: 07733 025725, www.themillbiofuels.com,, 100%

County Down (NI)

Crawfordsburn Service Station, 90 Ballyrobert Road, Crawfordsburn, Bangor, County Down, BT19 1JS, tel: 02891 852363, Biobiz, 95% blend

County Durham

Daleside Garage, Bishop Auckland, Witton Le Wear, County Durham, DL14 0BL, tel: 01388 488354, Petroplus, 5% blend

Cumbria

Penrith Truck Stop, Clifton Moor, Clifton, Penrith, Cumbria, CA10 2EY, tel: 01768 866995, Petroplus, 5% blend

Windermere Service Station, Main Road, Windermere, LA23 1DX, tel: 01539 447227, Greenergy, 5% blend

Derbyshire

Four Winds Services, Newhaven, Buxton, Derbyshire, SK17 0DU, tel: 01298 84999, Rix biodiesel Ltd, 5% blend

Hilltop Garage, Green Lane, Ocbrook, Derby, Derbyshire, DE72 3SE, tel: 01332 674205, Rix biodiesel Ltd, 5% blend

Wardlow Mires Service Station, Wardlow, Buxton, Derbyshire, SK17 8RW, tel: 01298 871445, Rix biodiesel Ltd, 5% blend

Watson & Cook, The Garage, Main Road, Brailsford, Ashbourne, Derbyshire, DE6 3DA, tel: 01335 360222, Rix biodiesel Ltd, 5% blend

Devon

Biofuel SW Ltd, Dunterton, Teignharvey, Newton Abbot, Devon, TQ12 4RS, tel: 01626 336011, Biofuel SW Ltd,, 100%

Devon Biofuels, Higher Sessland, Speyton, Crediton, Devon, EX17 5BA, tel: 01837 840614,, 100%

Green Car Fuels Ltd, Tree Beach Enterprize Park, Gunn Goodleigh, Barnstaple, Devon, EX32 7NZ, tel: 01271 817489, Green Car Fuels,, 100%

TryBiodiesel, Unit 4B, Yeo Vale Cross Industrial Estate, Lapford, Devon, EX17 6YQ, tel: 01363 884201, TryBiodiesel,, 100%

Dorset

South West Biofuels Ltd, Woolfields Farm, Milton on Stour, Gillingham, Dorset, SP8 5PX, tel: 01747 822602, Southwest Biofuels Ltd

Dyfed

Sundance Renewables, Excal House, Capel Hendre Industrial Estate, Ammanford, Dyfed, SA18 3SJ, tel: 01269 842401, www.sundancerenewables.org.uk,, 100% by arrangement (20 litre containers)

East Sussex

Bionic Fuels, The Old Dairy, Mill Farm, Hankham Hall Road, Pevensey, East Sussex, BN24 5AG, tel: 01323 460983, Bionic Fuels,, 100%

Rye Bio-Fuels (Edible Oil), Units A & B Weslake Industrial Park, Harbour Road, Rye, East Sussex, TN31 7TE, tel: 01797 225552, peterohara100@btinternet.com,,

100%

Shabitat, Saunder's Park, Lewes Road, Brighton, East Sussex, BN2 4AY, tel: 01273 677577, Magpie Coop, B100

Viridine Ltd, The Barn, Vixengrove Farm, Cinderhill, Chailey, East Sussex, BN8 4HR, tel: 01825 721437, Viridine Ltd,, 100%

Essex

Evergreen Biodiesel, Unit 6 Oak Business Park, Wix Road, Beaumont cum Moze, Essex, CO16 0AT, tel. 01255 870520, Evergreen Biodiesels,, 100%

JC Fuels Ltd, Wormington Road, Fordham, Colchester, Essex, CO6 3NS, tel. 01206 242355, J C Fuels Ltd,, 100%

Fife

Burnbank Filling Station, Coupar Road, Pitscottie, Cupar, Fife, KY15 5TB, tel: 01418 835094, Rix biodiesel Ltd, 5% blend

Burnside Autocentre, 10 Low Road, Auchtermuchty, Cupar, Fife, KY14 7AU, tel: 01337 828227, Rix biodiesel Ltd, 5% blend

Cairneyhill Service Station, 76 Main Street, Cairneyhill, Dunfermeline, Fife, KY12 8QX, tel: 01383 880344, Rix biodiesel Ltd, 5% blend

Dairsie Autopoint, Main Street, Dairsie, Cupar, Fife, KY15 4SR, tel: 01334 870271, Rix biodiesel Ltd, 5% blend

East Port Garage, Cupar Road, Newburgh, Cupar, Fife, KY14 6HA, tel: 01337 840379, Rix biodiesel Ltd, 5% blend

Strath Garage, 9 High Street, Strathmiglo, Cupar, Fife, KY14 7QA, tel: 01337 860255, Rix biodiesel Ltd, 5% blend

Gloucestershire

Hobrook Garage (The Greenshop), Cheltenham Road, Bisley, Stroud, Gloucestershire, GL6 7BX, tel: 01452 770629, email: enquiries@greenshop.co.uk, web: www.greenshop.co.uk, Greenergy, 5% blend

Pure Biodiesel, The Green Shed, Station Road Industrial Estate, South Woodchester, Stroud, GL5 5EQ, tel: 01453 872266 (by appointment), Pure Biodiesel,, 100%

S & J Biodiesel, Folly Farm, Northleach, Cheltenham, GL54 3LX, tel: 01451 861616, Email, 100%

Greater London

Pure Fuels, Unit A8, Hastingwood Trading Estate, 35 Harbet Road, London, N18 3HT, tel: 0208 803 8716, Pure Fuels, 100%

Greater Manchester

Bolton Alternative Fuels Cooperative, Gilnow Mill, Spa Road, Bolton, Lancs., BL1 4SF, tel: 07851936640, http://www.allcommunity.co.uk/bafc/1.html, 100%

Gwent

Biosave, Cwmbran biodiesel Outlet, StarTrading Estate, Ponthir, Cwmbran, Torfaen, NP18 1PQ, tel: 01633 431382, Biosave, 100%

Isle of Man

Fairy Cottage Filling Station, Laxey, Isle of Man, IM4 7HR, tel: 01624 861541, email, 100%

Kent

David Teal, Aeolus Biodiesel, 1 The Weald, Ashford, Kent, TN24 8RA, tel: 01233 621341, email: fuel@aeolus.worldonline.co.uk,, 100% biodiesel (transesterified and washed)

Kincardineshire

Fiddes Filling Station, Fordoun, Laurencekirk, Kincardineshire, AB30 4LD, tel: 01569 740494, Rix biodiesel Ltd, 5% blend

Lanarkshire

Airbles Raod Service Station, 91 Airbles Road, Motherwell, Lanarkshire, ML1 2TJ, tel: 01698 253432, Rix biodiesel Ltd, 5% blend

Armstrong Oils Ltd, Tillietudlum, Lesmahagow, Lanarkshire, ML11 9PN, tel: 01555 861122, Armstrong Oils Ltd,, 100%

Fishercoates Service Station, East Kilbride Road, Rutherglen, Glasgow, Lanarkshire, G73 5DU, Rix biodiesel Ltd, 5% blend

Tinto Garage, 61 Biggar Road, Symington, Biggar, Lanarkshire, ML12 6FT, tel: 01899 308200, Rix biodiesel Ltd, 5% blend

Lancashire

Bolton Alternative Fuels Co-op, Unit G/Y/1, Gilnow Mill, Spa Road, Bolton, BL1 4TF, tel: 07851 936640, Bolton Community,, 100%

Eco Bio-Diesel Ltd, Unit 5 Forbes Court, Billington Road, Burnley, Lancashire, BB11 5UB, tel: 01282 831777, Eco Bio-Diesel Ltd,, 100%

Leicestershire

Crossroads Garage, 99 Midland Road, Ellistown, Coalville, Leicestershire, LE67 1EH, tel: 01530 260262, Rix biodiesel Ltd, 5% blend

Lincolnshire

Archways Service Station, The Old Town Hall, Market Place, Franklin Square, Spilsby, Lincolnshire, PE23 5JD, tel: 01790 754571, Rix biodiesel Ltd, 5% blend

Bilsby Village Shop, Alford Road, Bilsby, Alford, Lincolnshire, LN13 9PY, tel: 01507 462246, Rix biodiesel Ltd, 5% blend

Brian Fairweather Autos, Fishtoft Road, Fishtoft, Boston, Lincolnshire, PE21 0QR, tel: 01205 361010, Rix biodiesel Ltd, 5% blend

Clarke’s Garage, Spilsby Road, Horncastle, Lincolnshire, LN9 6NQ, tel: 01507 522391, Rix biodiesel Ltd, 5% blend

Glentham Motors, High Street, Glentham, Market Rasen, Lincolnshire, LN8 2EQ, tel: 01673 878591, Rix biodiesel Ltd, 5% blend

Jordans of Scunthorpe, Grange Lane, North Scunthorpe, Lincolnshire, DN16 1BN, tel: 01724 841284, Rix biodiesel Ltd, 5% blend

Maltby Service Station, Maplethorpe Road, Maltby Le Marsh, Alford, Lincolnshire, LN13 0JP, tel: 01507 450372, Rix biodiesel Ltd, 5% blend

W D McEwan, Station Road, Sutton On Sea, Mablethorpe, Lincolnshire, LN12 2HJ, tel: 01507 441321, Rix biodiesel Ltd, 5% blend

Nicholsons Garage, Longs Corner, 1 - 7 Eastoft Road, Crowle, Scunthorpe, Lincolnshire, DN17 4LP, tel: 01724 710319, Rix biodiesel Ltd, 5% blend

Partney Filling Station, Partney, Spilsby, Lincolnshire, PE23 4PF, tel: 01790 752563, Rix biodiesel Ltd, 5% blend

Pitstop Garage, 32/33 Willingham Road, Market Rasen, Lincolnshire, LN8 3DX, tel: 01683 844688, Rix biodiesel Ltd, 5% blend

Ruskington Service Station, Rectory Road, Ruskington, Sleaford, Lincolnshire, NG34 9AB, tel: 01526 832321, Rix biodiesel Ltd, 5% blend

Spilsby Road Garage, Spilsby Road, New Leake, Boston, Lincolnshire, PE22 8JT, tel: 01205 270241, Rix biodiesel Ltd, 5% blend

Star Garage, Louth Road, West Barkwith, Market Rasen, Lincolnshire, LN8 5LF, tel: 01673 858326, Rix biodiesel Ltd, 5% blend

Young's Garage, Rasen Road, Tealby, Market Rasen, Lincolnshire, LN8 3XH, tel: 01673 838213, Rix biodiesel Ltd, 5% blend

Merseyside

Alchemy Biodiesel, Stone Lane, Off Great Howard Street, Liverpool, L3 7DX, tel. 07810 046620, Vinnyquirk@aol.com,, 100%

Biofuels Ltd, Yardley Road, Knowsley Industrial Estate, Liverpool, L33 7SS, tel: 0151 546 5001, Email,, 100%

The Alternative Fuel Company, 32 Carlton Street, Liverpool, L3 7ED, tel: 0151 298 1893, www.biodiesel-liverpool.co.uk,, 100%

Middlesex

Harefield Oil Terminal, Harvil Road, Harefield, Uxbridge, Middlesex, UB9 6JL, tel: 01296 501630, British Benzol, 5% blend, but 'phone to discuss higher blends. Note minimum amount is 205 litre drum

North Humberside

Brandesburton Motor Company, The Garage, Main Street, Brandesburton, Driffield, North Humberside, YO25 8RL, tel: 01964 543603, Rix biodiesel Ltd, 5% blend

Broach Hill Garage, Beverley Road, Cranswick, Driffield, North Humberside, YO25 9PQ, tel: 01377 270479, Rix biodiesel Ltd, 5% blend

Carlton Service Station, Station Road, Carlton, Goole, North Humberside, DN14 9NS, tel: 01405 860986, Rix biodiesel Ltd, 5% blend

EE-Why Service Station, Thornholme, Driffield, North Humberside, YO25 4NN, tel: 01262 490389, Rix biodiesel Ltd, 5% blend

Green Roof Service Station, 6 Church Lane, Swinefleet, Goole, North Humberside, DN14 8DQ, tel: 01405 704218, Rix biodiesel Ltd, 5% blend

Johnson's Garage, 77 Main Street, Elloughton, Brough, North Humberside, HU15 1HU, tel: 01482 667195, Rix biodiesel Ltd, 5% blend

Jordans Chanterlands, 247a Chanterlands Avenue, Hull, North Humberside, HU5 4DH, tel: 01482 338725, Rix biodiesel Ltd, 5% blend

Jordans of Goole, Stanhope Street, Goole, North Humberside, DN14 5BQ, tel: 01405 760803, Rix biodiesel Ltd, 5% blend

Jordans of Hornsea, 69 Newbigin, Hornsea, North Humberside, HU18 1PA, tel: 01964 535955, Rix biodiesel Ltd, 5% blend

Keyingham Service Station, Ottringham Road, Keyingham, Hull, North Humberside, HU12 9RX, tel: 01964 622265, Rix biodiesel Ltd, 5% blend

Nicholsons of Hedon, 4 - 8 Thorn Road, Hedon, Hull, North Humberside, HU12 8HP, tel: 01482 891593, Rix biodiesel Ltd, 5% blend

Rawcliffe Bridge Filling Station, Bridge Lane, Rawcliffe Bridge, Goole, North Humberside, DN14 8PJ, tel: 01405 839330, Rix biodiesel Ltd, 5% blend

Skipsea Service Station, Hornsea Road, Skipsea, Driffield, North Humberside, YO25 8ST, tel: 01262 468234, Rix biodiesel Ltd, 5% blend

Wardle's Filling Station, Boothferry Road, Howden, Goole, North Humberside, DN14 7DZ, tel: 01430 430388, Rix biodiesel Ltd,5% blend

Wyton Bar Filling Station, 388 Main Road, Bilton, Hull, North Humberside, HU11 4DB, tel: 01482 338770

North Yorkshire

Beansheaf Garage, Malton Road, Kirby Misperton, Malton, North Yorkshire, YO17 6UE, tel: 01653 668244, Rix biodiesel Ltd, 5% blend

Burniston Motor Works, 79 High Street, Burniston, Scarborough, North Yorkshire, YO13 0HH, tel: 01723 870326, Rix biodiesel Ltd, 5% blend

Cayton Service Station, 1 Main Street, Cayton, Scarborough, North Yorkshire, YO11 3RU, tel: 01723 582697, Rix biodiesel Ltd, 5% blend

Catterick Service Station, 40 High Street, Catterick, Richmond, North Yorkshire, DL10 7LD, tel: 01748 811233, Rix biodiesel Ltd, 5% blend

Drakes Garage, York Road, Shiptonthorpe, York, North Yorkshire, YO43 3PH, tel: 01430 871556, Rix biodiesel Ltd, 5% blend

Green Garage, Glaisdale, Whitby, North Yorkshire, YO21 2PR, tel: 01947 897237, Rix biodiesel Ltd, 5% blend

Hayton Service Station, Main Street, Hayton, York, North Yorkshire, YO42 1RJ, tel: 01759 302198, Rix biodiesel Ltd, 5% blend

Highfield Garage, Bubwith, Selby, North Yorkshire, YO8 6DN, tel: 01757 288385, Rix biodiesel Ltd, 5% blend

Honeybee Garage, Glaisdale, Whitby, North Yorkshire, YO21 2PR, tel: 01947 897444, Rix biodiesel Ltd, 5% blend

ID Oils, The Gardens, Malton Road, York North Yorkshire, YO32 9TN, tel: 01904 400552. Call before fuelling as supply is limited,, 100% blend

Stillington Garage, The Green, Stillington, York, North Yorkshire, YO61 1JX, tel: 01347 810256, Rix biodiesel Ltd, 5% blend

Summerfield Garage, Stainsacre, Whitby, North Yorkshire, YO22 4PA, tel: 01947 820044, Rix biodiesel Ltd, 5% blend

The Garage, Egton Village Shop, Egton, Whitby, North Yorkshire, YO21 1TZ, tel: 01947 895696, Rix biodiesel Ltd, 5% blend

Nottinghamshire

C J Bradley (Leverton) Ltd, The Garage, Town Street, South Leverton, Retford, Nottinghamshire, DN22 0BT, tel: 01427 880873, Rix biodiesel Ltd, 5% blend

Brookside Garage, Mickledale Lane, Bilsthorpe, Newark, Nottinghamshire, NG22 8RD, tel: 01623 870252, Rix biodiesel Ltd, 5% blend

Welbeck Service Station, Netherfield Lane, Meden Vale, Mansfield, Nottingham-shire, NG20 9PA, tel: 01623 842025 Rix biodiesel Ltd, 5% blend

Oxfordshire

Euro Eco Energy LLP, Views Farm, Windmill Hill, Great Milton, Oxfordfordshire, OX44 7NW, tel: 01844 278555, Euro Eco Energy, 100%

Goldenfuels Ltd, 38 Cowley Road, Oxford, OX4 1HZ, tel: 01865 423636, Goldenfuels,, 100% (20 & 200 litre container deliveries only)

Greensun Biodiesel, Westmill Farms, Watchfield, Oxfordshire, SN6 8TH, tel. 01793 765133, davidrogers1953@tiscali.co.uk, 100%

Silver Group Fuels Ltd, Unit 19 Cherwell Business Village, Southam Road, Banbury, Oxfordshire, OX16 2SP, tel. 08448 009314, The Silver Group, 100%

Pembrokshire

Community Biofuels, 1 Lanychaer, Fishguard, Pembrokeshire, SA65 9TL, tel: 0845 4589243, Community Biofuels, 100% (assumed)

Perthshire

J P Brown & Sons, The Garage, Kinloch Rannock, Pitlochry, Perthshire, PH16 5PQ, tel: 01882 632331, Rix biodiesel Ltd 5% blend

Burnside Garage, Thorntree Square, Dunning, Perth, Perthshire, PH2 0RP, tel: 01764 684203, Rix biodiesel Ltd, 5% blend

Burrell Street Filling Station, 65 Burrell Street, Crief, Perthshire, PH7 4DG, tel: 01764 666244, Rix biodiesel Ltd, 5% blend

Central Garage, 2 - 4 Andrew Street, Alyth, Blairgowrie, Perthshire, PH11 8AT, tel: 01828 632492, Rix biodiesel Ltd, 5% blend

Comrie Garage, Drummond Street, Comrie, Crieff, Perthshire, PH6 2DW, tel: 01764 670494, Rix biodiesel Ltd, 5% blend

Keathpark Service Station, Balmoral Road, Rattray, Blairgowrie, Perthshire, PH10 7AH, tel: 01250 875286 Rix biodiesel Ltd, 5% blend

Kirkmichael Village Shop, Main Street, Kirkmichael, Blairgowrie, Perthshire, PH10 7NT, tel: 01250 881272

Rix biodiesel Ltd, 5% blend W D Laing, The Garage, Spittalfield, Perth, Perthshire, PH1 4JX, tel: 01738 710206, Rix biodiesel Ltd 5% blend,

Spittal of Glenshee Hotel, Glenshee, Blairgowrie, Perthshire, PH10 7QF, tel: 01250 885215, Rix biodiesel Ltd 5% blend

Renfrewshire

Bishopton Garage, Greenock Road, Bishopton, Renfrewshire, PA7 5LA, tel: 01505 862441, Rix biodiesel Ltd 5% blend

Shropshire

Bridge Service Station, Gobowen Road, Oswestry, Shropshire, SY11 1HU, tel: 01691 653520, Tudor Griffiths Group, 5% blend

Griffiths Garage, High Street, Leintwardine, Craven Arms, Shropshire, SY7 OJZ, tel. 01547 540223, temc.travel@adse.net, 5% blend

The Mount Service Station, The Mount, Shrewsbury, Shropshire, SY3 8PF, tel: 01743 369623, 5% blend Tudor Griffiths Group,

Union Street Garage, Union Street, Bishops Castle, Shropshire, SY9 5AY, tel: 01588 638349, Wasteless Society, 100%

Somerset

Biosulis Ltd, Unit D5, Westfield Industrial Estate, Radstock, Somerset, BA3 4BH, tel: 01761 411011, Biosulis, 100%

South Humberside

Railway Street Filling Station, Railway Street, Grimsby, South Humberside, DN32 7DA, tel: 01472 345869, Rix biodiesel Ltd 5% blend,

Roxby Road Garage, 24 - 26 Roxby Road, Winterton, Scunthorpe, South Humberside, DN15 9SX, tel: 01724 733954, Rix biodiesel Ltd, 5% blend

Spencers Garage Ltd, 50 High Street, Messingham, Scunthorpe, South Humberside, DN17 3NT, tel: 01724 762812, Rix biodiesel Ltd 5% blend

Spencers Garage Ltd, 50 High Street, Messingham, Scunthorpe, South Humberside, DN17 3NT, tel: 01724 762812, Rix biodiesel Ltd 5% blend

South Yorkshire

Bio UK Fuels Ltd, Unit 17, Newhall Road Industrial Estate, Sheffield, South Yorkshire, S9 2TW, tel: 01142 445603, Bio UK Fuels, 100% blend

Central Garage, 3 High Street, Haxey, Doncaster, South Yorkshire, DN9 2HX, tel: 01427 752231, Rix biodiesel Ltd 5% blend

Reg Morris Garages, 1 Doncaster Road, Westwoodside, Doncaster, South Yorkshire, DN9 2ED, tel: 01427 752332, Rix biodiesel Ltd, 5% blend

Sowerby's, Toll Bar Garage, Bawtry Road, Austerfield, Doncaster, South Yorkshire, DN10 6QW, tel: 01302 710595, Rix biodiesel Ltd 5% blend

Staffordshire

Gaia Fuels, Unit 6 Brampton Workshops, Croft Road, Newcastle Under Lyme, Staffordshire, ST5 0SR, tel: 07866 068 029, Gaia Fuels, 100%

GT Gas Distribution, 36 Lanehead Road, Etruria, Stoke on Trent, Staffordshire, ST1 5PT, tel: 01782 279504, Elipse, 100%

West Sussex

Lockgate Nurseries, 72 Lockgate Road, Siddlesham, West Sussex, PO20 7QQ, tel: 01243 641492, email, 100%

West Yorkshire

Bio Diesel Future Fuels Ltd, Ryburn Mill, Hanson Lane, Halifax, HX1 4SD, tel: 01422 368880, Bio Diesel Future Fuels,, 100%

Greenworld biodiesel Ltd, Holthead, Slaithwaite, Huddersfield, HD7 5TY, tel: 01484 842157, Email,, 100%

Hebden Bridge Biofuels, Unit 6 Pennine Industrial Estate, Valley Road, Hebden Bridge, HX7 7BZ, tel: 01422 843558, hebdenbiofuel@btconnect.com,, 100%

Sunside Service Station Ltd, Saddleworth Road, Greetland, Halifax, West Yorkshire, HX4 8LZ, tel: 01422 373127, Sunside Service Station, 100%

Warwickshire

D & B Biofuels Ltd, Wessons Farm, Grafton Lane, Bidford on Avon, Warwickshire, B50 4DU, tel: 01789 772750, D & B Biofuels Ltd, 100%

West Midlands

Palmer's Garage, Corngreaves Road, Cradley Heath, West Midlands, B64 7BT, tel:

01384 566843, geoffdixonhal@aol.com1, 100%

Worcestershire

Bransford Biofuels Ltd, The Old Propagation House, New Farm, Bransford, Worcestershire, WR5 6LD, tel: 01886 830155, Bransford Biofuels, 100% blend. By appointment.

Countrywide Energy, Defford Mill, Earls Croome, Worcester, Worcestershire, WR8 9DF, tel: 01386 757349, Rix biodiesel Ltd, 5% blend Minimum order 500 litres deliveries only.

7.1.4 Norway

7.1.4.1 Milvenn

The BioDieNet partner Milvenn provides an excellent case of the starting up of UCOME production. This description below is based on the previous communication to the European Parliament through a feature article in Parliament Magazine (WNRI & Milvenn, 2006).

Figure 3 From the Milvenn production facilities

Milvenn is a success story of the effect of European Community policies for increasing biofuel production and use in Europe. It is an example of how the EU programmes for renewable energy can have the effect of creating advances in the biofuel market. In November 2004 Mark Pettit and Paul Winson, who would later establish Milvenn AS, made investigations into the possibilities of starting up biodiesel production in Bergen.

They contacted Western Norway Research (WNRI) Institute, renowned for its biofuel research through several European Commission programmes. WNRI had, among more, coordinated two projects in the DG TREN ALTENER programme (now a part of Intelligent Energy Europe) in which non-technological barriers to the use of biofuels were addressed. Moreover, WNRI had participated in a project that looked at biofuel production from waste. Milvenn consulted WNRI on biodiesel barriers and strategies for overcoming them, and in retrospect, Paul Winson has stated that this consultation was the reason he decided to start up biodiesel production.

The initial contact between WNRI and Milvenn included a meeting with the restaurant chain McDonald's, a potential supplier of used cooking oil (UCO) for the biodiesel production. It made sense to use this waste material as source for the biodiesel production, again based on the findings of the ALTENER projects as well as other projects. This was good news for Mark Pettit, whose professional background is in the food processing industry. He saw a possibility of utilizing his knowledge of systems for UCO handling and their qualities as biodiesel source. His teaming up with Paul Winson, a former aircraft engineer with additional experience from the offshore industry, proved to be a success.

Milvenn has built up a biodiesel production facility with a capacity for producing 300,000 litres annually. The company is collecting UCO from a wide range of restaurants, the food processing industry, and waste management companies – all of whom are located in Bergen and surrounding municipalities, and were having trouble disposing of waste cooking oil in an environmentally friendly way. The biodiesel produced by Milvenn is sold to customers ranging from private passenger car owners to large transport companies operating fleets of lorries and vans. The biodiesel is sold as pure biodiesel (B100) or as blend with fossil diesel (B50).

Milvenn's collaboration with WNRI has in fact been strengthened through support from Innovation Norway and the Research Council of Norway for a project researching strategies for overcoming non-technological barriers to biodiesel production from new raw material sources. On top of this, WNRI engaged Milvenn as a partner in BioDieNet. The role of Milvenn as a provider of hands-on knowledge connected to the establishing of locally adapted biodiesel production has proved to be extremely important for the success and impact of BioDieNet in establishing local UCOME production.

7.1.5 Germany

7.1.5.1 Petrotec AG

1. Year built:
2000

2. Name:
Petrotec AG

3. Address:
Fürst zu Salm Straße 18, D 46325 Borken – Burlo, Germany
+49 (0)2862 - 9100 - 19

4. Sources of financing:
Shareholders capital

5. Scale of production:
85,000 tonnes per year (100,000 tonne plant under construction in Emden,Germany)

6. Type of customers:
Refineries for blending fossil diesel, feet customers, mineral oil dealers

7. Regional network utilized:
Petrotec has ist own collecting system with ASF containers since 2001

8. Barriers encountered:
a) Problems with norm acceptance
b) tax problems

9. Strategies applied:
a)Working out better production and quality
b) lobbying

7.1.5.2 Saria (ecoMotion)

1. Year built:
2001

2. Name:
ecoMotion GmbH

3. Address:
Brüeler Chaussee 194, D-19406 STERNBERG
Tel: +49 (0) 23 06 / 9 27 09 – 50 / 51
Fax: +49 (0) 23 06 / 9 27 09 – 60
E-Mail: info@ecomotion-gmbh.de
Geschäftsführer:
Dr. Kurt Stoffel
Axel Becker

4. Sources of financing
100% daughter of SARIA Bio-Industries AG & Co KG, Selm, Germany

5. Scale of Production:
- 12.000 to per year in Malchin, Germany100.000 plant under construction in Sternberg, Germany (multi feedstock plant)
- 100.000 to plant under construction in Lünen, Germany (multi feedstock plant)
- Several partnerships in other Countries (Spain, Austria etc.)

6. Type of customers:
Fleet customers, public transport, transport companies, mineral oil dealers

7. Regional network utilized:
Using the network of the mother company SARIA AG

8. Barriers encountered
a) Problems with norm acceptance
b) tax problems
c) release of the products by car and truck producers

9. Strategies applied:
a) working out better production and quality
b) lobbying
c) working together with the producers of cars and trucks

7.1.5.3 Greasoline

1. Year built:
2003 to 2004 - project will run until 2007

2. Name:
Dr. rer. nat. Joachim Danzig,

3. Address:
Fraunhofer UMSICHT, Osterfelder Str. 3, D-46047 Oberhausen, Germany
phone: +49 208 8598 11 45
fax: +49 208 8598 14 24
+e-mail: Joachim.Danzig@umsicht.fraunhofer.de
For GREASOLINE matters: team@greasoline.com
+web: http://www.umsicht.fraunhofer.de/; www.greasoline.com

4. Sources of financing:
Fraunhofer Institute Oberhausen Germany, several sponsors

5. Scale of production:
Laboratory scale

6. Type of customers:
No customers

7. Regional network utilized: -

8. Barriers encountered:
Technical problems because of the new production method

9. Strategies applied:
Science

7.1.5.4 Greenfuel Ltd.

1. Year built:
2003 to 2004 - project will run until 2007

2. Name:
Dr. rer. nat. Joachim Danzig

3. Address:
Fort Lee Zentrum für Umwelt-, Rodborough Common Stroud, Gloucestershire, GL5 5BJ, U.K
Tel: ++44 (0) 1666 575002
Fax: ++44 (0) 1666 575457
Email: info@greenfuels.co.uk Internet: www.greenfuels.co.uk
Technology Centre:Bio- und Energietechnologie, Volmerstraße 5, D-12489 Berlin

4. Sources of financing: See above

5. Scale of Production: Unknown on behalf of UCOs

6. Type of customers: -

7. Regional network utilized: -

8. Barriers encountered: -

9. Strategies applied: -

7.2 Other European projects and initiatives for localised biodiesel production

7.2.1 Mureck

The case of Mureck in Austria is of particular interest (www.seeg.at). The idea of a biodiesel production facility for biodiesel started in Mureck in 1985. This town is far south in Austria, close to the border with Slovenia. After a pilot project in 1987, a cooperative termed Südsteirische Energie- und Eiweißerzeugungsgenossenschaft (SEEG) was formed in 1989. The building of a small scale plant started 1990 and production was commenced in 1991. The collection and conversion of used cooking oil to methyl ester (UCOME) began in 1993. The year after, fleet tests of UCOME in vehicles were started in Graz and Grossglockner.

The plant was established in collaboration with V&N (BDI), a combination plant relying both on virgin rape seed oil and recycled oil from nearby households and businesses. In 1997 this plant had an annual production capacity of 2,500 tonnes biodiesel (BLT, 1997). The operation is also known as the “Baüerliches RAPS-Projekt”.

The biodiesel produced at SEEG Mureck has biodegradability as shown in Table 25.

Table 25 Degradability of biodiesel compared with fossil diesel

	% degraded after 21 days
Fossil diesel	70.0
Biodiesel	99.6

SEEG Mureck was a partner in the Altener pilot study "Biodiesel (fatty acid methyl ester extracted from used vegetable oils) for use as motor fuel" in the city of Graz in the region of Styria in Austria, described below. Karl Totter was in charge of this project at SEEG Mureck.

Contact:
SEEG
8480 Mureck
Pestkreuzweg 3
Postfach 77
Telephone: (0 34 72) 35 77
Fax: (0 34 72) 39 10

Obmann:
Karl Totter, landwirtschaftsmeister
Eichfeld 35
A-8480 Mureck
Telefax: (0 34 72) 26 05

The UCOME produced in the esterification-facility in Mureck has been used as fuel in city buses in Graz since 1994. The buses are operated by Grazer Verkehrsbetriebe. Extensive testing of the performance of the buses was conducted by the Technical University of Graz, at the Institute for Combustion Machinery and Thermodynamics, headed by Dr. Theodore Sams. The measurements of fuel consumption and emissions of CO, HC, NO_x and particulate matter (PM) were carried out on dynamic roller test beds. These parameters were compared with the corresponding using fossil diesel with 0.05 % sulphur. Of the buses using UVOME, the effect of installing oxidative catalytic converter was analysed. The effect of delayed injection time to reduce the NO_x - emissions from the UVOME buses was also measured after changing the "Kurber"-angle of 5º. The results are shown in Figure 4 through Figure 8 (Data obtained from personal communication with Grazer Verkehrsbetriebe).

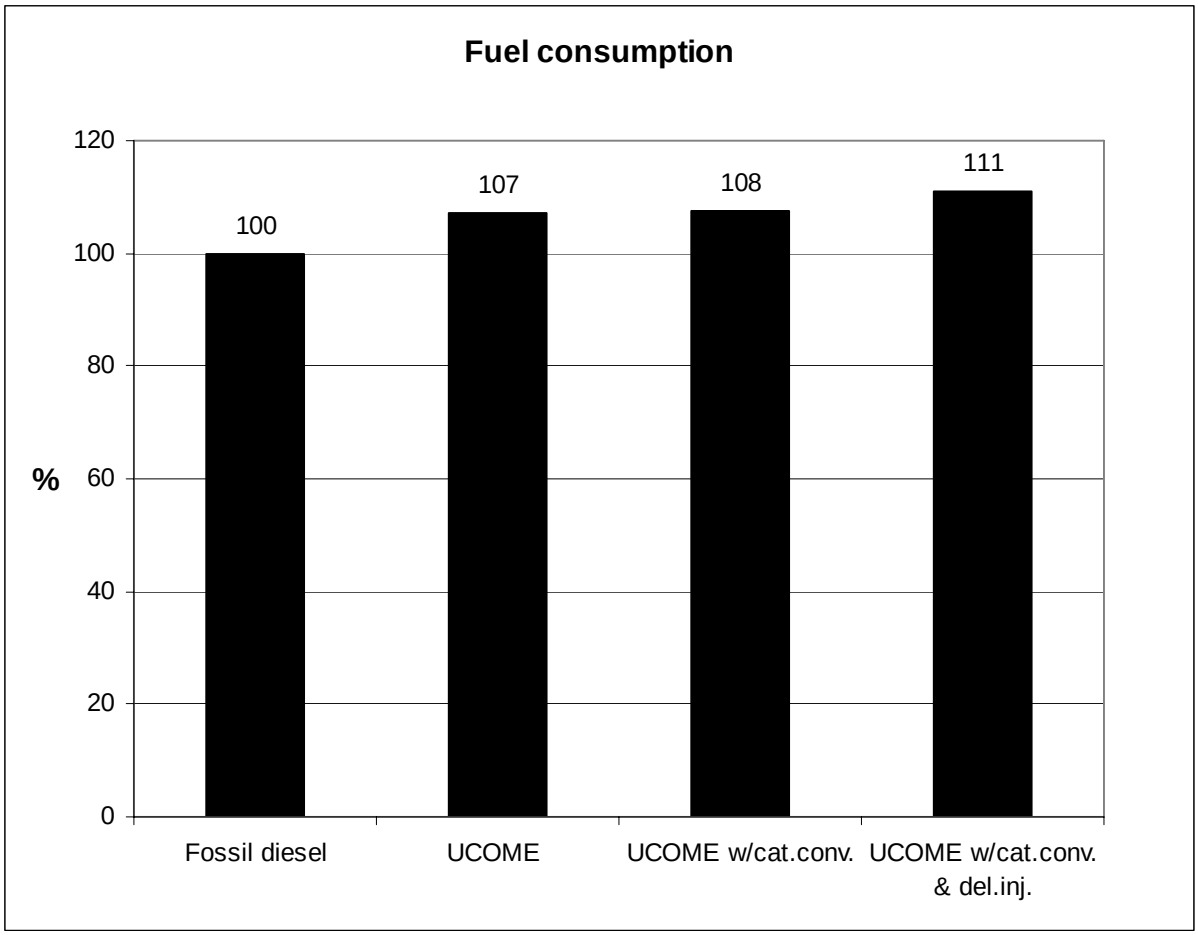

Figure 4 Fuel consumption in buses - UCOME compared with fossil diesel

It is clear from Figure 4 that the fuel consumption increased by 7% for the buses running on UCOME. A further slight increase of about 1 % was observed when using an oxidative catalytic converter. An additional increase of 3 % was seen when delaying the ignition point.

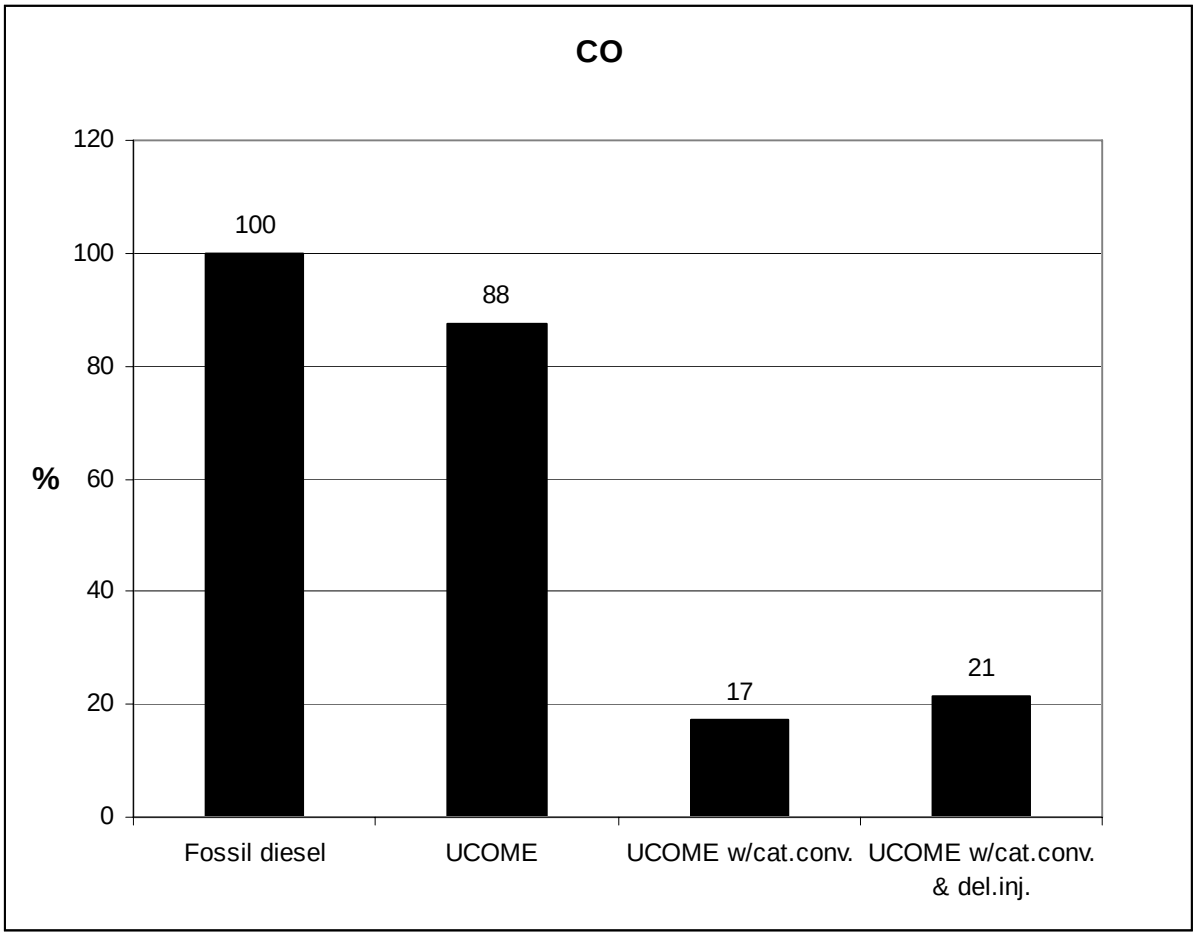

Figure 5 CO emissions in buses - UCOME compared with fossil diesel

As is evident from Figure 5, there is a significant reduction (12 %) in the emission of CO from the buses using UVOME. Installing an oxidative catalytic converter reduces the emission all the way down to 17 % of the corresponding emission from the fossil diesel buses. The delayed injection gives an increase of only 4 % from this level.

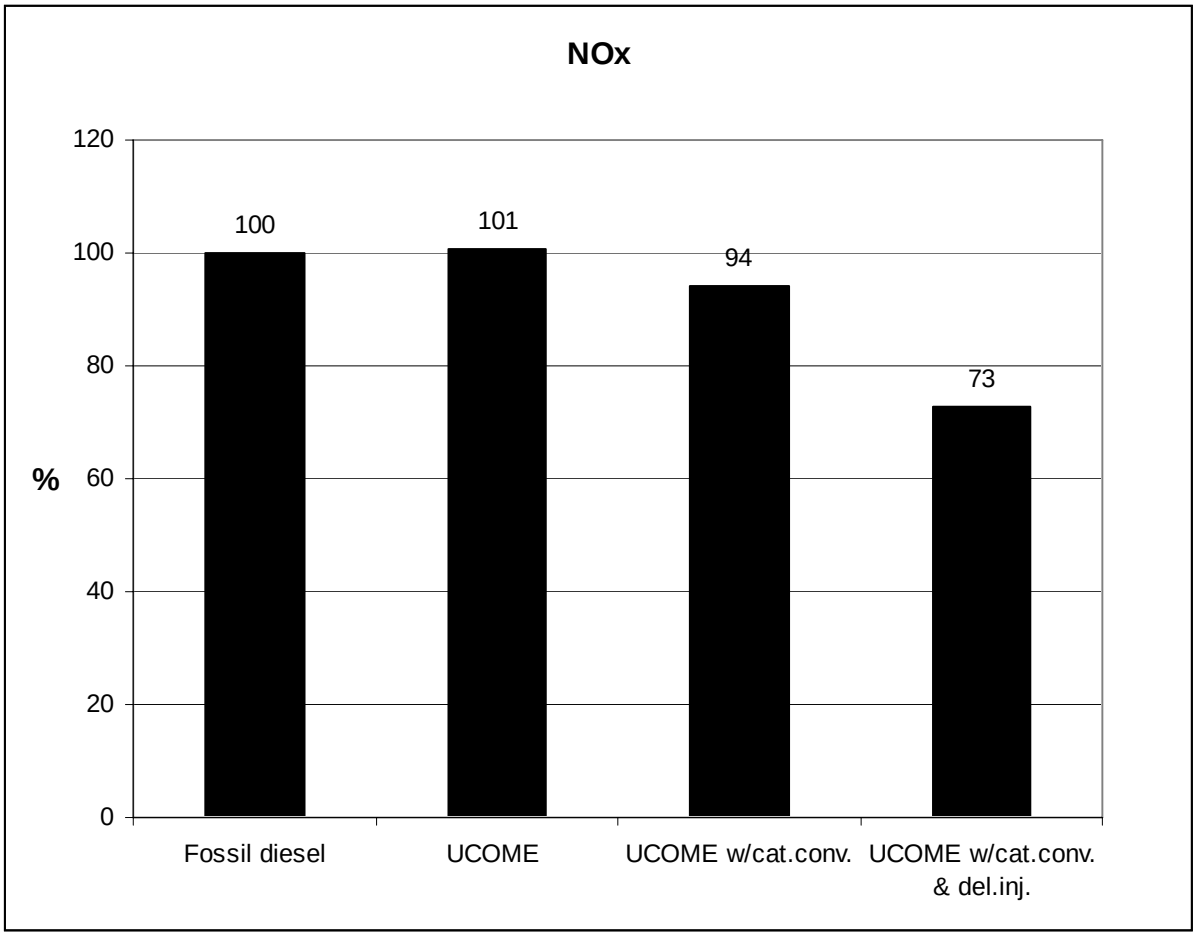

Figure 6 NO_x emissions in buses - UCOME compared with fossil diesel

In Figure 6 it is seen that the NO_x emission is slightly elevated in the exhaust from the UCOME buses. However, the installation of an oxidative catalytic converter brings these emissions down by 7 %. A further major reduction of 21 % in the NO_x emissions can be seen when delaying the injection time. It must be kept in mind that this, however, increases the fuel consumption slightly, as seen in Figure 4.

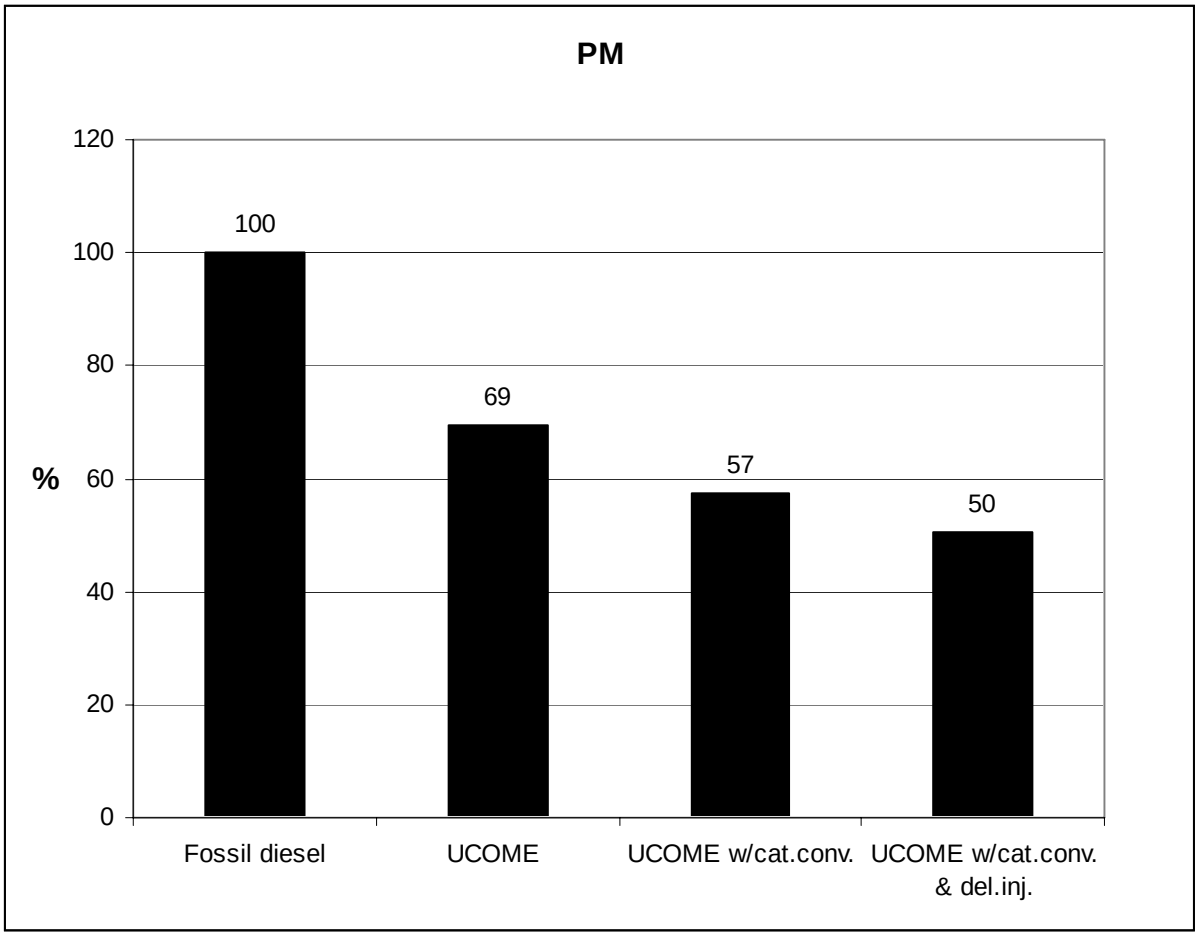

Figure 7 PM emissions in buses - UCOME compared with fossil diesel

A major reduction (31 %) in particle emissions was measured in the UVOME buses, as seen in Figure 7. This is further reduced 12 % by using oxidative catalytic converter. The particle emissions goes down even further (another 7 %) with the delayed ignition timing.

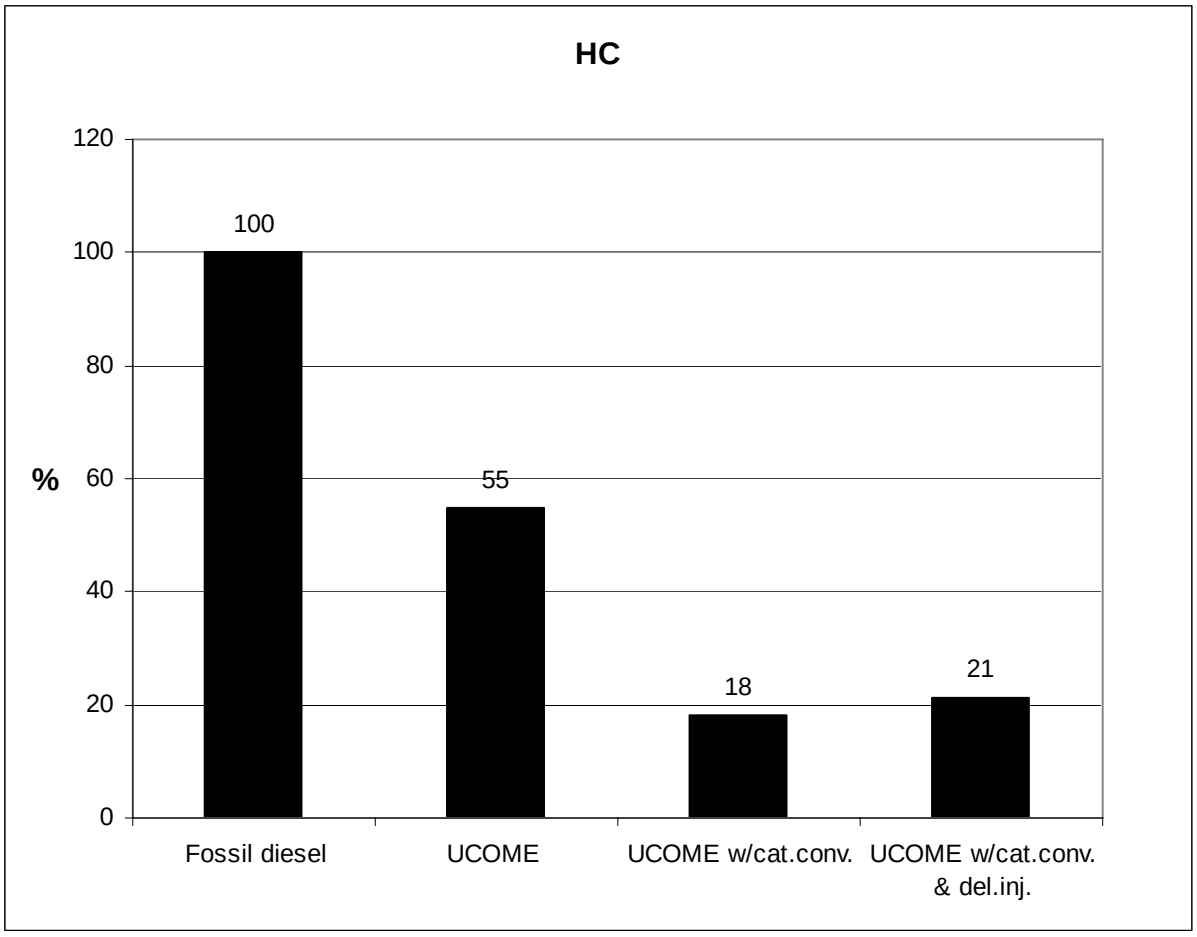

Figure 8 HC emissions in buses - UCOME compared with fossil diesel

The most dramatic reduction was however observed for HC. As is evident in Figure 8, there is a 45 % reduction for the UCOME buses. Installing an oxidative catalytic converter reduces the emission further all the way down to 18 % of the corresponding emission from the fossil diesel buses. The delayed injection gives an increase of only 3 % from this level.

7.2.2 EU projects

7.2.2.1 Completed projects

Altener projects in "Index of Liquid Biofuels Projects"

Federal Institute of Agricultural Engineering (BLT Wieselburg) published an "Index of Liquid Biofuels Projects" focusing on UCO (Woergetter, 1997). These are included here, including a short description of their aim and expected results. However, since these descriptions are mainly of projects underway in 1997, it should be checked what was actually carried out, and what knowledge can be drawn from them.

The decentralised collection of waste edible oils and fats in community as a logistical prerequisite for the increased use of biodiesel fuelled vehicles - A GRAZ EXPERIMENT

Contract: AL/1/96/AUS
Coordinator: Dieter Reif
Organisation: ÖKO-SERVICE Ltd

Address: Anton-Mell-Weg 14, Austria 8053 Graz
Total Cost (€): 107,000
EC Funds (€): 65,00
Collaboration with: German partner allowing for popularisation of the Graz model in other cities throughout the EU.

Aim:
To optimise the collecting system for waste, as well as edible oils and fats within the city of Graz. The collection of this household waste was to be optimised through the introduction of the "individual household collection" and the opening of an additional stationary collecting point. In addition, the entire fleet of vehicles and machines of the non-profit service company ÖKO-SERVICE Ltd was to be converted to run on biodiesel. This was to be supplemented with a fleet test in collaboration with Graz University of Technology.

Expected results:
A significant increase in the collection of quotas in Graz city
The use of biodiesel in various fleet tests
Further potential conversion of vehicles and machines depending on test results
Optimisation of collection logistics (e.g. public information and information campaigns)
Massive restrictions of illegal disposal of waste and edible oils and fats via the sewers or rubbish bins (relieving sewage treatment plants and waste disposal sites)
An improvement in the air situation in the highly polluted city area in Graz
Innovative effects for other national and transitional interested parties (the model effect)

Used vegetable oil methyl ester demonstration in Belgium

Contract: AL/43/95/B
Coordinator: Ir Renilde Craps
Organisation: VITO NV
Address: Boeretang 200, Belgium 2400 Mol
Total Cost (€): 353,000
EC Funds (€): 115,00
Collaboration with: University of Graz, Austria

Aim:
Introduction and demonstration of vehicles driving on biodiesel made from used edible oils, i.e. Used Vegetable Oil Methyl Ester (UVOME). The demonstration was to be executed on garbage collector trucks and company passenger cars – fleets in daily use. During two years the demonstration will increase progressively the number of vehicles and the blend concentration of UVOME. This is based on experiences from the preceding Altener project XVII/4.1030/93-22.

The items to be investigated are: fuel quality and characteristics, fuel consumption, emissions, maintenance costs and technical implications of UVOME use. Special attention is to be given to the wear behaviour of the injection systems and other critical components. In each case these items are to be compared to the corresponding items for mineral diesel.

Fuel consumption and emissions are measured using on-the-road emission and energy measuring systems for vehicles.
Information on the project is presented to the public and then responsible governments on order to inform them of the usage of this fuel.

Expected results:
Prove the feasibility of UVOME for heavy duty and light duty applications.
Quantification and qualification of possible technical problems, particularly related to wear behaviour.

For different levels of concentration of UVOME in the diesel fuel, fuel efficiency and emission measurements will determine the energy efficiency and environmental impact of UVOME use in different types of vehicles.

Through the actual use of UVOME, implications in the field of maintenance and costs are to be evaluated in the function of the concentration of UVOME in the diesel fuel. Fuel quality is evaluated as a function of time. Lubrication oil will be evaluated as a function of mileage.

The demonstration will inform the public of the feasibility of the utilisation of the fuel. The prospects for wider use of UVOME will be investigated.

Biodiesel (fatty acid methyl ester extracted from used vegetable oils) for use as motor fuel

Contract: AL/70/95/AUS
Coordinator: Ing Werner Kiehtreiber
Organisation: AME – Altfettmethylester Productions Ges.m.b.h.
Address: Heidestrasse 7, a-2433 Margarethen am Moos
Total Cost (€):219,000
EC Funds (€):109,00
Collaboration with: University of Graz, Institüt für Organische Chemie represented by Martin Mittlebach.

Aim:
Production of sample lots of UCOME. Fleet tests with construction machines, lorries and vehicles. Control of engines, gas exhaust measuring, analysis of engine oil over a longer period of time. Use of the results in the whole of the EU.

Expected results:
Use of UCOME as fuel. Possibility for the release of the biodiesel use by engine constructors.

Biodiesel production from waste cooking oils: Promotion of the establishment of an industry in Ireland

Contract: AL/72/95/IRL
Coordinator: Bernard Rice
Organisation: Teagasc

Address: Oak Park Research Centre, Carlow, Ireland
Total Cost (€):235,000
EC Funds (€):118,00
Collaboration with:
1. Dublin Products, which assembles waste cooking oil and produces tallow, and plans to build a biodiesel plant.
2. Austrian Biofuels Institute
3. R. Wynne, an assembler of rapeseed and other seed crops adjacent to Dublin Products with an interest in oil-seed production on set-aside land

Aim:
Establish the feasibility of, and provide technical support for, the establishment of a small scale biodiesel plant in Ireland, in which the mail raw material would be waste cooking oil, rapeseed and other plant oils, and tallow. An annual production of 3-5000 tonnes is envisaged. Biodiesel will be produced at pilot scale, its quality will be examined and process requirements for a high quality at a minimum cost will be examined. The performance of five vehicles operating on the biodiesel produced from these feedstocks will be monitored.

Expected results:
Expand the range of biodiesel feedstocks to include materials with lower cost than rape seed oil. The reduction in biodiesel cost achieved through using cheaper feedstocks will help to remove one of the biggest obstacles to more widespread production of biodiesel. The project will enhance the prospects of establishing a biodiesel industry in a small country such as Ireland, where achievement of a reasonable scale requires that the widest possible range of feedstocks be used. Small plants will also have a greater flexibility and enhanced prospect of survival if they have a range of feedstock options available to them.

A trial of esterified waste cooking oil as a summer and winter fuel for vehicles and heating boilers and investigation into the feasibility of establishing a small scale process

Contract: AL/73/96/IRL
Coordinator: Dr Robin Howard Hildige
Organisation: University of Limerick
Address: Plassey Technological Perk, Limerick
Total Cost (€): 231,000
EC Funds (€):116,000
Collaboration with: ADEME, who will identify a vehicle user in the Alpine region of France to assess the cold start and the cold climate performance of the fuel.

Aim:
The University of Limerick shall develop the processing of used cooking oil to produce biodiesel (UCOME), glycerol and minimise soap production. The biodiesel will be produced by the University of Limerick and used in Ford Transit and Escort vans belonging to Cork County Council. The power output, fuel consumption and exhaust emissions shall be monitored by the University of Limerick and compared to the performance of similar vehicles belonging to Cork County Council running on rape and sunflower methyl esters, and derived under the Altener contract

XVII/4.1030.AL/79/95/IRL. Cold temperature start is a potential problem with UCOME due to the presence in the raw material of high molecular weight constituents. Low temperature phase separation of UCOME results in solid aggregates impeding flow of the fuel in the fuel lines. The phase separation behaviour of the fuel will be investigated using differential scanning calorimeter and related to empirical pour point and cloud point test; the rheological behaviour of the fuel will be determined as a function of temperature. Studies by Teagasc have identified *camelina sativa* as as a more suitable crop than rape for an Irish biodiesel industry. The high iodine number of camelina oil has been suggested to constitute a problem by some engine manufacturers. Blending of camelina with UCOME would offer a mechanism for reducing the iodine number of the fuel and simultaneously enhancing the cold flow properties. Modification of the cold flow properties of the UCOME will be attempted using both highly unsaturated oil seed products (camelina) as well as commercial additives. UCOME as well as blends will be tested in a cold running modified engine test bed to assess performance.

Expected results:
The results will be related to both employment and the environment. Data collected from the engine trials, road vehicles and boiler studies will allow for direct comparison of the performance of UCOME with RME, SME, and fossil diesel. The optimum blend of UCOME and camelina methyl ester will be determined with respect to cold start, fuel line transport properties and the lower temperature limits of operation. The processing costs of the UCOME will be determined for a small scale (350 litres) process.

Employment and training of graduates in the biofuels industry will be generated immediately. Niche markets already exist, where UCOME is desirable due to its low toxic emissions compared to fossil diesel, e.g. users in inland waterways, inner city transport and any uses of diesel engines in confined spaces. The project will help to initiate a biodiesel industry in Ireland. Once established, the industry will enable methyl ester to be produced from oil seed grown by Irish farmers, thus providing employment in agriculture from a non-food area. In overall environmental terms the use of biodiesel avoids the introduction of burned carbon from the pre-history into today's atmosphere and hence avoids production of excess CO_2-emissions.

Other completed projects - LIFE & Altener

Biodiesel in protected areas and in the food-transport sector. 1996-1998. ALTENER 4.1030/Z/96-153

Biodiesel in heavy-duty vehicles in Norway – Strategic plan and vehicle fleet experiments. 1996-1998. ALTENER 4.1030/Z/209/96/NOR. Final report: Andersen et al. (1998), available at:
http://www.vestforsk.no/www/show.do?page=12&articleid=1187

Development of a complete economical recycling process for reuse of used fats in Biodiesel production. 1997-1999. LIFE97 ENV/F/000178

New markets for biodiesel in modern common rail diesel engines. 1998-2000. ALTENER 4.1030/Z/98-242

BioDiesel UK. 1998–2000. ALTENER 4.1030/Z/98-404.

The Non Technical Barriers Network for Liquid Biofuels. 1998-2000. ALTENER 4.1030/Z/98-529. www.liquid-biofuels.com/Blt_ntb.pdf

Biodiesel Courier International - A Union-Wide News Network. 1999-2001. ALTENER 4.1030/Z/99-386

Market Introduction Strategy for Biodiesel Produced from Waste Oils as an Environmentally Friendly Fuel on the Islands of Gran Canaria, Crete and Cyprus. 1999–2001. ALTENER 4.1030/Z/99-526
http://ec.europa.eu/energy/iebase/sectreps/03%20Transport.pdf

Bio-diesel. 2001–2002. ALTENER 4.1030/C/00-014
Collecting used cooking oils to their recycling as biofuel for diesel engines. 2002-2004. LIFE02 ENV/E/000253

7.2.2.2 Current projects - LIFE & EIE

These are on-going projects, which will have varying amounts of data available:

Vegetable oil initiative for a cleaner environment. 2006-2009. LIFE06 ENV/IT/000257
Biofuel Marketplace. 2006-2008. EIE/05/022/SI2.420009.
www.biofuelmarketplace.com

Promoting favourable conditions to establish biodiesel market actions (BIODIESEL CHAINS). 2006-2007. EIE-05-113. www.cres.gr/biodiesel

Carbon/Efficiency Labelling & Bio-Blending for Optimising Benefits of Biodiesel & Additive Use (CARBON LABELLING). 2006-2008. EIE/06/015. www.co2star.eu

COMmon PROcurement of collective and public service transport clean vehicles (COMPRO). 2007-2009. EIE/06/200/SI2.448437. www.compro-eu.org

Overcoming Non-Technological Barriers for full-scale use of Biodiesel in Europe (Pro-Biodiesel). 2006-2007. EIE-05-111. www.probiodiesel.com

Green Fleet Procurement Models (PROCURA). 2006-2008.
EIE/05/102/SI2.419855. www.fast.mi.it/procura

Renewable Fuels for Europe (REFUEL). 2006-2007. EIE/05/042/SI2.420193.
www.refuel.eu

Integrated promotion of the biodiesel chain (PROBIO). 2007-2009. EIE/06/167.
www.probio-project.com

7.2.2.3 Interreg projects

North Sea Bioenergy

WNRI has observatory status in this project. It covers small scale bioenergy production from various sources, which includes UCOME. It is coordinated by the BioDieNet Partner Province of Fryslân.

Contact:
Mrs. Anna van Dijk
A.vandijk@fryslan.nl
+ 31 58 2925108
+ 31 6 463 74 209

Expanding the use of biofuels in the Northern Periphery

The preparatory project "Expanding the use of biofuels in the Northern Periphery" in the Northern Periphery Programme (NPP) INTERREG III B 2000 – 2006 included UCOME in one of the biofuel energy chains that was envisaged. Special focus was on obtaining overview of the raw and waste material options and adapted production technologies for northern countries with cold ambient temperatures. This included assessing the main barriers to biofuel production, and developing strategies for overcoming them.

Contact info: Sjöfn Sigurgísladóttir, Director (sjofn@rf.is) and Helga Gunnlaugsdóttir, Head of Department of Environmental Research & Food Quality (helgag@rf.is), Icelandic Fisheries Laboratories - Rannsóknastofnun fiskiðnaðarins.

7.2.2.4 Other projects

Westray Development Trust, Highlands & Islands, Scotland

Westray Development Trust has carried out smaller scale projects in community development and a wide range of renewable energy including biofuel production, where UCOME has been considered as an option.
Contact:
Colin Risbridger, Renewables Engineer (colin@crisenergy.co.uk) or William McEwen, Co-Chair (mailgate@millwestray.com)

Technological Institute of Iceland

A project on utilising animal fat and talc for producing biodiesel has been conducted in Iceland. Technological Institute of Iceland (www.iti.is) has reported the results in Jónsdóttir et al. (2001).
Contact:
Halla Jónsdóttir, Technological Institute of Iceland, hallaj@iti.is
Tel: +354 570 7100, Fax: +354 570 7111

Central Ostrobothnia Polytechnic/CENTRIA R&D, Finland

Centria have projects on Biogas and Biofuel production methods and usage. This includes UCOME from fish waste, waste animal fat including fat from reindeer.

Contact: Antti Lauhikari, Research and Development manager (antti.lauhikari@cop.fi) or Maarit Sorvisto, Project Planner (maarit.sorvisto@cop.fi)

Science Portal

The quite comprehensive Dutch database "Science Portal" (www.bjernv.dds.nl) provides information on a wide range of organisations, institutes and funding possibilities, including relevant ones for biodiesel projects. The site serves the objective of offering a personal gateway to websites dedicated to the societal key assets: scientific research, technology and education.

Contact:
Bernard Verlaan
Ministry of Education, Culture and Science
Div. Central Organisation for Foresight Studies (COS)
Email: bjernv@dds.nl
Tel +31 70 412 4730

8 Conclusions

The results reported here have contributed towards establishing the state of the art within the production of UCOME in Europe. From the surveys conducted among the project partners, the status quo is established on production of UCOME in the ten countries Holland, Italy, Portugal, Spain, Germany, Hungary, Norway, Romania, Bulgaria and the United Kingdom. In addition, the results of the literature surveys have given an overview of suppliers of equipment for localised UCOME production, local markets, funding options, legal status of Energy Agencies, the implementation of the IPPC Directive, health and safety issues, as well as relevant projects and initiatives in other parts of Europe. The results have provided a basis for the subsequent work in BioDieNet, and thus preparing for increased localised production and use of UCOME in Europe.

The UCOME production in the ten BioDieNet countries thus constitutes about 13 % of the FAME produced in EU-25.

In a discussion of what the findings of this report implies for the increased use of UCOME in Europe, it is important to be aware of that UCOME can be produced from both used vegetable oil and used animal fat (UAF) from cooking processes. Western Norway Research Institute has conducted a study of potentials of biodiesel production from UAF collected from grease traps in restaurants and food processing industries in Norway. This was done through a survey of all installed grease traps in Bergen, combined with information from Bergen and Trondheim. This gave a basis for up-scaling to national level. The potential for UAF for biodiesel production in Norway was thus estimated to about 9 thousand m^3 per year, which is roughly a factor of 2 m^3 per 1000 inhabitants. If this factor is applied to all 10 BioDieNet countries, which has about 310 mill inhabitants in total, an additional 0.53 mill tonnes UCOME could theoretically be produced. If the factor is applied to all EU-25 with about 460 mill inhabitants, this increases to 0.79 mill tonnes, which is an increase of 25 % in the total EU-25 biodiesel production.

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EC (2005): *Assessment of the implementation by the Member States of the IPPC Directive. The Technical Annex.* European Commission .October 2005. (http://ec.europa.eu/environment/ippc/pdf/ippc_implementation.pdf)

Institute for European Environmental Policy (2003): *Implementation of the IPPC Directive (96/61): Analysis and progress of issues.* Policy Brief for the EP Environment Committee EP/IV/A/2003/09/01. Brief number 01/2003. www.europarl.europa.eu/comparl/envi/pdf/externalexpertise/ieep/ippc_brief.pdf

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10 Appendix 1: Questionnaire 1 (tasks 1- 3)

Dear BioDieNet Partners.
Attached you will find the WP2 questionnaire we discussed at the kick-off in Brussels. Please notice that this is to be considered a wish list rather than a set of requirements. Please compete as much as possible and return it to Idun Husabø Anderssen at iha@vestforsk.no. As we discussed in Brussels you have two weeks to respond, so please give your input within **March 5th**.

Also, since we are only asking you to access information which is already publicly available, it would be useful to have references or links to the documents themselves which we can use in the report on the Work Package.
Best regards,
Otto

Otto Andersen, PhD
Western Norway Research Institute
PO.Box 163
N-6851 Sogndal
Norway
Office phone: +47 57 67 61 71
Mobile phone: +47 977 10 928
Fax: +47 57 67 61 90
www.vestforsk.no
oan@vestforsk.no

BioDieNet WP 2 Questionnaire
BioDieNet WP 2 data acquisition from the 10 Partner countries
We kindly ask you to reply to the questions below. One set of answers per country.

Your name, organisation and e-mail:

Your country:

Part 1. Used Cooking Oil (UCO)

1.1. What are the main sources of UCO in your country? (restaurants, food processing industry, others)

1.2. Who are the main collectors of UCO in your country?

1.3. What type of virgin oil is used as input in the main forms of UCO in your country? (rape, sunflower, palm, etc.)

1.4. What national regulations apply to the use or disposal of UCO in your country?

1.5. How much UCO (in m^3) in your country is being:
collected?
utilized for purposes?
dumped?

1.6. What is the cost (€/m^3) of collecting UCO in your country?

1.7. What is the cost (€/m^3) of dumping UCO in your country?

1.8. What are the main environmental impacts of UCO in your country?

1.9. How much energy (kWh) is used in your country for:
UCO collection?
UCO dumping?

Part 2. Production of UCOME

2.0. What are the other main uses (than for biodiesel production) of UCO in your country?

2.1. What main production facilities for biodiesel from UCO exist today in your country? (Location, name of company, production capacity)

2.2. What technologies are used in the main production facilities for biodiesel from UCO in your country?

2.3. What biodiesel quality is obtained in the main production facilities for biodiesel from UCO in your country?

2.4. How much biodiesel (m^3) is produced from UCO in your country?

2.5. What are the environmental impacts of producing biodiesel from UCO in your country, in the form of:
discharges?
emissions?
waste?
energy use?
other?

Part 3. Supply of UCOME

3.1. Who are the main distributors of biodiesel from UCO in your country?

3.2. What type of logistics is used by the main distributors of biodiesel from UCO in your country?

3.3. How much (m^3) biodiesel from UCO in your country is used as:
transport?
stationary fuel for heating?
stationary fuel for electricity production?
other?

3.4. What are the main environmental impacts of the supply of biodiesel from UCO in your country?

Please fill in your answers and return to **iha@vestforsk.no** within March 5th. Please use the same e-mail address should you have questions related to the questionnaire.
Thank you for your assistance!

11 Appendix 2: Questionnaire 2 (Tasks 4 and 6)

WP2 Task 4

1. Who are the main customers for the local biodiesel production in your country?
2. In those countries where fleets are customers, how large are the fleets and what type of vehicles?
3. Are there obvious potential customers, e.g local authorities' fleets in your country? If yes, which?

WP2 Task 6

Dear all,
For the BioDieNet WP 2 Task 6 input on case studies we have prepared a template for you all to fill in. Remember that this is limited to small-scale production.
For each case of existing and planned projects please provide the following:

1. Year built
2. Location
3. Sources of financing
4. Scale of production
5. Type of customers
6. Regional network utilized
7. Barriers encountered
8. Strategies applied for overcoming the barriers

Please coordinate yourself within each country, so that you send ONE input from each country.
*Deadline: Friday June 22***

Best regards,

Otto Andersen
WNRI

Pure Fuels

Mr Tom Lasica of Pure Fuels collects used cooking oil from restaurants and takes away outlets and then generates it into pure diesel. There are currently no regional grants available in London. So rather than obtain a bank loan with excess interest, Mr Lasica used his own finances to set up the process. Production has started at the beginning of 2007 and has now reached its full scale. Pay back is being achieved by selling pure diesel to local haulage and courier companies. One such company The Courier Service Ltd is being supplied 300 to 400 litres a week. The bio-diesel can be sold as low as 84p per litre.

Essex Lion and Grain Company

With a six figure sum from the Welsh Assembly Support Agency, Mr Michael Spinks has set up and successfully run the Celtic Bio Diesel Company in Pembrokeshire Wales.

Mr Spinks also owns and runs the Essex Lion and Grain company which is a foodservice supplier situated in Hackney, London where he is looking at setting up another Bio Diesel operation. There are currently no grants in the London region and so Mr Spinks has not been able to run an operation on the same scale as the Celtic Bio Diesel Company. However he has been able to assist some of his competitors by providing them with additional supplies of Bio diesel generated in Wales and awaits grants to become available.