**Findings on City Biodiesel purchasing**
From: Subcommittee meeting June 30, 2010 (revised February 2 and February 22, 2011)
To: Community Environmental Advisory Council
For: City Attorney, Zach Cowan

**Introduction**
Over the course of several full commission meetings and two subcommittee meetings, the Community Environmental Advisory Commission has come to the findings below with regards to the city’s biodiesel purchasing practices. These findings are the result of the review of materials, including the city’s Purchase Order (contract) for biodiesel and the OPIS Index, and interviews with individuals involved in the sale of biodiesel to the city and with persons knowledgeable about the industry, the city’s purchasing practices and the city’s history with biodiesel use.

**Recommendations**
The CEAC requests that the City Attorney review the City’s biodiesel contract with Western States Oil. In particular, he should assess whether best pricing is being achieved, whether the OPIS Index is the best standard for pricing biodiesel and whether the current supplier has a conflict of interest because one of their employees could have influence over the price standard (the Bay Area OPIS Biofuels Index).

**Background**
The city currently has a purchase order contract with Western States Oil, which will be in effect until the end of FY 2013.\(^1\) The price is based on the daily Oil Price Information Service (OPIS) Index’s Bay Area biofuels report plus or minus $0.13.

David Williamson is a consultant for Western States and a former Ecology Center employee. He also runs his own biodiesel brokerage, Orange Diesel. On the OPIS Index for Oakland Western States and Orange Diesel have, until recently, been two of three companies that post prices on the biodiesel index (Sirona Fuels has begun posting its prices now).

State Water Resource Control Board rules do not allow for the storage of biodiesel blends in excess of 5% in underground storage tanks (UST). Until the rule is relaxed or a variance is issued, these rules will constrain the City’s ability to purchase larger quantities of biofuels because of limited above ground storage capacity. Mr. Williamson has been involved with efforts to institute a variance. Although the current volume purchased by the city is small, once the UST issue is resolved, the procurement of more substantial volumes could follow.

**Findings**
The CEAC has found the following:

- a. From the Public Works report:\(^2\)

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1 Berkeley City Council Consent Calendar, January 15, 2008, Item 11.
2 Joy Brown, Public Works Department. ‘CEAC Request for information on the City’s Use of Biodiesel.’ October 6, 2010.
• Berkeley began testing 20% soy biodiesel in late 2001 and 2002.
• January 2003, limited number of vehicles on 100% biodiesel (B100)
• June 2003, 180 vehicles went to 100% (B100), which lasted one to two years.
• The following maintenance problems occurred:
  o Increased changing of fuel filters, gaskets.
  o Quality control became a problem: bad fuel, contamination, bacteria bloom.
  o One bad batch contaminated everything and caused a long haul engine to seize and catch on fire causing $12K worth of damage.
  o Increased tank maintenance because of bacteria.
  o Garbage trucks were not starting in the morning.
  o Consultant Randall Von Weder determined bacteria mold found in the cleaner burning fuel had clogged engine filters and fuel.

These problems were attributed to poor quality of the product.

b. Only in late 2008 to early 2009 did CEAC realize that the City was using virgin soy biodiesel. CEAC held public meetings on the subject. In communications to staff CEAC requested the City change use to yellow grease biodiesel, which was better for climate change. The land use changes for soy agriculture also had adverse impact on the price of food and destruction of rain forests.

c. Mr. David Williamson was initially an employee of the Ecology Center making biodiesel at the City’s Second and Gilman site. At that time, he contacted several commissions to advise Council to change use from petroleum to biodiesel. He opened a biodiesel brokerage business, Orange Diesel, which he still holds and which still conducts a small volume of business. Mr. Williamson has been a supplier, broker or consultant to Public Works on all matters dealing with biodiesel. At this time, he is also a consultant with Western States Oil, the City’s fuel supplier.

d. Mr. Williamson approached four commissions to adopt recommendations to start use of biodiesel. He was successful in this matter. Public Works staff collected all commission recommendations and handled the matter outside of Council action. Staff promised to supply CEAC with regular status of biodiesel use, including any physical and inefficiency problems encountered.

e. Mr. Williamson acted as consultant to Public Works on fuel tank regulations at the time, suggesting to staff that his lobbying partners would reverse the underground tank ban for biodiesel. Failing to reverse the Governor’s ban, the lobby claimed success in pushing emergency regulations for a variance for biodiesel in underground fuel tanks. The ban claimed biodiesel was incompatible with underground fuel systems, which have many sensitive plastic and electronic components. It is presumed that Western States Oil would not lose money in the state ban because they would sell petroleum instead. At the time, CEAC was told the City would save $0.65 per gallon with the change. This was a substantial saving.

The Public Works director had previously written to the Council about the biodiesel
problem in 2005 saying that “The first problem is that the filters get clogged on the trucks -- then staff have to replace the lift pump…. The second problem is that the ejectors on the engine are problematic because the seals require constant replacement.” These problems that staff observed were largely the same concern observed by state regulators who banned the use of biodiesel for the underground systems.

f. The City stopped use of B20 soy diesel as a result of the regulatory changes in underground tanks in 2009. They continue to use soy diesel in above ground tanks at 5% level, apparently for lubrication purposes, as offered by Mr. Williamson.

g. On June 30, 2010 Mr. Williamson informed CEAC subcommittee that he was one certification short of a variance for the Corporation Yard underground tank. The other diesel tank would not be eligible as it was a high-risk single-walled steel construction tank.

h. In 2008 staff entered BQ-9000 certification as a quality requirement in the fuel RFP, which included biodiesel and petroleum diesel. Staff required substantial compliance by the yellow grease industry before allowing the product to be purchased. Sirona Fuel complained that this was an unfair condition added to stop yellow grease bidding, for which they were the leading contender. CEAC found BQ-9000 was created to maintain ASTM D6751 standards and simple best management practices. For this reason, and to appear to play fair with the yellow grease industry, the City would have been better advised to use the ASTM D6751 standard for quality rather than BQ-9000 certification and further impose it on a large segment of the yellow grease industry.

**Pricing**

i. It appears that staff in general was confused about the Oil Price Information Service (OPIS). The Auditor found that Public Works (PW) staff was checking pricing against OPIS data provided by Western States. But it appears that no one knew how the OPIS worked for biodiesel. We are confident that if staff knew, they would not have used OPIS.

j. A competitor of Western States and Orange Diesel, Sirona Fuels, sets their prices using the OPIS Petroleum Index (as opposed to the biodiesel index). The petroleum index represents a much greater volume of sales, is tied to the price of less than 100% (B100) biodiesel and is, Sirona notes, used by “a number of members in the industry.” The petroleum diesel index has up to 12 postings with different prices. The biodiesel index, given the smaller market, generally has 3 and sometimes only lists 1. Sirona stated that prices on the OPIS Biofuels Index treat prices the same regardless of the volume sold.

k. Mr. Williamson stated that Western Oil provided training to PW staff on the use of

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the OPIS for biodiesel, in addition to providing data. If these statements are true, and neither staff nor Mr. Williamson denied it at the CEAC meetings of June 30, 2010 and July 1, 2010, then the CEAC believes there is a possibility that Mr. Williamson was relied upon to both help write the Invitation for Bid (IFB) as well as bid on it. PW has stated that the City of San Francisco’s contract was used to write the Berkeley agreement.

1. The subcommittee found the issues describing biodiesel were complex, and the nature of any fledgling industry creates shaky and unreliable products, pricing and indexing. With such issues, it would have been best to hire a fuel expert to develop the IFB and exclude companies professionally connected to this expert from the bidding process.

m. The City Purchase Order was inadequate in other ways for protecting the City’s best interests. First and foremost, best pricing was not achieved for biodiesel by relying on the OPIS index. Second, there did not seem to be any provision to terminate the purchase agreement if it appeared to be a liability. An alternative would be for the City to request pricing for a set period and to structure the Purchase Order for a minimum 2-3 years with 2 1-year optional extensions. This provides mutual incentive for maintaining vendor performance and costs to extend the business relationship within the bidding criteria.

Further Questions
The CEAC still has questions with regards to the City’s biofuels purchasing. Specifically, we would like to see the IFB from 2007 and would like to know how a base price is calculated from the OPIS Index for sale (e.g. are the prices on the index averaged, is a mid-point between highest and lowest prices taken, is the highest or the lowest price used as the “Index Price”).

Individuals Interviewed
Joy Brown, Environmental Compliance Specialist, Public Works Department
Robert Kirsten, EVP of Business Development, Sirona Fuels
Paul Lacourciere, CEO, Sirona Fuels
David Williamson, Director of Marketing, Orange Diesel
INVITATION FOR BID (IFB)
Specification No. 06-10145-C
For
Fuels, Oil & Lubricants
(Gasoline, Diesel & BioDiesel Fuels, Automotive & Industrial Fluids & Lubricants)

Dear Bidder:

The City of Berkeley is soliciting invitations for bid for the purchase of “Fuels, Oil & Lubricants”. The specifications and selection process are summarized in this invitation for bid (IFB). **Bids must be received no later than 2:00 PM on Thursday, October 18, 2007.** All responses must be in a sealed envelope and have “Fuels, Oil & Lubricants” and “Specification No. 06-10145-C” clearly marked on the outer most mailing envelope. Please submit 1 original and 1 copy of the bid as follows:

**Mail or Hand Deliver To:**
City of Berkeley
Finance/Purchasing
2180 Milvia Street, 3rd floor
Berkeley, CA 94704

No bids will be accepted after the date and time stated above. **Submittal of Response by fax is NOT acceptable.** Incomplete bids and bids which do not conform to the requirements specified herein, will not be considered. Issuance of the IFB does not obligate the City to award a contract, nor is the City liable for any costs incurred by the bidder in the preparation and submittal of bids for the subject work. The City retains the right to award all or parts of this contract to several bidders, to not select any bidders, and/or to re-solicit proposals. The act of submitting a bid is a declaration that the bidder has read the IFB and understands all the requirements and conditions.

For questions concerning the listing of items, the anticipated work, or scope of the project, please contact Bill Ivie, Equipment Maintenance Superintendent, via email at bivie@ci.berkeley.ca.us no later than October 10, 2007. It is the vendor’s responsibility to check for answers to questions or any addenda on the City of Berkeley’s website at [http://www.ci.berkeley.ca.us/finance/Purchasing/RFPLList.htm](http://www.ci.berkeley.ca.us/finance/Purchasing/RFPLList.htm). For general questions concerning the submittal process, contact purchasing at 510-981-7320.

We look forward to receiving and reviewing your bid.

Sincerely,

Sharon Thygesen
General Services Manager
General Provisions

To the City of Berkeley, California:

1. **In submitting this Bid as herein described, the bidder agrees that:**

   a. He/she has, or they have, carefully examined the specifications, and all provisions relating to the items to be furnished or the work to be done attached herewith and made a part of this bid, and understand the meaning, intent and requirements of and agree to the same.

   b. He/she, or they, will enter into a written contract and furnish the item(s) or complete the work in the time specified, and in strict conformity with the City of Berkeley specifications therefore, for the prices quoted.

   c. **Transmittal of bid:** The "Offer/Bid Form” must be signed, sealed, marked with the specification number and delivered to the City of Berkeley as described herein prior to the time set for the opening of bids.

   d. **Opening of bids:** Bids will be opened publicly at the place, on the date and at or after the time set forth herein. The time for opening bids, as set forth, is strictly observed AND YOU ARE INVITED TO BE PRESENT IF YOU SO DESIRE.

2. **Action by the Council:**

   a. Award of contract may be made by the City Council within 30 calendar days from the date of opening of bids.

   b. The City of Berkeley, by action of the City Council reserves the right to accept or reject any bid or any part thereof or any combination of bids.

3. **Additions and Alterations:**

   a. No additions, alterations or conditions other than requested herein will be permitted. This bid form, the general provisions and the specifications have been approved by the City of Berkeley, and the making of additions, alterations, or conditions on this bid form may void the bid. Additional copies are available in Finance/Purchasing or on our website at: [http://www.ci.berkeley.ca.us/finance/purchasing/purchasing.htm](http://www.ci.berkeley.ca.us/finance/purchasing/purchasing.htm)

   b. Bids must be made on this form and letters of transmittal cannot be considered a part of the bid.

   c. In order to be considered bids must conform to the specifications. Deviations from specifications must be stated and may result in rejection of the bid. Attach additional sheets as necessary.

4. **Governmental Regulations:**

   a. Bid prices shall not be in excess of maximum prices permitted by the Federal or State Government.

   b. All orders are subject to ability to obtain and use materials and deliver finished products under Federal and State regulations and orders. If shipping dates are subject to delays resulting from preference ratings or priority shipments ordered or requested by the United States Government or by any department, commissions, or agency thereof, then the Contractor shall not be held liable for such delays.
5. Taxes:

A. When offer/bid is for materials and equipment.

The following provisions relating to taxes are applicable when furnishing materials or equipment only:

a. The City of Berkeley is liable for the State Sales Tax and where the County of purchase has adopted the Uniform Sales Tax Law and a City and/or County Tax is collected by the State, the City of Berkeley will be liable for this tax also. Do not include this tax in the amount bid. If applicable, it is to be added to the net amount invoiced by the successful bidder.

b. The City of Berkeley is exempt from the Federal Excise Tax and exemption certificates will be furnished. In certain instances the bidder and subcontractor may be liable for Federal Excise Taxes. Bidder must determine whether Federal Excise Tax is chargeable to him and if so the amount of tax should be included in the amount bid.

c. Any new or additional taxes levied after the adoption of these specifications that are payable by the City of Berkeley are not to be included in the price bid, but added thereto when invoiced.

B. When offer/bid requires labor to be furnished in addition to materials and equipment.

The following provisions relating to taxes are applicable when Offer/Bid Form and Specifications require that labor be furnished in addition to materials and equipment, and in such cases, the following provisions supercede and make void those provisions under paragraph 7a relating to taxes.

a. The City of Berkeley is liable for the State Sales Tax and where the County of purchase has adopted the Uniform Sales Tax law and a City and/or County Tax is collected by the State, the City of Berkeley will be liable for this tax also. Include this tax in the amount bid.

b. The City of Berkeley is exempt from the Federal Excise Tax and exemption certificates will be furnished. In certain instances the bidder and subcontractor may be liable for Federal Excise Tax. Bidder must determine whether Federal Excise is chargeable to him and if so, the amount of the tax should be included in the amount bid.

6. Price Protection:

In the event of a decline in market price(s) below the price(s) bid, the City of Berkeley shall automatically receive the benefit of such decline.

7. Royalties and Patents:

The Contractor shall pay all royalties and patent fees. He shall defend all suits and claims for infringements of any patent rights and shall save the City of Berkeley harmless from loss on account thereof, except that the City of Berkeley shall be responsible for all such loss when a particular process or the product of a particular manufacturer or manufacturers is specified. If, however, the Contractor has information that the procedures or articles specified is an infringement of a patent he shall be responsible for any loss unless he promptly gives said information to the City of Berkeley.
8. **Delivery:**
   
   a. Delivery shall be made within the time set forth on the “*Offer/Bid Form*” and to the locations listed on this solicitation.

   b. Contractor will not be held liable for failure to make delivery because of strikes, conscription of property, governmental regulations, acts of God, or any other causes beyond his control; provided a written extension of time is obtained from the City Manager.

9. **Payment:**

   **Invoices:** Invoices must be fully itemized, and provide sufficient information for approving payment and audit. Invoices should be mailed to:

   City of Berkeley  
   Accounts Payable  
   P.O. Box 700  
   Berkeley, CA  94701

   **Payments:** Will be made in the manner described and within the time(s) specified on the "*Offer/Bid Form*" assuming invoices are correct, and have been approved by the department.

10. **Penalties and Termination of Contract:**

   a. In the event the Contractor fails or refuses to deliver or provide the supplies, materials, equipment or services within the time(s) specified herein, or fails or refuses to comply with any requirement of the General Provisions or of the Specifications, the City of Berkeley may serve notice in writing upon him of its intention to purchase said supplies, or equipment or obtain said services from another source.

   Such notice shall contain the reasons for the City's intention to purchase from another source, and unless within 10 days after the serving of such notice, Contractor shall make complete delivery and/or comply with all requirements of the Specifications and General Provisions, said purchase will be made.

   b. In the event said purchase is made at a price higher than the contract price, the Contractor shall be liable to the City for an amount not to exceed the difference between the purchase price and the contract price.

   Payment shall be made to the City upon demand, and if any payments are owing to the Contractor by the City, such payments will be withheld and set off in an amount not to exceed the claim of the City against the Contractor.

   b. In the event any provision of the contract, including the General Provisions and Specifications, is violated, and the Contractor fails or refuses to comply after 10 days written notice is given by the City, the City shall have the additional right, without further notice to cancel the contract and/or declare such Contractor to be an irresponsible bidder, in which case no contract shall be awarded him by the City for a period of at least three (3) years from the date of violation, and then only after satisfactory evidence that he will comply with City Specification and contract provisions.
11. **Assignment of Contract:**

Neither the City nor the Contractor shall assign the contract without the written consent of the other party; nor shall the Contractor assign any monies due or to become due to him hereunder without the written consent of the Council of the City of Berkeley.

12. **Conflict in Specifications:**

The detailed requirements of the specifications shall supercede any requirement of these General Provisions that are in conflict therewith.
TO THE CITY OF BERKELEY, CALIFORNIA:
In submitting this bid (offer) as herein described, the bidder (offerer) agrees that (a) he/she, or they, have carefully examined the specifications, and all provisions relating to the items to be furnished attached herewith and made a part of this proposal, and understand(s) the meaning, intent and requirements of and agree to the same. (b) He/she, or they, agree(s), that if his/her or their bid is accepted, he/she, or they will enter into a written contract and furnish the item(s) and complete the work in the time specified, and in strict conformity with the City of Berkeley specifications therefore, for the prices bid.

Name of Firm or Person submitting this offer: ____________________________________________

Street Address/City/State/Zip _________________________________________________________

Signed by (written signature) _________________________________________________________

Name and Title (type or print) _________________________________________________________

Date ___________________________ Federal Tax ID ________________________

Phone ___________________________ FAX _________________________________

E-mail ___________________________ Web site ________________________________

Discounted Payment Terms: _________________________________________________________

Delivery Date: ______________________

ALL BIDS MUST BE SIGNED

Please bid all items as listed on the following page.
REFORMULATED GASOLINE, ULTRA LOW SULFUR DIESEL, BIODIESEL FUELS, FLUIDS AND LUBRICANTS

SPECIFICATIONS

All gasoline delivered under this contract shall meet the latest requirements of the California Air Resources Board (CARB), Federal and local governments as well as fuel industries laws, codes, requirements, standards and guidelines currently in force and any of those put into force during this contract. Particular attention shall be paid to Bay Area Air Quality Management District (BAAQMD) and American Society of Testing and Materials (ASTM) laws, regulations and standards.

PURPOSE

The City of Berkeley intends to award a four (4) year contract with three- two year options to extend the contract for a total of 10 years to the successful bidder(s).

The purpose of this Invitation to Bid (IFB) is to search for qualified vendors who are capable of providing the City of Berkeley (City) with its vehicle/equipment fleet fuel, fluid and lubricant requirements. These requirements include the sale to the City of non-Methyl Tertiary-Butyl Ether Gasoline, BioDiesel Fuels, Ultra Low Sulfur Diesel Fuel, Re-refined/Non-Re-refined Motor Oils, Transmission Fluids and certain Lubricants. In accordance with the City of Berkeley’s Environmentally Preferable Purchasing Policy, Resolution #62,693, http://www.ci.berkeley.ca.us/sustainable/government/62693.EnvironmentalPuchasingResolution.pdf The City intends to use re-refined oils and lubricants whenever possible as long as the products are consistent with the engine manufacturer’s warranty and maintenance requirements.

“Re-refined oil” is used oil that undergoes an extensive refining process to remove contaminants to produce new base oil. This base oil is then sold to blenders who add additive packages to produce lubricants such as motor oil, transmission fluid and grease.

The City maintains emergency generators, a fleet of vehicles and equipment in excess of six hundred (600), which uses gasoline and diesel fuel. The fleet composition consists of vehicles, both large and small, large trucks, and heavy motorized equipment. The City fleet is fueled at 11 locations throughout the City. These locations are as follows:

FUEL LOCATIONS

1. Corporation Yard - 1326 Allston Way Gasoline & Biodiesel
2. Transfer Station - 1199 Second Street Biodiesel
3. Civic Center - 2180 Milvia Biodiesel
4. Public Safety Building - 2134 Martin Luther King Jr. Way Biodiesel
5. Fire Stations:
   Fire Station 1 - 2442 8th Street Biodiesel
   Fire Station 2 - 2029 Berkeley Way Biodiesel
   Fire Station 3 - 2710 Russell St Biodiesel
   Fire Station 4 - 1900 Marin Avenue Biodiesel
   Fire Station 5 - 2680 Shattuck Avenue Biodiesel
   Fire Station 6 - 999 Cedar Street Biodiesel
   Fire Station 7 - 2931 Shasta Road Biodiesel
OIL & LUBRICANTS

Oil and other lubricants are delivered on an as needed basis to two locations. These locations are as follows:

1. Corporation Yard  _  1326 Allston Way
2. Transfer Station  _  1199 Second Street

City reserves the right to add or delete delivery sites.

Fuel, Oil, Lubricant List Specifications and Quantities for Bid: Please note that this includes the estimated quantities delivered to all locations of Diesel and Bio-diesel specified in the delivery location chart under specifications for fuel. The consumption estimates given below are for evaluation purposes and the City reserves the right to increase or decrease the quantities as needed.
TABLE 1

<table>
<thead>
<tr>
<th>NAME</th>
<th>COMPONENTS</th>
<th>COMPONENT PERCENTAGES</th>
<th>TOTAL ANNUAL ESTIMATED CONSUMPTION gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-diesel (B20)</td>
<td>Biodiesel BQ9000 certified with option to increase percentage, remainder comprised of ultra low sulfur diesel</td>
<td>20% B20 min and 80% max ultra low sulfur diesel</td>
<td>206,449</td>
</tr>
<tr>
<td>Bio-diesel (B5)</td>
<td>Biodiesel BQ9000 certified with option to increase percentage, remainder comprised of ultra low sulfur diesel</td>
<td>5%B5 min and 95% max ultra low sulfur diesel</td>
<td>38,940</td>
</tr>
<tr>
<td>Diesel</td>
<td>ultra low sulfur</td>
<td>100%</td>
<td>as needed</td>
</tr>
<tr>
<td>Gasoline</td>
<td>unleaded</td>
<td>NA</td>
<td>191,887</td>
</tr>
<tr>
<td>Re-refined Hydraulic Fluid C/Y</td>
<td>T303</td>
<td>NA</td>
<td>547</td>
</tr>
<tr>
<td>Re-refined Hydraulic Fluid T/S</td>
<td>AW46</td>
<td>NA</td>
<td>2,576</td>
</tr>
<tr>
<td>Re-refined Engine Oil</td>
<td>15W40</td>
<td>NA</td>
<td>6,000</td>
</tr>
<tr>
<td>Low Ash Engine Oil</td>
<td>15W40 &quot;Busguard&quot;</td>
<td>NA</td>
<td>400</td>
</tr>
<tr>
<td>Engine Oil</td>
<td>15W40 &quot;Busguard&quot;</td>
<td>NA</td>
<td>1,800</td>
</tr>
<tr>
<td>Re-refined Engine Oil</td>
<td>5W30</td>
<td>NA</td>
<td>620</td>
</tr>
<tr>
<td>Semi Synthetic Engine Oil</td>
<td>5W20</td>
<td>NA</td>
<td>1,050</td>
</tr>
<tr>
<td>Automatic Transmission Fluid</td>
<td>Mercon V &amp; Synthetic</td>
<td>NA</td>
<td>1,900</td>
</tr>
<tr>
<td>Re-refined Gear Oil</td>
<td>80/90W</td>
<td>NA</td>
<td>250</td>
</tr>
<tr>
<td>Chasis Lubricant</td>
<td>Starplex 2</td>
<td>NA</td>
<td>250</td>
</tr>
</tbody>
</table>

BASIS FOR DETERMINING PRICE:

The pricing methodology resulting from this bid shall be based on OPIS Rack Pricing.

For purposes of payment by the City, the prices shall be effective on the date the fuel is delivered to a City fuel site. OPIS pricing mark up or discount shall remain the same during the life of the contract. Under no circumstances will the City grant any proposals by Vendor for price adjustment during the life of the contract.

Indicate Discount (-) from or Mark up (+) to the OPIS, (select either discount or mark up):

Discount: - $_________/GAL
Mark Up: +$_________/GAL
### TABLE 2 – FUEL COST PROPOSAL

#### 1. Gasoline & Diesel Fuels

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Price Type</th>
<th>Discount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. Regular Unleaded Gasoline - RFS-MTBE</strong></td>
<td>OPIS PRICING FOR SAN FRANCISCO REGION</td>
<td></td>
</tr>
<tr>
<td>Fixed ADD-ON (+)</td>
<td>DISCOUNT (-)</td>
<td>Additional discount for 7500 gal deliveries</td>
</tr>
<tr>
<td><strong>b. Ultra Low Sulfur Diesel Fuel - OPIS PRICING FOR SAN FRANCISCO REGION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed ADD-ON (+)</td>
<td>DISCOUNT (-)</td>
<td>Additional discount for 7500 gal deliveries</td>
</tr>
</tbody>
</table>

#### 2. Biodiesel Fuels

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Price Type</th>
<th>Discount (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>a. Ultra Low Sulfur Bio-diesel Fuel = B20 - OPIS PRICING FOR SAN FRANCISCO REGION</strong></td>
<td>Fixed ADD-ON (+)</td>
<td>Additional discount for 7500 gal deliveries</td>
</tr>
<tr>
<td><strong>b. Ultra Low Sulfur Bio-diesel Fuel = B5 - OPIS PRICING FOR SAN FRANCISCO REGION</strong></td>
<td>or DISCOUNT (-)</td>
<td>Additional discount for 7500 gal deliveries</td>
</tr>
</tbody>
</table>

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Signed: ___________________________  Date: ___________________________

Print Name & Title: ___________________________  

Company: ___________________________

Contract Description/Specification No.: Fuel, Oil & Lubricants/06-10145-C
TABLE 3 – Biodiesel QUALITY CONTROL AND QUALITY ASSURANCE

<table>
<thead>
<tr>
<th>1. Are you BQ-9000 certified?</th>
<th>YES</th>
<th>Attach copy of certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO</td>
<td>Explain:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Is the Manufacturer BQ-9000 certified?</th>
<th>YES</th>
<th>Attach copy of certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO</td>
<td>Explain:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Is the Delivery Equipment used BQ-9000 certified?</th>
<th>YES</th>
<th>Attach copy of certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO</td>
<td>Explain:</td>
</tr>
</tbody>
</table>

Signed: ___________________________  Date: ________________

Print Name & Title: __________________________________________

Company: __________________________________________________

Contract Description/Specification No.: Fuel, Oil & Lubricants/06-10145-C
# TABLE 4 – OIL AND LUBRICANTS COST PROPOSAL – See Table 1 for quantities

<table>
<thead>
<tr>
<th>Product Category</th>
<th>Product Specifications</th>
<th>Package Style</th>
<th>Usage GALS/YR</th>
<th>Price $/GAL</th>
<th>Extended $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Category</td>
<td>SAE 15W-40, API CJ-4</td>
<td>Bulk</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CNG Engine Oil</td>
<td>SAE 15W-40, Cummins CES20074 and Detroit Diesel 7SE272</td>
<td>Bulk</td>
<td></td>
<td></td>
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<td>Gal Jugs (6/1 or 4/1 gal.)</td>
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<tr>
<td>Automotive Engine Oil</td>
<td>SAE W-30, API SM/SL, ILSAC GF-4</td>
<td>Bulk</td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
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<tr>
<td></td>
<td>SAE 5W-20 Synthetic Blend, API SM/SL, ILSAC GF-4</td>
<td>Bulk</td>
<td></td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transmission Fluid</td>
<td>Dexron III (Type H), Mercon, Allison C-4, Caterpillar TO-2</td>
<td>Bulk</td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
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<tr>
<td></td>
<td>Mercon V, Allison C-4, Caterpillar TO-2</td>
<td>Bulk</td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
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<td></td>
</tr>
<tr>
<td>Hydraulic Fluid</td>
<td>AW ISO 46, Denison HF-0, Cincinnati Machine P-70, Vickers M2950-S</td>
<td>Bulk</td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td>Gal Jugs (6/1 or 4/1 gal.)</td>
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<td></td>
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<tr>
<td></td>
<td>T303</td>
<td>Bulk</td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive Gear Oil</td>
<td>SAE 80-W-90, API GL-5/MT-1, Mack GO-J</td>
<td>Bulk</td>
<td></td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grease</td>
<td>NLGI 2, GC-LB, Lithium Complex</td>
<td>Bulk</td>
<td></td>
<td></td>
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<td>Drum (55/1)</td>
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<td></td>
<td></td>
<td></td>
<td>Gal Jugs (6/1 or 4/1 gal.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Pricing should be on a delivered basis and include all applicable California oil fees, such as California Recycle Oil fee, California Motor Oil fee and California Waste Oil fee. In addition, pricing should include any additional delivery charges, such as fuel surcharge, insurance surcharge and environmental fee.

2. Drum Deposit: $/drum. Refundable? YES NO

3. Drum Cleaning Fee: $/drum.

4. Payment Terms: % discount _____ days Net 30 days

5. Typical Order Lead Time: _____ days

6. Re-refined Oils - The primary products above that are good candidates for re-refined oils are diesel engine oil 15W-40, hydraulic oil ASW ISO 46, and automotive oil 5W-30

Signed: ___________________________ Date: _________________

Print Name & Title: ___________________________________________________________

Company: ____________________________

Contract Description/Specification No.: Fuel, Oil & Lubricants/06-10145-C
VENDOR QUALIFICATION CRITERIA

Vendor minimum qualification criteria include, but are not limited, to the following:

1. Vendors must have the ability to provide both full truck and trailer and tank wagon service to the City locations listed above when needed and the ability to deliver 500 gallons or less to each location.

2. The Vendor shall have been regularly and continuously engaged in the business of providing Reformulated Gasoline, Diesel Fuels, Oils and Lubricants to large fleet accounts for at least the last five (5) years and should have the capability of providing same to the City. Vendor should have five (5) years experience with Bio-Diesel fuels.

3. The Vendor shall possess all permits, licenses and professional credentials necessary to supply and transport product and perform services.

TECHNICAL SPECIFICATIONS

Biodiesel, Biodiesel Blend and Diesel Fuel (Biodiesel Fuel)

This specification describes the requirements for the supply of Biodiesel and Biodiesel Blend. The Fuel shall be compatible for use with all diesel engines. The Biodiesel and Biodiesel Blend fuel shall in no way harm existing and future diesel engines. All Biodiesel and all Biodiesel blended in a Biodiesel Blend shall conform to ASTM D 6751 and meet or exceed BQ9000 certification standards. All petroleum distillate diesel fuel blended in a Biodiesel Blend shall be CARB#2 Ultra-Low Sulfur Fuel.

The base diesel fuel shall be refined dyed ultra low sulfur diesel fuel, with a maximum sulfur content of 15ppm, shall be as specified in ASTM D 6751 standard and any Federal rules and regulations. Bio fuel shall be a certified “virgin” product, recycled oils of any type are NOT permissible for this contract

TABLE 5 – TECHNICAL SPECIFICATIONS FOR B100

<table>
<thead>
<tr>
<th>Biodiesel</th>
<th>ASTM D-6751 modified as follows:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Method</td>
<td>Limits</td>
</tr>
<tr>
<td>Free Glycerin</td>
<td>ASTM D 6584 0.006 %</td>
</tr>
<tr>
<td>Monoglycerides</td>
<td>ASTM D 6584 0.040 %</td>
</tr>
<tr>
<td>DiGlycerides</td>
<td>ASTM D 6584 0.020 %</td>
</tr>
<tr>
<td>TriGlycerides</td>
<td>ASTM D 6584 0.020 %</td>
</tr>
<tr>
<td>Total Glycerin</td>
<td>ASTM D 6584 0.080 %</td>
</tr>
<tr>
<td>Pour Point</td>
<td>ASTM D 2500 -5 Deg C</td>
</tr>
<tr>
<td>Water and sediment</td>
<td>ASTM D 2709 0.010 %</td>
</tr>
<tr>
<td>Cloud Point</td>
<td>ASTM D 2500 5 Deg C</td>
</tr>
<tr>
<td>Flash Point</td>
<td>ASTM D 93 190 Deg C</td>
</tr>
<tr>
<td>KF Water</td>
<td>ASTM D 6304 200 ppm</td>
</tr>
</tbody>
</table>
• Modifications reflect special needs for operations within the Coastal region of California.
• Biodiesel to be manufactured by solely by processes employing a “water-wash” as a polishing step.
• Feedstocks will be from domestic sourced first-use vegetable oils. No animal fats, tropical oils such as poultry fat, palm and coconut will be used as a source of feedstock. No brown grease or yellow grease will be used as feedstock.
• Contractors experience with fleet operations and Biodiesel production will be weighed.
• Contractor will provide a certificate of analysis delineating the above listed test results.
• Plant or origin will be BQ-9000 certified.
• Distributors will be BQ-9000 certified.
• Fuel will be produced and distributed in accordance with BQ-9000 guidelines as a minimum.
• Contractor will advise if the methyl esters were exposed to ambient temperatures below the listed pour point. Contractor will advise customer as to what mitigations were taken to prevent/obviate crystal fractionization.
• Field test will be conducted at each delivery
• Random full testing will occur to determine veracity of plants’ tests.
• Each delivery will have the following documentation:
  o Weight tags from plant or rail head
  o Bill of lading
  o Analysis Certificate from producer
  o Invoice will be provided that has the following attachments
    ▪ Weight tags from plant or rail head
    ▪ Bill of Lading (including additive packages)
    ▪ Certification on Bill of lading that the truck was clean of product, free of gasoline
    ▪ Analysis Certificate from producer
    ▪ Memo from distributor delineating field testing and sample retention
    ▪ Copy of third party testing done randomly or third party testing (ASTM) if warranted.

• Samples will be taken at the following points:
  o Plant by plant staff
  o Storage Point by Distributor

*Fuel will not be distributed if suspect (City of Berkeley will receive 100 % ULSD for those loads).

"Biodiesel Blend" means a blend of Biodiesel with petroleum-based diesel fuel, designated BXX, where XX represents the volume percentage of Biodiesel fuel in the blend.

As of this date, there is not a separate ASTM specification for Biodiesel Blends. ASTM is currently working on a specification or Biodiesel Blends up to B20. At such time that ASTM adopts such a specification, vendor's Biodiesel Blends shall meet the specification.

Vendor shall blend all Biodiesel Blends in accordance with industry standards to ensure a thoroughly blended Biodiesel Blend that does not separate over time.

All Biodiesel Blends shall have the minimum and/or maximum characteristics described below, unless agreed to otherwise in writing by City Department in advance.

DELIVERY REQUIREMENTS
Biodiesel, Biodiesel Blend and Diesel Fuel (Biodiesel Fuel)

The City of Berkeley operates approximately 180 +dieSEL vehicles and equipment to serve the City's needs. Berkeley requires that an adequate supply of Biodiesel fuel be on hand at all times. The contractor shall schedule deliveries of Biodiesel fuel under a "keep full" plan, which will maintain fuel tank levels at the Transfer Station and Corporation Yard locations between three-quarter full and full. This requirement will normally require deliveries to City locations once a week at the Transfer Station, and once a month at the Corporation Yard. Deliveries to Fire Stations are required one time per week as needed.

When making deliveries of Biodiesel fuel under this contract, the Contractor shall use equipment that complies with all applicable Federal, State and local governmental regulations and that is BQ9000 certified. All personnel shall be trained in safety measures to preclude accidents endangering City personnel or property.

All diesel fuel delivered shall be passed through a 60-mesh screen before entering Berkeley's storage tanks. This may be accomplished by inserting a 60-mesh screen in the delivery line of the Truck-transport or by inserting a 60-mesh screen in the fill pipe of Berkeley's storage tanks. It shall be the responsibility of the Contractor to provide and use the 60-mesh screen as described in the paragraph. All spills shall be the Contractor's responsibility, including all materials and equipment needed for the cleanup. Vendor will be held liable for any damage or citations incurred as result of any spills.

A Loading Ticket "rack tag" or similar document showing the quantity of fuel must accompany each delivery. Delivery quantities are to be temperature adjusted of 60 degrees F. Delivery tickets are to be signed by designated City personnel at time and place of delivery.

30-Day Notification: The City will provide the vendor with a 30 day written notice whenever it plans to switch form one blend of Biodiesel Blend to another.

ADDITIONAL BIODIESEL PROVISIONS

Background: Biodiesel is a relatively new fuel with unique fuel properties. The vendor will need to work with the City to ensure fuel quality and an adequate supply to meet the City's needs.

Guidelines: All potential bidders are encouraged to review the "2006 Biodiesel Handling and Use Guideline" prior to submitting bids. The guidelines can be found at http://www.nrel.gov/vehiclesandfuels/npbf/pubs_Biodiesel.html

BIO DIESEL SAMPLES AND TESTING BIODIESEL

Vendor agrees to provide the City with a copy of the producer's "Certificate for Biodiesel" certifying that such Biodiesel meets the standards of ASTM D 6751 and BQ9000 standards as requested by City.

Vendor agrees to conduct industry standard testing of each batch of Biodiesel the vendor receives to assure quality. The vendor agrees to share the results of each such test with the City agency purchasing the fuel. If the test results indicate that the Biodiesel does not meet the specifications given herein, then the City shall have the right to refuse to accept the fuel. In addition, the City may, at any time, take a sample of fuel from the truck making the delivery, and have the sample tested by an independent testing laboratory to determine compliance with the specifications given herein. If the test analysis of the fuel sample show that the Biodiesel Blend does not comply with the specifications, the Contractor shall pay all costs of making said test analysis and the City shall have the right to refuse to accept the fuel.

TABLE 6 - DELIVERY LOCATIONS
<table>
<thead>
<tr>
<th>LOCATION</th>
<th>AVERAGE ANNUAL USAGE</th>
<th>STORAGE CAPACITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corporation Yard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1326 Allston Way</td>
<td>191,887</td>
<td>10,000 gallon Unleaded Unleaded</td>
</tr>
<tr>
<td></td>
<td>24,217</td>
<td>10,000 gallon Biodiesel B20</td>
</tr>
<tr>
<td>Transfer Station</td>
<td>164,527</td>
<td>20,000 gallon Biodiesel B20</td>
</tr>
<tr>
<td>1199 Second Street</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Safety Building</td>
<td>220</td>
<td>4,000 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Civic Center Building</td>
<td>220</td>
<td>250 gallons Biodiesel B5</td>
</tr>
<tr>
<td>2180 Milvia St.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Station 1 - 2442 8th Street</td>
<td>1,500</td>
<td>500 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 2 - 2029 Berkeley Way</td>
<td>8,000</td>
<td>500 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 3 - 2710 Russell Street</td>
<td>2,000</td>
<td>500 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 4 - 1900 Marin Avenue</td>
<td>6,000</td>
<td>500 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 5 - 2680 Shattuck Avenue</td>
<td>8,500</td>
<td>500 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 6 - 999 Cedar Street</td>
<td>11,000</td>
<td>1000 gallon Biodiesel B5</td>
</tr>
<tr>
<td>Fire Station 7 - 2931 Shasta Road</td>
<td>1,500</td>
<td>500 gallon Biodiesel B5</td>
</tr>
</tbody>
</table>

Estimated annual quantity for Biodiesel fuel required for this contract: 419,571 gallons per year (380,631 gallons B20 and 38,940 gallons B5).
SHIPPING

Designated tank trucks will be BQ9000 certified for delivery of all fuels described herein. The vendor shall provide the City with documentation showing compliance on all fuel delivery trucks to BQ9000 standards.

DELIVERIES

Contractor shall make deliveries as required to the locations listed in this document, in the quantities and frequencies individually requested, so as not to interrupt City services and operations. Contractor must be able to deliver to all the locations listed in this document. Additional locations may be added during the term of the contract.

If the contractor fails to deliver gasoline or diesel in the manner, or within the time frame called for by this contract or, as requested by the City, the City may purchase the fuel from another source on the open market. If the City has to pay a greater price, the excess price will be charge to and collected from the Contractor.

When deliveries of several products are combined to provide for a full-tank trailer-load to one location, the full-tank trailer price shall apply.

All calls for delivery of any fuels shall be filled within 48 hours.

BID EVALUATION

OPIS Reports: The successful vendor shall provide the City of Berkeley Equipment Maintenance Division with a subscription to the Oil Price Information Service to be delivered to the Public Works Equipment Superintendent, 1326 Allston Way, Berkeley, California, 94702 and faxed or emailed to City of Berkeley Purchasing Dept, Fax: 510.981.7390, sdegnan@ci.berkeley.ca.us. Account to be set up upon award of contract. The subscription must be for the term of the contract, even if renewed. The OPIS report supplied to the City of Berkeley will be used to monitor the pricing of the fuel supplied by the successful vendor. The subscription shall be provided free of charge.

Bidders must enter firm bid prices corresponding to the items on the Bid Sheet for all Gasoline, Diesel & Bio-Diesel Fuels, Automotive & Industrial Fluids & Lubricants (Tables 2 through 4 are to be completed by Bidder and signed by authorized person in company to agree to terms listed herein. The net per gallon price for gasoline and Biodiesel fuel shall be calculated by showing the discount to be subtracted from, or the increase to be added to the average price(s) as posted in the Oil Price Information Service’s (OPIS) index for San Francisco Region. Any and all Superfund fees or other governmental imposed fees shall be a part of either the discount or increase quoted.

It is understood that contract prices will be subject to the increases or decreases in the OPIS, however, the discount from or the increase to be added to those prices shall remain fixed for the period of award regardless of the bidder’s supplier.

Said prices are to reflect the bidders firm, fixed mark-up (plus) or mark-down (minus) only, not including the corresponding OPIS Pricing index for San Francisco Region, as indicated. No rounding off, up or down will be considered. Bid prices are to be F.O.B. Destination.

Bid prices will be evaluated using the following information and computations:

OPIS Pricing index for San Francisco Region for the published week plus the bidder's mark-up (Plus) or Mark-down (Minus), less any applicable cash payment discount.
BILLING PRICES

In order to provide for automatic adjustments in the price of fuel delivered under this contract, the price shall be based on the average of the OPIS Pricing index for San Francisco Region as shown in the latest issue of "OIL PRICE INFORMATION SERVICE", PUBLISHED BY United Communications Group, plus the firm, fixed mark-up (plus) or mark-down (minus) which is bid by the successful bidder, plus the corresponding "Add-on Rate", where applicable for, for smaller deliveries.

As stated above, the City intends to use a B20 Biodiesel Blend except where B5 is indicated. The City may also purchase Biodiesel Blends with a higher or lower percentage of Biodiesel during the term of the contract. For Biodiesel Blends that have an OPIS Pricing index for San Francisco Region, the price of such Biodiesel Blends shall be as set forth in the contract.

Any price changes and adjustments must be faxed immediately to Attention: Public Works Equipment Maintenance, fax number 510-981-6630. The City reserves the right to require immediate visual verification of any such notice quoted.

When applicable, invoices for fuel delivered shall separately indicate amounts charged for California sales tax, the Motor Vehicle Fuel License Tax (Revenue & Taxation Code 7301 et sq.) for gasoline, and the California Use Fuel Tax (Revenue & Taxation Code 8601 et sq.) for diesel fuel.

- California State DF Tax 0.18000/gal
- Oil Spill Recovery 0.00120/gal
- Federal Lust Tax 0.00100/gal
- Federal Oil Spill Liability Tax 0.00120/gal

No other state taxes or fees shall be invoiced for fuel delivered. The City is exempt from federal excise taxes and fees, and no such amounts shall be included on any invoice.

A. SCOPE OF CONTRACT:

The contract will be a requirements contract that will provide for the City of Berkeley's normal supply requirements during the period specified elsewhere in this Invitation for Bids. The City of Berkeley may purchase such quantities as listed herein or as may be needed from time to time during the life of the contract. There is no guarantee of quantity. Except as otherwise provided herein, the Contractor will be obligated to deliver all such quantities as may be ordered from time to time.

B. TERM OF CONTRACT AND PAYMENT PROCEDURES:

1. Term of Contract - The contract shall be effective from the date of award for an initial four year period with three two year options to extend for a period up to a maximum of 10 years. The options to extend will be exercised only if the General Services Manager determines:
   a. that contract prices will remain the same, or
   b. that Contractor has performed satisfactorily.
   c. that the City of Berkeley specifications/requirements have not significantly changed.
   d. extension of the contract will be affected by issuance of a letter of extension to the Contractor by the City Manager.
2. **Payment** - Payments will be made in accordance with discounted payment terms or within 30 days after receipt and acceptance of goods and/or services provided the Finance Accounts Payable Division has received correct invoices.

3. **Invoices** – Invoices shall be in a format acceptable to the City. Invoices must be forwarded in triplicate and shall be fully itemized and have sufficient description to permit audit.

4. **Placing of Orders** – Orders will be placed as required by authorized City employees for the length of the contract.

C. **BID EVALUATION FACTORS AND METHOD OF AWARD:**

1. **Acceptance/Rejection of Bids** - The City of Berkeley reserves the right to accept or reject any bid, or any part thereof or any combination of bids.

2. **Method of Award** - Award will be made to the lowest responsible bidder on an item-by-item basis to one or more bidders or in an aggregate to one bidder, whichever best meets the needs of the City.

3. **Deviations from Specifications** - The City reserves the right to accept minor deviations from the specifications.

4. **Estimated Quantities** - The quantities shown on the Offer/Bid Form are estimates only, and are subject to increase or decrease as demands may require. The City does not guarantee any quantities.

D. **DELIVERY TERMS:**

1. **Delivery F.O.B.** - Delivery of all goods shall be F.O.B. Destination at the City of Berkeley.

2. **Time of Delivery** - Delivery of all items ordered shall be made after each request is made by authorized City employees in a timely manner, and as stated on Offer/Bid Form. Contractor shall maintain sufficiently large and varied stock as to insure deliveries with a minimum of delay.

3. **Deliveries** will be scheduled and accepted Monday through Friday between the hours of 7 a.m. and 5 p.m. at the locations listed on page Berkeley, California unless special arrangements have been made.

4. **Method of Delivery** - Items should be delivered by truck, or by an acceptable shipping company on an as needed basis as required by authorized City employees. The ability to track items is desirable.

5. **Stand-By/Emergency Deliveries** - Vendor shall be able to dispatch compartment tank wagon trucks for provision of gasoline fuel to any City locations or fuel sites within 4 hours of receipt of notification. If necessary, additional tank wagon will need to be dispatched after notification.

Vendor must provide a name and telephone number of the person who will serve as the 24-hour, seven-day contact.

Name: ___________________________
Telephone: ______________________

Vendor shall state the charge for the Stand-by Emergency delivery per hour, portal to portal, including loading: $ ___________ /hour.
5. Vendor shall maintain records of monthly volumes of various fuels, oils, automotive fluids and lubricants delivered to each of the City’s locations and shall provide the City monthly reports of all purchases, itemized by number, location, date delivered, quantity in gallons, type of fuel, the effective price, all taxes and fees. This monthly report must be submitted with 15 days following each month.

Under this Invitation for Bid, the City of Berkeley will not negotiate. Quoting Firms responding to this Invitation for Bid must offer their best and final price.

E. INFORMATION TO BE FURNISHED BY BIDDERS:

Failure to provide the following information with your bid may be cause for rejection of your bid.

1. Non-Discrimination/Workforce Composition Form - Pursuant to City of Berkeley Ordinance No. 5876, (B.M.C. Ch. 13.26), any person or firm (unless specifically exempted by the ordinance), who submits a bid or offer on a City contract shall be required to have a Work Force Composition Form reviewed by the Contract Compliance Officer of the City prior to award of such contract. **This Work Force Composition Form must be submitted with your bid.**

Businesses with fewer than five employees are exempt from submitting this form. Also, the City Manager may exempt other bidders in "exigent circumstances". (See B.M.C. secs. 13.26.030 and 13.26.050.)

2. Nuclear Free Berkeley Disclosure Form - Berkeley Municipal Code section 12.90.070 prohibits the City from granting contracts to companies that knowingly engage in work for nuclear weapons. This contracting prohibition may be waived if the City Council determines that no reasonable alternative exists to doing business with a company that engages in nuclear weapons work. If your company engages in work for nuclear weapons, explain on the Disclosure Form the nature of such work.  **Bidders must submit the attached Nuclear Free Disclosure Form with their proposal.**

3. Oppressive States Disclosure Form - The City of Berkeley prohibits granting of contracts to firms that knowingly provide personal services to number of Countries. This contracting prohibition may be waived if the City Council determines that no reasonable alternative exists to doing business with a company who is located in one of these areas. If your company or any subsidiary is located in one of the areas, explain on the Disclosure Form the nature of such work.  **Bidders must submit the attached Oppressive States Disclosure Form with their proposal.**

4. City of Berkeley Business License - Virtually every contractor that does business with the City must obtain a City business license as mandated by B.M.C. Ch. 9.04. The business license requirement applies whether or not the contractor has an office within the City limits. However, a "casual" or "isolated" business transaction (B.M.C. section 9.04.010) does not subject the contractor to the license tax. The infirm, warehousing businesses and charitable organizations are the only entities specifically exempted in the code from the license requirement (see B.M.C. sections 9.04.290, 9.04.295 and 9.04.300). Non-profit organizations are granted partial exemptions (see B.M.C. section 9.04.305).

Vendor must apply for a City business license and show proof of application to Purchasing Manager within 7 days of being selected as intended awardee.

The Customer Service Division of the Finance Department located at 1947 Center Street, Berkeley, CA 94704, handles business licenses. Vendors should contact this division for
questions and/or information about obtaining a City business license, in person, or by calling 510.981.7200

5. **Equal Benefits Disclosure Form** - Chapter 13.29 of the Berkeley Municipal Code requires that contractors offer domestic partners the same access to benefits that are available to spouses. **Bidders must submit the attached Equal Benefits Disclosure Form with their bid.** A certification of compliance with this ordinance will be required upon execution of a contract.

F. **DATA REQUIRED FOR BID EVALUATION:**

1. Bidders are required, in submitting their bids, to examine the detailed specifications closely. The bidder must complete the detailed specifications and write in any differences in the item(s) being offered. Failure to state exceptions will be cause for rejections of the bid. If any item specified is not available write “N/A” in the appropriate space.

2. A timeline for delivery of product

3. The following completed and signed

   a. Offer/Bid Form
   b. Nuclear Free Disclosure Form
   c. Oppressive States Compliance Statement for Commodities Form
   d. Equal Benefits Disclosure
   e. Workforce Composition Form

   *If Exceptions are taken, EXPLAIN EXCEPTIONS below: (attach additional sheets as necessary)*

   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________
Nuclear Free Zone Disclosure Form
City of Berkeley

I (we) certify that:

1. I am (we are) fully cognizant of any and all contracts held, products made or otherwise handled by this business entity, and of any such that are anticipated to be entered into, produced or handled for the duration of its contract(s) with the City of Berkeley. (To this end, this disclosure form may be signed by more than one individual, if a description of which type of contracts each individual is cognizant is attached.)

2. I (we) understand that Section 12.90.070 of the Nuclear Free Berkeley Act (Berkeley Municipal Code Ch. 12.90; Ordinance No. 5784-N.S.) prohibits the City of Berkeley from contracting with any person or business that knowingly engages in work for nuclear weapons.

3. I (we) understand the meaning of the following terms as set forth in Berkeley Municipal Code Section 12.90.130:

"Work for nuclear weapons" is any work the purpose of which is the development, testing, production, maintenance or storage of nuclear weapons or the components of nuclear weapons; or any secret or classified research or evaluation of nuclear weapons; or any operation, management or administration of such work.

"Nuclear weapon" is any device, the intended explosion of which results from the energy released by reactions involving atomic nuclei, either fission or fusion or both. This definition of nuclear weapons includes the means of transporting, guiding, propelling or triggering the weapon if and only if such means is destroyed or rendered useless in the normal propelling, triggering, or detonation of the weapon.

"Component of a nuclear weapon" is any device, radioactive or non-radioactive, the primary intended function of which is to contribute to the operation of a nuclear weapon (or be a part of a nuclear weapon).

4. Neither this business entity nor its parent nor any of its subsidiaries engages in work for nuclear weapons or anticipates entering into such work for the duration of its contract(s) with the City of Berkeley.

Based on the foregoing, the undersigned declares under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Printed Name: ____________________________ Title: ____________________________

Signature: ____________________________ Date: ____________________________

Business Entity:

_____________________________________

Specification Name & No.: **Fuels, Oils and Lubricants 06-10145-C**
The undersigned, an authorized agent of ____________________________ (hereafter "Vendor"), has had an opportunity to review the requirements of Berkeley City Council Resolution No. 59,853-N.S. (hereafter "Resolution"). Vendor understands and agrees that the City may choose with whom it will maintain business relations and may refrain from contracting with those Business Entities which maintain business relationships with morally repugnant regimes. Vendor understands the meaning of the following terms used in the Resolution:

"Business Entity" means "any individual, firm, partnership, corporation, association or any other commercial organization, including parent-entities and wholly-owned subsidiaries" (to the extent that their operations are related to the purpose of the contract with the City).

"Commodities" includes, but is not limited to, any tangible supplies, goods, vehicles, machinery or equipment.

"Oppressive State" means: **Tibet Autonomous Region and the Provinces of Ado, Kham and U-Tsang**.

The Commodities, which Vendor proposes to supply to the City, are not manufactured, assembled, extracted, harvested or refined in any Oppressive State. Vendor understands that it is not eligible to receive or retain a City contract if at the time the contract is executed, or at anytime during the term of the contract, it buys, sells, leases or distributes Commodities in the conduct of business with, or provides Personal Services to:

a. The governing regime in any Oppressive State.
b. Any business or corporation organized under the authority of the governing regime of any Oppressive State.
c. Any person for the express purpose of assisting in business operations or trading with any public or private entity located in any Oppressive State.

Vendor further understands and agrees that Vendor's failure to comply with the Resolution shall constitute a default of the contract and the City Manager may terminate the contract and bar Vendor from bidding on future contracts with the City for five (5) years from the effective date of the contract termination.

The undersigned is familiar with, or has made a reasonable effort to become familiar with, Vendor's business structure and the geographic extent of its operations. By executing the Statement, Vendor certifies that it complies with the requirements of the Resolution and that if any time during the term of the contract it ceases to comply, Vendor will promptly notify the City Manager in writing.

Based on the foregoing, the undersigned declares under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Printed Name: ____________________________ Title: ____________________________

Signature: ____________________________ Date: _________________

Business Entity: ___________________________________________________________________________________

**Specification Name & No.: Fuels, Oils and Lubricants 06-10145-C**

I am unable to execute this Statement; however, Vendor is exempt under Section VII of the Resolution. I have attached a separate statement explaining the reason(s) Vendor cannot comply and the basis for any requested exemption.

Signature: ____________________________ Date: _________________
# NON-DISCRIMINATION/WORKFORCE COMPOSITION FORM FOR NON-CONSTRUCTION CONTRACTS

To assist the City of Berkeley in implementing its Non-Discrimination policy, it is requested that you furnish information regarding your personnel as requested below and return it to the City Department handling your contract.

**Organization:**  __________________________________________________ **Address:** _________________________________________

<table>
<thead>
<tr>
<th>Occupational Category</th>
<th>Total Employees</th>
<th>White</th>
<th>Black</th>
<th>Asian</th>
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<tr>
<td></td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
</tr>
</tbody>
</table>

Official/Administrators

Professionals

Technicians

Protective Service Workers

Para-Professionals

Office/Clerical

Skilled Craft Workers

Service/Maintenance

Other (Specify)

**TOTALS:**

Is your business MBE/WBE/DBE certified?   Yes _______ No _______ If yes, by what agency?  __________________________________________

If yes, please specify:  Male:  ________   Female: ________   Indicate ethnic identification  __________________________________________

Do you have a Non-Discrimination policy?  Yes _______        No ________

Signed:  ________________________________________________________________   Date: __________________________________________

Verified by:  _____________________________________________________________   Date:  __________________________________________

City of Berkeley Contract Compliance Officer 8/91

**Specification Name & No:**  Fuels, Oils and Lubricants 06-10145-C
Occupational Categories

**Officials and Administrators** - Occupations in which employees set broad policies, exercise overall responsibility for execution of these policies, or provide specialized consultation on a regional, district or area basis. Includes: department heads, bureau chiefs, division chiefs, directors, deputy superintendents, unit supervisors and kindred workers.

**Professionals** - Occupations that require specialized and theoretical knowledge that is usually acquired through college training or through work experience and other training that provides comparable knowledge. Includes: personnel and labor relations workers, social workers, doctors, psychologists, registered nurses, economists, dietitians, lawyers, systems analysts, accountants, engineers, employment and vocational rehabilitation counselors, teachers or instructors, and kindred workers.

**Technicians** - Occupations that require a combination of basic scientific or technical knowledge and manual skill that can be obtained through specialized post-secondary school education or through equivalent on-the-job training. Includes: computer programmers and operators, technical illustrators, highway technicians, technicians (medical, dental, electronic, physical sciences) and kindred workers.

**Protective Service Workers** - Occupations in which workers are entrusted with public safety, security and protection from destructive forces. Includes: police officers, fire fighters, guards, sheriffs, bailiffs, correctional officers, detectives, marshals, harbor patrol officers, and kindred workers.

**Para-Professionals** - Occupations in which workers perform some of the duties of a professional or technician in a supportive role, which usually requires less formal training and/or experience normally required for professional or technical status. Such positions may fall within an identified pattern of a staff development and promotion under a "New Careers" concept. Includes: library assistants, research assistants, medical aides, child support workers, police auxiliary, welfare service aides, recreation assistants, homemaker aides, home health aides, and kindred workers.

**Office and Clerical** - Occupations in which workers are responsible for internal and external communication, recording and retrieval of data and/or information and other paperwork required in an office. Includes: bookkeepers, messengers, office machine operators, clerk-typists, stenographers, court transcribers, hearings reporters, statistical clerks, dispatchers, license distributors, payroll clerks, and kindred workers.

**Skilled Craft Workers** - Occupations in which workers perform jobs which require special manual skill and a thorough and comprehensive knowledge of the processes involved in the work which is acquired through on-the-job training and experience or through apprenticeship or other formal training programs. Includes: mechanics and repairpersons, electricians, heavy equipment operators, stationary engineers, skilled machining occupations, carpenters, compositors and typesetters, and kindred workers.

**Service/Maintenance** - Occupations in which workers perform duties which result in or contribute to the comfort, convenience, hygiene or safety of the general public or which contribute to the upkeep and care of buildings, facilities or grounds of public property. Workers in this group may operate machinery. Includes: chauffeurs, laundry and dry cleaning operatives, truck drivers, bus drivers, garage laborers, custodial personnel, gardeners and groundskeepers, refuse collectors, and construction laborers.
CITY OF BERKELEY
Equal Benefits Ordinance Disclosure Form

As a condition of being awarded a contract with the City of Berkeley, the selected Contractor/Vendor (“Contractor”) may be required, during the performance of the contract, to comply with the City’s non-discrimination provisions of the Equal Benefits Ordinance (“EBO”) as set forth in Berkeley Municipal Code, Chapter 13.29. The EBO requires that during the performance of a contract, the Contractor shall provide equal benefits to its employees with spouses and employees with domestic partners. Benefits include, but are not limited to, health benefits, bereavement leave, family medical leaves, membership and membership discounts, moving expenses, retirement benefits, and travel benefits. A cash equivalent payment is permitted if an employer has taken all reasonable efforts to provide domestic partner’s with access to benefits but is unable to do so. A situation in which a cash equivalent payment might be used is if the employer has difficulty finding an insurance provider that is willing to provide domestic partner benefits.

The EBO is applicable to the following employers:

- For-profit employers that have a contract with the City for the purchase of goods, services, public works or improvements, and other construction projects in the amount of $25,000 or more
- Non-profit employers that have a contract with the City for the purchase of goods, services, public works or improvements, and other construction projects in the amount of $100,000 or more
- Lessees of public property, licensees, concessionaires, and franchises that generate $350,000 or more in annual gross receipts
- Entities which receive a grant agreement of $100,000 or more

Contractors who are subject to the EBO must certify to the City before execution of the contract by completing form EBO-1 that they are in compliance with the EBO or have been issued a waiver by the City. Contractors must also allow authorized City representatives access to records so the City can verify compliance with the Ordinance.

The EBO includes provisions that address difficulties associated with implementing procedures to comply with the EBO. Contractors can delay implementation of procedures to comply with the EBO in the following situations:

1. until the first effective date after the first open enrollment process following the contract execution date, not to exceed two years if the Contractor submits evidence of engaging in reasonable efforts to comply with the EBO;
2. until administrative steps can be taken to incorporate nondiscrimination in benefits in the contractor’s infrastructure, not to exceed three months, unless extended at the discretion of the City Manager; and
3. until the expiration of a Contractor’s current collective bargaining agreement(s)

Compliance with the EBO

If a Contractor has not received a waiver from complying with the EBO and the timeframe within which it can delay implementation has expired but it has failed to comply with the EBO, the Contractor may be deemed to be in material breach of the City agreement. In the event of a material breach, the City may cancel, terminate or suspend the City agreement, in whole or in part. The City also may deem the Contractor an irresponsible bidder and disqualify the Contractor from contracting with the City for a period of five years. In addition, the City may assess liquidated damages against the Contractor which may be deducted from money otherwise due the Contractor, and pursue any other remedies available at law or in equity.

By my signature below, I acknowledge that the Contractor understands that to the extent it is subject to the provisions of B.M.C. Chapter 13.29, the Contractor shall comply with this provision.

Printed Name: ___________________________________________ Title: ___________________________
Signature: ___________________________________________ Date: ___________________________
Business Entity: __________________________________________________________________________

Specification Name & No.: Fuels, Oils and Lubricants 06-10145-C
CERTIFICATION OF COMPLIANCE WITH EQUAL BENEFITS ORDINANCE

If you are a **contractor**, return this form to the originating department/project manager. If you are a **vendor** (supplier of goods), return this form to the Purchasing Division of the Finance Dept.

SECTION 1. CONTRACTOR/VENDOR INFORMATION

<table>
<thead>
<tr>
<th>Name:</th>
<th>Vendor No.:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td>City:</td>
</tr>
<tr>
<td>Contact Person:</td>
<td>Telephone:</td>
</tr>
<tr>
<td>E-mail Address:</td>
<td>Fax No.:</td>
</tr>
</tbody>
</table>

SECTION 2. COMPLIANCE QUESTIONS

A. The EBO is inapplicable to this contract because the contractor/vendor has no employees.
   - [ ] Yes   [ ] No (If “Yes,” proceed to Section 5; if “No”, continue to the next question.)

B. Does your company provide (or make available at the employees’ expense) any employee benefits?
   - [ ] Yes   [ ] No
     If “Yes,” continue to Question C.
     If “No,” proceed to Section 5. (The EBO is not applicable to you.)

C. Does your company provide (or make available at the employees’ expense) any benefits to the spouse of an employee?
   - [ ] Yes   [ ] No

D. Does your company provide (or make available at the employees’ expense) any benefits to the domestic partner of an employee?
   - [ ] Yes   [ ] No
     If you answered “No” to both Questions C and D, proceed to Section 5. (The EBO is not applicable to this contract.)
     If you answered “Yes” to both Questions C and D, please continue to Question E.
     If you answered “Yes” to Question C and “No” to Question D, please continue to Section 3.

E. Are the benefits that are available to the spouse of an employee identical to the benefits that are available to the domestic partner of the employee?
   - [ ] Yes   [ ] No
     If you answered “Yes,” proceed to Section 4. (You are in compliance with the EBO.)
     If you answered “No,” continue to Section 3.

SECTION 3. PROVISIONAL COMPLIANCE

A. Contractor/vendor is not in compliance with the EBO now but will comply by the following date:
   - [ ] By the first effective date after the first open enrollment process following the contract start date, not to exceed two years, if the Contractor submits evidence of taking reasonable measures to comply with the EBO; or
   - [ ] At such time that administrative steps can be taken to incorporate nondiscrimination in benefits in the Contractor’s infrastructure, not to exceed three months; or
   - [ ] Upon expiration of the contractor’s current collective bargaining agreement(s).

B. If you have taken all reasonable measures to comply with the EBO but are unable to do so, do you agree to provide employees with a cash equivalent?*
   - [ ] Yes   [ ] No

* The cash equivalent is the amount of money your company pays for spousal benefits that are unavailable for domestic partners.
SECTION 4. REQUIRED DOCUMENTATION

At time of issuance of purchase order or contract award, you may be required by the City to provide documentation (copy of employee handbook, eligibility statement from your plans, insurance provider statements, etc.) to verify that you do not discriminate in the provision of benefits.

SECTION 5. CERTIFICATION

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that I am authorized to bind this entity contractually. By signing this certification, I further agree to comply with all additional obligations of the Equal Benefits Ordinance that are set forth in the Berkeley Municipal Code and in the terms of the contract or purchase order with the City.

Executed this _______day of _________________, in the year __________, at __________________, ________ (City) (State)

_____________________________________   ______________________________________
Name  (please print)      Signature

_____________________________________   ______________________________________
Title        Federal ID or Social Security Number

FOR CITY OF BERKELEY USE ONLY

☐ Non-Compliant (The City may not do business with this contractor/vendor)
☐ One-Person Contractor/Vendor          ☐ Full Compliance          ☐ Reasonable Measures
☐ Provisional Compliance Category, Full Compliance by Date: _________________________________

Staff Name(Sign and Print): _____________________________________ Date: ____________ ________________
RESOLUTION NO: 63,952-N.S.

PURCHASE ORDER: WESTERN STATES OIL FOR FUEL FOR CITY VEHICLES

WHEREAS, fuel is needed for the City fleet and equipment; and

WHEREAS, Resolution No. 50,961–N.S., approved by the City Council on October 6, 1981, authorized the purchase of fuel on the open market; and

WHEREAS, on July 10, 2007, Resolution 63,772–N.S. was adopted which authorized expenditures not to exceed $1,400,000 in FY 2007 and $750,000 for the first six months of FY 2008, while a bid for fuel, oil and lubricants was being prepared; and

WHEREAS, on October 2, 2007 the City issued an Invitation for Bid for fuel, oil and lubricants and Western States Oil submitted the lowest bid; and

WHEREAS, prices will be fixed on a mark up of $0.0225 for regular unleaded gasoline, $0.135 for ultra low sulfur bio-diesel B20 and $0.135 for ultra low sulfur bio-diesel B5 over the weekly published Oil Price Information Service report, which sets for the industry standard; and

WHEREAS, the Western States Oil submitted the lowest responsible bid, and can provide bio-diesel fuel, thus contributing to the City’s commitment to reduce greenhouse gas emissions and environmental improvement goals; and

WHEREAS, funds for these purchases are available in FY 2008 in the Equipment Maintenance Fund (865-5702-410-5533 and 865-5704-410-5533) and funds for future purchases through FY 2013 will be available in the same fund.

NOW THEREFORE, BE IT RESOLVED by the Council of the City of Berkeley that the City Manager is authorized to execute a purchase order for Western States Oil for fuel for City vehicles in an amount not to exceed $682,000 for FY 2008, with a 5% escalation for each fiscal year through FY 2013. Total authorization for purchasing fuel for six years will not exceed $8,595,809. Funds to pay for fuel are available from the Equipment Maintenance Fund.

The foregoing Resolution was adopted by the Berkeley City Council on January 15, 2008 by the following vote:

Ayes: Anderson, Capitelli, Maio, Moore, Olds, Spring, Worthington, Wozniak and Bates.

Noes: None.

Absent: None.

Attest: Pamyia Means, MMC, City Clerk

Tom Bates, Mayor

Resolution No. 63,952-N.S.
CITY OF BERKELEY
PURCHASING DIVISION
2130 MILVIA STREET * BERKELEY, CA 94704
(510) 981-7320
FAX: (510) 981-7390 / TDD (510) 981-6903

WESTERN STATES OIL COMPANY
1790 SOUTH TENTH STREET
SAN JOSE, CA 95112

CITY OF BERKELEY
PW-EQUIPMENT MAINTENANCE
1326 ALLSTON WAY
BERKELEY, CA 94702

Please forward all invoices to: City of Berkeley,
Accounts Payable Division, P.O. Box 700, Berkeley, CA 94701

VENDOR NO. 25198
DISCOUNT TERMS NET/10
F.O.B. 
EST. FREIGHT/CONTRACT 
DEPARTMENT / DIVISION 

DATE REQUIRED 06/30/10
CONTRACT NO. 
ACCOUNT NO. 86557024105533
PROJECT NO. 134273
REQ. NO. *

LINE NO. QUANTITY UNIT ITEM NO. AND DESCRIPTION UNIT PRICE EXTENDED PRICE

* * CHANGE ORDER * *
* * *

REMARKS:
FY10 BPO - PERIOD OF PERFORMANCE 7/1/09 TO 6/30/10
AUTHORIZED USERS - BAL JOHAL, ANTONIO LEE AND WILLIAM THOMPSON
*NOTE* KBEP TRACK OF FY10 EXPENDITURES - DO NOT EXCEED $1,503,810.00
SEE CALCULATED PER FISCAL YEAR APPROVED AMTS BELOW
FY10 $682,000
FY09 $1,442,200
FY10 $1,503,810
FY11 $1,579,001
FY12 $1,657,851
FY13 $1,740,848
5-YEAR TOTAL NOT TO EXCEED $8,595,809
line #2 for cr memo #752770 sl

CONDITIONS — Read Carefully

1. Invoices and packages must bear this Purchase Order number.
2. The conditions of this order are not to be modified by any verbal understanding.
3. The City assumes no responsibility for goods delivered without the authority of properly executed purchase orders.
4. Acceptance of this order includes acceptance of all terms, prices, delivery instruction, specifications and conditions stated.
5. The right is reserved to cancel this order if not filled within the contract time, if specified.
6. Terms and conditions on the reverse are a part of this order.

SHERRI DEGNAN
Buyer's Name

Approved / Purchasing Manager
Date

VENDOR

COMPANY
CITY OF BERKELEY
PURCHASING DIVISION
2180 MELVIA STREET * BERKELEY, CA 94704
(510) 981-7320
FAX: (510) 981-7350 / TDD (510) 981-6903

WESTERN STATES OIL COMPANY
1790 SOUTH TENTH STREET
SAN JOSE, CA 95112

CITY OF BERKELEY
PW-EQUIPMENT MAINTENANCE
1326 ALLSTON WAY
BERKELEY, CA 94702

Please forward all invoices to: City of Berkeley,
Accounts Payable Division, P.O. Box 700, Berkeley, CA 94701

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<td>100000.00</td>
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<td>1.0000</td>
<td>14986.71</td>
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</table>

**CONDITIONS — Read Carefully**

1. Invoices and packages must bear this Purchase Order number.
2. The conditions of this order are not to be modified by any verbal understanding.
3. The City assumes no responsibility for goods delivered without the authority of properly executed purchase orders.
4. Acceptance of this order includes acceptance of all terms, prices, delivery instructions, specifications and conditions stated.
5. The right is reserved to cancel this order if not filled within the contract time, if specified.
6. Terms and conditions on the reverse are a part of this order.

**CONTINUED**

SHERRI DEGNAN
Buyer's Name

Approved / Purchasing Manager

Date
**Ethanol Market Overview:**

Quiet Week Leaves Little Change

Ethanol markets had a very slow week, but prices that moved around basically held within recent ranges with talks shifting on the latest corn moves or vacillations in the petroleum market.

Spot ethanol in Chicago for what was left of May was still available at $1.59/gal at last word, right about where it could be done a week ago. Patable June ethanol traded $1.605/gal and any-June at around $1.60-$1.61/gal eased off midweek highs while indicating little overall change for the week.

New York Harbor ethanol barges and West Coast railroad volume bounced off the lowest levels traded earlier in the week, taking prices back near week-ago levels.

Blending indications remained firm, with profitable economics for ethanol while the latter-week rebound in gasoline prices only enhanced that relationship. Weekly DOE data indicated conventional gasoline blended with ethanol at 4.757 million b/d, down only slightly from the all-time high reported the previous week and up almost 32% against the same time last year.

Meantime, monthly DOE data released late in the week had U.S. ethanol production reaching a new all-time high in March. Domestic plants pumped out 847,000 b/d for the month, up 1.7% from February and 32% ahead of the same time last year. Overall output also reached a new record, at 26.27 million bbl in March, beating the previous high recorded in January by more than 3.4%.

DOE also had March ethanol stockpiles at 19.691 million bbl nationwide, moving up 794,000 bbl, or about 4.2% month-to-month and nearly 26% more than the same time in 2009.

**Chicago**

- Ethanol: 1.5972-1.5975, 1.5973-1.5975, 1.5970-1.5972, 1.5960-1.5970, 1.5960-1.5972, 1.5960-1.5972, 1.5960-1.5972, 1.5960-1.5972
- Unleaded: 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937
- ULSD: 1.9407-1.9442, 1.9407-1.9442, 1.9407-1.9442, 1.9407-1.9442, 1.9407-1.9442, 1.9407-1.9442, 1.9407-1.9442

**Los Angeles**

- Ethanol: 1.6900-1.7300, 1.6900-1.7100, 1.6900-1.7100, 1.6900-1.7100, 1.6900-1.7100, 1.6900-1.7100, 1.6900-1.7100
- Biodiesel: 1.5973-1.6000, 1.5973-1.6000, 1.5973-1.6000, 1.5973-1.6000, 1.5973-1.6000, 1.5973-1.6000, 1.5973-1.6000
- Unleaded: 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937, 1.9387-1.9937
- ULSD: 1.9807-1.9837, 1.9807-1.9837, 1.9807-1.9837, 1.9807-1.9837, 1.9807-1.9837, 1.9807-1.9837, 1.9807-1.9837

**Brazil**

- Anhydrous Ethanol: 1.94-1.98
- Hydrous Ethanol: 1.71-1.76

From the publishers of Oil Price Information Service, Retail Fuel Watch, LP Gas Fax, OPIS Jet Fuel Report and Oil Express.
## Wholesale (Rack) Biodiesel Prices

Prices include confirmed moves through May 27, 2010

<table>
<thead>
<tr>
<th>Location</th>
<th>Date</th>
<th>Term</th>
<th>Arrival</th>
<th>Rack</th>
<th>Biodiesel Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oakland</td>
<td>05/27/2010</td>
<td>Term</td>
<td>Local</td>
<td>105g</td>
<td>297.60</td>
</tr>
<tr>
<td>Oakland</td>
<td>05/27/2010</td>
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<td>Local</td>
<td>105g</td>
<td>297.60</td>
</tr>
</tbody>
</table>

**Note:** The prices listed above are for wholesale rack biodiesel. Exact prices may vary depending on location and quantity purchased. Always verify current prices with your local supplier.
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Hi Melanie and Nabil,

Please read these comments and attachments, and also forward them as public comment to all CEAC commissioners and staff. These are extremely important to your March 3rd discussion and possible action on biodiesel (item 9.4 on your agenda).

Hello CEAC Commissioners and staff,

I have just read with interest, and also concern, your staff's report on biodiesel for the CEAC and have two key matters to bring to your attention.

1) The report was interesting, and well done, in that it exposed serious conflicts of interest in the way that biodiesel was brought forward as an option in Berkeley and approved. As a grassroots organizer in San Francisco with deep concerns about the use of biodiesel, I have experienced very similar and serious conflicts of interest involved in the advocacy of biodiesel to our Board of Supervisors; most notably, that a majority of the San Francisco Biodiesel Access Taskforce consists of members who have direct financial interests in the promotion and sale of biodiesel; and they have tended to gloss over and obfuscate problems that have arisen in the biodiesel approval process in order to fast track favorable (and unwarranted) approvals. The fact that your experience in Berkeley has been so similar raises the very real specter that such aggressive and biased promotion of biodiesel by advocates or contractors who have conflicts of interest, is likely a systemic rather than merely incidental problem. It is my belief that this condition has arisen from the general uncritical public acceptance of biodiesel promoters nation wide as 'environmentalists', rather than more accurately viewing them as interested and biased parties with the same complex motivations as any other business actor taking part in a highly competitive industry.

2) My second and more important comment, is that the report was very troubling in that, though it did passively mention that there are still open questions about the advisability of using biodiesel, it did not have a more up to date and critical analysis based on new evidence compiled over the last few years showing widespread dramatic problems with biodiesel and biodiesel mandates. This new information and analysis is now indicating that biodiesel made and used in high volumes from any feedstock -including- yellow grease, causes, across the board, far more environmental problems and greenhouse gas emissions than the petroleum diesel that it is meant to replace. For the basic fundamentals on why biofuels across the board are destructive see http://biofuelwatch.org.uk/

Most importantly, and more specifically, please note the attached reports and my comments about them below which are vital to making educated decisions about biodiesel.

First: See the summary on page 21 of the attached document 'Biofuels_ILUC_Analysis_EU' which is very recent, and is the first report of its kind to comprehensively examine indirect land use change (ILUC) impacts of biofuels for the European Union. It states clearly that green house gas emissions will increase dramatically due to biodiesel and other biofuel mandates and use.
Second: In relation to yellow grease, which is mentioned in your staff's report as the preferred feedstock for biodiesel, please note that reliance on yellow grease and tallow for a biodiesel feedstock will not solve -any- of the ILUC problems created by other feedstocks like crop soy for one key reason - Nearly all yellow grease and tallow are -already- used to make other products like soaps, cosmetics, paints, animal feed and pet foods. None of these greases are actually 'waste' as is often deceptively claimed by biodiesel advocates. The reason that this basic reality will create the same ILUC problems as crop feedstocks is the obvious complication that, once yellow grease and tallow are being used for diesel production, all of these other non-fuel product industries will be forced to then turn to crop oils for the fat sources that they -must- have to produce their products, and hence the exact same ILUC problems will be perpetuated.

For proof of this reality, see attached an analysis done for the UK government on possible impacts of tallow biodiesel production in Britain entitled 'Tallow_Biodiesel_Report_AEA'. Note on page VI (page 6 of the pdf) the executive summary makes clear that all rendered tallow is currently used. None of it is landfilled. (Some biodiesel advocates have falsely claimed that these fats would otherwise be landfilled.) For my own local validation of this as a fundamental condition, I personally called the Darling International rendering plant in San Francisco and verified that likewise, all of its rendered tallow is used by current industries. None of it is landfilled.

It is for all these cited reasons, that I strongly urge the City of Berkeley to completely abandon all pursuit of biodiesel and other biofuel use strategies as a failed and inherently environmentally destructive model; and to instead more heavily promote a transition to far more widespread electric mass transit and rail, along with electric car shares and taxis, for transportation and shipping; at the same time putting a much stronger effort into building a local renewable electricity infrastructure in Berkeley through methods like Community Choice Aggregation.

Thank you for your careful consideration of these comments,

Eric Brooks
Sustainability Chair
San Francisco Green Party
415-756-8844
Anticipated Indirect Land Use Change Associated with Expanded Use of Biofuels and Bioliquids in the EU – An Analysis of the National Renewable Energy Action Plans

November 2010

Author – Catherine Bowyer, Senior Policy Analyst, IEEP

This report is available to download at www.ieep.eu

Contents

Summary ........................................................................................................................................ 2
1. Introduction ........................................................................................................................ 3
2. Methodological Approach ................................................................................................. 4
3. Delivering the 2020 Target ............................................................................................... 6
4. Anticipated Increase in Biofuel Usage Associated with the RED .................................... 9
5. Calculating Indirect Land Use Change ........................................................................... 10
6. Anticipated Indirect Land Use Change – the Size of the Challenge .............................. 12
7. Indirect Land Use Change – The GHG Consequences ................................................... 13
8. Assessing the Additional Impact of Bioliquids ............................................................... 19
9. Conclusions ....................................................................................................................... 21
10. Annex .............................................................................................................................. 22

1 IEEP would like to thank Ian Skinner of Transport and Environmental Policy Research for his support in peer reviewing this report to ensure its quality and accuracy.

2 This report was prepared by IEEP for Transport and Environment and partners
Summary

- This study represents a first analysis and estimate of the effects of Indirect Land Use Change (ILUC) associated with the increased use of conventional biofuels that EU Member States have planned for within their National Renewable Energy Action Plans (NREAPs). These documents specify how European governments plan to deliver their transport targets under the Renewable Energy Directive (RED). 23 NREAPs were available at the time of drafting and the analysis is based upon these. ILUC effects have been calculated using recently released studies by the European Commission.

- The RED target, for 10% of transport fuel to be from renewable sources by 2020, is anticipated to stimulate a major increase in the use of conventional biofuels up to 2020, contributing up to 92% of total predicted biofuel use or 24.3 Mtoe in 2020. This would represent 8.8% of the total energy in transport by 2020; 72% of this demand is anticipated to be met through the use of biodiesel and 28% from bioethanol.

- Member States are anticipating importing significant proportions of these fuels and their associated feedstocks. Figures reported equate to 50% of bioethanol and 41% of biodiesel in 2020. However, actual imported levels of feedstock are anticipated to be higher as it is unclear whether the imports anticipated by Member States refer to feedstock for ‘domestic’ processing into biofuels as well as imports of processed biofuels.

- Additionally Member States are estimated to be sourcing 4349 Ktoe of bioliquids from conventional feedstocks in 2020. Used for heating and electricity, these will have similar ILUC consequences as for biofuels representing an additional emission source of greenhouse gas emissions (GHG). ILUC impacts from these bioliquids are estimated to equate to an area of between 1 and 1.9 million ha and GHG emissions of between 211 and 400 MtCO2e.

- In 2020 15,047 Ktoe of the biofuels used would be additional to 2008 levels and sourced from conventional ie primarily food crop based feedstocks; this can be considered to be additional demand stimulated by the RED.

- Using currently available data, this additional demand for these fuels is anticipated to lead to between 4.1 and 6.9 million ha of ILUC ie an area equivalent to just larger than Belgium to just under that of the Republic of Ireland.

- This additional ILUC was calculated to result in between 44 and 73 million tonnes of CO2 equivalent (MtCO2e) on an annualised basis ie between 876 and 1459 MtCO2e in total.

- Under the RED biofuels must deliver a required level of GHG savings relative to fossil fuels to count towards the targets. Even when this saving is taken into account estimated additional GHG emissions arising from ILUC are between 273 and 564MtCO2e (for the period 2011 to 2020) or between 27 and 56 MtCO2e annually. The latter equates to up to 12% of emissions from EU agriculture in 2007 or 6% of total transport emissions. Put another way this would be equivalent to between 12 and 26 million additional cars on the road across Europe in 2020.

- Based on this assessment, and the assumptions adopted, use of additional conventional biofuels up to 2020 on the scale anticipated in the 23 NREAPs would lead to between 80.5% and 167% more GHG emissions than meeting the same need through fossil fuel use.

- This analysis was based on what were considered the most appropriate assumptions using the evidence and models available at the time of drafting. However, sensitivity analysis shows that even with far lower estimates of ILUC arising per unit of additional biofuel consumption and of GHG emissions per unit area of ILUC the use of conventional biofuels envisaged in the NREAPs fails to deliver the reduction in GHG emissions required under the RED, and leads to an increase in GHG emissions overall.

- This analysis underlines the need to address the question of ILUC as a priority for biofuels policy and to include ILUC in the criteria for assessing whether biofuels should count towards the delivery of targets under the RED for 2020, and more generally EU European climate change mitigation goals. Moreover, it also raises urgent questions about the appropriateness of projected levels of conventional biofuel use by Member States in 2020. Many have focused little effort in their NREAPs on promoting advanced biofuels or pursuing a greater efficiency in their transport sector so as to reduce the overall climate burden.
1. Introduction

The EU Renewable Energy Directive, RED, on the promotion of the use of energy from renewable sources (Directive 2009/28/EC) is a powerful measure at the heart of European energy and climate policy. It sets out two targets aimed at the promotion of renewable energy. The first requires the delivery of 20% of total energy from renewable sources by 2020, with the level of effort differentiated across the Member States. The second specifically promotes the use of energy from renewable sources within the transport sector, requiring 10% of all transport fuels to be delivered from renewable sources by 2020 across every Member State. When the Directive was adopted, it was unclear precisely what technologies and approaches would be adopted by the Member States in order to deliver these targets. To reveal, open to scrutiny and monitoring, the national approaches to meeting these targets the RED also explicitly requires that each Member State produce a National Renewable Energy Action Plan (NREAP).

The NREAPs are critical to understanding the anticipated consequences associated with meeting the EU RED targets. As of mid October 2010 23 Member States had submitted their NREAP to the Commission. This analysis represents a first attempt to analyse the data presented by the Member States to ascertain the characteristics of the demand generated by the targets in one important area: the anticipated use of biofuels.

To deliver the RED transport target there are a number of potential technologies available to Member States:
- use of conventional, also known as first generation, biofuels;
- use of advanced biofuels, these are specified within the RED under Article 21.2 as those derived from wastes, residues, non-food cellulosic material, and ligno-cellulosic material and count double towards the delivery of the 2020 transport target;
- efficiency gains within the transport sector that reduce fuel needs, therefore, the overall quantity of renewable energy needed to meet the target; and
- the electrification of the transport system, utilising renewable electricity.

Meeting the RED target for transport, and also to a more limited extent the use of bioliquids in heating and electricity generation, is anticipated to increase the demand for conventional biofuel and bioliquid feedstocks. Moreover the RED is an important element of the EU’s efforts to reduce greenhouse gas (GHG) emissions. As a consequence the RED specifies sustainability criteria intended to both limit the consequences of direct land use change associated with

4 Austria, Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK
5 These include commodities such as oil seed crops including rape seed and soy, palm oil, wheat, maize, sugar cane and sugar beet.
6 The RED specifies that biofuel feedstocks used to comply with the EU targets must not be grown on land that held certain environmentally sensitive characteristics after January 2008 ie that is considered highly biodiverse or a significant carbon store. Article 17 of the Directive specifies the land uses to be protected. As a consequence these land uses should be protected from being directly converted to feedstock production to meet expanded EU demand.
expanded demand for feedstocks and requires minimum (GHG) savings to be delivered by all biofuels and bioliquids used to meet the EU targets.

While the RED specifies mechanisms for dealing with direct land use change arising from the cultivation of feedstocks, it as yet fails to take into account indirect land use change (ILUC). ILUC is generated by the elevated demand for agricultural commodities as a consequence of biofuel consumption. When biofuels are grown on existing arable land, which will often be the case, ILUC can ensue elsewhere, either in the same country or in other parts of the world. This is because current demand for food and animal feed may well remain unchanged and cannot be assumed to fall. As a consequence pre-existing agricultural production can be displaced into new areas. This displacement will cause some new land to be brought into arable production possibly far from the area in which the biofuel feedstock is being grown, potentially impacting grasslands, forests or other natural habitats. The expansion in the area of cultivation leads to land use change, which is associated with significant GHG emissions as a consequence of the release of carbon locked up in soils and biomass. Moreover the expansion in cultivated area and more intensive use of agricultural land can pose a potentially significant threat to biodiversity globally. For the RED Directive to deliver the intended goal of contributing towards the EU’s effort to combat climate change the additional GHG emissions from ILUC would need to be controlled, ensuring they are less than the savings in direct emission reductions delivered by biofuel use.

Given the information held in the NREAPs and ongoing work to determine the ILUC impacts associated with biofuel use in the EU, it is now possible to estimate the ILUC consequences associated with an individual Member State’s biofuel demand driven by the 2020 targets. This paper presents the initial findings of such an analysis based on the 23 NREAPs published to date. The aim of this exercise is to help inform debate on ILUC and its consequences. This is intended to support the Commission’s work on ILUC, given that a report and new potential proposals to take account of ILUC are scheduled to be published by the end of 2010 – as specified in the RED.

2. Methodological Approach

This assessment incorporated 5 key analytical steps set out in figure 1, below. These represent a process starting with the collation of data from the NREAPs and using published data and methodologies to establish an acceptable baseline for measuring the ILUC impact of expanded biofuel demand associated with the RED targets. These methods allowed the anticipated area of ILUC to be estimated along with the volume of associated GHG emissions. The primary data sources used within the assessment were as follows:

– NREAP information per Member State regarding the level of conventional and Article 21.2 biofuels to be used by 2020, bioliquid usage in 2020 and other transport related actions to deliver the RED targets;
– DG Energy data on 2008 usage of biofuels by Member State;

---

7 The RED Article 17.2 requires that biofuels and bioliquids used to meet the EU targets or that are subsidised by Member States deliver a 35% GHG saving compared to the use of fossil fuels (this applies from December 2010 when the EU Directive must formally be transposed by the Member States). The required level of saving rises to 50% from 1 January 2017 and 60% from 1 January 2018 for fuels produced by installations that started production after January 2017.
8 These can be downloaded at [http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm](http://ec.europa.eu/energy/renewables/transparency_platform/action_plan_en.htm)
9 This is available at [http://www.eurobserv-er.org/pdf/baro198.pdf](http://www.eurobserv-er.org/pdf/baro198.pdf)
Joint Research Centre (JRC) analysis reviewing ILUC modelling efforts and conclusions regarding potential ILUC impact in terms of land use change measured in hectares (ha) and associated GHG impact\(^{10}\) (supported by analysis by other groups of ILUC impacts including that by Ecofys\(^{11}\));

- Data from the Intergovernmental Panel on Climate Change regarding GHG emissions from land use change\(^{12}\);
- FAO data on area of agricultural and arable land in EU Member State\(^{13}\);
- DG Energy data on GHG emissions per Member State in 2007 – both for transport and total GHG emissions (excluding international bunkers and LULUCF)\(^{14}\);
- Data on anticipated fuel efficiency and car usage up to 2020\(^{15}\).

**Figure 1 – Outline of the methodological steps and approach used within this analysis**

<table>
<thead>
<tr>
<th>Step</th>
<th>Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Collation of data from the existing NREAPs on biofuel demands per MS&lt;br&gt;Proportion of renewable energy in transport sector by 2020&lt;br&gt;Total demand – biofuels, bioethanol, biodiesel&lt;br&gt;Demand for conventional vs advanced biofuels vs renewable electricity in transport&lt;br&gt;Supply impact ie proportion of domestic vs imported biofuels to be used</td>
</tr>
<tr>
<td>2</td>
<td>Identification of increase in conventional biofuel use by 2020 attributable to the RED target&lt;br&gt;Assumed a basis of Jan 2008 for pre-RED demand for bioethanol and biodiesel&lt;br&gt;Assumed that Jan 2008 usage is 100% conventional biofuels&lt;br&gt; Increase = projected MS usage of bioethanol/biodiesel – 2008 levels</td>
</tr>
<tr>
<td>3</td>
<td>Identification of anticipated ILUC associated with the increase in biofuel use&lt;br&gt;ILUC = anticipated increase in level of bioethanol/biodiesel use by 2020 x ILUC conversion factor ie kHa change per kToe relevant fuel&lt;br&gt;ILUC conversion factors based on parameters derived from JRC analysis of ILUC modelling – provides an upper and lower estimate – see annex regarding calculations for approach to determining ILUC parameters</td>
</tr>
<tr>
<td>4</td>
<td>Identifying the GHG emission consequences associated with ILUC&lt;br&gt;GHG impact = ILUC scale x GHG conversion factor ie tCO2e per kha&lt;br&gt;GHG associated with land use change based on conclusions from the JRC study and estimates from IPCC – lower, central and upper values used to create a mean&lt;br&gt;GHG volumes divided by 20 to provide an annualised level of emissions in line with the RED specification and emission savings associated with biofuel usage subtracted from the total to provide a picture of additional ILUC emissions by 2020.</td>
</tr>
<tr>
<td>5</td>
<td>Converting the ILUC estimates into meaningful proxies&lt;br&gt;Comparing the level of biofuel related ILUC for a single Member States with the total area of arable land in that MS&lt;br&gt;Comparing the GHG impacts for a single Member State to their corresponding transport emissions and emissions from agriculture&lt;br&gt;Calculating the impact in terms of additional cars on the road in 2020 based on additional GHG emissions associated with ILUC</td>
</tr>
</tbody>
</table>

\(^{10}\) European Commission, Joint Research Centre (JRC), Institute for Energy, 2010, Indirect Land Use Change from increased biofuels demand, Comparison of models and results for marginal biofuels production from different feedstocks, Robert Edwards, Declan Mulligan and Luisa Marelli

\(^{11}\) Ecofys, October 2009, Summary of approaches to accounting for indirect impacts of biofuel production, Stijn Cornelissen and Bart Dehue


\(^{13}\) This can be downloaded at [http://faostat.fao.org/](http://faostat.fao.org/)


\(^{15}\) Details on car usage set out in [http://www.transportenvironment.org/Publications/prep_hand_out/lid/568](http://www.transportenvironment.org/Publications/prep_hand_out/lid/568), details on car emissions determined in discussions with external experts
3. Delivering the 2020 Target

The 23 NREAPs indicate that by 2020 a total of 26 Mtoe (Million tonnes of oil equivalent) of biofuels will be being made use of by the relevant Member States. This represents 9.5% of energy in transport within these Member States being sourced from biofuels in 2020, taking account of energy efficiency gains anticipated. This compares to a total for usage of biofuels for all Member States of 10.2 Mtoe in 2008 or 9.4 Mtoe used in the relevant 23 Member States. The 2020 target is, therefore, anticipated to stimulate a major increase in the use of biofuels by 2020, with these remaining the primary technology for delivering renewable energy in the transport sector and delivering the RED 10% target.

Of this, the majority ie over 92% or 24.3 Mtoes of the biofuels utilised are anticipated to be conventional biofuels ie sourced primarily from agricultural feedstocks such as oil seeds, palm oil, sugar cane and beet, wheat, soy etc. This would represent 8.8% of the total energy used in transport by 2020. Advanced biofuels are anticipated to account only for 0.6% of total energy in transport by 2020 amounting to 1.7Mtoe by 2020 in the 23 Member States. It had been hoped that the bonus provided for in the RED for the use of advanced biofuels (ie that they count double towards the achievement of the 2020 target) might better stimulate their greater use. Despite this, however, it seems that production of large volumes of advanced biofuels will not be stimulated by the RED.

The anticipated scale of total biofuel use and the selective use of advanced biofuels by Member States is highly varied given the huge differences in the size and make up of national transport sectors. For example Germany is anticipated to use by far the highest volumes of biofuels in 2020, followed by the UK, France, Spain and Italy. This high user group is anticipated to account for a total of 19.5 Mtoe of biofuel by 2020 – see figure 2. All other Member States are each anticipating using less than 1 Mtoe biofuel by 2020.

In terms of use of advanced biofuels, Cyprus states that all its biofuels will be sourced from this group by 2020 while Denmark anticipates using primarily conventional biodiesel but only advanced bioethanol sources. Meanwhile others, including some major users, such as Austria, Greece, Lithuania, Luxembourg, Slovenia and the UK anticipate 100% use of conventional biofuels in 2020. The largest user by volume of advanced biofuels in 2020 is anticipated to be Italy (400 Ktoe ie thousand tonnes of oil equivalent), followed by Spain, France, Finland, Germany and the Netherlands. Advanced biodiesel based fuels are anticipated to account for almost double that of advanced bioethanol (1022 versus 539Ktoe respectively\textsuperscript{16}). Figure 2 presents the total projected usage of biofuels split between conventional and advanced biofuels, demonstrating the contrast in volumes. Figure 3 presents the overall percentage use of conventional biofuels by Member State with the proportion standing at over 80 per cent in the great majority.

\textsuperscript{16} It should be noted that Romania did not provide details of the break down of biofuel usage within its NREAP hence total figures for advanced biofuel usage different slightly from the breakdown between biodiesel and bioethanol.
There is much higher usage of biodiesel anticipated in 2020 than bioethanol; 72% of biofuels are anticipated to be sourced from biodiesel. In total 18.9 Mtoe of biodiesel are anticipated to be consumed in 2020 compared to 6.2 Mtoe of bioethanol. Only Sweden anticipates making use of over 50% bioethanol in 2020; by contrast Slovenia and Luxembourg would be utilising approximately 90% biodiesel.

In 2020 Member States are certainly not all anticipating to be sourcing their biofuels domestically with many relying on a high proportion of imports to secure biofuel supplies. On average the 23 Member States are anticipating importing 50% of bioethanol and 41% of biodiesel in 2020, equating to 3.1 and 7.7 Mtoe respectively. The reliance on imports and the total volumes involved varies significantly across the Member States, with imports accounting for between 100% and 0% of biofuels depending on the country. It should, however, be noted that it is unclear from many of the NREAPs whether the figures for imports relate explicitly to...
the importing of all materials to be used as biofuels in 2020 into the country concerned ie whether they include both raw feedstocks for conversion to biofuels in country and pre-processed biofuels or whether they relate only to pre-processed biofuels. Examining the figures it is considered that a mixture of approaches to this calculation has been applied by national governments. Therefore, overall levels of imports related to biofuel consumption may higher than reported. Imports relate to levels entering the market in that particular Member State, therefore, probably include exports from other EU countries.

The UK is anticipated to be importing by far the largest quantities of bioethanol in 2020, anticipating use of 1.5 Mtoe of imported bioethanol or 81% of its total bioethanol usage; levels of imports of bioethanol by all other Member States lie below 450Ktoe. Germany and the UK anticipate significantly greater volumes of biodiesel imports than other Member States, 2.9 and 2.2 Mtoe respectively or 64 and 91% of their biodiesel usage. In total the UK is expected to be the highest importer of biofuels by volume utilising 3.7 Mtoe of imported biofuels in 2020. Figure 4 presents the anticipated reliance on imports of biofuels per Member State in percentage terms.

Figure 4 – Reported reliance of the Member States on the imports of Biofuels to Meet Demand in 2020

It should be noted that Romania did not report the breakdown between different biofuel sourcing and usage within the NREAP therefore they are excluded from this figure.

Liquid fuels from biomass can also be used in stationary energy sources, such as diesel generators or space heaters replacing fossil fuels to provide heat and power. These bioliquids would be anticipated to be sourced in the same manner to biofuels and are subject to the same sustainability criteria under the RED. For those countries utilising bioliquids this would result in impacts additional to those associated with transport demand. Consequently, bioliquids should also be considered in any ILUC assessment for biofuels and also within policies designed to alleviate this. The scale of additional impact associated with bioliquids is discussed in section 8 of this report. Within their NREAPs only eight of the 23 Member States explicitly specified that they anticipate making use of bioliquids within these stationary sources, generating an additional demand for 5,462Ktoe primarily associated with heating - anticipated usage by Member State is presented within Table 1. Additionally the UK noted in their NREAP that they have yet to determine levels of bioliquid usage.
Table 1 – Anticipated use of bioliquids in heating and electricity supply

<table>
<thead>
<tr>
<th>Member State</th>
<th>Total bioliquids in stationary sources – Ktoe by 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>3</td>
</tr>
<tr>
<td>Denmark</td>
<td>9</td>
</tr>
<tr>
<td>Finland</td>
<td>3021</td>
</tr>
<tr>
<td>Germany</td>
<td>836</td>
</tr>
<tr>
<td>Italy</td>
<td>568</td>
</tr>
<tr>
<td>Portugal</td>
<td>932</td>
</tr>
<tr>
<td>Slovenia</td>
<td>28</td>
</tr>
<tr>
<td>Sweden</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>5,462</td>
</tr>
</tbody>
</table>

4. Anticipated Increase in Biofuel Usage Associated with the RED

To assess the ILUC impacts associated with the increase in biofuels use generated by the RED it is necessary to understand the baseline usage of biofuels prior to the Directive coming into force. Within this analysis the baseline usage of biofuels is assumed to be equivalent to total consumption in 2008, based on data reported in the Euroobserver. This baseline is equivalent to others used within the RED to determine the limit of its influence. The additional biofuel demand generated by the RED would, therefore, be the difference between 2008 figures and predicted figures for 2020.

At present ILUC assessments have only been completed to assess the impact of conventional biofuels. While it is noted that advanced biofuels, especially those based on lingo cellulosic technologies or non-food crops will also place demand on land it is not currently possible to appropriately estimate their impact with much accuracy. As a consequence this assessment of the increase in biofuel consumption is confined to the anticipated rise in the consumption of conventional biofuels up to 2020. Given the limited market penetration of advanced biofuels in 2008 it is assumed that all biofuel usage in that year was conventional. For the purpose of this analysis the increase in conventional fuel use associated with the RED is, therefore, total EU 2020 biofuel consumption less total 2008 biofuel use and minus any use of advanced biofuels in 2020. The uncertain impacts of advanced biofuels, which will be responsible for some additional ILUC, are thus set aside.

Based on the data specified in the NREAPs by 2020 total additional usage of conventional biofuels is calculated to be 15.1 Mtoe, with a split of 72% new biodiesel demand and 28% new bioethanol demand. While the UK will not be the highest user of biofuels in 2020, it foresees the greatest increase in conventional biofuel use due to the relatively low 2008 baseline, the lack of use of advanced biofuels and low assumptions regarding energy efficiency in the transport sector by 2020. Germany, while the largest overall user of biofuels in 2020 drops to third place in the ranking of additional demand due to the relatively high 2008 baseline and the inclusion of advanced biofuels and higher levels of other renewable energy sources in the transport mix in 2020. Amongst the 23 Member States reviewed the UK, Spain, Germany, Italy and France account for 72% of the additional biofuel demand between 2008 and 2020.
Table 2 – Increase in conventional biofuel usage anticipated as a consequence of the RED, between 2008 and 2020

<table>
<thead>
<tr>
<th>Country</th>
<th>Increase in Bioethanol Usage, 2008 to 2020 (Ktoe)</th>
<th>Increase in Biodiesel Usage, 2008 to 2020 (Ktoe)</th>
<th>Increase in Biofuels Usage, 2008 to 2020 (Ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UK</td>
<td>1640</td>
<td>1764</td>
<td>3403</td>
</tr>
<tr>
<td>Spain</td>
<td>255</td>
<td>2380</td>
<td>2635</td>
</tr>
<tr>
<td>Germany</td>
<td>396</td>
<td>1963</td>
<td>2360</td>
</tr>
<tr>
<td>Italy</td>
<td>442</td>
<td>972</td>
<td>1414</td>
</tr>
<tr>
<td>France</td>
<td>160</td>
<td>916</td>
<td>1076</td>
</tr>
<tr>
<td>Greece</td>
<td>414</td>
<td>136</td>
<td>550</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>66</td>
<td>396</td>
<td>462</td>
</tr>
<tr>
<td>Ireland</td>
<td>121</td>
<td>304</td>
<td>425</td>
</tr>
<tr>
<td>Netherlands</td>
<td>143</td>
<td>252</td>
<td>394</td>
</tr>
<tr>
<td>Sweden</td>
<td>250</td>
<td>123</td>
<td>373</td>
</tr>
<tr>
<td>Romania</td>
<td>140</td>
<td>228</td>
<td>366</td>
</tr>
<tr>
<td>Portugal</td>
<td>27</td>
<td>313</td>
<td>340</td>
</tr>
<tr>
<td>Finland</td>
<td>26</td>
<td>280</td>
<td>306</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>42</td>
<td>150</td>
<td>192</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>22</td>
<td>150</td>
<td>172</td>
</tr>
<tr>
<td>Slovenia</td>
<td>17</td>
<td>154</td>
<td>171</td>
</tr>
<tr>
<td>*Denmark</td>
<td>-5</td>
<td>130</td>
<td>125</td>
</tr>
<tr>
<td>Lithuania</td>
<td>20</td>
<td>85</td>
<td>106</td>
</tr>
<tr>
<td>Austria</td>
<td>25</td>
<td>79</td>
<td>104</td>
</tr>
<tr>
<td>Slovakia</td>
<td>43</td>
<td>22</td>
<td>65</td>
</tr>
<tr>
<td>Latvia</td>
<td>0</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Malta</td>
<td>6</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>*Cyprus</td>
<td>0</td>
<td>-14</td>
<td>-14</td>
</tr>
<tr>
<td>Total</td>
<td>4250</td>
<td>10797</td>
<td>15047</td>
</tr>
</tbody>
</table>

*Cyprus and Denmark show negative figures as they anticipate making use of a high proportion of advanced biofuels by 2020. Given that it is not possible to take account of the impacts of these fuels at present these negative figures were excluded from further analysis.

** It should be noted that in their NREAP Romania did not report the split between different biofuel uses in 2020, in order to enable further calculations the total figure for Romanian biofuel usage was differentiated between bioethanol and biodiesel sources based on the average split across all other Member States.

5. Calculating Indirect Land Use Change

To convert the increase in biofuel demand generated by the RED into an approximation of ILUC impact it is necessary to apply a conversion factor predicting the anticipated extent of ILUC in terms of area change per unit of additional biofuel consumed. There are a number of economic models that have been developed to estimate the impact of a marginal increase in biofuel production. A comparative analysis of the outputs of these models has been undertaken by the Joint Research Council (JRC). The JRC analysis presents a range of potential factors that could be used to convert estimates of biofuel consumption into estimates of associated land use change and enables these to be compared and contrasted. For the purposes of this study the comparative analysis completed by the JRC has been used as a basis for determining robust ILUC conversion factors, which have been applied using upper and lower bounds.

While the scenarios specified within the JRC study as a basis for modelling efforts are not perfectly tailored to the anticipated fuel mix in 2020, they provide the best available proxy for converting a given volume of biofuel use to anticipated area of associated ILUC. Clearly this can be achieved only at an aggregated level. The assumptions in the different models have an
important influence on the resulting outcomes. To ensure the overall rigour of this exercise and that the model results and conversion factors were appropriately applied, we consulted a number of experts within the field and examined in detail the model assumptions to develop the best set of conversion factors for this analysis.

The ILUC conversion factors used within this assessment are presented in table 3. A summary of the logic behind the determination of these factors is presented in the Annex of this report, calculations. Lower and upper bounds were used in the analysis to take account of the differences in outcomes associated with variable modelling assumptions and consequent outputs. The ILUC conversion factors are multiplied by the anticipated additional usage of conventional bioethanol and biodiesel in 2020 to provide an estimated area in hectares of the potential ILUC.

Table 3 – ILUC conversion factors, expressed as thousand hectares of ILUC resulting from 1 Ktoe of additional biofuel consumption.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>ILUC conversion factor; 1000 ha per Ktoe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Bioethanol</td>
<td>0.39</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>0.23</td>
</tr>
</tbody>
</table>

It should be noted that the factors derived represent relatively conservative estimates of ILUC based on the JRC analysis and are likely to underestimate real GHG impacts associated with the expanded agricultural production arising from ILUC. This is a consequence of the assumptions used within the modelling exercises. In particular the majority of models assume higher levels of yields than are likely to be realised on land that is drawn into arable production at the frontiers of cultivation. The JRC study also notes that the mix of feedstocks used in the production of biodiesel in some cases over estimates anticipated yield increases expected in the palm oil sector. Moreover, as noted above, advanced biofuels and bioliquids will also have a land use impact additional to those arising from conventional biofuels, which it is not possible to take into account here. Finally, the calculations of GHG impacts associated with ILUC, and more generally with increased biofuel demand, are likely to inherently underestimate GHG emissions, as noted below.

Estimates for emissions associated with ILUC only take into account the one-off release of GHGs associated with the change of one land use to another. As such they do not take account of the following additional sources of GHG emissions that would be associated with expanded and more intensified cultivation of crops:

- there is no allowance made for any sequestration forgone into the longer term by removal of a previous land cover, which might be significant in the case for example of young growth forest converted to arable;
- estimates for ILUC often do not take into account that much land brought into arable use will likely be less suited to cultivation than the existing area and therefore give lower yields for a given level of inputs, hence emissions from cultivation may be higher than the average; and
- all the ILUC models assume in addition to land use change a certain proportion of intensification of existing agricultural production, which in turn is anticipated to lead to higher GHG emissions per tonne of crop harvested. This would, for example, be associated with use of nitrogen rich fertilisers or loss of soil organic matter during ongoing cultivation.
6. Anticipated Indirect Land Use Change – the Size of the Challenge

The ILUC impacts attributable to additional conventional biofuel usage by 2020 in all 23 Member States assessed within this study are between 4.1 and 6.9 million ha. At the lower end this would be approximately equivalent to land use changing across the total area of arable land in Hungary or double that in Denmark, Finland or Lithuania; or at the upper end would be equivalent to doubling the total area of arable land in the UK or a 50% increase in arable land in either Poland or Spain. This would also equate to at the lower end an area slightly larger than Belgium or just smaller than the Netherlands and at the upper end an area slightly larger than Latvia or Lithuania and just under that of Republic of Ireland. Another way of putting this would be that this is the same area as between 82% and 138% of land used for palm oil production in Indonesia during 2008.

Table 4 presents the ILUC estimates arising from projected biofuel usage per Member State. It should be noted that this land use change is unlikely to take place in the country in question but will impact either within or beyond Europe, with the nature of this determined by the feedstocks used; as a consequence this represents a significant European footprint across the globe. To continue the comparison with the area of palm oil production in Indonesia, at the upper end of the estimates, the UK, Spain and Germany would each be responsible for an ILUC impact that was equivalent to more than 20% of land currently used for Indonesian palm oil production.

To provide a sense of scale of the anticipated ILUC impact figure 5 compares the anticipated change associated with a Member State’s consumption of conventional biofuels to the area of arable land in use within that Member State. In this respect the proportionate ILUC impact is highest in those Member States with limited area of arable land per capita ie effectively those characterised by denser development patterns and higher per capita transport needs. The UK, Slovenia, Malta and Luxembourg would all be responsible for ILUC (at the upper level) equivalent to more than 20% of their own arable land area.

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17 Arable land is defined by the Food and Agriculture Organization of the United Nations (FAO) as: land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for “Arable land” are not meant to indicate the amount of land that is potentially cultivable - this is a wider category under the FAO statistics, called agricultural land.

18 Based on data for 2007 from the FAO.
19 Based on Eurostat data from 2004 regarding country area.
Table 4 – Estimated ILUC per Member State associated with increased demand for conventional biofuels between 2008 and 2020.

<table>
<thead>
<tr>
<th>Member State</th>
<th>Lower estimate of total ILUC - 1000 ha</th>
<th>Upper estimate of total ILUC - 1000 ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Kingdom</td>
<td>1044</td>
<td>1615</td>
</tr>
<tr>
<td>Spain</td>
<td>647</td>
<td>1167</td>
</tr>
<tr>
<td>Germany</td>
<td>606</td>
<td>1059</td>
</tr>
<tr>
<td>Italy</td>
<td>395</td>
<td>651</td>
</tr>
<tr>
<td>France</td>
<td>273</td>
<td>481</td>
</tr>
<tr>
<td>Greece</td>
<td>192</td>
<td>273</td>
</tr>
<tr>
<td>Sweden</td>
<td>126</td>
<td>183</td>
</tr>
<tr>
<td>Ireland</td>
<td>117</td>
<td>195</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>117</td>
<td>206</td>
</tr>
<tr>
<td>Netherlands</td>
<td>113</td>
<td>183</td>
</tr>
<tr>
<td>Romania</td>
<td>107</td>
<td>172</td>
</tr>
<tr>
<td>Portugal</td>
<td>83</td>
<td>150</td>
</tr>
<tr>
<td>Finland</td>
<td>74</td>
<td>135</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>51</td>
<td>87</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>43</td>
<td>77</td>
</tr>
<tr>
<td>Slovenia</td>
<td>42</td>
<td>76</td>
</tr>
<tr>
<td>Denmark</td>
<td>30</td>
<td>56</td>
</tr>
<tr>
<td>Austria</td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td>Lithuania</td>
<td>28</td>
<td>48</td>
</tr>
<tr>
<td>Slovakia</td>
<td>22</td>
<td>32</td>
</tr>
<tr>
<td>Malta</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Latvia</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4143</strong></td>
<td><strong>6902</strong></td>
</tr>
</tbody>
</table>

Figure 5 – Estimate of Member States’ proportionate ILUC impact – comparing the area of ILUC from conventional biofuels to the area of arable land available in each Member State.

7. *Indirect Land Use Change – The GHG Consequences*

GHG emissions associated with land use change are the consequence of a loss of carbon from soils and pre-existing biomass. They represent a one-off ‘hit’ of emissions associated with that land’s change in status. It is these emissions that are estimated here, based on the anticipated level of ILUC calculated above. To convert land use change into consequent GHG emissions a conversion factor must be applied. The level of GHG emissions associated with land use change
will vary depending on prior land use; therefore, there is a wide range of possible conversion factors. To take this into account emission levels were calculated based on three different factors utilised in other similar assessments.\(^{21}\)

Table 5 – The range of default values used to convert land use change in ha to GHG emissions

<table>
<thead>
<tr>
<th>Default values for land conversion - GHG impact</th>
<th>38 tC/ha</th>
<th>40 tC/ha</th>
<th>95 tC/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower (based on IPCC lower default value for conversion to cropland)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central (adopted by JRC as a basis for its calculation)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper (based on IPCC upper default value for conversion to cropland)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For simplicity the figures presented within the rest of this section represent a mean of the values gained from applying all three conversion factors – in essence equivalent to 57 tC/ha\(^{22}\). This is justified given that in reality a number of different land types will be converted as a consequence of ILUC. Using this assumption, table 6 presents the average total GHG emissions resulting from ILUC as a consequence of the anticipated increase in biofuel use up to 2020. As this is a one off emission of GHGs associated with the change in land use it has been converted to annualised emissions, based on the 20 year time horizon specified in the RED. For total ILUC associated with biofuel use within the 23 Member States the annualised emissions are between 44 and 73 Million tonnes of CO2 equivalent. At the upper end this is the equivalent to the total GHG emissions generated by either Bulgaria or Hungary in 2007. Put another way this would represent just under 16% of emissions from the EU’s agricultural sector or just over 7% of total EU transport emissions in 2007.

\(^{21}\) It is noted that there are conversion factors that sit above and below the levels specified in table 6. The range proposed is considered the most appropriate for conversion to croplands.

Table 6 – Total ILUC related GHG emissions based on the mean values for land conversion – The table presents the totals per Member State in terms of ILUC emissions to deliver the additional volume of biofuels by 2020 specified in the 23 NREAPs and the annualised GHG emissions per year per Member State, based on a 20 year time horizon (as specified in the RED).

<table>
<thead>
<tr>
<th>Member State</th>
<th>Total GHG emissions associated with ILUC from additional biofuel use in 2020</th>
<th>Annualised emissions associated with total ILUC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower ILUC; Mt CO2e</td>
<td>Upper ILUC; Mt CO2e</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>220.71</td>
<td>341.39</td>
</tr>
<tr>
<td>Spain</td>
<td>136.71</td>
<td>246.75</td>
</tr>
<tr>
<td>Germany</td>
<td>128.10</td>
<td>223.89</td>
</tr>
<tr>
<td>Italy</td>
<td>83.62</td>
<td>137.66</td>
</tr>
<tr>
<td>France</td>
<td>57.72</td>
<td>101.74</td>
</tr>
<tr>
<td>Greece</td>
<td>40.66</td>
<td>57.71</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>24.69</td>
<td>43.64</td>
</tr>
<tr>
<td>Ireland</td>
<td>24.75</td>
<td>41.20</td>
</tr>
<tr>
<td>Netherlands</td>
<td>23.99</td>
<td>38.76</td>
</tr>
<tr>
<td>Sweden</td>
<td>26.56</td>
<td>38.64</td>
</tr>
<tr>
<td>Romania</td>
<td>22.61</td>
<td>36.27</td>
</tr>
<tr>
<td>Portugal</td>
<td>17.45</td>
<td>31.75</td>
</tr>
<tr>
<td>Finland</td>
<td>15.73</td>
<td>28.57</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>10.76</td>
<td>18.41</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>9.12</td>
<td>16.23</td>
</tr>
<tr>
<td>Slovenia</td>
<td>8.89</td>
<td>16.02</td>
</tr>
<tr>
<td>Denmark</td>
<td>6.31</td>
<td>11.93</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5.82</td>
<td>10.07</td>
</tr>
<tr>
<td>Austria</td>
<td>5.93</td>
<td>10.05</td>
</tr>
<tr>
<td>Slovakia</td>
<td>4.61</td>
<td>6.72</td>
</tr>
<tr>
<td>Latvia</td>
<td>0.53</td>
<td>1.01</td>
</tr>
<tr>
<td>Malta</td>
<td>0.63</td>
<td>0.92</td>
</tr>
<tr>
<td>Total</td>
<td>876</td>
<td>1459</td>
</tr>
</tbody>
</table>

To qualify towards the delivery of the RED targets, biofuels must deliver a certain proportion of GHG savings, which rises from 35% in 2011 to 50% by 2017. For the purpose of this exercise, it is assumed that biofuels consumed in response to the RED conform to these criteria, aside from their ILUC impact. To understand the overall consequences for emissions associated with additional biofuel usage stimulated by the RED targets this GHG benefit must, therefore, be subtracted from the emissions associated with ILUC23.

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23 The GHG savings were calculated by assuming a linear increase from 2008 to 2020 in terms of the volume of biofuel usage per year per Member State. The volume of usage in 2008 was then subtracted from this to provide a figure of additional use associated with the RED comparable to the ILUC figure. The additional usage per year was then multiplied by the GHG emission reductions required under the RED for that given year, this reduction was based on the assumption of a linear increase in reductions from 2011 at 35% to 50% in 2017, additional savings were then assumed at the same rate up to 56% in 2020. The GHG emission reductions are based on the savings specified in the RED and the assumptions specified within the Annexes of the RED that fossil based petrol and diesel generate 43 MJ/kg of energy and that for each MJ 83.8gCO2e are released. As the RED only specifies reductions in emissions from 2011 onwards, meaning it is unclear the level of reduction in 2008-2010. As a consequence this calculation of additional emissions was only applied to 2011 to 2020.
When account is taken of biofuels anticipated GHG savings from switching from fossil fuels to biofuels between 2011 and 2020\(^2\) (the dates specified in the RED) total additional emissions from ILUC associated with the increased use of biofuels are still anticipated to range from 273 and 565 MtCO\(_2\)e or between 2.9 and 6 gCO\(_2\)e/kg\(\text{e}.\) This effectively represents emissions that would be additional to those arising were Europe to remain reliant on fossil fuels to provide for our transport needs up to 2020. This equates to additional GHG emissions of between 27.3 and 56.5 MtCO\(_2\)e on an annualised basis\(^2\). At the upper end this is comparable to just over 12\% of emissions from agriculture in the EU in 2007 or just under 6\% of emissions from transport in the EU in 2007. Put another way, the additional GHG emissions associated with ILUC up to 2020 would amount to the equivalent of placing between 12.4 and 25.6 Million additional cars on the road across Europe in 2020\(^2\). Based on the assumptions set out in this study the additional emissions from ILUC, associated with the predicted increase in conventional biofuels use within the 23 Member States up to 2020, can be estimated to lead to between 80.5 and 166.5\% more GHG emissions than if that same fuel need were met using fossil fuels ie diesel and petrol\(^2\).

Figure 6 – Additional GHG emissions anticipated as a consequence of ILUC associated with the expansion in biofuel demand up to 2020 – these represent emissions over and above what would be expected if fossil fuels were to continue to account for these quantities of transport fuels given that GHG savings associated with biofuel use have been subtracted.

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\(^2\) Both ILUC emissions and the emissions saved were based on the additional usage of biofuels above the 2008 baseline up to 2020.

\(^2\) Annualised figures based on the 20 year discounting period specified in the RED for land use change were used in order to provide the 2011 to 2020 figures – see footnote 22. To provide the annualised data in this instance it is, therefore, appropriate to divide the total ILUC figure up to 2020 by the number of years between 2011 and 2020 to avoid double counting of this reduction.

\(^2\) The number of additional cars on the road is calculated by dividing the additional GHG emissions from ILUC on an annualised basis by the estimated level of emissions per car in 2020. The latter is calculated based on the assumption that on average cars will produce 170gCO\(_2\)e/km in 2020 and will travel on average 13,000km per year. This equates to 2.21tCO\(_2\)e per car per year. These calculations are based on established scenarios for future car use in Europe.

\(^2\) This calculation is based on the standard default values for fossil fuels in the RED, Annex III.
Table 7 – Comparing the additional annualised GHG emissions as a consequence of ILUC due to expanded use of biofuels up to 2020 by Member State and the number of additional cars on the road these figures would equate to in 2020.

<table>
<thead>
<tr>
<th></th>
<th>Annualised emissions from additional ILUC</th>
<th>Additional million cars on the road in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower ILUC; Mt CO2e</td>
<td>Upper ILUC; Mt CO2e</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>7.31</td>
<td>13.34</td>
</tr>
<tr>
<td>Spain</td>
<td>3.95</td>
<td>9.45</td>
</tr>
<tr>
<td>Germany</td>
<td>3.82</td>
<td>8.61</td>
</tr>
<tr>
<td>Italy</td>
<td>2.63</td>
<td>5.34</td>
</tr>
<tr>
<td>France</td>
<td>1.71</td>
<td>3.91</td>
</tr>
<tr>
<td>Greece</td>
<td>1.43</td>
<td>2.28</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>0.73</td>
<td>1.68</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.77</td>
<td>1.59</td>
</tr>
<tr>
<td>Sweden</td>
<td>0.92</td>
<td>1.52</td>
</tr>
<tr>
<td>Netherlands</td>
<td>0.77</td>
<td>1.51</td>
</tr>
<tr>
<td>Romania</td>
<td>0.73</td>
<td>1.41</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.50</td>
<td>1.22</td>
</tr>
<tr>
<td>Finland</td>
<td>0.45</td>
<td>1.09</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>0.33</td>
<td>0.71</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>0.27</td>
<td>0.62</td>
</tr>
<tr>
<td>Slovenia</td>
<td>0.26</td>
<td>0.61</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.18</td>
<td>0.46</td>
</tr>
<tr>
<td>Austria</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>Lithuania</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>Slovakia</td>
<td>0.16</td>
<td>0.26</td>
</tr>
<tr>
<td>Latvia</td>
<td>0.01</td>
<td>0.04</td>
</tr>
<tr>
<td>Malta</td>
<td>0.02</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>27</strong></td>
<td><strong>56</strong></td>
</tr>
</tbody>
</table>
Figure 7 – The proportion of 2007 GHG emissions from transport that would be accounted for by the annualised, additional emissions from ILUC. The Member State figures are compared to the overall value for the 23 Member States reviewed to provide a basis for comparison. The position of a Member State will depend on both the level of ILUC associated emissions and the scale of transport emissions in 2007.

Figure 8 – The per capita CO2 emissions associated with additional ILUC emissions per Member State based on the upper estimates of additional ILUC emissions. This graph demonstrates which Member States are above and below the overall average for the 23 countries reviewed in terms of per capita impact. It demonstrates the intensity of a populations ILUC GHG impact.
8. Assessing the Total Impact including Bioliquids

Eight of the 23 NREAPs available specify that the relevant Member State will make use of bioliquids for heat and power as well as biofuels for transport in 2020 (additionally the UK specifies that it has yet to determine anticipated bioliquid usage). Given that bioliquids are in essence the same product as biofuels, albeit utilised in a different way, and that they are subject to the same rules under the RED the impact of their use alongside biofuels will have a cumulative impact in terms of land use change and more specifically ILUC. This section examines briefly the additional ILUC impact anticipated to be associated with bioliquid use in 2020.

In total the additional use of conventionally produced bioliquids from the eight Member States is estimated to be 4350 Ktoe. Member States were not required to specify the split of bioliquid use between conventional and advanced biofuels, therefore, this figure was calculated using the same proportional usage of conventionally produced bioliquids as was reported for biofuels. This is appropriate given that the sourcing from biofuels and bioliquids is likely to be from the same material streams. In total the additional demand for bioliquids would be equivalent to 28% of the total demand for conventional biofuels in 2020. The majority of this material is anticipated to be made use of by Finland and Portugal. The usage of bioliquids in these Member States is anticipated to be far greater than for conventional biofuels in 2020 – see table 10.

Given the more limited data provided on bioliquid use in the NREAPs, compared to biofuel use, it was necessary to make two assumptions to enable ILUC to be calculated. These were: firstly that bioliquids would be made up entirely of biodiesel in 2020; and secondly that no bioliquids are in use at present for heating and electricity - as there is no comparable baseline data. Based on applying the same conversion factors as for biofuels the following estimates for the area of ILUC and GHG emissions associated with bioliquids were made.

Bioliquids are anticipated to result in an additional area of ILUC between 1000 and 1892 thousand ha, contributing between 211 and 399 million tonnes of additional CO2e - see tables 11 and 12. In total biofuels are anticipated to lead to emissions between 875 and 1459 MtCO2e – based on figures unadjusted for GHG savings. Cumulatively, biofuels and bioliquids combined would lead to emission levels of between 1087 and 1858 MtCO2e by 2020.

Table 10 - Calculating the usage of bioliquids from conventional feedstocks in 2020 based on the proportion of convention biofuel use in the relevant Member State and comparing the scale of usage of bioliquids to biofuels in 2020.

<table>
<thead>
<tr>
<th>Member State</th>
<th>% conventional biofuel use in 2020</th>
<th>Use of conventional bioliquids in stationary sources in 2020; Ktoe</th>
<th>Additional use of conventional biofuels in 2020 compared to 2008 - Ktoe</th>
<th>Comparing the impact of bioliquids to biofuels; conventional bioliquid use as a percentage of conventional biofuels use in 2020.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>68</td>
<td>2050</td>
<td>306</td>
<td>670%</td>
</tr>
<tr>
<td>Portugal</td>
<td>98</td>
<td>916</td>
<td>340</td>
<td>269%</td>
</tr>
<tr>
<td>Germany</td>
<td>97</td>
<td>812</td>
<td>2360</td>
<td>34%</td>
</tr>
<tr>
<td>Italy</td>
<td>84</td>
<td>478</td>
<td>1414</td>
<td>33%</td>
</tr>
<tr>
<td>Sweden</td>
<td>88</td>
<td>57</td>
<td>373</td>
<td>15%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>100</td>
<td>28</td>
<td>171</td>
<td>16%</td>
</tr>
<tr>
<td>Member State</td>
<td>Lower</td>
<td>Upper</td>
<td>Lower</td>
<td>Upper</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Finland</td>
<td>472</td>
<td>892</td>
<td>16</td>
<td>29</td>
</tr>
<tr>
<td>Portugal</td>
<td>211</td>
<td>399</td>
<td>17</td>
<td>32</td>
</tr>
<tr>
<td>Germany</td>
<td>187</td>
<td>353</td>
<td>128</td>
<td>224</td>
</tr>
<tr>
<td>Italy</td>
<td>110</td>
<td>208</td>
<td>84</td>
<td>138</td>
</tr>
<tr>
<td>Sweden</td>
<td>13</td>
<td>25</td>
<td>27</td>
<td>39</td>
</tr>
<tr>
<td>Slovenia</td>
<td>6</td>
<td>12</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>Denmark</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Austria</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>1000</td>
<td>1892</td>
<td>876</td>
<td>1459</td>
</tr>
</tbody>
</table>

Table 11 – The table sets out the total area of ILUC anticipated to be caused by the use of bioliquids as specified in the NREAPs.

<table>
<thead>
<tr>
<th>Member State</th>
<th>GHG emissions from ILUC associated with bioliquids – MtCO2e Lower</th>
<th>Upper</th>
<th>GHG emissions from ILUC associated with biofuels – MtCO2e Lower</th>
<th>Upper</th>
<th>Total GHG emissions from both biofuels and bioliquids - MtCO2e Lower</th>
<th>Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>100</td>
<td>188</td>
<td>16</td>
<td>29</td>
<td>115</td>
<td>217</td>
</tr>
<tr>
<td>Portugal</td>
<td>45</td>
<td>84</td>
<td>17</td>
<td>32</td>
<td>62</td>
<td>116</td>
</tr>
<tr>
<td>Germany</td>
<td>39</td>
<td>75</td>
<td>128</td>
<td>224</td>
<td>168</td>
<td>299</td>
</tr>
<tr>
<td>Italy</td>
<td>23</td>
<td>44</td>
<td>84</td>
<td>138</td>
<td>107</td>
<td>182</td>
</tr>
<tr>
<td>Sweden</td>
<td>3</td>
<td>5</td>
<td>27</td>
<td>39</td>
<td>29</td>
<td>44</td>
</tr>
<tr>
<td>Slovenia</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>16</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Denmark</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>12</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Austria</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>211</td>
<td>400</td>
<td>876</td>
<td>1459</td>
<td>1087</td>
<td>1859</td>
</tr>
<tr>
<td>Annualised emissions (divided over 20 years)</td>
<td>11</td>
<td>20</td>
<td>44</td>
<td>73</td>
<td>54</td>
<td>93</td>
</tr>
</tbody>
</table>

Table 12 – Presents the additional GHG emissions anticipated as a consequence of ILUC associated with bioliquids, this is compared to the unadjusted levels of ILUC anticipated from biofuels with a revised total present as to the cumulative GHG impacts of both biofuels and bioliquids.
9. Conclusions

This study shows that the 23 Member States examined are predominantly anticipating using conventional biofuels to deliver their 2020 renewable transport target under the RED, requiring an additional 15.1 Mtoe of supply compared to 2008 levels. As a consequence of this expanded use of conventional biofuel use ILUC could be estimated to account for between 4.1 and 6.9 million ha for biofuels alone.

Assuming there is no further action undertaken to address ILUC, the major increase in the use of conventional biofuels and the consequent change in land use has been calculated to lead to between 44 and 73 million tonnes of CO2 equivalent being released on an annualised basis. Even when the GHG emission savings required under the RED sustainability requirements for biofuels are taken into account, rather than aiding climate change mitigation up to 2020, the use of these biofuels would lead to the production of additional GHG emissions. As a consequence the use of these additional conventional biofuels could not be considered to contribute to the achievement of EU climate change policy goals.

Not only does this study suggest that ILUC associated with the reported additional use of conventional biofuels up to 2020 would lead to additional GHG emissions in 2020, the additional quantities of emissions are substantial. Using the method adopted in this study these additional emissions are estimated to range from 27.3 to 56.4 MtCO2e on an annual basis up to 2020. Indeed, this estimate would represent emissions from ILUC 80.5 to 166.5% worse than would be delivered from continued reliance on fossil fuels in the transport sector. These results clearly depend upon the assumptions adopted within this study, primarily the level of ILUC associated with the use of conventional biofuels and the level of GHG emissions associated with land use change.

Given ongoing uncertainties about the location and consequences of ILUC, every effort was made to adopt the most appropriate assumptions based on the evidence available at the time of drafting. The key assumptions and the rationale for them are set out transparently throughout the report. These assumptions could be improved through better knowledge of the types of feedstock to be used for biofuel production and likely locations of supply, providing a better understanding of likely displacement effects. Hopefully this will become available in due course. It will also be important to seek greater consensus over the assumptions and parameters to be applied during modelling and application of the predicted levels of biofuel use up to 2020 and the ILUC impacts.

Nonetheless, the level of uncertainty is diminishing. Sensitivity analysis completed during the work demonstrates that the overarching message of failure to deliver GHG savings from conventional biofuel use remains the same even when far lower estimates of ILUC and GHG emissions from land use change are applied. This underlines the need to address the question of ILUC associated with biofuel use as a priority. The current evidence clearly points to ILUC emissions undermining the arguments for the use of conventional biofuels as an environmentally sustainable, renewable technology. Moreover, this analysis raises questions about the appropriateness of anticipated conventional biofuels use by the Member States up to 2020. In addition to action on ILUC the GHG consequences of biofuel use could be reduced substantially by focusing increased effort on alternative routes for delivery of the 2020 targets, for example by greater efficiency savings in the sector and increased emphasis on the use of advanced fuels.
Certain national governments are anticipating making use of a significant quantity of bioliquids to deliver renewable energy for heat and electricity up to 2020, in addition to biofuels. This will require an expansion in the same crops and resources as for biofuels. Eight Member States reported in their NREAPs that they will make use of bioliquids in 2020; amounting to an estimated 4.4 Mtoe of conventionally produced fuels. This would equate to an additional ILUC impact of between 1 and 1.9 million ha and GHG emissions of between 211 and 400 MtCO2e. When figures for bioliquids and biofuels are combined the total area of ILUC would rise to between 5.1 and 8.8 million ha. The total associated GHG emissions would also increase, leading to a combined figure of between 1087 and 1859 MtCO2e or between 54 and 93 MtCO2e on an annualised basis (before any emissions savings are discounted).

10. Annex

Glossary of Terms and Abbreviations

- **Advanced biofuels** – Also known as second generation fuels, in the context of this study these are defined as the types of biofuels specified under Article 21.2 of the RED as counting as double towards the achievement of the 2020 targets. These include biofuels produced from wastes, residues, non-food cellulosic material, and ligno-cellulosic.
- **Arable land** - defined by the Food and Agriculture Organization of the United Nations (FAO) as: land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category.
- **Biofuels versus bioliquids** – Within the RED bioliquids are defined as - liquid fuel for energy purposes other than for transport, including electricity and heating and cooling, produced from biomass; whereas biofuels are defined as liquid or gaseous fuel for transport produced from biomass.
- **CO2e** – Carbon Dioxide equivalent, used as a standardised metric for evaluating GHG impact.
- **Conventional biofuels** - Also known as first generation fuels, in the context of this study these are in essence produced from primarily food crops. This commonly includes maize, sugar cane, sugar beet, wheat, palm oil, oil seeds such as rape and soy.
- **Ha** - Hectare
- **Ktoe or Mtoe**- Kilo Tonnes of Oil Equivalent or Mega Tonnes of Oil Equivalent, i.e. 1 thousand or 1 million tonnes – used as a standard metric for evaluating energy use.
- **MJ** – Megajoules
- **NREAP** – National Renewable Energy Action Plan – dossier specified in the RED within which Member States must report on how they propose to meet the 2020 targets for renewable energy and renewable transport fuels

Calculations - Conversion Methodology

The conversion factors used for calculating the scale of ILUC in hectares were divided into upper and lower factors for both bioethanol and biodiesel. These were then combined to provide the overall ILUC figures for biofuels up to 2020. The basis for determining the conversion factors within this study was the comparative study completed by JRC in which various models developed to assess ILUC were reviewed. This included outputs from key EU
based and international modelling teams who have developed economic models to determine the extent to which land use will change as a consequence of increased demand for biofuel feedstock commodities. JRC asked the modelling teams to run four standardised scenarios intended to imitate different types of increase in demand for biofuel feedstocks aimed at understanding the consequent scale of land use change. The models assessed by the JRC were AGLINK-COSIMO (from OECD), CARD (from FAPRI-ISU), IMPACT (from IFPRI), G-TAP (from Purdue University), LEI-TAP (from LEI) and CAPRI (from LEI). In addition there is also the IFPRI–MIRAGE model considered separately from the JRC analysis. At the time of drafting, however, concerns regarding the assumptions adopted in this particular model combined with the fact that the results are very substantially lower than for all other studies meant that it was not adopted as a basis for this analysis. It should, however, be noted that the results were used in order to help inform the sensitivity analysis.

Despite attempts to standardise the scenarios the models assessed by JRC produced a variety of results and as a consequence a potential range of ILUC conversion factors that could be applied. This is a result of the variable assumptions applied within the models assessed. To determine the most appropriate ILUC conversion factors for use in this study IEEP evaluated the different model assumptions and likely reliability in consultation with experts from the JRC and with reference to other studies completed on this issue (i.e., work by Ecofys). Based on this assessment the following judgements were made in order to determine the most appropriate conversion factors for both biodiesel and bioethanol fuels, which were then applied within this exercise.

It should be noted that while the modellers were asked to run certain scenarios for biofuel usage in 2020 none of these fully represented the likely mix of feedstocks used in the EU in 2020. Instead the only way to enable comparison was to shock the models to specify increased demand for specific commodities rather than the whole range likely to be used to produce additional biofuels. As a consequence separate ILUC factors emerged primarily for EU produced biodiesel from oil seeds, palm oil from Indonesia, wheat bioethanol from the EU and corn ethanol for the US. These were taken into account when determining the most appropriate conversion factors for use in this work.

- **Biodiesel** – for biodiesel the conversion factor selected as the lower bound was the AGLINK factor for EU production of biodiesel from oil seeds, while the upper bound was selected as the CARD/FAPRI factor for EU production of biodiesel from oil seeds. Other higher estimates, for example from LEI-TAP for EU produced biodiesel, were discounted, in this case as a consequence of concerns regarding the appropriateness of oil seed elements within the model.

These upper and lower factors selected were applied to all biodiesel, both imported and domestic production. This was justified on the basis of these appearing, within model results identified for JRC and within other exercises, to be largely similar to the anticipated ILUC impact of palm oil production, based on the change in production area. It should be noted that the output from the G-TAP model for palm oil was much lower than for other estimates, this is considered to be a consequence of over-estimates in likely yield increases and this figure was, therefore, discounted.

- **Bioethanol** – For domestic EU production of bioethanol the lower bound selected was based on the figures for EU produced wheat based ethanol from the AG LINK model. The upper bound selected was the equivalent scenario from the G-TAP model. Other estimates
from IMPACT, for example, were discounted because of concerns regarding elasticities and assumptions relating to reductions in food consumption leading to a low ILUC estimate. It should be noted that the JRC consider outputs from G-TAP to be more accurate than for other models in terms of bioethanol impacts, this is because of the differentiated way this model takes into account yields on converted land by factoring in a frontier yield effect.

Unlike biodiesel for bioethanol there is likely to be a significant difference between the ILUC impact of domestically produced and imported bioethanol. This is because large proportions of ethanol imports are anticipated to be produced from sugar cane and in a number of studies sugar cane’s ILUC impact has proved to be lower than for other crops. Therefore, while the wheat based ethanol figures were used as a proxy for domestic bioethanol production the AG LINK value for sugar cane was applied to imports. Given the wide variety of anticipated imports into Member States an average rate of imports was applied to provide two consistent upper and lower factors for bioethanol. The level of imports was assumed to be 43%.
Advice on the Economic and Environmental Impacts of Government Support for Biodiesel Production from Tallow

Report to the Department of Transport

Restricted Commercial
ED05914
Issue Number 1a
Date 4th April 2008
Advice on impacts of Government support for biodiesel production from tallow
Advice on impacts of Government support for biodiesel production from tallow

Executive summary

Tallow as a biofuel feedstock

The Government’s Renewable Transport Fuel Obligation (RTFO) will come into effect in April 2008. It will require road transport fuel suppliers to ensure that, by 2010/11, 5% of total road transport fuel supply in the UK is made up of renewable fuels, equivalent to around 2.5 billion litres of fuel per year. Approximately 50% of renewable fuels used in 2010/2011 is likely to be made up of biodiesel and 50% bioethanol. Biodiesel can be produced from a variety of feedstocks, including virgin vegetable oils, used cooking oils and tallow (which is a by-product from the meat rendering industry).

Biodiesel made from tallow will qualify for certificates under the RTFO, and it is also a biofuel within the definition in the European Commission’s Biofuels Directive.

Tallow is also used in the food, feed, medicinal and non-food sector, and some of the existing uses of tallow include:

- Oleochemicals
- Soap
- Bird Food
- Cooking
- Candles
- Steel Rolling
- Heating fuel
- Flux

Concerns have been expressed regarding the use of tallow as a biodiesel feedstock particularly with regard to its environmental benefits and its potential economic impact on certain sectors including the UK’s oleochemical, speciality chemicals and cleaning product industries.

Aims of the project

This project examined these concerns with the objective of:

1. Establishing whether the Renewable Transport Fuel Obligations (RTFO), by supporting the production of biodiesel from tallow, will have adverse effects on the other industries, which use tallow as a feedstock.

2. Enabling the Government to consider whether changes need to, and could, be made to the design of the RTFO as the result of the above.

In order to accomplish these objectives, four specific tasks were developed:

Task 1: An understanding of the UK market for tallow

This task examined the current UK market, including the tallow supply chain in the UK; the major players in the tallow supply chain; and the major users of tallow in the UK. In addition, identification and understanding of the principal alternative feedstocks to tallow in the biodiesel and oleochemical, speciality chemicals and cleaning product industries was also undertaken. This work included discussions with key stakeholders who provided data that was used in the analysis undertaken in the project.

Task 2: An assessment of the impact of use of tallow in biodiesel on tallow price

This task examined the impact of increases in tallow price on other industries which use tallow as a feedstock. This used data collected as part of Task 1. The results from this review informed an analysis of key issues around the impact of the RTFO – the extent to which tallow prices are likely to have been affected by Government support for tallow as a biodiesel feedstock and the likely impact of the RTFO on the future price of UK tallow.
Advice on impacts of Government support for biodiesel production from tallow

Task 3: An assessment of the impact of the RTFO on the UK oleochemicals, speciality chemicals and cleaning product industries

This analysis assessed the potential wider impacts of the RTFO on the supply of UK tallow, and the impact of the RTFO on the UK oleochemical, speciality chemicals and cleaning product industries. This included an assessment of the likely impact of the RTFO on the supply of UK tallow and an assessment of whether the RTFO is could lead to the diversion of tallow away from existing markets into biofuels.

Task 4: Assessment of whether the diversion of tallow into biodiesel from other industries will have a beneficial or harmful greenhouse gas impact

This analysis examined the wider sustainable development issues of the diversion of tallow from oleochemicals to biodiesel, specifically by examining the overall impact on greenhouse gas emissions. This is relevant in understanding the potential implications for tallow of the minimum GHG saving threshold for biofuels included in the draft Renewable Energy Directive.

Project team

This project was undertaken by a team of experts led by AEA Technology: Richard Miller (Miller-Klein associates), Nick Dale (Metroeconomica) and E4tech.

The Findings

The UK Tallow sector

UK tallow is a limited resource, the size of which is dependent predominantly on UK meat production. The only way to expand this resource is to import tallow from abroad. This is not simple. Imported tallow is expensive compared to UK tallow; in addition, the 'hub' for import of tallow into Europe is in Rotterdam and there is significant additional cost to importing this tallow into the UK. Effectively this limits the tallow available to the UK to around 250,000t/y, with some small additional import/export mainly centred around the import of Irish tallow. This situation is discussed in more detail in Chapter 2.

Currently all tallow produced is used for some economic purpose. None is disposed to landfill. (Figure 3 in Chapter 2 provides a breakdown of use). The main uses are dictated by the category of tallow under the Animal By-products Regulations

Category 1 can only be used for burning or fuel production

Category 2 can be used for industrial applications

Category 3 can be used for human contact (e.g. in soaps and cosmetics).

This is a key influence on the current predominant uses: burning of (mainly category 1) tallow in boilers by the rendering industry to raise process heat and the use of category 2 and 3 tallow by the oleochemicals and soap industry. Other, smaller-scale uses involve power generation, biofuels production, animal feed and food.

The UK oleochemicals and soap sectors exist because of the historical supply of cheap tallow in the UK. If this feedstock increases significantly in price (relative to alternative feedstocks available abroad) or the supply of the feedstock diminishes, the sector is unlikely to exist in the UK. This is because export tariffs on alternative feedstocks (most notably palm oil) make production of oleochemicals and soaps from other feedstocks uncompetitive in the UK.

Alternative feedstocks for the key uses for tallow were examined:

- The rendering industry currently substitutes fuel oil (or natural gas) for tallow for generation of process heat and steam, depending on the relative prices of these fuels.
- The oleochemical and soap industry is more complex. For the major products the main alternative feedstock is palm oil, although for some chemicals mineral oils are more appropriate. The oleochemicals industry and the rendering industry provided information on the chemical processing of tallow to its various products and this is presented in Chapter 2.

1 See Chapter 2 for an explanation of these terminologies.
Advice on impacts of Government support for biodiesel production from tallow

Tallow prices

The UK rendering industry and oleochemicals industry comprise relatively few organisations. Trade in tallow is not done on the open market, but as direct contracts between companies. Consequently much information regarding the use of tallow and its price is commercially sensitive and this study was unable to uncover precise data regarding tallow price. This means that the analysis undertaken had to be done on relative trends in prices and on ranges of tallow prices rather than actual prices; and that these figures were provided by the industry because there is no independent source of information on tallow prices.

However, some trends are clear. In the absence of subsidies the price of category 1 tallow is linked to fuel oil prices. As fuel oil prices increase the incentive to the rendering industry to use tallow in their boilers increases. Category 2 and 3 tallow prices reflect the trends in category 1 tallow, plus the additional cost of segregation and processing. The upper price of category 2 and 3 tallow is linked to the lowest equivalent virgin plant oil, minus the transport costs and any import or export tariffs. Price trends in tallow and other oils and fats relative to 2003 were provided by Uniqema. Other information on oils and fats prices was obtained from Oil World1. The prices of oils and fats have been climbing steeply recently and there is an indication that the tallow price is linked to these trends and is also rising. However, the nature of this link is not clear. The prices and price trends for tallow are provided in Chapter 3. If category 1 prices increase sufficiently this acts to disincentivise the production of the category 2 and 3 tallow and their availability decreases. This situation has a significant effect on the oleochemicals and soap industry, for which alternative feedstocks are not available in the UK and, if this situation is sustained for any period, would result in the closure of a significant part of its production in the UK.

In the absence of clear prices, the analysis in this report (Chapter 4) focused on evaluating the likely effects of assumed price changes on decision making by relevant sectors and on identifying the price thresholds that lead to changes in decisions. In addition the likely impacts of meeting biodiesel blend targets on the feedstock demands of different sectors and the financial impact on the oleochemicals sector, if it had to pay specific prices for feedstock was also modelled.

Results of this work included:

- An examination of the theoretical maximum ‘willingness to pay’ of biodiesel producers suggests that with the current duty relief the production of biodiesel is already quite competitive with unblended diesel. This is a function of the current high whole sale price of diesel, but the introduction of further measures under the RTFO to incentivise supply of biofuels may have the effect of further increasing the attractiveness of producing biodiesel, including from tallow.

- Assuming the RTFO 5 per cent biofuel target was met through biodiesel analysis of the least cost solution (under the assumptions in the economic model) would be that biodiesel producers buy all the available domestic supply of tallow. This is likely to be supplemented by imports from Republic of Ireland and continental Europe. In this scenario, renderers would buy fuel to replace tallow used for energy; and the oleochemical industry would no longer be able to use any domestic tallow. Therefore, under this assumption (that biodiesel sector meets their feedstock demands at least cost and only then do other sectors buy any excess supply available), there is likely to be a significant diversion of tallow away from existing markets. Even if lower percentage targets were met the diversion effect would still be strong.

- In this situation, the increased prices for alternative feedstocks to domestic tallow would have significant effects on the oleochemicals industry.

- It must be remembered that this is a theoretical situation. The tallow-biodiesel refining capacity in the UK is low at present. However, biodiesel plants are not complex refining plants and it is possible to establish new ones relatively quickly, subject to planning. There is currently an application for a 150,000t/y biodiesel plant that would be able to take tallow as a feedstock.

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1 www.oilworld.biz
2 It could be related to a number of factors such as the oil price, the current shortage of certain foods and feed which has led to rising prices for agricultural commodities and the substitution of feedstocks in the presence of high prices, but this is speculation without hard evidence.
Advice on impacts of Government support for biodiesel production from tallow

- The model suggests that at the current price of tallow (£150/t for category 1 assumed in this analysis), profits of renderers would be maximised when over half the production of tallow would be category 1 (which would all be used for in house energy by renderers), the rest being sold as category 3. As tallow prices increase a threshold would be reached above which it becomes more profitable for renderers to switch production to category 1 and away from category 2 and 3. In the model examined in Chapter 4, at or above £186/t for category 1 (after meeting in house energy demands), it becomes more profitable for renderers to sell all remaining tallow as category 1 and none as category 2 and 3, unless the price of Category 3 simultaneously increases to £367/t.

- The overall conclusion is that any price increases to category 1 tallow, which may be brought about by increased demand from the biodiesel sector given RTFO incentives or for other reasons, would result in a switch away from category 3 and towards category 1, all other factors being equal. The model indicated that the threshold where no category 2 or 3 tallow is produced in the UK was an increase of about 25 per cent in the current category 1 tallow price (to £186/t from the assumed current price of £150/t).

Socio-economic impacts

We have been unable to obtain sufficient information about the patterns of employment and value added for the alternative uses for tallow to do an in-depth analysis of socio-economic impacts. However, a crude analysis shows that switching tallow to biodiesel will have a net negative effect on employment, gross value added and the balance of trade.

The production of tallow biodiesel is a relatively simple process compared to production of oleochemicals and soap. The oleochemicals industry produces a wider range of products, using a greater variety of chemical transformations, and using a wider range of equipment. In contrast, the essence of a biodiesel plant is minimum complexity and greatest efficiency in producing a single product.

Uniqema estimate that there are over 200 people directly employed in the oleochemical and soap industries (Uniqema 2008). In addition, because of the complexity of their operations there are a large number of contractors and service providers also involved in these sectors. These jobs would be likely to disappear following a major shift of tallow to biodiesel production.

A plant producing about 125kT biodiesel/y would employ about 45-50 people (Argent 2008). There would also be jobs in support and service sectors, but these would probably be no more that the proportion of support and service sector jobs in oleochemicals and soap. Such a plant would use a slightly larger amount of tallow than the current UK oleochemical and soap industries (125kt versus 82kT).

The oleochemical and soap industries have exports of more than £30m p.a. If missing domestic capacity is replaced by imports, the oleochemicals sector has provided figures that indicate the net negative change in the balance of trade is of the order of £100m/y.

For this study we have focused on impacts in the UK and not tried to estimate or compare the net impacts on other economies, particularly Asia.

Overall there are measurable, but not large, socio-economic impacts from the switch of tallow from oleochemicals and soap to biodiesel.

Impact on GHG emissions of the diversion of tallow to biodiesel

The time scale and data available for this analysis restricted the potential for undertaking an in-depth ‘cradle to grave’ life cycle analysis of the use of tallow for biofuels or oleochemicals within this work. Instead two comparative scenarios were examined in which tallow was either used for biofuels or oleochemicals. These are described in detail in Chapter 5, together with a list of the assumptions inherent in each scenario. Essentially the scenarios were:

1. A scenario in which tallow is used for soap and oleochemicals production, with category 1 tallow being used by the rendering industry for fuel. It was assumed that biodiesel would be produced from palm oil in the UK and palm oil would be transported by tanker to the UK.

Palm oil is not currently used in any great quantity to produce biodiesel in the UK. However, this scenario was justified on the basis that palm oil is the closest feedstock technically to tallow that could be used to replace tallow in any quantity; and it is the cheapest of the bio-oil feedstocks.
Advice on impacts of Government support for biodiesel production from tallow

2. A scenario in which all tallow was diverted to biodiesel. It was assumed that soap and oleochemicals would be produced from palm oil in the Far East and transported by boat to the UK\(^5\). The rendering industry would need to use an alternative energy source and it was assumed that this would be fuel oil.

These scenarios are not strictly representative of what might happen, as is indicated in the footnotes and in Chapter 5. Consequently, they were subjected to a number of sensitivity analyses. These included examination of: the type of boiler fuel which replaces tallow when tallow is used for biodiesel; the type of fuel used by Malaysian soap and oleochemical manufacturers; the energy efficiency and relative mass of soap and oleochemical products transported; the amount of energy and chemicals required for biodiesel production from tallow; the type of process used to produce biodiesel.

The results of this analysis indicated:

- The most important sensitivity in the analysis is the fuel switching at the rendering plant. If displacement of tallow into biodiesel production results in the rendering industry using low sulphur fuel oil instead of tallow for fuel, there will be a significant net increase in GHG emissions (183kT of CO\(_2\)e in total, which is equivalent to 974 kg CO\(_2\)e/t tallow displaced). However, the overall result is very sensitive to the assumption about the fuel that is used as fuel oil. Some of the rendering industry can use natural gas, which would result in a net increase in GHG emissions, but lower than for fuel oil. If the rendering industry were to use a biomass fuel\(^6\) then the GHG emissions would be much smaller and probably lower than the use of tallow for oleochemicals (depending on the influence of the other key assumptions, such as soap and oleochemical manufacture in South East Asia; international transport; tallow biodiesel production etc.). Before drawing conclusions about the impact of diverting tallow into biodiesel production would have on GHG emissions, it is necessary to gain a better understanding of two factors:
  - whether burning biomass (such as MBM) would be economically attractive for renderers and
  - whether biomass supply in the UK would expand to ensure all existing biomass demand is met.

- Thus there is a need for more data on what is actually happening at the rendering plant in order to ensure the calculation of GHG emissions from production of biodiesel from tallow is an accurate reflection of what is actually happening at the rendering plant. One way to take this into account is to update the default value with the RTFO\(^7\) where the boundary could be expanded to ensure it takes account of any fuel switches which occur (i.e. the scope of the fuel chain could be expanded to take account of the fuel used) at the rendering plant. At the moment data on the fuel switching at the rendering plants is not sufficient to ensure that the reporting is representative of what actually happens at the plant. In the future the RTFO will be linked to carbon savings and this would provide an incentive to the rendering industry to use a low emission fuel at their plants. In order to encourage reporting of actual data (i.e. on the type of fuel used) the default assumption could be that low sulphur fuel oil is used. This would create an incentive on renderers to use another low-carbon fuel instead of tallow, particularly if credits under the RTFO were linked to a biofuel’s GHG saving. It would also ensure the Renewable Fuels Agency was aware of what impact the RTFO was having on the market for tallow.

- The other sensitivity analysis undertaken indicated that the other factors examined (i.e. the type of fuel used to provide process heat in soap and oleochemical manufacture, the assumptions made about international transport and the assumption that biodiesel plants require the same energy and chemical inputs regardless of their feedstock) all make a difference to the GHG emissions, but it was concluded that none of these influence the overall conclusion of the main analysis.

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\(^5\) Not all oleochemicals produced from tallow could use palm oil as a replacement feedstock. In some cases mineral oils would be needed. However, palm oil is the closest feedstock to tallow in its chemical properties and a significant proportion of oleochemicals and soaps could be made using palm oil. In addition the oleochemicals sector indicated that in the absence of tallow it is likely that production would shift to palm oil in the Far East.

\(^6\) For example, the rendering industry have indicated an interest in developing MBM as a fuel for their rendering plants. This would take some investment, as the burning of some grades of MBM is strictly controlled. In addition MBM is used as a fuel in other sectors and the substitution of fuels in these sectors would need to be considered.

\(^7\) See: [http://www.dft.gov.uk/rra/reportsandpublications/carbonand sustainabilityguidance.cfm](http://www.dft.gov.uk/rra/reportsandpublications/carbonandsustainabilityguidance.cfm)
Advice on impacts of Government support for biodiesel production from tallow

- A further sensitivity relates to biodiesel production technologies. The analysis assumes that all biodiesel is produced using a conventional trans-esterification process. However, other processes exist which may be able to convert fats and oils to diesel more efficiently. Several companies are, for example, developing hydrotreatment processes which can use tallow (and vegetable oils) to produce a fuel which is very similar to mineral diesel (e.g. Neste’s NExBTL process, ConocoPhillips’ RenewDiesel process). Analysis undertaken for the companies developing these technologies (e.g. IFEU, 2006) indicates that hydrotreating processes would lead to a biodiesel with higher GHG savings than conventional FAME. However, the analysis carried out above would not be particularly sensitive to the choice of processing technology – since the same technology would have to be used in both scenarios.

Other Environmental impacts

To obtain a balanced understanding of the full environmental impact of switching tallow from oleochemicals to biodiesel it is also important to consider other environmental impacts from the use of tallow in the oleochemicals or biodiesel industry. We were unable to gather clear data on potential environmental impacts from the processing of tallow to oleochemicals or biodiesel to allow comparison between the two routes. Such impacts could arise from additional emissions to air, soil and water from the processing of tallow, the production and disposal of by-products. We do not have clear evidence that these emissions would be significantly higher from the oleochemical or biodiesel use of tallow.

This leaves consideration of their respective roles for recycling or reusing residues and the value of the co-products: do these processes create useful products and does the processing result in co-products that are wastes or have any environmental impact?

The use of tallow both in the oleochemicals and the biodiesel sector represents the production of a new product from a by-product of the rendering industry and both processes represent recovery of value from tallow, as defined in the EC interpretation of the definition of wastes (EC 2007). It could be argued that the use of tallow for oleochemicals represents recycling and the use for biodiesel represents energy recovery. Indeed the oleochemicals industry argues that its products represent processing further up the waste hierarchy, as defined in the UK Waste Strategy (Defra 2007), which is true. This does not represent an argument for better environmental impact per se. To do this the whole environmental impact needs to be considered, including all emissions from processing and the disposal or use of by-products. Within the scope of this study it is not possible to do this.

Key questions

There are a number of key questions that also need to be considered:

1. What impact will development of novel technologies and second-generation processing have on biodiesel in the longer term?
2. Does the RTFO unduly encourage one use of tallow over another?
3. If the RTFO were to be modified to create a level playing field for all users of tallow, would the oleochemicals industry be able to survive until this happened?
4. How could the RTFO be modified to avoid these problems, in a manner consistent with the EU and international legislation?
5. To what extent are the problems faced by the oleochemicals industry due to current high tallow prices as opposed to wider, global economic factors?

1. What impact will development of novel technologies and second-generation processing have on biodiesel in the longer term?

The economics of first-generation technology currently used to produce biofuels around the world are heavily dependent on feedstock costs. This means that production costs can only be kept down if feedstock costs are low. As a result there is considerable pressure on the cheapest feedstocks. There are a number of technologies being developed to allow the production of biofuels from lignocellulosic feedstocks. The impetus behind this development is twofold: they allow the use of wastes and feedstocks that currently have little value or use; and they enable more sustainable or more efficient land use. Unfortunately these processing technologies are currently expensive and technological development is still required. However, there are second generation demonstration plants in operation and more demonstration plants are planned.
Advice on impacts of Government support for biodiesel production from tallow

Many analysts predict this technology will be available within the next five to 15 years. Once the technology is in operation it may supersede first generation technologies in regions such as Europe where feedstock costs are high. Consequently the current methods for producing biodiesel may be phased out in favour of more advanced technology in Europe in the long term.

Marine algae are also being explored as a longer term source of oil for processing into fuel and chemicals. Many of the oil and energy companies have research programmes in this area, as algae are believed to offer the potential for much higher conversion of primary photosynthetic products into oil compared to land crops.

2. Does the RTFO unduly encourage one use of tallow over another?
The analysis in this report demonstrates that the RTFO makes the production of biodiesel from tallow attractive and increases the biodiesel producers’ willingness to pay for tallow. This provides an incentive to produce more category 1 tallow and not to produce category 3 tallow unless its price rises substantially, too.

3. If the RTFO were to be modified in the future to create a level playing field for all users of tallow, would the oleochemicals industry in the UK be able to survive until this happened?
There is no cheap alternative feedstock that the oleochemicals industry can use in the UK if tallow is diverted to biodiesel. It is likely that even a relatively short term switch to biodiesel would have a significant impact on the survival of the oleochemicals industry in the UK.

4. How could the RTFO be modified to avoid these problems in a manner consistent with EU and international legislation?
For feedstocks such as tallow that already have existing applications the RTFO should take into account the effect of substitution on the overall sustainability of switching to biofuels production, particularly on GHG emissions. The Govt should consider the implications of this carefully, particularly in the context of the proposed shift to a carbon-linked RTFO.

5. To what extent are the problems faced by the oleochemicals industry due to current high tallow prices as opposed to wider, global economic factors?
The oleochemicals industry is facing a number of problems at the moment, including competition from products from the palm oil industry in the Far East. Biofuels are not solely to blame for the problems faced by the oleochemicals industry – they are part of a much bigger picture. However, feedstock costs are a significant proportion of costs for the oleochemicals industry and the industry exists in the UK because historically there has been a supply of cheap tallow. The significance of feedstock costs in the oleochemicals business model means that it is particularly vulnerable to increase in feedstock costs. In addition, it is difficult for the industry to pass these prices onto its customers in the current competitive environment. Consequently, tallow prices are not the only factor affecting the oleochemicals industry but they will have important consequences. At the moment palm oil prices are also high (both in the UK and the Far East) but any price rise for tallow, relative to the price of palm oil, would be difficult for the oleochemicals industry.

Conclusions

- The RTFO is likely to increase the maximum price biodiesel producers are willing to pay for tallow. Depending on prices of alternative feedstocks this may result in diverting supplies from current uses but the economic analysis suggests that this could result in any case with or without the RTFO.
- One of the consequences of increased prices for category 1 tallow is likely to be a reduction in availability of category 2 and 3 tallow.
- Tallow is relatively cheap compared to other biodiesel feedstocks. This means that if biodiesel producers only use price to decide which feedstock to use, tallow is very attractive. If the refining capacity was available tallow would be a significant source of biodiesel in the UK.
- Tallow biodiesel refining capacity in the UK is currently met from only one plant, which has a capacity of 45kT/y. According to our figures only 17kT/y are currently used for biodiesel. This situation will change in the future if the proposed Ellesmere Port plant is developed. This plant has a proposed capacity of 150kT/y. This means that although tallow is an attractive feedstock for biodiesel, the refining capacity currently limits the amount of biodiesel that can be produced from tallow. However, developing biodiesel plants is relatively straight-forward and can be done relatively quickly.
Advice on impacts of Government support for biodiesel production from tallow

- The current high prices for mineral diesel acting together with the RTFO could divert a significant proportion of tallow into biodiesel production (with the caveat that tallow-biodiesel refining capacity is currently limited, as indicated above). Tallow is the major feedstock for the UK oleochemical and soap industry. Diversion of this feedstock to another use would remove tallow as a feedstock for the oleochemicals and soap industry in the UK and could result in a significant shift of UK oleochemical production to the Far East.
- The environmental impact of the shift from the current uses of tallow to biodiesel production is ‘negative’ in terms of GHG emissions, although this conclusion is dependent on the fuel substituted for heat production at the rendering plant. This is an important consideration in the sustainability of using tallow for biodiesel production.
- All tallow produced in the UK is currently being used. If tallow is switched to biodiesel production, alternative feedstocks are required for the other tallow uses. These feedstocks are likely to be fossil oils or imported vegetable oils. The sustainability of this switch should be considered in more depth.
- The economic impacts of switching tallow from oleochemicals to biodiesel in the UK requires more in depth analysis. From the data we have it appears that there will be a loss of income from oleochemicals exports and a need to import oleochemicals, which are not compensated by the decreased need to import diesel. If this is correct it would result in a negative impact on the balance of trade.
- From the information we have obtained the social cost of the shift of tallow from oleochemicals to biodiesel is a net reduction in jobs.
- If the RTFO is to result in more environmentally sustainable transport fuels it is important that indirect impacts are considered. In the case of wastes that have existing applications the impact of the switch to biofuels on the overall environmental emissions must be considered as part of the calculation of net GHG emission reductions.
- The oleochemicals industry in the UK is facing a number of problems, including increased competition from the Far East. Biofuels are not solely to blame for the problems faced by the oleochemicals industry – they are part of a much bigger picture. However, from the analysis presented in this report, it is clear that demand for tallow for biodiesel could contribute to the problems, although there is not very much direct evidence that this is happening at present.

Recommendations

There are three main recommendations from this report:

1. Our analysis shows that, from a GHG perspective, the use of tallow as a biofuel results in greater emissions. This finding is dependent on the assumptions made in the analysis. A sensitivity analysis of these assumptions indicated that only one of these assumptions would make a significant difference to this outcome, and this is the fuels used as a substitute for tallow in boilers at the rendering plants. If a biomass fuel such as MBM were used for these boilers rather than the fossil fuel used in our analysis a much better GHG balance is achieved. However, this depends on the source of the MBM and how it is used. To take this into account we recommend that the scope of the RTFO Carbon Reporting methodology could be expanded to ensure it takes account of any fuel switches which occur at the rendering plant, i.e. the scope of the fuel chain could be expanded to take account of the fuel used at the rendering plant. At the moment data on the fuel switching at the rendering plants is not sufficient to ensure that the reporting is representative of what actually happens at the plant. In the future the RTFO will be linked to carbon savings and this would provide an incentive to the rendering industry to use a low emission fuel at their plants. In order to encourage reporting of actual data (i.e. on the type of fuel used) the default assumption could be that low sulphur fuel oil is used. This would provide a default that reduces the incentive for a renderer to burn fuel oil, particularly when the RTFO is linked to a biofuel’s GHG saving. It would also ensure the Renewable Fuels Agency was aware of what impact the RTFO was having on the market for tallow.

2. The revised Renewable Energy Directive proposes that certain more sustainable feedstocks such as wastes will be regarded as more sustainable.8

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8 The text is designed to encourage second generation biofuels and states: ‘In order to demonstrate compliance with national renewable energy obligations the contribution made by biofuels from wastes, residues, non food cellulosic material and ligno-cellulosic material shall be considered to be twice that made by other fuels’. This has been interpreted by some stakeholders to mean that tallow-biodiesel will be rated more highly than other biofuels.
Advice on impacts of Government support for biodiesel production from tallow

The approach makes no provision for displacement impacts or other indirect effects. Our work has shown that it is important that substitution and indirect impacts are included in the environmental sustainability criteria used to assess biofuels. **We recommend that the Government should draw attention to the likely impacts of the proposed double reward for certain types of biofuels including biodiesel produced from tallow.**

3. The UK cannot act unilaterally. **It is important to share the findings of this research with the European Commission and other Member States.**
Advice on impacts of Government support for biodiesel production from tallow
# Table of contents

Acknowledgements xvii

1 Introduction 1
   1.1 Tallow as a biofuel feedstock 1
   1.2 Aims of the project 1
   1.3 Project team 2
   1.4 Structure of report 2

2 Task 1 - Understanding of the UK Market 3
   2.1 Tallow Definition 3
   2.2 The Rendering Process 4
   2.3 Tallow Categories and Grades 4
   2.4 Tallow Availability 4
   2.5 Imports and Exports 5
   2.6 Tallow Uses 6
   2.7 Key Industrial Processes for Tallow Use 7

3 Task 2 - Impact of tallow use in biodiesel on tallow price 14
   3.1 Price development for tallow 14

4 Task 3 – RTFO impact on the other sectors 17
   4.1 Introduction 17
   4.2 Economic Analysis 17
   4.3 Conclusions from the economic analysis 24

5 Impact of the diversion of tallow to biodiesel from other uses on GHG emissions 26
   5.1 Description of the two scenarios 26
   5.2 Key assumptions 31
   5.3 Key results 33
   5.4 Conclusions from GHG analysis 37

6 Discussion 38
   6.1 The UK Tallow sector 38
   6.2 Tallow prices 39
   6.3 Socio-economic impacts 40
   6.4 Impact on GHG emissions of the diversion of tallow to biodiesel 40
   6.5 Other Environmental impacts 42
   6.6 Key questions 42
   6.7 Principal Conclusions 44
   6.8 Recommendations 44

References 46
Advice on impacts of Government support for biodiesel production from tallow

Appendices

Appendix 1  Participants in the UK Rendering Industry
Appendix 2  Oleochemical and soap manufacturers in the UK
Appendix 3  Task 3 Outline of model and assumptions
Appendix 4  Article from ICIS Chemical Business (Finch 2008)
Advice on impacts of Government support for biodiesel produced from tallow

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Advice on impacts of Government support for biodiesel production from tallow

1 Introduction

1.1 Tallow as a biofuel feedstock

The Government’s Renewable Transport Fuel Obligation (RTFO) will come into effect in April 2008. It will require road transport fuel suppliers to ensure that, by 2010/11, 5% of total road transport fuel supply in the UK is made up of renewable fuels, equivalent to around 2.5 billion litres of fuel per year. Approximately 50% of renewable fuels used in 2010/2011 is likely to be made up of biodiesel and 50% bioethanol. Biodiesel can be produced from a variety of feedstocks, including virgin vegetable oils, used cooking oils and tallow; a by-product from the meat rendering industry.

Biodiesel made from tallow will qualify for certificates under the RTFO, and it is also a biofuel for the purpose of the European Commission’s Biofuels Directive. The Biofuels Directive is to be superseded by a new Renewable Energy Directive, proposals for which were published in draft on 23 January, 2008. The Directive includes proposed sustainability criteria, which is that Member States must not support biofuels which do not offer at least a 35% saving in GHG emissions relative to fossil fuels. If tallow-based biodiesel were found not to meet this criterion, it might be excluded from incentives even though it met the biodiesel definition. Annex VII of the Directive refers to typical and default GHG savings for waste and animal oil biodiesel (it gives a figure of 83% for the typical value and 77% for the default value).

Tallow is also used in the food, feed, medicinal and non-food sector, and some of the existing uses of tallow include:

- Oleochemicals
- Soap
- Bird Food
- Cooking
- Candles
- Steel Rolling
- Heating fuel
- Flux

Concern has been expressed that using tallow as a biodiesel feedstock offers no net environmental benefits and will have an adverse economic impact on certain sectors for example the UK’s oleochemical, speciality chemicals and cleaning product industries.

1.2 Aims of the project

This project examined these concerns with the objective of:

- Establishing whether the Renewable Transport Fuel Obligations (RTFO), by supporting the production of biodiesel from tallow, will have adverse effects on the other industries, which use tallow as a feedstock.

- Enabling the Government to consider whether changes need to, and could, be made to the design of the RTFO as the result of the above.

In order to accomplish these objectives, four specific tasks were developed:

1. An understanding of the UK market
   To set the context for the project an understanding of the current UK market was necessary. This included the tallow supply chain in the UK; a summary of the major players in the tallow supply chain and of the major users of tallow in the UK. To further understand the impact of the RTFO on the industries, an identification and understanding of the principal alternative feedstocks to tallow in the biodiesel and oleochemical, speciality chemicals and cleaning product industries was also examined.

2. An assessment of the impact on use of tallow in biodiesel on tallow price
   Increases in tallow price could clearly have adverse effect on other industries which use tallow as a feedstock. To examine this, an assessment of the impact of use of tallow in biodiesel on tallow price was conducted. This used data collected as part of the task above.
Advice on impacts of Government support for biodiesel production from tallow

The results from this review informed an analysis of key issues around the impact of the RTFO – the extent to which tallow prices are likely to have been affected by Government support for tallow as a biodiesel feedstock and the likely impact of the RTFO on the future price of UK tallow.

3. An assessment of the impact of the RTFO on the UK oleochemical, speciality chemicals and cleaning product industries
This assessed the potential wider impacts of the RTFO on the supply of UK tallow, and the impact of the RTFO on the UK oleochemical, speciality chemicals and cleaning product industries. This included an assessment of the likely impact of the RTFO on the supply of UK tallow and an assessment of whether the RTFO is likely to lead to the diversion of tallow away from existing markets into biofuels.

4. Assessment of whether the diversion of tallow into biodiesel from other industries will have a beneficial or harmful greenhouse gas impact
This part of the work examined the wider sustainable development issues of the diversion of tallow from oleochemicals to biodiesel, specifically by examining the overall impact on greenhouse gas emissions. This is particularly relevant in understanding the potential implications to tallow if the future Renewable Energy Directive mandates greenhouse gas emissions from biofuels.

1.3 Project team
This project was undertaken by a team of experts lead by AEA Technology:
• Richard Miller (from Miller-Klein associates) led the data collection and review for Tasks 1, 2 and 3
• Nick Dale from Meteoeconomica led the analysis in Task 3.
• E4tech led Task 4.

1.4 Structure of report
The report is structured along the same lines as the tasks described above:

Chapter 2 provides the context for the use of tallow in the UK and includes the data collected in Tasks 1 and 2 of the work.

Chapter 3 examines the evidence for the impact of biodiesel development on the price of tallow.

Chapter 4 describes the analysis undertaken in Task 3 to examine the impact of the RTFO on the oleochemical, speciality chemicals and cleaning product industry in the UK.

Chapter 5 presents the analysis of the greenhouse gas emissions.

Chapter 6 presents the discussion and conclusions.

Chapter 7 presents the recommendations.
2 Task 1 - Understanding of the UK Market

2.1 Tallow Definition

Tallow is an animal fat obtained by rendering animal carcasses and waste from the food industry. Like vegetable oils, tallow is a triglyceride (Figure 1). A triglyceride consists of a three carbon glycerol head group (shown in red) to which are added three fatty acid chains. All triglycerides have the same basic structure, and the differences in properties and use of commercial triglycerides depends entirely on the length, degree of unsaturation and other chemical modifications to the fatty acid chains.

![Structure of a triglyceride](image)

Table 1 shows the typical percentage fatty acid distribution in several commercial oils and fats. The fatty acids are described in terms of the number of carbon atoms in the chain and the number of double bonds, or the degree of unsaturation, in the chain. C18 represents a fatty acid with 18 carbons and no double bonds. C18:1, 18 carbon atoms and one double bond. These distributions are important because they define the applications for which the oils and fats are most suitable. For example, palm kernel oil and coconut oil are richer in shorter chains and are extensively used to make surfactants, whereas tallow, rape and palm have a good distribution for making diesel.

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>Beef tallow</th>
<th>Palm</th>
<th>Rape</th>
<th>Soya</th>
<th>Palm Kernel</th>
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Table 1 shows the typical percentage fatty acid distribution in several commercial oils and fats. The fatty acids are described in terms of the number of carbon atoms in the chain and the number of double bonds, or the degree of unsaturation, in the chain. C18 represents a fatty acid with 18 carbons and no double bonds. C18:1, 18 carbon atoms and one double bond. These distributions are important because they define the applications for which the oils and fats are most suitable. For example, palm kernel oil and coconut oil are richer in shorter chains and are extensively used to make surfactants, whereas tallow, rape and palm have a good distribution for making diesel.
Advice on impacts of Government support for biodiesel production from tallow

The closest vegetable oil to tallow is palm. Rape and soy have less C16 and a lot more polyunsaturated fatty acids. Fatty acid distribution is important in thinking about substituting vegetable oils for tallow in industrial applications.

2.2 The Rendering Process

Rendering is a straightforward process in which animal carcases and trimmings are crushed and heated. This process drives off the water, sterilises the material and allows it to be separated into the fats (tallow) and meat and bone meal (MBM).

Raw materials are all the unusable parts of a carcase, including bones, internal organs and trimmings. Raw materials are collected for processing from abattoirs and from butchers and food processing sites.

Rendering is an energy intensive process and the industry has traditionally used some of the tallow it produces as fuel.

The industry has undergone substantial consolidation over the years as have abattoirs. The current membership of the UK Renderers Association is given in Appendix 1.

2.3 Tallow Categories and Grades

Following the BSE crisis, three categories of tallow were defined based on the source of the raw materials. These also defined the applications the tallow could be used for (Defra 2001, Animal By-Products Regulations 2005):

Category 1 is very high-risk material and must be completely destroyed. It includes the carcases of animals suspected or confirmed as having a transmissible spongiform encephalopathy (TSE), the carcases of zoo and pet animals, particularly hazardous parts of the animal, known as Specified Risk Material (SRM), and catering waste from international transport. This category can be used for:

− Fuel.

Category 2 is also high-risk material (e.g. diseased animals, animals which die on farm and which do not contain SRM at the point of disposal). This category can be used for:

− fuel;
− production of tallow derivatives for technical use only.

Category 3 Any material which has previously been fit for human consumption, such as catering waste. This category can be used for:

− fuel;
− pet food production;
− production of tallow derivatives.

In addition to the three categories, tallow is graded in terms of quality. The two key grades for the UK market are:

− grade 2 – high quality, low colour, used for demanding applications such as soap;
− grade 6 – low quality, highly coloured, used for technical applications.

2.4 Tallow Availability

The industry processes the by-products of approximately 2 million cattle, 10 million pigs, 14 million sheep and 800 million chickens annually. Approximately 2 million tonnes of animal by-products are processed.

Estimates of the amount of tallow produced range from 200kT p.a. to 290kT p.a. depending on the definition of what is included and the reference year (Argent Energy, 2008; CIA2008; UKRA 2008; Uniqema 2008). The consensus is that 220 – 240 kT is available in principle for industrial use.

Uniqema (2008) provided the breakdown for tallow production in shown in Figure 2:
Category 3 tallow comprises 49.5 kT/y. grade 2 and 23 kT/y. grade 6. All of the category 2 tallow is grade 6.

Other information sources gave different details on the split of production, but these were not substantially different from the above.

Apart from the legal requirements, renderers have some choices about which categories of tallow to produce. Their goal is to maximise the return from the various grades of product they produce. There are costs associated with segregating material into the three categories, and depending on the prevailing market price, renderers may choose to downgrade material that could be category 2 or 3 into category 1.

With increasing value of category 1 tallow as a fuel, there has been a significant fall in the amount of category 2 and 3 tallow being produced (Argent Energy 2008, Uniqema 2008).

Rendering of animal by-products also yields MBM, and currently approximately 400 kT p.a. is produced in the UK.

The amount of tallow produced in the UK has been stable for a number of years. It is governed by the size of the national herds and flocks, and is unlikely to change significantly in the foreseeable future.

Production of tallow in the EU totals approximately 2.5 MT p.a. (Agent Energy 2008). There are estimated to be about 14 MT p.a. of tallow available globally.

### 2.5 Imports and Exports

Category 3 tallow may be exported. Last year 37 kT were exported; 30 kT to the EU and 7 kT outside the EU. Of that about 17 kT was poultry fat for use in pet food (UKRA 2008). Uniqema estimated that 15 kT of poultry fat was exported for pet food, 23 kT of category 3 for soap and industrial applications, and an additional 5 kT of category 1 for burning (Uniqema 2008). The Chemical Industries Association estimated 30 kT of exports.

About 30 kT of tallow is also imported, from continental Europe (6 kT of Category 2 grade 6) and from Eire (8 kT of Category 3 grade 2 and 17 kT of Category 3 grade 6) ([Uniqema 2008].)

Tallow could in principle be imported directly from both North and South America. However, this is not done at present due to costs, and the availability of tallow from other sources.

The flow of imports and exports is governed by mismatches in the supply and demand for the various categories and grades, the market prices both in the UK and in Europe, and the cost of transportation.
2.6 Tallow Uses

Tallow can be used in a several ways. The key applications are:

- human nutrition
- animal feed
- oleochemicals and soap
- biodiesel
- power generation
- burning for process heat and power

The current UK uses are shown in Figure 3 (Uniqema 2008). These figures exclude exports.

**Figure 3 Uses of tallow in the UK (kT p.a.)**

This figure shows that 43% of the tallow is used as a fuel source, and 33% for industrial applications such as oleochemicals and soaps.

This is a rather different balance than found when considering the EU as a whole where a much greater portion of the available tallow goes into animal feed (Figure 4 (EFPRA 2008)).

Overall, the UK market is currently self-sufficient in tallow use and production. Currently the UK is a net importer of tallow by 3.5 kT p.a. (Uniqema 2008).

Current trends are for more tallow to be used for biodiesel and other fuels. With a fixed amount of tallow available on the market, this can only be obtained by diverting tallow from existing applications such as burning or oleochemical and soap production. Since category 1 tallow can be used for fuel, this trend is part of the pressure on production of category 2 and 3 tallow that can be used for oleochemicals and soaps.
2.7 Key Industrial Processes for Tallow Use

If we ignore the use of tallow for in the food and animal feed chain, the key uses of tallow are as a fuel or for oleochemicals and soap. Of the fuel uses, burning for process energy and electricity generation do not require any further significant processing of the tallow. Biodiesel, oleochemicals and soap all require significant processing.

2.7.1 The potential use of tallow as a fuel

The rendering industry currently uses tallow as a fuel to raise heat and steam for its processing. The rendering industry asserts that this use is threatened by the application of the Animal By-products Regulation (ABPR), under which it is required that tallow is disposed of within a Waste Incineration Directive (WID) compliant incinerator. Some of the rendering industry operators are currently appealing against this, i.e. the competent authority’s decision to modify their permits to ensure WID compliance, and the results of those appeals are awaited. We understand, however, that there are WID compliant boilers available at the scale required in the rendering industry (Tecgen 2008). Consequently we do not believe that this application is threatened by the outcome of the appeal.

It is interesting to note that under the proposals for the banding of the Renewable Obligation (RO), combined heat and power of biomass fuels will be awarded 2 ROCs per MWh. Tecgen’s process is combined heat and power and would qualify for this higher band in the RO. This would provide an incentive for the use of tallow as a fuel for heat and power. We have not studied the economics of this use of tallow as part of this analysis, but it is likely to be of interest to the rendering industry if they have to install WID compliant plant.

2.7.2 Biodiesel

Diesel road fuel can be produced from tallow in two distinctly different ways.

The most familiar process, which currently dominates the market, is production of fatty acid methyl esters (FAME). The three fatty acid chains are split from the glycerol head group and the acid functionality capped with a methyl group.

Figure 5 shows a FAME molecule based on the C18:1 fatty acid, oleic acid. This is methyl oleate. Figure 6 provides a flow chart for the production of FAME from oils and fats.
Although structurally rather different to conventional diesel, FAME can be successfully blended with conventional diesel at a variety of dose rates, or used as a pure road fuel in modified engines.

Triglycerides from vegetable oil or animal fats are converted by transesterification with a base catalyst and methanol to fatty acid methyl esters (FAME) and glycerine. The methanol replaces the glycerol which is released for recovery. The FAME is purified for use as biodiesel and the glycerine purified for sale into other markets as a co-product.

The basic process can accommodate virtually any plant oil, as well as animal fat and used cooking oil. However, the technical properties of the biodiesel depend on the fatty acid distribution of the original triglyceride and the level of various contaminants. Tallow and used vegetable oil have a high level of free fatty acids from degraded triglycerides, and these interfere with the transesterification process. They must be separately esterified in a pre-processing step before the main transesterification.

Transesterification of tallow to FAME is currently practised by Argent Energy at their plant in Motherwell. This has a capacity of 45 kT p.a. of feedstock and is supplied with both tallow and used cooking oil. Their Ellesmere Port plant is currently under construction with a capacity of 150 kT of feedstock (Argent Energy 2008)
Advice on impacts of Government support for biodiesel production from tallow

Tallow as a feedstock has some advantages and some disadvantages. FAME from tallow has a higher cetane number than plant oil biodiesel. This means cleaner and more efficient burning in diesel engines. However, tallow FAME has a higher cloud point because of the high levels of saturated fatty acids. This means that tallow biodiesel tends to crystallise out at low temperatures creating problems in engines. Used neat (100%) tallow FAME would not meet the European standard for biodiesel. However, when blended at 5% into conventional diesel the mixture meets relevant fuel quality standards.

Vegetable oils can easily substitute for tallow in FAME production. The most commonly used oils in the UK for biodiesel are used vegetable oil and oilseed rape. Imported soya and palm are used to a lesser extent, but may be used more in the future.

The second process involves the hydrogenation of oils and fats to produce a synthetic diesel (see Figure 7).

**Figure 7 Production of Synthetic Diesel by Hydrotreating of Oils and Fats**

The oils and fats are treated with hydrogen in the presence of a catalyst. This breaks the glycerol from the fatty acids, removes all oxygen and removes any double bonds. The glycerol is converted to propane, and together with any fragments created by the hydrogenation process is separated and used within the refinery. The synthetic diesel is a very high quality product that is chemically identical to conventional diesel.

This process is very attractive to petroleum refining companies as it uses technology they already use and are familiar with, is compatible with their supply chain and creates a product that is identical to the rest of their diesel production.

Neste operate a stand-alone process illustrated in Figure 7. They have a 170 kT p.a. output plant in Finland using locally produced tallow, and plans for an 800 kT p.a. plant in Singapore based on vegetable oils. The synthetic diesel can be used directly, or blended with other diesel streams. Neste have no plans to operate the process in the UK, or to use UK sourced tallow (Neste 2008).

Conoco-Phillips operates a similar process, except that they blend the oils and fats into a crude diesel stream before the hydrotreating process. The product of this process is a diesel blend. Conoco-Phillips are currently using approximately 600 kT p.a. of rendered animal fats for this process in the US. In Eire they have demonstrated the process on soya oil. At the moment if they were to use tallow in Europe it would be Irish tallow used in the Whitegates refinery in Eire (Conoco Phillips 2008).
Advice on impacts of Government support for biodiesel production from tallow

Whilst neither Neste nor Conoco-Phillips currently intend to use UK tallow, it is clear that the widespread adoption of this technology by oil majors could have a major effect on the market for both feedstocks and biofuels. The hydrotreating process can use a wide variety of oils and fats. Feedstocks are selected on availability and price, and in the case of Neste the sustainability of the feedstocks.

2.7.3 Oleochemicals

The oleochemical industry produces a very wide range of chemicals and intermediates that are used in many industries including:
- soap and detergents;
- plastics;
- rubber;
- lubricants;
- paper;
- paints, coatings and inks;
- adhesives;
- food;
- personal care.

The three key chemical commodities made from oils and fats are:
- fatty acids – produced by splitting the glycerine head group from the fatty acids in the triglycerides;
- fatty alcohols – produced by transesterifying the triglycerides to methyl esters and then reducing them;
- glycerine – for every tonne of triglyceride processed, approximately 100kg of glycerine is produced, for which a market needs to be found.

Current markets for these three basic commodities are (Finch 2008):

Figure 8 Global market for fatty acids
The oleochemical industry in the UK produces a much more restricted range of products. It does not produce fatty alcohols, only acids and their derivatives and glycerine. The key processes are shown in Figure 11 (Uniqema 2008).

Oils and fats are initially ‘split’ into glycerine and fatty acids using water at high temperature and pressure to hydrolyse the ester linkages between the fatty acids and the glycerine. The glycerine dissolves in the water and is separated, concentrated by flash evaporation and purified to a commercial grade.

The fatty acids are cooled to a point where the saturated fatty acids crystallise out and can be separated from the unsaturated fatty acids which remain liquid using centrifuges. The solid fraction is called stearine as it contains high levels of C18 stearic acid. The liquid fraction is called oleine as it contains high levels of C18:1 oleic acid. These are commodity products in their own right.

Fatty acids can be further purified by distillation under vacuum to yield a range of distilled fatty acid, usually with a tighter specification on fatty acid composition.

Fatty acids can be hydrogenated to produce saturated fatty acids, or reacted with alcohols to produce a range of esters for applications such as lubricants.
Advice on impacts of Government support for biodiesel production from tallow

Figure 11  Oleochemical Processes used in UK industry

These products are sold either as intermediates to other chemical companies for onward conversion, or to end users for use in many of the industries listed in Figure 8.

- 90% of the feedstock for the UK industry is tallow.
- Approximately 60% of production is exported.

It is technically possible to substitute plant oils for tallow in the processes described above. Palm oil is the nearest substitute in terms of fatty acid distribution. However, tallow is traditionally a lower cost feedstock than palm oil and the feedstock costs would be increased by the higher price of substitute oil, plus additional transport costs to ship it to the UK from Continental Europe.

In addition, Asian palm oil is subject to an export tariff from producer countries, whereas downstream products are not. These tariffs have been set up to support the development of a downstream industry in oil producing countries so that they can capture more of the value chain. The bulk of the products produced by the oleochemical industry in the UK are commodities that are already being produced in oil producing countries. It is therefore impossible to compete on price from a palm or other tropical oil base.

The UK oleochemical industry currently exists because of access to cheap tallow and transport costs to and from Europe.

2.7.4  Soap

Soap has traditionally been made in large quantities in the UK. However, a reduction in the market for bar soap in the developed world, plus competition from low-cost producers in Asia, has dramatically cut soap production in the UK. All the major soap makers (e.g. Unilever, P&G and Cussons) have either ceased, or are ceasing, production in the UK. The remaining soap makers (see Appendix 2) are SMEs producing specialist soaps for their own brands or on contract to other companies. There are about six companies left producing soap in the UK (UK CPIA 2008).

The basic soap making process for the UK is illustrated in Figure 12 (UKCPIA 2008). A mixture of vegetable oils and tallow is treated with an alkali such as sodium hydroxide. This process is known as direct saponification. It splits the glycerine from the fatty acids and makes sodium soaps of the fatty acids. Other materials such as glycerine and unreacted alkali are washed from the soap and the crude glycerine can be purified for sale. The cleaned soap is then dried to achieve the desired water content, typically under vacuum. Perfume, colour and other ingredients are added to the raw soap and the soap is moulded into bars on a finishing line.
Advice on impacts of Government support for biodiesel production from tallow

There are several variants to this process. For high volume soap production distilled fatty acids of the desired blend are neutralised with alkali to produce the soap. This avoids the handling of triglycerides and the production of glycerine as a co-product. This is the major process for the large soap producers, but not for the relatively small scale production in the UK.

Many soap-makers stop at the drying stage and produce ‘soap-base’ in the form of noodles or chips. Smaller companies can then buy the base and add any desired ingredients before moulding the final soap bar. This minimises the equipment they require. All they need is a blender/extruder and a stamping and wrapping line.

**Figure 12 Basic soap making process**

Pure tallow soap is very hard and does not lather well; so a typical formulation for toilet soap is:

- Tallow 60%
- Coconut Oil 16% - 20%
- Palm Oil 16% - 20%

The vegetable oils improve lather depth and skin-feel (UKCPIA 2008).

Pure vegetable soap can also be made, and is considered by many to be superior in performance. In many markets there is a reluctance to use animal by-products for cosmetic purposes and pure vegetable soaps are preferred.

Soap makers in the UK could easily replace tallow with vegetable oils such as palm. However, palm based vegetable soap is already produced in very large quantities in oil producing countries. There are tariff barriers on the export of the oil, but not on the export of the soap. With the benefit of tariff barriers, large scale and lower production costs, these producers would be significantly cheaper than UK producers if they had to import palm oil.

The soap making industry in the UK now only exists because of access to a cheap source of tallow.
Task 2 - Impact of tallow use in biodiesel on tallow price

3.1 Price development for tallow

It has proved difficult to obtain reliable price information on tallow in the UK as there is no open market.

However, Uniqema have provided historical data for UK high and low grade tallow and for tallow compared to a basket of commercial vegetable oils (Uniqema 2008). Figure 13 shows the date for UK tallow from 1999 to 2007. The prices are relative to an index of 100 in December 1999. The time series shows that prices fluctuate continuously, as would be expected for a commodity feedstock in limited supply. However, prices remained fairly stable until the middle of 2005, when they began to rise steadily for both grades of tallow. By the end of 2007 the price had doubled in 30 months. The price increase seems slightly greater for low grade than for high grade tallow.

Figure 13  Tallow Price Index 1999 – 2007 (Uniqema 2008)
Advice on impacts of Government support for biodiesel production from tallow

Figure 14 compares the price development of various grades of tallow with other key commercial vegetable oils. Prices are indexed to 100 in October 2003. The oils being compared are:

- Soya
- Rape
- Coconut Oil (CNO)
- Palm Kernel (PKO)
- Palm Oil (PO)
- Palm Oil Stearine (POST) Palm oil split and separated into the saturated fraction
- Bleached Fancy Tallow (BFT) imported from the US
- Bonefat (very high grade tallow)
- Technical Beef Tallow
- UK Tallow

Figure 14  Oils and Fats Price Index 2003 – Today (Uniqema 2008)

This data shows the same general price increase from the middle of 2005 for all oils and fats. On this graph UK tallow seems to have risen in price faster than the other oils and fats. However, this apparent difference depends critically on the relative prices in the index month.

Some direct evidence for development of tallow prices is shown in Figure 15 which compares historical prices for Bleached Fancy Tallow, CIF Rotterdam with a basket of oils FOB at their port of origin (Oil World 2008).

Bleached Fancy Tallow (BFT) is imported from the US and is not directly comparable with UK tallow prices. However, it does show some interesting features. The BFT price closely tracks the palm price. In reality, it would trade at a discount to palm in Europe as the palm price does not include transport costs whereas the BFT figure does. Secondly, by comparing the actual cost progression for BFT with the relative movements in Figure 14 it is clear that UK tallow has increased in price faster than BFT over the period 2003 to 2007.
The prediction for future tallow prices is continued upward pressure. This is driven by a combination of high vegetable oil prices driven by demand for human consumption and biodiesel, dragging the higher quality tallow grades up, and high oil prices, dragging the lower quality fuel grades of tallow higher (Argent Energy 2008; CIA 2008; UKRA 2008; Uniqema 2008). The complexity of the market can be seen in the news item from ICIS Chemical Business (Finch 2008), reproduced in its entirety in Appendix 4.
4 Task 3 – RTFO impact on the other sectors

4.1 Introduction

The lack of transparent data on costs and prices and the time limitations in this project prevented in depth economic analysis. Instead two key questions were considered:

Whether the RTFO is likely to lead to the diversion of tallow away from existing markets into biofuels.

The likely impact of the RTFO on the supply of UK tallow (i.e. an assessment of any changes in the relative percentages of category one, two and three tallow produced).

4.2 Economic Analysis

Economic analysis has been undertaken to provide understanding of these issues. This analysis does not attempt to model price changes for tallow and alternative feedstocks brought about by the introduction of the RTFO. Rather it has focused on evaluating the likely effects of assumed price changes on decision making by relevant sectors and to identify price thresholds that lead to changes in decisions. It has also modelled the likely impacts of meeting biodiesel blend targets on the feedstock demands of different sectors and the financial impact on the oleochemicals sector if it had to pay specific prices for feedstock. The analysis of biodiesel blend targets on the feedstock demands has, to some extent, been based on an approach used in a study (Stiefelmeyer et al. 2006), which analysed the economic impact of the mandated use of biodiesel blends in Canada, focusing specifically on the oilseed sector and the rendered animal fats industry.

It is stressed that the analysis is based on data provided through stakeholder consultation and sourced literature; however, some assumptions have had to be made where data has been lacking. The analysis does not give firm conclusions, but is intended to contribute to the assessment of likely impacts of the RTFO on use of tallow in the UK. A detailed description of the economic models used and the underlying assumptions is given in Appendix 3. The analysis sought to provide insights to address a number of questions from the point of view of key sectors in the tallow market.

Principal questions

Q1: How might biodiesel producers’ maximum willingness to pay (WTP) for tallow change as a function of increasing fuel duty?

Here, assuming that feedstock costs comprise 80% of total net production costs (an average of values reported in Duncan 2003, Nelson 2006 and Schmidt 2004), we sought to identify the maximum feedstock cost biodiesel producers could incur while maintaining pump price parity with unblended diesel, with various rates of duty relief on biodiesel. We then viewed this maximum cost as biodiesel producer’s maximum WTP for feedstock; we are not saying that biodiesel producers will pay this amount, but rather they could pay this amount while maintaining pump price parity with diesel.

Given the assumptions in Appendix 3, the results showed that, with no duty relief, biodiesel producers could pay up to £265 per tonne tallow while maintaining pump price parity with unblended diesel. Since the quoted price in consultations for category 1 tallow was about £150/t, this result indicates that the biodiesel producers can afford to pay more for category 1 tallow feedstock than the assumed market price while remaining competitive with unblended diesel, even without the duty relief. With 20 ppl duty relief, biodiesel producers’ could pay up to £435/t tallow delivered, while maintaining pump price parity with unblended diesel. Of course they would not pay this price since it is significantly higher than alternative feedstock. The maximum WTP of biodiesel producers for feedstock would be capped at the lowest alternative feedstock price.
Advice on impacts of Government support for biodiesel production from tallow

We also considered here how the RTFO buy-out price might affect the maximum WTP for feedstock of biodiesel producers while maintaining pump price parity with unblended diesel. When a buy-out price of 15 ppl is paid by fuel suppliers, and if it is assumed that these suppliers will pass on all this additional cost to the pump price for diesel, then there will be a total price differential of 35ppl, including the 20 ppl duty relief on biofuel supply foregone by fuel suppliers paying the buy-out, and biodiesel producers’ maximum WTP would increase to about £563 per tonne tallow in this analysis. The signalled intention is that the combined price differential brought about by the duty incentive and buy-out price will fall to 30 ppl in 2010-11, in which case the biodiesel producers’ maximum WTP would be about £520 per tonne tallow in this analysis. It is stressed again, however, that these maximum WTP figures are only theoretical because they are significantly higher than real alternative feedstock prices.

There may also be an indirect effect on WTP if the buy-out funds are recycled to all fuel producers which have redeemed certificates under the RTFO. This might further increase the maximum WTP of biodiesel producers while maintaining pump price parity with unblended diesel. However, this effect would depend on the total funds gathered which are determined by total amount of buy-outs in a given year. This is not known in advance although it is the Government’s intention that the buy-out price should be sufficiently high to ensure that obligated suppliers do not routinely resort to its use. Therefore, if the RTFO is working as intended total buy-out funds will be low or zero.

Varying the assumed proportion of total net production costs comprising feedstock costs will change the results given above. However, the general conclusion seems quite robust that biodiesel producers could – in principle – offer higher prices for tallow and still remain competitive with unblended diesel; a situation that is only enhanced by the presence of the duty relief and the buy-out option. The results also suggest that, since the diesel wholesale price is relatively high in comparison to historical levels, biodiesel producers appear not currently to need the full duty relief or buy-out price to compete with unblended diesel at the pump – assuming that they can obtain suitable quantities of feedstock at prices below about £265/t.

It should also be pointed out that, while the combination of duty incentive and buy-out price will produce a cost differential between biodiesel and diesel of 35 ppl in 2008, these two elements should be treated as separate instruments with separate effects in analysis. The duty incentive is a reduction in fuel duty paid at the pump (referred to as a subsidy by some consultees although it is technically a reduction in tax due rather than a net subsidy payment by Government) while the buy-out price is a penalty paid by suppliers for producing diesel rather than biodiesel and therefore not redeeming RTFO certificates. The former instrument will make a difference to general tax revenues, while revenues from the latter instrument may be recycled among suppliers with redeemed RTFO certificates (in which case it could be described as a subsidy).

Q2: What will renderers do in terms of producing Category 1, 2, and 3, tallow given different prices for each?

To help address this question, we assume that 250,000 t of tallow in all categories is produced in the UK per annum. Of this total, category 1 tallow will be sold to other sectors or used as a fuel by renderers, depending on a number of assumptions given in Appendix 3 regarding the relative price of alternative oil based energy sources (e.g. HFO, gas oil) vis-à-vis the price offered for category 1 tallow, and historical use of tallow and other oils to meet the energy needs of renderers. If profitable, tallow will be converted to category 2 and 3 and sold to other sectors. While stakeholder consultation noted a significant cost differential for renderers to segregate category 2 and 3 from category 1 tallow we do not have precise figures for this and assumptions for these conversion costs are given in Appendix 3.

Using a simple linear programming model (see Appendix 3 for a description) we look at the tallow production decisions taken by renderers as they maximise profits under a number of tallow price scenarios. Subject to the assumptions presented in Appendix 3, the results are summarised below:

In the ‘base case’ about 65 per cent of UK tallow production would be category 1, of which all would be used as a fuel by renderers, and the remainder, around 35 per cent, would be sold as category 3. In the stakeholder interview with Uniqema figures for production by category were quoted indicating about 45 per cent category 1 (most used for energy by renderers and the remainder used for biodiesel) and 55 per cent for category 2 and 3.
Advice on impacts of Government support for biodiesel production from tallow

In the case where the price of category 1 tallow is increased from £150/t to £265/t (recall from above that we assume this price is the estimated maximum WTP of biodiesel producers even without duty relief), renderers will maximise profits by producing only category 1 tallow, still meet all their energy demands from tallow, and sell the surplus category 1 tallow to biodiesel producers. No category 2-3 tallow is produced in the model if the price of category 1 tallow were to increase to this level. Even if the price of category 1 were to rise to only £186/t, it becomes more profitable for renderers to switch all production to category 1, and away from category 3 (which is produced under the base case). At this price, after meeting in-house energy demands, it becomes more profitable for renderers to sell all the remaining tallow as category 1.

If the price of category 1 tallow were to reach £326/t, it becomes more profitable for renderers to sell all tallow produced as category 1, and meet all oil-based in-house energy needs by purchasing oil. Recall from above, that with duty relief equal to 20 ppl, biodiesel producers could – in theory – offer prices in excess of this £326/t, while maintaining pump price parity with unblended diesel. However, whether buyers of category 1 tallow will actually offer this price depends on the price of alternative feedstocks. For instance, vegetable oils are – generally – available at higher prices than this at present. Premiums paid on imported category 2-3 tallow range from +£10 to +100/t, depending on source. The price of used cooking oil is lower – at about £170/t – but has limited availability.

Assuming that the price of category 1 tallow increases to £186/t (the consequences for renderers decision-making is outlined above), category 3 will not be produced unless the price of category 3 subsequently increases to at least £367/t, i.e. at £367/t the gross marginal profit on category 3 is greater than the gross marginal profit on category 1 at £186/t, hence it becomes more profitable again to produce category 3 tallow. (Note that this observation from the model is based on conversion cost assumptions given in Appendix 3).

If the price of oil were to drop from £360/t to £185/t, then renderers would maximise profit by selling all tallow as category 3, and purchase oil to meet all oil-based energy demands. Clearly this is an unrealistically low price. The base case price of £360/t of oil – taken from the Uniqema submission on “tallow economics” – is much lower than those found in Quarterly Energy Prices December 2007. We considered higher oil prices in the model, however, prices above £360/t were not found to alter base case decisions by renderers; all renderers oil-based energy needs are still met by using category 1 tallow.

In the absence of data on the additional cost of producing category 2 tallow relative to category 1 tallow and category 3 tallow relative to category 2 tallow, we assumed that the gross profit margin on category 2 tallow was 50 per cent, and the cost of producing category 3 tallow was 20 per cent more than the cost of producing Category 2 tallow. In other words, the cost of production category 3 tallow is assumed to be an increasing function of the cost of producing category 2 tallow. We tested the sensitivity of the model to these assumptions. The tests found that if gross profit margin on category 2 tallow were to drop below 40 per cent (or the additional cost of separation to increase above approx. £150/t) and the cost of producing category 3 tallow increase accordingly, then the profitability of category 3 would drop below that of category 1 tallow, and the surplus tallow after in-house oil-based energy demands are met, would be sold as category 1 tallow and not converted to category 3 tallow. If the gross profit margin on category 2 tallow was 100 per cent (i.e. costs of separation were zero) this was found not to change the base case decisions of renderers (i.e. no more category 2 or 3 tallow is produced) with renderers still preferring to use category 1 tallow to meet oil-based energy needs. Thus we can conclude that conversion cost assumptions would only effect base case decisions by renderers if they are too low, and the conversion cost to category 2 from category 1 exceeds about £150/t. If the conversion costs are actually lower then what we have assumed, base case decisions are unaffected.

Q3. What are likely impacts on purchases of feedstock for key sectors, assuming that specific biodiesel blend targets are met?

The third part of the economic analysis aimed was to model the least cost solutions for meeting feedstock demand by sector subject to meeting biodiesel targets from 1 per cent up to 5 per cent blends (this is equivalent to meeting the UK volume-based target of 5 per cent under the RTFO). Current price data assumptions and assumptions about current quantities of alternative feedstocks used by sector are given in Appendix 3.

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9 UK price of category 3 is quoted as between £350 and £380 in stakeholder consultation
Advice on impacts of Government support for biodiesel production from tallow

Figure 16 shows how the biodiesel sector might source feedstocks, subject to decisions on minimising cost, to supply 1 per cent to 5 per cent biodiesel blends. This assumes the biodiesel sector meet their feedstock demands at least cost and only then do other sectors buy any excess supply available. This shows that biodiesel producers will first buy available domestic tallow as well as used cooking oil at 1 per cent blend. At higher blends where all supply of domestic tallow is bought, the sector will look to import tallow from cheapest sources (Republic of Ireland) and to buy palm as the cheapest available vegetable oil alternative. At 4 and 5 per cent blends imports of EU tallow will be bought.

**Figure 16  Least Cost Solution for UK Biodiesel Sector to Supply 1% to 5% Target (Tonnes)**

Note: The analysis represented in this chart only uses cost for the basis for decisions. This indicates that tallow biodiesel would meet a significant proportion of UK biodiesel. However, it should be noted that the refining capacity for biodiesel does not currently match this potential demand (although new plants would be relatively straightforward to develop). Rape seed and soy do not feature in this analysis, but currently oil seed rape is important in biodiesel production in the UK, whereas very little biodiesel is produced from palm oil. This shows the theoretical nature of the analysis; but it also shows that if cost alone dictated decisions on biodiesel production, very little, if any biodiesel would come from anything other than tallow, used cooking oil (UCO) and palm oil.

The analysis also looked at impacts on the oleochemical industry and other users of feedstocks, given the above assumption that their supply of feedstocks will be the excess remaining after purchases by biodiesel producers. This showed that if the UK biodiesel sector meets a lower 1 per cent blend target, most of the UK produced tallow would be used as fuel by renderers and the oleochemical sector may only be able to purchase about 3 per cent or below of UK produced tallow and would therefore need to start buying higher priced feedstock (e.g. imports from Ireland and other vegetable oil alternatives, primarily palm oil); although we have been informed that it is not economically viable for the UK oleochemical industry to import palm feedstocks due to competition from Asian producers). The consequences for the oleochemical industry of needing to purchase alternative higher priced feedstocks to tallow is illustrated in the analysis of Q 4.
Q 4. What are the potential impacts on profitability of the oleochemical industry?

This part of the analysis simulates the potential impacts on the profitability of the UK oleochemical industry from incurring additional feedstock costs. See Appendix 3 for an explanation of the methodology. It should be noted that the switch to the use of alternative feedstocks by the oleochemical industry assumed in this part of the analysis may be limited by technical considerations.

In the absence of specific data on the proportion of total variable production costs comprised of feedstock costs three scenarios were simulated, for each of 6 possible increases in the price of feedstocks. The results are summarised in Figure 17, Figure 18 and Figure 19 for scenarios where the feedstock costs are assumed to be 60 per cent, 70 per cent and 80 per cent of total variable production costs respectively. Each figure shows the estimated percentage change in gross operating surplus (an indicator of profitability) under six price change scenarios, where it is assumed that alternative feedstocks are bought at a higher price relative to a base case price of £300/t. For each price change scenario the change in gross operating surplus is estimated for varying degrees of cost transfer. Under each price change scenario it is assumed that all feedstock is purchased at the higher price.

As noted in Appendix 3, the underlying financial data is for NACE 24.5113, which includes other sub-sectors to oleochemicals. The results must therefore be viewed with caution. However, the results do show that if the price the oleochemicals industry had to pay for feedstocks were to increase (as would be necessary if higher prices were to be offered for category 1 tallow, and if other feedstocks were expensive - see conclusions to Q2 above) the oleochemicals sector would face potentially significant declines in gross operating surplus (GOS). For example, under the assumption that feedstock costs comprise 60 per cent of variable production costs, an increase in feedstock costs from £300 to £345/t (approx equivalent to using only imported sources of tallow from the rest of the EU as opposed to UK category 2 tallow) GOS would decline by 50 per cent assuming no cost transfer. At 50 per cent cost transfer, GOS would decline by approx 25 per cent. Under the assumption that feedstock costs comprise 80 per cent of variable production costs, an increase in feedstock costs from £300 to £370/t (approx equivalent to using only imported palm oil as opposed to UK category 2 tallow) GOS would be completely eroded with no cost transfer. The degree to which costs can be transferred to customers depends on how competitive is the market for products from oleochemicals. Feedback in the stakeholder workshop suggested that there is very limited scope for the oleochemical industry due to strong competition in the market. In general, the results from these simulations – as summarised in the figures below – suggest potentially significant risks to the profitability of the oleochemicals sector if they have to pay higher prices for feedstocks.

Figures 17-19 show percentage change in gross operating surplus versus proportion of cost that can be transferred to customers. Before interpreting the figures, it is worth pointing out that if the raw material price increase leads to a -100% change in the operating surplus (or greater reduction) then the companies are predicted to incur losses from their operation. At the other extreme, if the companies are able to fully transfer any increase in their raw material cost (i.e. a position towards the right hand side of the figure) then virtually no price increase will affect them. The cost transfer value is strongly influenced by the competition faced by the oleochemicals industry, which we know is acute – they find it difficult to pass any cost increase to their customers. As such their current plight is represented by area close to the left hand side (i.e. near to 0% cost transfer according to stakeholder consultation). In Figure 17 (based on the assumption that 60% of the total variable cost is due to tallow price) the increases in tallow price by £95 per tonne (at 0% cost transfer) and £170 per tonne (if there is less than approximately 50% cost transfer) would wipe out any surplus. However, where tallow cost makes up a greater than 60% of the total variable cost, the situation would be more acute (see Figures 18 and 19, based on tallow contributing 70% and 80% of the variable cost, respectively).

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10 Feedback from the Oleochemical sector states that: “feedstock costs are highly dominant in relation to overall production costs for oleochemicals. In the case of basic fatty acids, the cost of the feedstock is greater than 80% of the variable costs of production”.

11 Gross operating surplus is the surplus generated by operating activities after the labour factor input has been recompensed. It can be calculated from the value added at factor cost less the personnel costs. It is the balance available to the unit which allows it to recompense the providers of own funds and debt, to pay taxes and eventually to finance all or a part of its investment.

12 Cost transfer refers to the degree to which increased costs for feedstocks paid by oleochemicals industry is transferred to customers by increased prices of oleochemical products.

13 NACE Code 24.51 refers to ‘Manufacture of soap and detergents, cleaning and polishing preparations’. 
Advice on impacts of Government support for biodiesel production from tallow

Figure 17  Estimated Change in Gross Operating Surplus for Oleochemical Producer when buying Alternative Feedstock (Feedstock 60% of total variable production costs)

![Graph showing estimated change in gross operating surplus for oleochemical producer, cost transfer percentage vs. percentage change in baseline gross operating surplus. Legend includes lines for 10, 45, 65, 70, 95, and 170% cost transfer percentage.]

Note: the legend for Figure 17, Figure 18 and Figure 19 is interpreted as follows – e.g. the line labelled "10" indicates what we simulated to happen to GOS if the base case price of feedstock were to increase by £10 per t, under a range of cost transfer percentages. These are based on assumed price increase of alternative feedstocks as given in Appendix 3 (Assumptions for Q4).

Figure 18  Estimated Change in Gross Operating Surplus for Oleochemical Producers when buying Alternative Feedstock (Feedstock 70% of total variable production costs)

![Graph showing estimated change in gross operating surplus for oleochemical producers, cost transfer percentage vs. percentage change in baseline gross operating surplus. Legend includes lines for 10, 45, 65, 70, 95, and 170% cost transfer percentage.]

Note: the legend for Figure 17, Figure 18 and Figure 19 is interpreted as follows – e.g. the line labelled "10" indicates what we simulated to happen to GOS if the base case price of feedstock were to increase by £10 per t, under a range of cost transfer percentages. These are based on assumed price increase of alternative feedstocks as given in Appendix 3 (Assumptions for Q4).
Figure 19  Estimated Change in Gross Operating Surplus for Oleochemical Producer when buying Alternative Feedstock (Feedstock 80% of total variable production costs)
4.3 Conclusions from the economic analysis

1. Is RTFO likely to lead to the diversion of tallow away from existing markets into biofuels?

Results from Q1, the analysis of theoretical maximum WTP of biodiesel producers, suggests that with the current duty relief production of biodiesel is already quite competitive with unblended diesel. Since the diesel wholesale price is relatively high in comparison to historical levels, biodiesel producers may remain competitive with unblended diesel at the pump even without the current duty relief and imminent buy-out price, assuming necessary quantities of feedstock are available at prices below about £265 per tonne. Thus, while the introduction of further measures under the RTFO to incentivise transport fuel suppliers to supply biofuels may have the effect of further increasing the attractiveness of producing biodiesel, including from tallow given continued favourable prices with respect to other feedstocks, according to this analysis even without further incentives under RTFO the production of biodiesel producers is competitive within its market.

Results from Q3 suggest that were the 5 per cent target for biodiesel blend to be met in the least cost solution, biodiesel producers would buy all available domestic supply of tallow and this would be supplemented by imports from Republic of Ireland and EU. In this scenario, the rendering industry would buy fuel to replace tallow used for energy and the oleochemical industry would no longer use any domestic tallow. Therefore, under the given assumption that the biodiesel sector meet their feedstock demands at least cost and only then do other sectors buy any excess supply available, there is likely to be a significant diversion of tallow away from existing markets if the 5 per cent target were met and even if lower percentage targets were met the diversion effect would still be strong.

Results from Q4 show that the increased prices for buying alternative feedstocks to domestic tallow (as would be necessary under the conclusion to Q3) faced by the oleochemical sector would have significant effects on gross operating surplus. Under the higher assumptions on the proportion of feedstock costs in production (80 per cent of variable production costs), using palm oil as an alternative to tallow – as we simulated would happen even with a 1 per cent blend target being met - would result in a 100 per cent reduction in gross operating surplus, if there was no cost transfer and about 50 per cent reduction in gross operating surplus if there was 50 per cent cost transfer.

2. Likely impact of the RTFO on the supply of UK tallow in categories 1, 2 and 3.

Q2 above addressed the question of what renderers will do to maximise profits in terms of relative production of category 1, 2, and 3 tallow given different prices for tallow. At current price of tallow (£150/t for category 1 assumed in this analysis), to maximise profits of renderers the model suggests that over half the production of tallow would be category 1 which would all be used for in house energy by renderers, the rest being sold as category 3. Raising prices of tallow a threshold would be reached after which it becomes more profitable for renderers to switch production to category 1 and away from category 2 and 3. In the model at £186/t for category 1, after meeting in house energy demands, it becomes more profitable for renderers to sell all remaining tallow as category 1 and none as category 2 and 3 unless the price of category 3 simultaneously increases to £367/t.

The overall conclusion here is that any price increases to category 1 tallow, which may be brought about by increased demand from the biodiesel sector given RTFO incentives or for other reasons, would result in a switch away from category 3 and towards category 1, all other factors being equal. In the model the threshold where no category 2 or 3 tallow is produced in the UK was an increase of about 25 per cent in the current category 1 tallow price.

3. Socio-economic impacts

We have been unable to obtain sufficient information about the patterns of employment and value added for the alternative uses for tallow to provide a reliable assessment. However, a crude analysis shows that switching tallow to biodiesel will have a net negative effect on employment, gross value added and the balance of trade.
Advice on impacts of Government support for biodiesel production from tallow

The production of tallow biodiesel is a relatively simple process compared to production of oleochemicals and soap. The latter produce a wider range of products, using a greater variety of chemical transformations, and using a wider range of equipment. In contrast, the essence of a biodiesel plant is minimum complexity and greatest efficiency in producing a single product.

Uniqema estimate that there are over 200 people directly employed in the oleochemical and soap industries (Uniqema 2008). In addition, because of the complexity of their operations there are a large number of contractors and service providers also involved in these sectors. These jobs would all disappear following a major shift of tallow to biodiesel production.

A biodiesel plant producing about 125kT/y would employ about 45-50 people (Agent 2008). There would also be jobs in support and service sectors, but not more as a proportion than in oleochemicals and soap. Such a plant is of an economic size, and would use a similar but larger amount of tallow than the oleochemical and soap industries (125kt versus 82kT).

The oleochemical and soap industries have exports of more than £30m p.a. If missing domestic capacity is replaced by imports, the net negative change in the balance of trade is of the order of £100m p.a.

For this study we have focused on impacts in the UK and not tried to estimate or compare the net impacts on other economies, particularly in Asia.

Overall there are measurable, but not large, socio-economic impacts from the switch of tallow from oleochemicals and soap to biodiesel.
5 Impact of the diversion of tallow to biodiesel from other uses on GHG emissions

This section of the report discusses the consequences that diverting tallow into biodiesel production will have on greenhouse gas (GHG) emissions. In order to do this, the GHG emissions arising from two hypothetical scenarios are compared. The two scenarios are described in Section 5.1, key assumptions are set out in Section 5.2 and results are given in Section 5.3.

It is important to emphasise that the analysis carried out in this section of the report rests heavily on a number of assumptions. Any conclusions drawn are entirely conditional on the validity of these assumptions. The results section (Section 5.3) includes some brief sensitivity analysis to illustrate the influence of the assumptions.

The time scale and data available for this analysis restricted the potential for undertaking an in-depth cradle to grave life cycle analysis of the use of tallow for biofuels or oleochemicals within this work. Instead we have examined two comparative scenarios in which tallow is either used for biofuels or oleochemicals and sensitivities around these analyses. These scenarios allow comparison of the impact on GHG emissions of switching tallow from oleochemicals and soap production to biodiesel. Section 5.1 describes the basis for the scenario analysis; Section 5.2 provides a description of the assumptions made in the analysis; Section 5.3 presents the results and sensitivity analysis; and Section 5.4 provides the conclusions.

5.1 Description of the two scenarios

The impact of diverting tallow into biodiesel production on GHG emissions is estimated by comparing two scenarios. The first, Scenario 1, represents a policy environment in which biodiesel produced from tallow is ineligible for support under the Renewable Transport Fuel Obligation (RTFO) and fuel duty rebates for biofuels and no tallow is used for biodiesel. Scenario 2 represents the likely scenario in April 2008 – where biodiesel from tallow is eligible for this support. In both Scenarios, it is assumed that no other end use of tallow would be incentivised by the UK government or European policy (e.g. Renewable Electricity Obligation). Figure 21 provides a flow chart of the processes covered in the two scenarios.

On the basis of the economic analysis given in Chapter 2 of this report, it is assumed that:

- In Scenario 1 inedible tallow has three uses: oleochemical manufacture, soap manufacture and as a boiler fuel in rendering plants.
- In Scenario 2 all inedible tallow is used for biodiesel manufacture.

Table 2 summarises the quantities of tallow used in both Scenarios. These figures are taken from the data on tallow use in the UK provided in Chapter 2 of this report.

<table>
<thead>
<tr>
<th>Process</th>
<th>Scenario One (tonnes)</th>
<th>Scenario Two (tonnes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soap &amp; oleochemical manufacture</td>
<td>106</td>
<td>0</td>
</tr>
<tr>
<td>Boiler fuel (renders)</td>
<td>82</td>
<td>0</td>
</tr>
<tr>
<td>Biodiesel production</td>
<td>0</td>
<td>188</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td>188</td>
</tr>
</tbody>
</table>
Advice on impacts of Government support for biodiesel production from tallow

In Scenario 1 it is assumed that the tallow that (under current market and policy conditions) is used for biodiesel manufacture and electricity generation would instead be used for soap and oleochemical manufacture. The rendering industry is assumed to have no need or capacity for additional tallow burning.

In order to construct two scenarios which are directly comparable, it is necessary to ensure demand for all relevant products is met in each scenario. Scenario 1 must, therefore, include an alternative supply of biodiesel produced from a feedstock other than tallow. Scenario 2 must include an alternative supply of (1) oleochemical products and soap which is produced from a feedstock other than tallow and (2) boiler fuel for UK meat renders.

5.1.1 Alternative supply of biodiesel for scenario One

Under the conditions given for Scenario 1, the alternative supply of biodiesel is produced from palm oil, for the following reasons.

- Palm oil is the next cheapest feedstock after tallow (see Figure 27).
- Supply of palm oil is increasing, therefore it is likely to be readily available.
- Biodiesel produced from palm is technically quite similar to biodiesel produced from tallow.

The UK government has announced its intention to move (in April 2010) to an RTFO which rewards biofuels on the basis of the GHG savings they achieve. Such a scheme has the potential to change the relative incentives for biofuels produced from different feedstocks. However, under the current methodology used to assess GHG savings, palm oil biodiesel has a higher GHG saving than many other biodiesel fuel chains (see Figure 20). Therefore, palm oil based biodiesel is still likely to be the alternative supply for Scenario 1 under an RTFO that was linked to GHG savings (provided the current methodology is not changed).

It is assumed that approximately the same amount of biodiesel is produced from 1 tonne of palm oil and 1 tonne of tallow. Therefore, to ensure that the same amount of biodiesel is supplied in both Scenarios, 188 kT of palm oil must be supplied in Scenario 1.

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14 Note: it is assumed that the loophole, which currently allows soy-based biodiesel imported from the USA to receive subsidies in both the USA (a production subsidy) and the UK, will not exist in the near future and, therefore, that this supply chain should not be considered as the alternative supply of biodiesel in Scenario 1.
5.1.2 Alternative supply of boiler fuel for scenario Two

The tallow used as a boiler fuel in Scenario 1 will be replaced by the next cheapest boiler fuel which is technically compatible with existing infrastructure. Because the rendering industry currently use tallow as a fuel for boilers any replacement fuel would need to be a liquid. Table 3 shows that the next cheapest liquid boiler fuel would be low sulphur fuel oil.

Table 3 – Prices of liquid fuels in the UK (average 2005 – 07)

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Price (£ / GJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Sulphur Fuel Oil</td>
<td>£5.69</td>
</tr>
<tr>
<td>Light Fuel Oil</td>
<td>£7.95</td>
</tr>
<tr>
<td>Automotive Diesel</td>
<td>£22.25</td>
</tr>
</tbody>
</table>

Another boiler fuel that could be used by renderers is their other product, meat and bone meal. It has not been possible to establish how likely this is, therefore, the assumption made for the main analysis is that light fuel oil is the alternative supply. The implications of this assumption are discussed in the sensitivity analysis.

It is assumed the boilers used by renderers will operate at approximately the same efficiency regardless of whether they are burning tallow or fuel oil.

Therefore, to ensure the same amount of heat and electricity is provided to the renderers in both Scenarios around 75 kT of fuel oil will be used as boiler fuel in Scenario 2.

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15 Using lower heating values of 37 GJ / tonne for tallow and 40.5 GJ / tonne for heavy fuel oil.
5.1.3 Alternative supply of oleochemicals and soap for Scenario Two

The analysis presented in Chapter 2 of this report implies that, if tallow was not available to the UK oleochemicals and soap industries (as is the case in Scenario 2), this industry would cease to exist and existing demand for these products would be met by supply from South East Asia. In Scenario 2, it is therefore assumed that the alternative supply of soap and oleochemicals comes from South East Asia, where the feedstock used is palm oil. In reality this is a simplifying assumption, since some products (e.g. lubricant esters) are expensive to make from palm oil, and would probably be replaced by petrochemical products (which would have a GHG emissions associated with them). However, these products are thought to be in the minority and have been ignored due to the time and data constraints on this study.

It is assumed that approximately the same amount of oleochemical products and soap is produced from 1 tonne of palm oil and 1 tonne of tallow. Therefore, to ensure that the same quantities of soap and oleochemical products are supplied in both Scenarios, 106 kT of palm oil must be supplied in Scenario 2.

5.1.4 Displacement contacts

The products produced in Scenario 1 and 2 can have displacement impacts. For example, the biodiesel supplied in both Scenario 1 and 2 will effectively displace some fossil diesel out of the fuel mix. The emissions associated with producing and using this fossil diesel will be avoided and there will be a net reduction in GHG emissions as a result of the displacement.

It is assumed that any displacement impact will be the same in both Scenario 1 and Scenario 2 – e.g. that the same quantity of fossil diesel emissions are avoided in both Scenarios. Therefore, the displacement impacts will not be considered further in this analysis.

Figure 21 provides a graphical summary of the two scenarios which are considered in this analysis.
Advice on impacts of Government support for biodiesel production from tallow

Figure 21  Two scenarios compared to estimate impact of diverting tallow into biodiesel manufacture on GHG emissions

Scenario One: no policy incentives for tallow.

Scenario Two: tallow biodiesel eligible for support under the RTFO and fuel duty rebates.

Table 4 summarises the quantities of the different feedstocks used in each Scenario.

<table>
<thead>
<tr>
<th>Process</th>
<th>Scenario One</th>
<th>Scenario Two</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tallow (tonnes)</td>
<td>Palm oil (tonnes)</td>
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<td>188</td>
</tr>
<tr>
<td>Total</td>
<td>188</td>
<td>188</td>
</tr>
</tbody>
</table>
5.2 Key assumptions

Availability of data and timescales mean that it is not possible for this analysis to quantify the full cradle to grave GHG emissions resulting from each supply chain in both scenarios. However, with some careful assumptions it is possible to simplify the analysis and still compare the GHG impact of diverting tallow into biodiesel production.

There are several sources of GHG emissions which can be assumed not to vary between Scenario 1 and Scenario 2:

- All GHG emissions from livestock production and meat processing. Changes in demand for tallow will not have any influence on UK herd sizes, or on the quantity of meat processed, due to its low contribution to overall revenue. Therefore, GHG emissions from these two stages will not differ between Scenario 1 and 2.
- All GHG emissions from use and disposal phases. The end products in each scenario (soap, oleochemical products and biodiesel) are broadly identical regardless of the feedstock used to produce them – therefore, the GHG emissions which occur during use and disposal phases will be identical.

There are five sources of GHG emissions which must be analysed further in order to establish how the GHG emissions they produce vary between scenarios: rendering; soap and oleochemicals manufacture; palm growing and oil extraction; international transport; biodiesel production. Potential differences between the GHG emissions occurring from these processes in Scenario 1 and Scenario 2 are discussed below.

5.2.1 Rendering plants

The main sources of GHG emissions from a rendering plant are from energy inputs (e.g. for process heat, electricity etc) and chemical inputs. There will be no difference in the amount of energy or chemical used between the two Scenarios since:

- exactly the same rendering plants are being used in both Scenarios, and
- the amount of material processed through the rendering plant is the same in both Scenarios.

However, the assumptions made about the type of fuel used to provide energy to the rendering plant will clearly lead to a difference in GHG emissions. In Scenario 1, boiler fuel needs are met by tallow and in Scenario 2, this tallow is replaced by fuel oil. This will lead to an increase in emissions from rendering plants in Scenario 2 as tallow has a carbon intensity of zero (including upstream and combustion emissions) and low sulphur fuel oil has an carbon intensity of 80.6 kg CO₂e / GJ (JEC 2007).

5.2.2 Soap and oleochemical manufacture

The main sources of GHG emissions from a soap and oleochemical manufacturing plant are energy use and chemical use. In Scenario 1, soap and oleochemical manufacture occur in the UK, while in Scenario 2 these processes take place in South East Asia – probably Malaysia.

Malaysian soap and oleochemical plants will be newer and, therefore, more energy efficient than their UK counterparts (Rupilius and Ahmad). However no detailed data comparing the efficiency of manufacturing plants in the two countries is available. Therefore, it is assumed that soap and oleochemical plants will use the same amount of energy and chemicals regardless of whether they are in Malaysia or the UK.

The type of fuel used to supply energy to the manufacturing plants could also influence the GHG emissions from the processing step. Anecdotal evidence and advice from industry suggests that natural gas will be the fuel used by soap and oleochemical plants in the UK. Analysis of industrial energy use statistics in Malaysia suggests that natural gas may also be the preferred fuel for soap and oleochemical plants. In 2000 petroleum products (probably heavy fuel oil) met nearly 50% of Malaysian industrial energy needs, by 2005 this share had fallen to 37%.
Advice on impacts of Government support for biodiesel production from tallow

Over the same period, the share contributed by natural gas has increased from 20% to 30%. These statistics suggest that natural gas is currently the most attractive fuel for Malaysian soap and oleochemical producers. If both the UK and Malaysian producers are using natural gas, then GHG emissions from this source will be essentially the same in both scenarios. The sensitivity analysis in Section 5.3.1 discusses the implications of this assumption.

5.2.3 Palm growing and oil extraction

The GHG emissions per tonne of oil from palm growing and palm oil extraction are assumed to be the same regardless of whether the oil is being used for biodiesel manufacture or oleochemical and soap manufacture. However, as Table 4 shows, the amount of palm oil required is less in Scenario 2 than in Scenario 1. Therefore, total GHG emissions from palm growing and oil extraction will be lower in Scenario 2.

5.2.4 International Transport

GHG emissions from international transport could be influenced by the total amount of product moved and by the amount of energy used per tonne of product moved. It is difficult to compare the total amount of product being shipped in each scenario because the quantities of oleochemical products and soap produced are not known. However, there will probably be slightly less GHG emissions associated with transporting 1 tonne of palm oil (Scenario 1), than the soap and oleochemical products produced from 1 tonne of palm oil (Scenario 2).

Palm oil would be transported at high volumetric densities in tankers, while soap and oleochemical products will be transported at lower densities due to packaging and handling requirements (in containers or similar). This will mean transport of palm oil is more energy efficient (in terms of energy used per tonne of product shipped) than transport of soap and oleochemical products. Unfortunately, it has not been possible (given the time constraints of the study) to quantify the impact of this difference on GHG emissions from international transport.

An additional influence on international transport GHG emissions is that 1 tonne of palm oil will produce more than 1 tonne of soap and oleochemical products – since mass is gained from water and chemicals in the various reactions which produce these products (e.g. 1 tonne of palm oil will produce roughly 1.05 tonnes of glycerine and fatty acids). It has not been possible to quantify the increase in mass and the resulting impact on GHG emissions.

Because it has not been possible to identify the influence of these two factors it is effectively assumed that transport sector GHG emissions are the same in both Scenarios (except insofar as Scenario 1 requires significantly more palm oil than Scenario 2). The impact of this assumption is discussed in the sensitivity analysis in Section 5.3.1.

5.2.5 Biodiesel manufacture

The main sources of GHG emissions from biodiesel plant are energy inputs, chemical inputs and co-products. Because tallow requires an extra processing step (esterification) prior to entering the standard biodiesel production process it uses more energy and chemicals than are used in producing palm oil based biodiesel. Unfortunately, it has not been possible to collect data which quantifies these additional energy and chemical demands. The analysis is therefore undertaken on the assumption that the type of feedstock used for biodiesel production has no influence on the energy and chemical requirements of the process. The impact of this assumption is discussed in the sensitivity analysis in Section 5.3.1.

An additional influence on the GHG emissions resulting from biodiesel production can be the uses of co-products. Uses for co-products from tallow-based biodiesel production may differ from the uses of co-products from palm oil-based biodiesel production. Both feedstocks produce two co-products in addition to biodiesel: glycerol (approximately 100 kg/tonne biodiesel) and potassium sulphate (approximately 40 kg/tonne biodiesel).

There are two ways in which co-products can be treated within an assessment of a product's GHG emissions. The first involves expanding the system boundaries to identify what happens when the co-product enters the market (i.e. does it displace another product from a different supply chain?) and what impact this has on GHG emissions (i.e. are some GHG emissions avoided because the displaced product is no longer produced?).
Advice on impacts of Government support for biodiesel production from tallow

The second approach involves allocating emissions between the various products on the basis of a product characteristic such as mass, volume or market value.

The RTFO Carbon Reporting Methodology currently treats co-products from biodiesel production using the approach of allocation by market value.

While system expansion is the preferred approach under this Methodology (E4Tech 2008), the multitude of end uses for glycerol and potassium sulphate and the lack of market data on these end uses meant that a system expansion approach would introduce too much uncertainty into the analysis. A similar approach is used here to understand the impact of co-products.

Each of the co-products from biodiesel production can be have a wide range of end uses; however, for co-products produced from certain categories of tallow some of these uses will be restricted. Discussions with the Environment Agency have confirmed that derivates of tallow are likely to be subject to the same restrictions as the tallow itself (see Chapter 2). This means that glycerol which is produced from Category 1 tallow will have to be burnt.

It is assumed that this glycerol would be used to generate steam for process heat at the biodiesel plant\(^\text{16}\) – thereby offsetting some fossil fuel requirements. The impact of this displacement is assessed using the system expansion method.

This displacement also means that there is less glycerol available for non-energy uses in Scenario 2 (all of the glycerol produced from palm oil in Scenario 1 is assumed to be used for non energy uses), implying that an alternative source of glycerol is needed to balance the two scenarios. This alternative source of glycerol would most likely be derived from South East Asian palm oil (if this is the next most expensive source of soap and oleochemicals, it is also likely to be the next most expensive source of glycerol). The GHG emissions from this additional supply of glycerol are taken into account. It should be noted that there is a surplus of glycerol in the world at present. This means that it has little value and some producers are paying for the disposal of glycerol. We think it is likely that glycerol produced from palm oil based oleochemical manufacture in South East Asia would stay in that region (there would be no incentive to transport it to the UK).

Co-products produced from category 2 tallow should be eligible for “technical” uses (i.e. non-food or feed) and Category 3 tallow should be eligible for any use. Further data on the displacement impact of glycerol has not been collected; therefore, category 2 and category 3 tallow will be treated using the market value allocation method. This means that co-products from category 2 or 3 tallow will have the same impact on the GHG emissions attributed to the biodiesel as they do for palm oil-based biodiesel.

### 5.3 Key results

Based on the assumptions made in Section 5.2, it is possible to calculate the additional GHG emissions which occur in each scenario – full details of these calculations and the data used is available separately. Table 5 summarises the additional emissions which would occur, by process. The net effect of displacing tallow into biodiesel (i.e. Scenario 2) is an increase in GHG emissions of around 183 kT, which is equivalent to 974 kg CO\(_2\)/tonne tallow displaced. The primary reason for this increase in emissions is the displacement of tallow from use as a boiler fuel by renderers, which means that a more carbon intensive fuel (low sulphur fuel oil) must be used. This effect is somewhat reduced by the higher demand for palm oil in Scenario 1.

\(^{16}\) It is assumed that all Category 1 tallow (99 ktonne) will be used by biodiesel producers who have modified boilers which are capable of burning glycerol.
Table 5  

<table>
<thead>
<tr>
<th>Process</th>
<th>Change in GHG emissions (tonnes CO$_{2}$e)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rendering</td>
<td>+264,868</td>
</tr>
<tr>
<td>Soap and oleochemicals manufacture</td>
<td></td>
</tr>
<tr>
<td>Palm growing and oil extraction (including international transport)</td>
<td>+89,872</td>
</tr>
<tr>
<td>Biodiesel production</td>
<td>+8,053</td>
</tr>
<tr>
<td>TOTAL</td>
<td>+272,921</td>
</tr>
<tr>
<td>Net impact</td>
<td>+183,049</td>
</tr>
</tbody>
</table>

5.3.1 Sensitivity analysis

As mentioned in the introduction to this section of the report, a number of assumptions have been made in order to analyse the GHG impact of displacing tallow into biodiesel production. It is important to understand the influence of changes in these assumptions before drawing any conclusions from the analysis. Key assumptions include:

1. The type of boiler fuel which replaces tallow in Scenario 2
2. The type of fuel used by Malaysian soap and oleochemical manufacturers in Scenarios 2
3. The energy efficiency and relative mass of soap and oleochemical products transported in Scenario 2
4. The amount of energy and chemicals required for biodiesel production from tallow in Scenario 2
5. The type of process used to produce biodiesel
6. The impact of land use change in the production of palm oil

Each of these assumptions and the impact different assumptions would have on the overall results are discussed below.

1. The type of boiler fuel which replaces tallow in Scenario 2

The assumption that heavy fuel oil replaces tallow in Scenario 2 is clearly the most influential assumption in the whole analysis. As mentioned earlier, the rendering industry could switch to burning another product of their process – meat and bone meal (MBM). The consequences of using MBM as a boiler fuel in Scenario 2 are worth exploring:

- Because MBM is a form of biomass, the CO$_2$ resulting from its combustion would not lead to a net increase in atmospheric GHG emissions – i.e. these emissions would not be counted in the analysis above.
- Burning MBM for heat at the rendering plant would have no impact on upstream GHG emissions (from animal rearing & processing).

These factors suggest there would be no increase in GHG emissions from rendering plants between Scenario 1 and 2. However, it is also necessary to consider how the MBM was being used previously (i.e. in Scenario 1), what will be used to replace it in Scenario 2 and to estimate the consequences for GHG emissions.

Category 1 and 2 MBM must be burnt in order to comply with waste management legislation, currently it is predominantly used to generate electricity and in cement manufacture. Electricity generated from MBM receives Government support under the Renewable Electricity Obligation, and use of MBM in cement manufacture is encouraged by the European Emissions Trading Scheme. Category 3 MBM has similar uses, but may also be used in pet foods.

Note: it is assumed that this demand for palm oil has not caused any direct or indirect land use change.
Advice on impacts of Government support for biodiesel production from tallow

Identifying what would replace MBM in its current end uses is highly uncertain; however, it is considered likely that the replacement product would be some form of biomass or waste. Sufficient quantities of either biomass or waste to replace MBM in energy applications are likely to be available – e.g. recent decreases in the amount of biomass which is allowed to be co-fired to generate electricity under the Renewable Electricity Obligation suggest additional biomass supply should be available; and the significant quantities of waste which are currently being landfilled in the UK suggests additional waste supply should be available.

If the current uses of MBM (i.e. renewable electricity generation and cement manufacture) were to switch to biomass or waste then this could have a significant effect on the GHG emissions in Scenario 2. Biomass would be considered as having no GHG emissions from combustion and some biomass containing wastes would also have very low GHG emissions, which would mean that switching to these alternatives sources of fuel would result in no extra GHG emissions. If the switch was to wastes derived from fossil derivatives there would be an increase in GHG emissions, which would have to be calculated based on the waste composition.

If all of the MBM which was used at the rendering plant was replaced by biomass, there would be no increase in GHG emissions from the rendering plant in Scenario 2.18 If it were to be replaced by wastes containing fossil derivatives the GHG emissions would need to be examined in more detail.

There is an argument that using MBM at the rendering plant would ultimately lead to the displacement of a fossil fuel somewhere in the market. However, the supply of biomass is not fixed (at least in the medium and long run) and can be expanded in several ways (e.g. recovery of more wood waste from forestry). An important mechanism for expanding the biomass supply curve in the UK is likely to be the growing of more energy crops.

Clearly the overall result of this analysis is very sensitive to the assumption made about the type of fuel which would replace tallow at the rendering plants in Scenario 2.

The relative economics of burning MBM instead of low sulphur fuel oil at the rendering plant need to be explored further before a decisive conclusion about the impacts of using tallow for biodiesel production can be fully understood.

2. The type of fuel used by Malaysian soap and oleochemical manufacturers in Scenarios 2

The assumption in the main analysis above was that natural gas is the fuel most likely to be used to provide process heat for soap and oleochemical manufacture. This is a reasonably certain assumption for UK production; however, it is less certain for Malaysian soap and oleochemical production, where fuel oil may be used instead.

It has not been possible, given the time constraints of the study, to establish the energy requirements of soap and oleochemical production processes – in order to establish the impact using heavy fuel oil in Malaysia would have on GHG emissions. However, it is possible to give a sense of scale:

- Process heat requirements for soap and oleochemical production are likely to be similar to those for biodiesel production since the reactions required are broadly similar.
- Therefore, (based on the RTFO default values), approximately 1.7 GJ of natural gas would be required to provide process heat sufficient for 1 tonne of (say) soap.
- If the same amount of heat was provided using heavy fuel oil, then this would increase GHG emissions per tonne of product by around 40%. If all 106,000 tonnes of palm oil was processed in plants using heavy fuel oil in Scenario 2, this would increase total GHG emissions by approximately 5,000 tonnes.

Clearly the assumption about what type of fuel is used to provide process heat in soap and oleochemical manufacture is important. However, it is unlikely to influence the overall conclusion of the main analysis.

3. The energy efficiency and relative mass of soap and oleochemical transport in Scenario 2

It was assumed that international transport emissions would not differ between scenarios due to a lack of available data. In particular it was assumed that:

- the lower volumetric density of soap and oleochemical products during transport, would have a negligible impact on transport energy efficiency and therefore on resulting GHG emissions.

18 There may be some additional GHG emissions as a result of additional transport steps being required, however, these are likely to be relatively small.
Advice on impacts of Government support for biodiesel production from tallow

- the mass gained when palm oil undergoes various chemical reactions to produce soap and oleochemicals would not lead to significantly higher GHG emissions from international transport.

While in reality these assumptions would clearly be wrong, it is important to understand that their impact is relatively small. Transporting 1 tonne of palm oil from South East Asia to Europe would produce approximately 260 kgCO₂e. If international transport in Scenario 2 was 10% less energy efficient (due to the lower volumetric density) and 10% more mass had to be transported, the resulting increase in GHG emissions would still only be of the order of 5,800 tonnes CO₂e.

The assumptions made about international transport are important, however, it is unlikely that they would influence the overall conclusion of the main analysis.

4. The amount of energy and chemicals required for biodiesel production from tallow in Scenario 2

As discussed above, it has not been possible to establish the additional energy and chemical requirements of tallow biodiesel production. Instead it has been assumed that these inputs are the same regardless of the feedstock used. In order to understand the importance of this assumption, the impact of a 10 percent increase in energy inputs (i.e. MJ of natural gas and electricity required to produce a tonne of biodiesel) and chemical inputs (i.e. kg methanol/t of biodiesel) has been explored. For every 10% increase in these inputs, GHG emissions from tallow biodiesel production (Scenario 2) would increase by approximately 9,000 tonnes CO₂e.

The assumption that biodiesel plants require the same energy and chemical inputs regardless of their feedstock is important; however, it is unlikely that they would influence the overall conclusion of the main analysis.

5. The type of process used to produce biodiesel

Another sensitivity relates to biodiesel production technologies. The analysis assumes that all biodiesel is produced using a conventional trans-esterification process; however, other processes exist which may be able to convert fats and oils to diesel more efficiently.

Several companies are, for example, developing hydrotreatment processes which can use tallow (and vegetable oils) to produce a fuel which is very similar to mineral diesel (e.g. Neste's NExBTL process, ConocoPhillips' RenewDiesel process).

Analysis undertaken for the companies developing these technologies (e.g. [18]) indicates that hydrotreating processes would lead to a biodiesel with higher GHG savings than conventional FAME. However, the analysis carried out above would not be particularly sensitive to the choice of processing technology – since the same technology would have to be used in both Scenario 1 and 2.

It is worth noting that hydrotreatment processes require similar quantities of energy for different feedstocks, so the sensitivity discussed under point 4 above would not be relevant if this was the technology selected.

6. The impact of land use change in the production of biodiesel

There is currently much concern about the increase in demand for palm oil in the Far East and the impact this will have on deforestation in the region (Casson 2003, UNEP 2007). The increase in demand for palm oil has come about predominantly as a result of its use in food (FAO 2003). However, there are also ambitious targets for biodiesel production in countries such as Thailand, Indonesia, Malaysia, China and India. For the first three of these it is likely that palm oil will be the oil of choice for biodiesel production. If this pressure is added to by increased production of oleochemicals in the Far East, will this result in more land use change? It has been shown that deforestation of tropical rain forest in Indonesia can result in the release of large quantities of carbon from the land (Hooijer et al. 2006).

Should we take this into account in the present analysis? This is quite a complex question. Palm oil plantations cannot be blamed alone for deforestation, as logging of valuable tropical timber and slash and burn agriculture have also been blamed (UNEP 2007, Casson 2003). In addition much of the oil used in oleochemicals in the Far East is palm kernel oil, a secondary product after the palm fruit has been processed for palm oil for food. It is clear that there could be some addition impact on GHG emissions from the increased demand for palm oil for oleochemicals in the Far East, should production shift there, but it is not possible to categorically say that all of this production would be met by deforestation of tropical rainforest. Some may be met by the development of plantations on land that has been left uncultivated after logging of rain forest and therefore improve carbon retention in degraded soils. In this work we considered the GHG impacts in the UK.
Advice on impacts of Government support for biodiesel production from tallow

The effect of global land use change on GHG emissions is complex and controversial and is being examined elsewhere by DfT and the RFA. It is recommended that this topic is examined in a more in depth study once the treatment of carbon release from land use change is clarified.

5.4 Conclusions from GHG analysis

The results given in Table 5 clearly show that if displacement of tallow into biodiesel production results in renderers using low sulphur fuel oil, there will be a significant net increase in GHG emissions. However, the overall result is very sensitive to this assumption. If, for example, the rendering industry were to replace tallow with MBM instead, then the difference in GHG emissions between scenarios could be much smaller and probably be lower in Scenario 2 (depending on the influence of the other key assumptions discussed in the sensitivity analysis: soap and oleochemical manufacture in South East Asia; international transport; tallow biodiesel production).

Before more definitive conclusions about the impact diverting tallow into biodiesel production would have on GHG emissions can be drawn, it is necessary to gain a better understanding of two factors:

- whether burning MBM would be economically attractive for the rendering industry and
- whether biomass supply in the UK would expand to ensure all existing biomass demand is met.

Finally, the scope of the RTFO Carbon Reporting methodology could be expanded to ensure it takes account of any fuel switches which occur at the rendering plant. In order to encourage reporting of actual data (i.e. on the type of fuel used) the default assumption could be that low sulphur fuel oil is used. This could create an incentive for renderers to seek out low carbon fuels as an alternative source to tallow, particularly if the RTFO were to be linked to a biofuel’s GHG saving. It would also ensure the Renewable Fuels Agency was aware of what impact the RTFO was having on the market for tallow.
Advice on impacts of Government support for biodiesel production from tallow

6 Discussion

This report was commissioned to examine whether the RTFO, by supporting the production of biodiesel from tallow, will have adverse effects on the other industries that use tallow as a feedstock and to enable the Government to consider whether changes need to, and could, be made to the design of the RTFO as the result of the above.

The work was undertaken as a series of four separate, but related, studies, and included consultation with the key stakeholders who have an interest in tallow use in the UK. These four studies provided:

- an overview of the current tallow industry in the UK and the sectors that use tallow as a feedstock
- the position and concerns of the major stakeholders and the relevance of tallow to their business
- the way in which the RTFO might impact on the price of tallow and the subsequent impact this would have on the various stakeholder groups, and
- the effect of switching production of tallow from oleochemicals to biodiesel on GHG emissions.

The time scale of the work and the data available precluded in-depth analysis and modelling, but the work undertaken does provide sufficiently clear evidence to allow conclusions to be drawn. These are listed below, together with a discussion of assumptions and any factors to which they are sensitive.

6.1 The UK Tallow sector

UK tallow is a limited resource, the size of which is dependent predominantly on UK meat production. The only way to expand this resource is to import tallow from abroad. This is not simple. Imported tallow is expensive compared to UK tallow; in addition, the ‘hub’ for import of tallow into Europe is in Rotterdam and there is significant additional cost to importing this tallow into the UK. Effectively this limits the tallow available to the UK to around 250,000t/y, with some small additional import/export mainly centred around the import of Irish tallow. This situation is discussed in more detail in Chapter 2.

Currently all tallow produced is used for some economic purpose. None is disposed to landfill. Figure 3 in Chapter 2 provides a breakdown of use. The main uses are dictated by the category of tallow under the Animal By-products Regulations19

- Category 1 can only be used for burning or fuel production
- Category 2 can be used for industrial applications
- Category 3 can be used for human contact products (e.g. in soaps and cosmetics).

This is a key influence on the current predominant uses: burning of (mainly category 1) tallow in boilers by the rendering industry to raise process heat and the use of category 2 and 3 tallow by the oleochemicals and soap industry. Other, smaller-scale uses involve power generation, biofuels production, animal feed and food.

The UK oleochemicals and soap sectors exist because of the historical supply of cheap tallow in the UK. If this feedstock increases significantly in price (relative to alternative feedstocks available abroad) or the supply of the feedstock diminishes, the sector is unlikely to exist in the UK. This is because export tariffs on alternative feedstocks (most notably palm oil) make production of oleochemicals and soaps from other feedstocks uncompetitive in the UK.

- Alternative feedstocks for the key uses of tallow were examined:
  - The rendering industry currently substitutes fuel oil (or natural gas) for tallow for production of process heat and steam, depending on the relative prices of these fuels.
  - The oleochemical and soap industry is more complex. For the major products, a range of vegetable oils can be substituted, although the nearest equivalent in price and performance is palm oil. For some downstream products, mineral oils are more appropriate. The oleochemicals industry and the rendering industry provided information on the chemical processing of tallow to its various products and this is presented in Chapter 2.

19 See Chapter 2 for further explanation of these terminologies.
Advice on impacts of Government support for biodiesel production from tallow

6.2 Tallow prices

The UK rendering industry and oleochemicals industry comprise relatively few organisations. Trade in tallow is not done on the open market, but as direct contracts between companies. Consequently much information regarding the use of tallow and its price is commercial and this study was unable to uncover the data regarding tallow price. This means that the analysis undertaken had to be done on relative trends in prices and on ranges of tallow prices rather than precise figures; and that these figures were provided by the industry because there is no independent source of information on tallow prices available.

However, some trends are clear. In the absence of subsidies the price of category 1 tallow is linked to fuel oil prices. As fuel oil prices increase the incentive to the rendering industry to use tallow in their boilers increases. Category 2 and 3 tallow prices reflect the trends in category 1 tallow, plus the additional cost of segregation and processing. The upper price of category 2 and 3 tallow is linked to the lowest equivalent virgin plant oil, minus the transport costs and any import or export tariffs. Price trends in tallow and other oils and fats relative to 2003 were provided by Uniqema. Other information on oils and fats prices were obtained from Oil World. The prices of oils and fats have been climbing steeply recently and there is an indication that the tallow price is linked in some way and is also rising. However, it is not clear exactly why this should be so. Prices and their trends for tallow are provided in Chapter 3. If category 1 prices increase sufficiently it acts to disincentivise the production of the category 2 and 3 tallow and their availability decreases. This situation has a significant effect on the oleochemicals and soap industry, for which alternative feedstocks are not available in the UK and, if it is sustained for any period, would result in the closure of a significant part of its production in the UK.

In the absence of clear prices, the analysis in this report (Chapter 4) focused on evaluating the likely effects of assumed price changes on decision making by relevant sectors and on identifying the price thresholds that lead to changes in decisions. In addition the likely impacts of meeting biodiesel blend targets on the feedstock demands of different sectors and the financial impact on the oleochemicals sector if it had to pay specific prices for feedstock was also modelled.

Results to the work on economic analyses were:

- Even without the RTFO there is still an incentive for tallow to be used to produce biodiesel, given the current high oil price.

- An examination of the theoretical maximum ‘willingness to pay’ of biodiesel producers suggests that with the current duty relief the production of biodiesel is already quite competitive with unblended diesel. This is a function of the current high wholesale price of diesel, but the introduction of further measures under the RTFO to incentivise supply of biofuels may have the effect of further increasing the attractiveness of producing biodiesel, including from tallow.

- Assuming the RTFO 5 per cent biofuel target was met through biodiesel analysis of the least cost solution (under the assumptions in the economic model) would be that biodiesel producers buy all the available domestic supply of tallow. This is likely to be supplemented by imports from Republic of Ireland and continental Europe. In this scenario, renderers would buy fuel to replace tallow used for energy; and the oleochemical industry would no longer be able to use any domestic tallow. Therefore, under this assumption (that biodiesel sector meets their feedstock demands at least cost and only then do other sectors buy any excess supply available), there is likely to be a significant diversion of tallow away from existing markets. Even if lower percentage targets were met the diversion effect would still be strong.

- In this situation, the increased prices for alternative feedstocks to domestic tallow would have significant effects on the oleochemicals industry.

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20 It could be related to a number of factors such as the oil price, the current shortage of certain foods and feed which has led to rising prices for agricultural commodities and the substitution of feedstocks in the presence of high prices, but this is speculation without hard evidence.
Advice on impacts of Government support for biodiesel production from tallow

- It must be remembered that this is a theoretical situation. The tallow-biodiesel refining capacity in the UK is low at present. However, biodiesel plants are not complex refining plants and it is possible to establish new ones relatively quickly, subject to planning. There is currently an application for a 150,000t/y biodiesel plant that would be able to take tallow as a feedstock.

- The model suggests that at the current price of tallow (£150/t for category 1 assumed in this analysis), profits of renderers would be maximised when over half the production of tallow would be category 1 (which would all be used for in house energy by renderers), the rest being sold as category 3. As tallow prices increase a threshold would be reached above which it becomes more profitable for renderers to switch production to category 1 and away from category 2 and 3. In the model examined in Chapter 4, at £186/t for category 1, after meeting in house energy demands, it becomes more profitable for renderers to sell all remaining tallow as category 1 and none as category 2 and 3, unless the price of Category 3 simultaneously increases to £367/t.

- The overall conclusion is that any price increases to category 1 tallow, which may be brought about by increased demand from the biodiesel sector given RTFO incentives or for other reasons, would result in a switch away from category 3 and towards category 1, all other factors being equal. The model indicated that the threshold where no category 2 or 3 tallow is produced in the UK was an increase of about 25 per cent in the current category 1 tallow price (to £186/t from the assumed current price of £150/t).

6.3 Socio-economic impacts

We have been unable to obtain sufficient information about the patterns of employment and value added for the alternative uses for tallow to provide a reliable assessment. However, a crude analysis shows that switching tallow to biodiesel will have a net negative effect on employment, gross value added and the balance of trade.

The production of tallow biodiesel is a relatively simple process compared to production of oleochemicals and soap. These produce a wider range of products, using a greater variety of chemical transformations, and using a wider range of equipment. In contrast, the essence of a biodiesel plant is minimum complexity and greatest efficiency in producing a single product.

Uniqema estimate that there are over 200 people directly employed in the oleochemical and soap industries (Uniqema 2008). In addition because of the complexity of their operations there are a large number of contractors and service providers also involved in these sectors. These jobs would all disappear following a major shift of tallow to biodiesel production.

A biodiesel plant producing about 125kT/y a would employ about 45-50 people (Argent 2008). There would also be jobs in support and service sectors, but not more as a proportion than in oleochemicals and soap. Such a plant is of an economic size, and would use a similar but larger amount of tallow than the oleochemical and soap industries (125kt versus 82kT).

The oleochemical and soap industries have exports of more than £30m p.a. If missing domestic capacity is replaced by imports, the net negative change in the balance of trade is of the order of £100m p.a.

For this study we have focused on impacts in the UK and not tried to estimate or compare the net impacts on other economies, particularly in Asia.

Overall there are measurable, but not large, socio-economic impacts from the switch of tallow from oleochemicals and soap to biodiesel.

6.4 Impact on GHG emissions of the diversion of tallow to biodiesel

The time scale and data available for this analysis restricted the potential for undertaking an in-depth cradle to grave life cycle analysis of the use of tallow for biofuels or oleochemicals within this work. Instead two comparative scenarios were examined in which tallow was either used for biofuels or oleochemicals. These are described in detail in Chapter 5, together with a list of the assumptions inherent in each scenario.
Advice on impacts of Government support for biodiesel production from tallow

Essentially the scenarios were:

Scenario 1: in which tallow is used for soap and oleochemicals production, with Category 1 tallow being used by the rendering industry for fuel. In this scenario it was assumed that biodiesel would be produced from palm oil in the UK\(^{21}\). Palm oil would be transported by tanker to the UK.

Scenario 2: in which all tallow was diverted to biodiesel. In this scenario it was assumed that soap and oleochemicals would be produced from palm oil in the Far East and transported by boat to the UK\(^{22}\). The rendering industry would need to use an alternative energy source and it was assumed that this would be fuel oil.

These scenarios are not strictly representative of what might happen, as is indicated in the footnotes and in Chapter 5. Consequently, they were subjected to a number of sensitivity analyses. These included examination of: the type of boiler fuel which replaces tallow when tallow is used for biodiesel; the type of fuel used by Malaysian soap and oleochemical manufacturers; the energy efficiency and relative mass of soap and oleochemical products transported; the amount of energy and chemicals required for biodiesel production from tallow; the type of process used to produce biodiesel.

The results of this analysis indicated:

- The most important sensitivity in the analysis is the fuel switching at the rendering plant. If displacement of tallow into biodiesel production results in the rendering industry using low sulphur fuel oil instead of tallow for fuel, there will be a significant net increase in GHG emissions (183 kT of CO\(_2\)e in total, which is equivalent to 974 kg CO\(_2\)e/t tallow displaced). However, the overall result is very sensitive to the assumption about the fuel that is used as fuel oil. Some of the rendering industry can use natural gas, which would result in a net increase in GHG emissions, but lower than for fuel oil. If the rendering industry were to use a biomass fuel\(^{23}\) then the GHG emissions would be much smaller and probably lower than the use of tallow for oleochemicals (depending on the influence of the other key assumptions, such as soap and oleochemical manufacture in South East Asia; international transport; tallow biodiesel production etc.). Before drawing conclusions about the impact of diverting tallow into biodiesel production would have on GHG emissions, it is necessary to gain a better understanding of two factors:
  - whether burning biomass (such as MBM) would be economically attractive for renderers and
  - whether biomass supply in the UK would expand to ensure all existing biomass demand is met.

- Thus there is a need for more data on what is actually happening at the rendering plant in order to ensure the calculation of GHG emissions from production of biodiesel from tallow is an accurate reflection of what is actually happening at the rendering plant. To take this into account the scope of the RTFO Carbon Reporting methodology\(^{24}\) could be expanded to ensure it takes account of any fuel switches which occur (i.e. the scope of the fuel chain could be expanded to take account of the fuel used) at the rendering plant. At the moment data on the fuel switching at the rendering plants is not sufficient to ensure that the reporting is representative of what actually happens at the plant. In the future the RTFO will be linked to carbon savings and this would provide an incentive to the rendering industry to use a low emission fuel at their plants. In order to encourage reporting of actual data (i.e. on the type of fuel used) the default assumption could be that low sulphur fuel oil is used. This would create an incentive on renderers to use another low-carbon fuel instead of tallow, particularly if credits under the RTFO were linked to a biofuel’s GHG saving.

---

\(^{21}\) Palm oil is not currently used in any great quantity to produce biodiesel in the UK. However, this scenario was justified on the basis that palm oil is the closest feedstock technically to tallow that could be used to replace tallow in any quantity; and it is the cheapest of the bio-oil feedstocks.

\(^{22}\) Not all oleochemicals produced from tallow could use palm oil as a replacement feedstock. In some cases mineral oils would be needed. However, palm oil is the closest feedstock to tallow in its chemical properties and a significant proportion of oleochemicals and soaps could be made using palm oil. In addition the oleochemicals sector indicated that in the absence of tallow it is likely that production would shift to palm oil in the Far East.

\(^{23}\) For example, the rendering industry have indicated an interest in developing MBM as a fuel for their rendering plants. This would take some investment, as the burning of some grades of MBM is strictly controlled. In addition MBM is used as a fuel in other sectors and the substitution of fuels in these sectors would need to be considered. Analysis of this use involves speculation about future possibilities and so it was not examined further in this work.

\(^{24}\) See: [http://www.dft.gov.uk/rfa/reportsandpublications/carbonandsustainabilityguidance.cfm](http://www.dft.gov.uk/rfa/reportsandpublications/carbonandsustainabilityguidance.cfm)
Advice on impacts of Government support for biodiesel production from tallow

It would also ensure the Renewable Fuels Agency was aware of what impact the RTFO was having on the market for tallow.

- The other sensitivity analysis undertaken indicated that the other factors examined (i.e. the type of fuel used to provide process heat in soap and oleochemical manufacture, the assumptions made about international transport and the assumption that biodiesel plants require the same energy and chemical inputs regardless of their feedstock) all make a difference to the GHG emissions, but it was concluded that none of these influence the overall conclusion of the main analysis.

- Another sensitivity relates to biodiesel production technologies. The analysis assumes that all biodiesel is produced using a conventional trans-esterification process. However, other processes exist which may be able to convert fats and oils to diesel more efficiently. Several companies are, for example, developing hydrotreatment processes which can use tallow (and vegetable oils) to produce a fuel which is very similar to mineral diesel (e.g. Neste’s NExBTL process, ConocoPhillips’ RenewDiesel process). Analysis undertaken for the companies developing these technologies (e.g. IFEU, 2006) indicates that hydrotreating processes would lead to a biodiesel with higher GHG savings than conventional FAME. However, the analysis carried out above would not be particularly sensitive to the choice of processing technology – since the same technology would have to be used in both scenarios.

6.5 Other Environmental impacts

To obtain a balanced understanding of the full environmental impact of switching tallow from oleochemicals to biodiesel it is also important to consider other environmental impacts from the use of tallow in the oleochemicals or biodiesel industry. We were unable to gather clear data on potential environmental impacts from the processing of tallow to oleochemicals or biodiesel to allow comparison between the two routes. Such impacts could arise from additional emissions to air, soil and water from the processing of tallow, the production and disposal of by-products. We do not have clear evidence that these emissions would be significantly higher from the oleochemical or biodiesel use of tallow.

This leaves consideration of their respective roles for recycling or reusing residues and the value of the co-products: do these processes create useful products and does the processing result in co-products that are wastes or have any environmental impact?

The use of tallow both in the oleochemicals and the biodiesel sector represents the production of a new product from a by-product of the rendering industry and both processes represent recovery of value from tallow, as defined in the EC interpretation of the definition of wastes (EC 2007). It could be argued that the use of tallow for oleochemicals represents recycling and the use for biodiesel represents energy recovery. Indeed the oleochemicals industry argues that its products represent processing further up the waste hierarchy, as defined in the UK Waste Strategy (Defra 2007), which is true. This does not represent an argument for better environmental impact per se. To do this the whole environmental impact needs to be considered, including all emissions from processing and the disposal or use of by-products. Within the scope of this study it is not possible to do this.

6.6 Key questions

There are a number of key questions that also need to be considered:

- What impact will development of novel technologies and second-generation processing have on biodiesel in the longer term?
- Does the RTFO unduly encourage one use of tallow over another?
- If the RTFO were to be modified to create a level playing field for all users of tallow, would the oleochemicals industry be able to survive until this happened?
- How could the RTFO be modified to avoid these problems?
Advice on impacts of Government support for biodiesel production from tallow

1. What impact will development of novel technologies and second-generation processing have on biodiesel in the longer term?
The economics of first-generation technology currently used to produce biofuels around the world are heavily dependent on feedstock costs. This means that production costs can only be kept down if feedstock costs are low. As a result there is considerable pressure on the cheapest feedstocks. There are a number of technologies being developed to allow the production of biofuels from lignocellulosic feedstocks.

The impetus behind this development is twofold: they allow the use of wastes and feedstocks that currently have little value or use; and they enable more sustainable/efficient land use. Unfortunately these processing technologies are currently expensive and technological development is still required. However, there are second generation demonstration plants in operation and more demonstration plant are planned. Many analysts predict this technology will be available within the next five to 15 years. Once the technology is in operation it may supersede first generation technologies in regions such as Europe where feedstock costs are high. Consequently the current methods for producing biodiesel may be phased out in favour of more advanced technology in Europe in the long term.

Marine algae are also being explored as a longer term source of oil for processing into fuel and chemicals. Many of the oil and energy majors have research programmes in this area as algae are believed to offer the potential for much higher conversion of primary photosynthetic products into oil compared to land crops.

2. Does the RTFO unduly encourage one use of tallow over another?
The analysis in this report demonstrates that the RTFO makes the production of biodiesel from tallow attractive and increases the biodiesel producers’ willingness to pay for tallow. This provides an incentive to produce more category 1 tallow and not to produce category 3 tallow unless its price rises substantially, too.

3. If the RTFO were to be modified in the future to create a level playing field for all users of tallow, would the oleochemicals industry in the UK be able to survive until this happened?
There is no cheap alternative feedstock that the oleochemicals industry can use in the UK if tallow is diverted to biodiesel. It is likely that even a relatively short term switch to biodiesel would have a significant impact on the survival of the oleochemicals industry in the UK.

4. How could the RTFO be modified to avoid these problems in a manner consistent with EU and international legislation?
For feedstocks such as tallow that already have existing applications the RTFO should take into account the effect of substitution on the overall sustainability of switching to biofuels production, particularly on GHG emissions. The Govt should consider the implications of this carefully, particularly in the context of the proposed shift to a carbon-linked RTFO.

5. To what extent are the problems faced by the oleochemicals industry due to current high tallow prices as opposed to wider, global economic factors?
The oleochemicals industry is facing a number of problems at the moment, including competition from products from the palm oil industry in the Far East. Biofuels are not solely to blame for the problems faced by the oleochemicals industry – they are part of a much bigger picture. However, feedstock costs are a significant proportion of costs for the oleochemicals industry and the industry exists in the UK because historically there has been a supply of cheap tallow. The significance of feedstock costs in the oleochemicals business model means that it is particularly vulnerable to increase feedstock costs. In addition, it is difficult for the industry to pass these prices onto its customers in the current competitive environment. Consequently, although tallow prices are not the only factor affecting the oleochemicals industry they will have important consequences. At the moment palm oil prices are also high (both in the UK and the Far East) but any price rise for tallow relative to the price of palm oil would be difficult for the oleochemicals industry.
6.7 Principal Conclusions

- The RTFO is likely to increase the maximum price biodiesel producers are willing to pay for tallow. Depending on prices of alternative feedstocks this may result in diverting supplies from current uses but the economic analysis suggests that this could result in any case with or without the RTFO.
- One of the consequences of increased prices for category 1 tallow is likely to be a reduction in availability of category 2 and 3 tallow.
- Tallow is relatively cheap compared to other biodiesel feedstocks. This means that if biodiesel producers only use price to decide which feedstock to use, tallow is very attractive.
- Tallow biodiesel refining capacity in the UK is currently met from only one plant, which has a capacity of 45kT/y. According to our figures only 17kT/y are currently used for biodiesel. This situation will change in the future if the proposed Ellesmere port plant is developed. This plant has a proposed capacity of 150kT/y. This means that although tallow is an attractive feedstock for biodiesel the refining capacity currently limits the amount of biodiesel that can be produced from tallow. However, developing biodiesel plants is relatively straight-forward and can be done relatively quickly.
- The current high prices for mineral diesel acting together with the RTFO could divert a significant proportion of tallow into biodiesel production (with the caveat that tallow-biodiesel refining capacity is currently limited, as indicated above). Tallow is the major feedstock for the UK oleochemical and soap industry. Diversion of this feedstock to another use would remove tallow as a feedstock for the oleochemicals and soap industry in the UK and could result in a significant shift of UK oleochemical production to the Far East.
- The environmental impact of the shift from the current uses of tallow to biodiesel production is ‘negative’ in terms of GHG emissions, although this conclusion is dependent on the fuel substituted for heat production at the rendering plant. This is an important consideration in the sustainability of using tallow for biodiesel production.
- All tallow produced in the UK is currently being used. If tallow is switched to biodiesel production, alternative feedstocks are required for the other tallow uses. These feedstocks are likely to be fossil oils or imported vegetable oils. The sustainability of this switch should be considered in more depth.
- The economic impacts of switching tallow from oleochemicals to biodiesel in the UK requires more in depth analysis. From the data we have it appears that there will be a loss of income from oleochemicals exports and a need to import oleochemicals, which are not compensated by the decreased need to import diesel. If this is correct it would result in a negative impact on the balance of trade.
- From the information we have obtained the social cost of the shift of tallow from oleochemicals to biodiesel is a net reduction in jobs.
- If the RTFO is to result in more environmentally sustainable transport fuels it is important that indirect impacts are considered. In the case of wastes that have existing (disposal outlets or) applications, the impact of the switch to biofuels on the overall environmental emissions must be considered as part of the calculation of net GHG emission reductions.
- The oleochemicals industry in the UK is facing a number of problems, including increased competition from the Far East. Biofuels are not solely to blame for the problems faced by the oleochemicals industry – they are part of a much bigger picture. However, from the analysis presented in this report, it is clear that demand for tallow for biodiesel could contribute to the problems, although there is not very much direct evidence that this is happening at present.

6.8 Recommendations

There are three main recommendations from this report:

1. Our analysis shows that, from a GHG perspective, the use of tallow as a biofuel results in greater emissions. This finding is dependent on the assumptions made in the analysis. A sensitivity analysis of these assumptions indicated that only one of these assumptions would make a significant difference to this outcome, and this is the fuels used as a substitute for tallow in boilers at the rendering plants. If a biomass fuel such as MBM were used for these boilers rather than the fossil fuel used in our analysis a much better GHG balance is achieved. However, this depends on the source of the MBM and how it is used.
Advice on impacts of Government support for biodiesel production from tallow

To take this into account we recommend that the scope of the RTFO Carbon Reporting methodology could be expanded to ensure it takes account of any fuel switches which occur at the rendering plant, i.e. the scope of the fuel chain could be expanded to take account of the fuel used at the rendering plant. At the moment data on the fuel switching at the rendering plants is not sufficient to ensure that the reporting is representative of what actually happens at the plant. In the future the RTFO will be linked to carbon savings and this would provide an incentive to the rendering industry to use a low emission fuel at their plants. In order to encourage reporting of actual data (i.e. on the type of fuel used) the default assumption could be that low sulphur fuel oil is used. This would provide a default that reduces the incentive for a renderer to burn fuel oil, particularly when the RTFO is linked to a biofuel's GHG saving. It would also ensure the Renewable Fuels Agency was aware of what impact the RTFO was having on the market for tallow.

2. The revised Renewable Energy Directive proposes that certain more sustainable feedstocks such as wastes will be regarded as more sustainable.\textsuperscript{25} The approach makes no provision for displacement impacts or other indirect effects. Our work has shown that it is important that substitution and indirect impacts are included in the environmental sustainability criteria used to assess biofuels. We recommend that the Government should draw attention to the likely impacts of the proposed double reward for certain types of biofuels including biodiesel produced from tallow.

3. The UK cannot act unilaterally. It is important to share the findings of this research with the European Commission and other Member States.

\textsuperscript{25} The text is designed to encourage second generation biofuels and states: ‘In order to demonstrate compliance with national renewable energy obligations the contribution made by biofuels from wastes, residues, non food cellulosic material and ligno-cellulosic material shall be considered to be twice that made by other fuels’. This has been interpreted by some stakeholders to mean that tallow-biodiesel will be rated more highly than other biofuels.
Advice on impacts of Government support for biodiesel production from tallow

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Advice on impacts of Government support for biodiesel production from tallow

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Advice on impacts of Government support for biodiesel production from tallow

Appendices

Appendix 1: Participants in the UK Rendering Industry
Appendix 2: Oleochemical and soap manufacturers in the UK
Appendix 3: Task 3 Outline of model and assumptions
Appendix 4: Article from ICIS Chemical Business (Finch 2008)
Appendix 1

Participants in the UK Rendering Industry

[data taken from the UK Renderers Association website www.ukra.co.uk]

Table 6  Members of the UK Renderers Association:

- A Hughes and Son Ltd
- Alba Proteins Ltd
- Argent Oils Ltd
- Caledonian Proteins
- Dungannon Proteins Ltd
- Foyle Food Group Ltd
- Harrisons Poultry Ltd
- J G Pears (Newark) Ltd
- John Pointon and Sons Ltd
- Linergy Ltd
- Lisburn Proteins Ltd
- McIntosh-Donald Ltd
- Omega Proteins Ltd
- P Waddington & Co Ltd
- PDM Group
- Peninsular Proteins Ltd
- Sun Valley Foods Ltd
- The Argent Group

Figure 22  Location of Rendering Plants in the UK
Appendix 2

Oleochemical and Soap Manufacturers in the UK

The only significant oleochemical company manufacturing in the UK is the Uniqema division of Croda, with a factory in Bromborough on the Wirral (www.uniqema.com).

Soap Producers Listed as Members of the UK Cleaning Products Industry Association www.ukcpi.org

- Coronation Export / Import Ltd
- Dicom Dalli UK Ltd
- John Drury & Co Ltd
- Kay's (Ramsbottom) Ltd
- PZ Cussons (UK) Ltd
- Sigma Soap Ltd
- Standard Soap Company Ltd

Not all of these are currently manufacturing soap in the UK. Those that are include John Drury & Co, Kays, Sigma Soaps and Standard Soap Company.
Task 3: Outline of model and assumptions

Assumed decision problem - renderers

It is assumed that renderers will seek to maximise profit when deciding what to do with the tallow they produce. Renderers are assumed to sell tallow at the highest market price. If the relative price offered by biodiesel producers vis-à-vis the price of fossil fuels was right, then renderers would sell tallow for conversion to biodiesel and replace it in their own operations with an equivalent amount of fossil fuel.

Hence, we assume that renderers face the following decision problem with respect to finding outlets for the tallow they produce:

\[
\text{Max } \Pi = \sum_{i=1,2,3} \left( \pi_i - q_F \times p_F \right)
\]

Where:

- \( \Pi \) = Profit from tallow.
- \( \pi_i^{S,E} \) = Profit from category \( i \) tallow, which is either used to meet the energy demands of own operations (\( E \)) or sold (\( S \)).
- \( q_F \) = Quantity of fossil fuel purchased to meet energy demands of own operations.
- \( p_F \) = Price of delivered fossil fuel (assumed to be HFO).
- \( \pi_i^S \) = Profit from category \( i \) tallow that is sold.
- \( \pi_i^E \) = Profit from category \( i \) tallow that is used to meet energy demands of own operations.
- \( \pi_i^S \) = Profit from category \( i \) tallow that is sold.
- \( \pi_i^E \) = Profit from category \( i \) tallow that is used to meet energy demands of own operations.
- \( q_i^{S,E} \) = Quantity of category \( i \) tallow, which is either used to meet the energy demands of own operations (\( E \)) or sold (\( S \)).
- \( p_i \) = Market price for category \( i \) tallow.
- \( c_i \) = Incremental cost of upgrading category 1 tallow to category 2 and 3 tallow.
- \( \alpha \) = Ratio of the net calorific value of tallow to the net calorific value of fossil fuel (assumed to be HFO).
Advice on impacts of Government support for biodiesel production from tallow

Subject to the following constraints.

\[
\sum_i q_{i}^{s,e} \geq \text{Zero.}
\]

\[
q_{f} \geq \text{Zero.}
\]

\[
q_{f} + \sum_i q_{i}^{e} = \text{Total energy demands of own operations.}
\]

\[
\sum_i q_{i}^{s,e} \leq \text{Total production of tallow.}
\]

**Assumed decision problem – biodiesel producers (and other users of oil and fat feedstocks)**

It is assumed that the basic decision problem facing biodiesel producers is that of least-cost feedstock procurement, given total capacity and the relative yield of biodiesel from different feedstocks. However, because the purpose of this study is to consider the strategic position of tallow relative to other feedstocks, assuming that specific blend targets (1-5 per cent) for biodiesel production are met, a slightly different approach is taken. As biodiesel producers must compete for feedstocks with other end-users of fats and oils - namely food, animal feed, oleochemicals, and renderers (who use tallow to meet the energy demands of their own operations), the decision problem is set up to minimise the total feedstock cost of producing historical levels of output by each of these sectors. The relevant feedstocks are rapeseed oil, palm oil, soy oil, tallow (separated between UK-produced category 1, UK-produced category 2 + 3, imports of category 2 plus 3 from the Republic of Ireland, and imports of category 2 plus 3 from the rest of the EU) and yellow grease. Constraints are imposed on the cost model that require it to meet biodiesel blend targets, plus historical demands for fat and oil in foods, animal feed, oleochemicals, and the energy needs of renderers. Hence, we assume that biodiesel producers and other users of oils and fats face the following decision problem with respect to sourcing feedstocks:

\[
\min \ C = \sum_{i = B, F, A, C} c_{i}^{k}
\]

Where:

\[
C = \text{Cost of sourcing feedstocks. Available feedstocks include: UK produced category 1 tallow and category 2 + 3 tallow, category 2 + 3 tallow imported from the Republic of Ireland or the rest of the EU, yellow grease, soy oil, palm oil and rapeseed oil.}
\]

\[
c_{i}^{k} = \sum_{k} q_{i}^{k} \times p_{k}
\]

\[
q_{i}^{k} = \text{Quantity of feedstock } k \text{ purchased by sector } i .
\]

\[
p_{k} = \text{Market price of feedstock } k .
\]
Advice on impacts of Government support for biodiesel production from tallow

Subject to the following constraints.

\[ q_i^k \geq 0 \]

\[ \sum_k q_i^k = \text{Total feedstock demands of sector } i \]

\[ \sum_i q_i^k \leq \text{Total supply of feedstock } k \]

\[ \sum_k q_i^k = \text{Total quantity of feedstocks needed to met the blend target(s).} \]

\[ q_{UK \text{cat 1 tallow}}^{1+} = \text{Zero.} \]

\[ q_{\text{Yellow grease}}^{F,R,C} = \text{Zero.} \]

\[ q_{\text{UK cat 2+3, imported cat 2+3 tallow}}^{1} = \text{Zero.} \]

The model is solved first for biodiesel producers. The excess supply, once biodiesel demand is met, is then made available to the other sectors to meet their feedstock demands.
Advice on impacts of Government support for biodiesel production from tallow

Assumptions Q1.

- The wholesale price of diesel is 33.60 ppl (from Quarterly Energy Prices (BERR)).
- The profit margin on diesel is 7.50 ppl.
- The duty on diesel is 50.35 ppl.
- The profit margin on biodiesel is 10.00 ppl.
- VAT is levied on both diesel and biodiesel at the standard rate of 17.5%.
- Feedstock costs comprise 80% of the total net production costs of biodiesel.
- CAPEX and fixed OPEX comprise 15% of the total net production costs of biodiesel (this includes capital repayments).
- Variable OPEX comprise 5% of the total net production costs of biodiesel.
- Feedstock yield is 1,067 kg feedstock per 1000 kg biodiesel.
- Biodiesel density is 0.88 grams of biodiesel per l biodiesel.
- Revenue from co-products are not included. At present, the value of biodiesel glycerine is very low as a result of increasing supply on the European market.

Assumptions Q2.

- Total demand for oil to meet the energy demands of operations is 141,659 tonnes per year, of which 140,000 is tallow.
- The price of oil delivered to meet energy demands is £360 per tonne.
- The ratio of the calorific value of tallow to oil is 0.90.
- The baseline price of category 1, 2 and 3 tallow is, respectively, £150 per t, £300 per t and £365 per t.
- The gross profit margin per t of category 2 tallow is assumed = 50% (used to approximate the additional cost of producing category 2 tallow relative to category 1 tallow).
- The mark-up of category 3 tallow production costs relative to category 2 tallow production costs is assumed to be 20% (used to estimate the cost of producing category 3 relative to category 2 tallow).

Assumptions Q3.

- Price data assumptions are as follows (averages for 2007 based on stakeholder consultations and data from Oil World):

<table>
<thead>
<tr>
<th>(£ per tonne)</th>
<th>End-user 1 Biodiesel</th>
<th>End-user 2 Chemicals</th>
<th>End-user 3 Food</th>
<th>End-user 4 Feed</th>
<th>End-user 5 Renderers</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 Tallow (domestic)</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Yellow Grease</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>C 2 &amp; 3 Tallow (domestic)</td>
<td>335</td>
<td>335</td>
<td>335</td>
<td>335</td>
<td>335</td>
</tr>
<tr>
<td>C 2 &amp; 3 Tallow (import RoI)</td>
<td>345</td>
<td>345</td>
<td>345</td>
<td>345</td>
<td>345</td>
</tr>
<tr>
<td>Palm</td>
<td>370</td>
<td>370</td>
<td>370</td>
<td>370</td>
<td>370</td>
</tr>
<tr>
<td>C 2 &amp; 3 Tallow (import EU)</td>
<td>380</td>
<td>380</td>
<td>380</td>
<td>380</td>
<td>380</td>
</tr>
<tr>
<td>Soy</td>
<td>395</td>
<td>395</td>
<td>395</td>
<td>395</td>
<td>395</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>470</td>
<td>470</td>
<td>470</td>
<td>470</td>
<td>470</td>
</tr>
</tbody>
</table>

Assumptions are made about which sectors would use which feedstocks. Oleochemical sector would not use category 1 tallow or yellow grease. Food sector would use only vegetable oils and not tallow or yellow grease. Category 1 tallow would not be used for feed. Renderers would only use category 1 (and category 2 and 3??) tallow.

Oleochemicals sector total demand for feedstocks is 88,890 tonnes pa (based on stakeholder information that Oleochemicals use 80 kt tallow per year, which is about 90% of total feedstocks).
Advice on impacts of Government support for biodiesel production from tallow

Assumption for Q 4.

Using a simple microeconomic model of a firm, increases in base case variable production costs, turnover and gross operating surplus have been simulated for an average enterprise in NACE 24.51; note that this classification includes oleochemicals, but also detergents, cleaning and polishing preparations. The increase in variable production costs are the result of having to pay more for feedstocks. The base case price of feedstock is assumed to be £300 per t (roughly the price for category 2 tallow). A set of 6 different feedstock prices are simulated:

- £310 (approx premium for imports from Eire)
- £345 (approx premium for imports from the rest of the EU)
- £365 (approx category 3 tallow price)
- £370 (palm oil price)
- £395 (Soya oil price or imported tallow price from S. America)
- £470 (Rapeseed oil)

The simulations consider a range of cost-pass through assumptions from zero % to 100%. The assumed price elasticity of demand for all products from the sector is -0.3.
Advice on impacts of Government support for biodiesel production from tallow

Appendix 4

Article from ICIS Chemical Business (Finch 2008)

European surfactant and soap manufacturers are in turmoil as competition for renewable energy feedstocks causes shortages and oil prices push up oleochemicals

Heidi Finch/London

EU TARGETS for increasing the use of biofuels, combined with the surge in oil prices, are driving up fatty alcohol and acid prices, and threatening downstream markets. And this is likely to continue in 2008.

Traditionally, the price of palm oil has been independent of crude, but since use of vegetable oil for biofuels began, there has been a correlation between crude movements and those of its vegetable oil counterparts.

In tandem with January's Brent crude high of $96.56/bbl, fourth-quarter (Q4) crude palm oil (CPO) peaked at Malaysian ringgit (MS) 3,000 ($918) ex-works. There was a similar picture in Q1, 2008.

Feedstock competition for vegetable oil and animal fat has also increased with the emergence of the biodiesel market. Fatty alcohol and fatty acid production now compete with biodiesel for vegetable oil feedstock and the fatty acid and biodiesel markets are rivals for tallow.

Market pressure has caused the European Chemical Industry Council (Cefic) to ask for the EU renewables policy - which sets usage targets - to be reconsidered, amid growing concerns about availability for animal and vegetable oil and fat in 2008.

"It is a waste of good tallow fat raw materials to burn them for energy, and it is causing fundamental feedstock shortages in the oleochemical industry," says Alf Eriksson, business sector manager at AAK/Tefac Oleochemicals.

In the fatty acid market, tallow is used as a substitute raw material for palm oil and as a result, tallow generally follows the price of its vegetable-based competition. However, late in 2007, tallow prices broke with tradition and managed to gain ground on palm oil.

In Q4, tallow contract prices rose by €80-100/tonne, taking values to the low to mid-€500s/tonne FD (free delivered) NWE (Northwest Europe).

In turn, the high feedstock costs pushed up fatty alcohol and fatty acid prices, squeezing downstream margins.

Fatty alcohol and acid find downstream outlets in the soaps and surfactant industries, cosmetics, personal care products and wood preservatives.

Surfactant manufacturers are still suffering

Despite feedstock flexibility, surfactant manufacturers are feeling the high upstream cost pressures. One natural fatty alcohol buyer says that it has struggled to pass on increases into the commodity surfactant sector, and lost some business to its synthetic competition.

Similarly, one tallow fatty acid customer says it is not only difficult to secure business in the commodities sector, but also for specialties, adding that it has been forced to cut back its volume requirements by 15% in Q4.

Industrial applications that had previously benefited from traditionally lower tallow fatty acid prices have also been affected by rising feedstock costs.

Earlier in 2007, tallow prices were considerably lower than its palm oil counterparts.

This triggered a shift in buying patterns where substitution between vegetable and tallow fatty acids was possible. Fatty acid buyers in the surfactant sector were able to take advantage of the attractive price gap.

But this price difference soon eroded during Q4, as tallow and tallow fatty acid prices continued to move up, gaining ground on the high price evolution of its palm oil counterparts.

Looking to Q1 2008, feedstock price pressure is set to continue, according to market participants.

Q1 tallow contract prices are likely to move up by €80-100/tonne, to €600-650/tonne FD NWE. Tallow fatty acid sellers are determined to push for substantial increases of €100-200/tonne on the back of rising raw material costs, supply constraints and strong market fundamentals.

This has led a few fatty acid players to reconsider their quotas to include more vegetable-over tallow-based product, a U-turn in buying patterns from Q3. However, one fatty acid customer says it does not consider this any real solution, taking into account recent palm oil volatility.
June 10, 2010

Nabil Al-Hadithy, Secretary
Community Environmental Advisory Commission
2118 Milvia Street
Toxics Management, 3rd Floor
Berkeley, CA 94704

Re: Yellow Grease-Based Bio-Diesel Quality and Pricing

Dear Secretary Al-Hadithy:

Thank you very much for the opportunity to talk with the Community Environmental Advisory Commission (CEAC) at its June 3, 2010 meeting. As I presented at that meeting, Sirona Fuels was established to make a difference in the communities in which it operates. With respect to our biodiesel production, we are committed to being part of our local community both as a fuel supplier and by making contributions to social needs. We operate the Blue Sky Bio-Fuel biodiesel production facility in Oakland. We employ 10 people at this plant, providing skilled, semi-skilled and unskilled green collar jobs, and we are growing. This plant recycles Used Cooking Oil (UCO) to produce Yellow Grease-based bio-diesel; a fuel with the lowest possible carbon footprint. Virtually all of our oil is supplied by local businesses, including restaurants and local UCO collectors. We work with the City of San Francisco to recycle UCO collected through its SFgreasecycle program. We also have a recycling program where we donate money to local schools when those schools sign up businesses to recycle their UCO with Sirona. All of the fuel we produce is sold to local customers. Our customer base includes end-users, retail stations and fuel distributors. We believe that these business practices reflect our commitment to our community.

In addition to being an integral part of our community, Sirona is committed to bringing quality, professionalism and integrity to this industry. We have protocols in place to verify the quality of our biodiesel at every stage of the process. We have consistent pricing methodologies that keep our product competitive with petroleum diesel and offer term contracts for those customers that are interested. We are open with our customers when we have any production issues. These are all centered around addressing the two key concerns that were identified at the CEAC’s meeting: fuel price and quality.

Fuel Pricing
Sirona Fuels’ pricing is based on the petroleum diesel index published by Oil Price Information Service (OPIS). We found this price reporting index is used by a number of members of the industry. The petroleum diesel index is based on prices reported by six different entities, each posting a price for branded fuel and/or unbranded fuel, resulting in twelve posted prices. We consider this index reasonably representative of petroleum diesel
prices in the Bay Area. Conversely, the published prices for biodiesel at most have three reporting entities, and often have only one.

Attached please find excerpts from the May 27 issue of the weekly OPIS newsletter. These excerpts show prices reported for the San Francisco and the Oakland markets. In terms of understanding these indices, the basic terms you need to know are: 1) SME stands for Soy Methyl Ester, which is biodiesel made from virgin soy oil; 2) YGME stands for Yellow Grease Methyl Ester, which is biodiesel made from recycled cooking oil or grease; 3) B99 means biodiesel that has a very small (less than 1%) amount of a petroleum additive, which is used to allow the party adding the additive to receive the federal tax credit; and 4) BXX is a blend of petroleum diesel and biodiesel, where the numbers following the B indicate the percentage of biodiesel (for example, B20 means fuel that is 20% biodiesel and 80% petroleum diesel).

You can see on these pricing sheets that at most there are three entities reporting prices for biodiesel on any index, only one of which is an actual producer (Community Fuels). The others are brokers typically importing biodiesel from the Midwest. The Oakland markets have at most two reporting entities and most of the indices, both in San Francisco and Oakland, only have one reporting entity — Orange Diesel. The B5 SME market that was raised at the meeting and is used for the contracts supplying B5 to your fire department has only Orange Diesel and Golden Gate Petroleum reporting prices. Respectively, they reported $2.53/gallon and $2.30/gallon during the week of May 27. Petroleum diesel prices at the time were $2.05/gallon.

As I said at the meeting, our company does not report pricing on OPIS. If we did, we would only be reporting YGME (used cooking oil-based biodiesel) pricing. We have no confidence that the methodology used by OPIS on its biodiesel indices is appropriate. In order for an index to be valid, posted prices must reflect actual sales at those prices, there must be a verification that transactions actually occurred, and consideration must be given to price outliers. The only other entity that posts to markets that we would post to is Orange Diesel. If we posted actual sale prices for a given day, our sales would be given the exact same weight as Orange Diesel’s claimed sale price. So, for example, if we sold 10,000 gallons for $2.00, that sale would be treated the same as a posted price of $2.50 by Orange even if Orange sold little or no fuel at that price. Until there is some integrity behind the OPIS biodiesel index, we are not willing to post pricing. In addition, because our sales are small as compared with petroleum diesel, posting prices could create a competitive issue for our customers.

We take issue with the Public Works staff’s claim that the City of Berkeley has no relationship with Orange Diesel. In the email message you sent to Robert Kirsten on June 1, 2010, Public Works stated that they have no relationship with Orange Diesel, but at the same time stated that Dave Williamson is the representative for Western States Petroleum — the City’s supplier of fuel. Dave Williamson is the only contact for Orange Diesel listed on Orange Diesel’s website, and we believe is the only employee of Orange Diesel, sells biodiesel as Orange Diesel and posts prices to OPIS. The fact the Mr. Williamson works for both Orange Diesel and Western States Petroleum means that the City has a relationship Orange Diesel even though there may not a specific contractual arrangement with Orange
Diesel. We believe the City should be concerned that it has a contract for fuel set to an index that is heavily influenced by an employee of the fuel supplier.

**Fuel Quality**

We understand from your email message as well that Dave Williamson claims the quality of fuel produced from Yellow Grease is “random” and that according to Public Works’ staff, the City will not consider using Yellow Grease biodiesel until “there are multiple California production plants that are BQ9000 certified and have long term consistency and quality control in their product.” These statements are deeply concerning to us.

With respect to the statement by the Public Works staff, in the fall of 2009 (during the height of interest in using locally produced, used-cooking oil biodiesel) we understand that Western States Petroleum purchase fuel for Berkeley through a broker called SUMA. SUMA sold Western States fuel that it had purchased from us. As a result, we believe the City has already used our fuel without incident. Suggesting that the City has not used fuel from non-BQ9000 certified producers is inaccurate and staff does not appear to offer an explanation as to why it wishes to set new criteria concerning when it might consider using a locally produced, recycled product. From our perspective, requiring that “there are multiple California production plants that are BQ9000 certified and have long term consistency and quality control in their product” is effectively stating that the City of Berkeley will not even consider using a locally produced, low carbon fuel for the foreseeable future. I do not believe this is what the City intends.

There are two facets of Mr. Williamson’s claim that the fuel quality is “random”: consistency and quality. Virgin soy oil has very consistent chemical characteristics. That consistency allows the fuel produced to also have consistent characteristics. The “random” nature of the fuel specifications of Yellow Grease-based biodiesel stems from the fact that, unlike virgin soy oil, Yellow Grease does not have consistent chemical characteristics. The Yellow Grease that we refine is comprised of numerous combinations of oils including soy, corn, sunflower seed and canola. The chemical characteristics are also influenced by how old the oil is, how hot is was cooked at, whether additives were added to extend the oil’s useful life and the type of food that is cooked in it. The variable chemical characteristics of the Yellow Grease carry over to the fuel.

Consistency, however, is not the same as quality. Fuel can be consistently poor just as much as it can be consistently good. The purpose of the refining process is to modify the chemical characteristics of the oil so that it can function properly as a fuel. The standards for whether the oil has been adequately modified are set by the ASTM. In order to qualify as “biodiesel,” the oil must be refined such that it satisfies the ASTM specifications. There is no difference between the ASTM specifications for Yellow Grease biodiesel and Soy biodiesel; both types of fuel must be properly refined to satisfy the ASTM standards.

Few soy biodiesel producers actually have a third party confirm that every batch of their fuel meets the ASTM specifications. As a result, you can receive out-of-spec soy biodiesel just as easily as out-of-spec Yellow Grease biodiesel. We have seen the effects of out-of-spec soy biodiesel on some users in particular with respect to high acid numbers harming fuel pumps.
The only way to be certain that a customer is receiving quality fuel is for the customer to receive a certificate of analysis from an independent third party certifying that the fuel satisfies the ASTM specifications. This is exactly what Sirona does. Attached you will find a data sheet comparing a recent analysis of our fuel to the ASTM specifications. You will see that our fuel exceeds the ASTM specifications. I have also attached certificates for a number of our recent reactions, showing the results of the standards that are the most variable and critical to the industry. We have been operating the plant for over a year, and no fuel has left our yard that was out of specification. We have had no complaints from customers over the quality of our fuel and none of our vehicles, all of which run on our biodiesel, have experienced any failures from using our fuel.

While we are not BQ9000 certified, our procedures ensure that our customers always receive quality fuel. Public Works’ position that it is not willing to work with a local fuel producer without giving any consideration to whether it can produce a quality fuel are concerning, especially when there does not appear to be any effort to monitor the quality of fuel supplied from out-of-state sources.

**Fuel Market**

Finally, Public Works appears to believe that the issue of the City’s biodiesel purchasing is moot because the volume of biodiesel being purchased is so low. We take exception to this statement. While the City’s consumption is currently about 100 gallons per month of pure biodiesel, this occurred only because of state regulations concerning storage of B20 in underground tanks. At the June 3 meeting, Public Works stated that they only had one item remaining to address in order to obtain the variance necessary to store B20 in its underground tanks. Based on the City’s past usage, once this variance is obtained, the City’s use of B20 should increase to approximately 200,000 gallons per year, comprising 40,000 gallons of biodiesel. We consider this volume to be material and believe the City should strongly consider using a locally-produced, quality fuel to meet this demand.

Thank you again for the opportunity to address the CEAC. We are happy to cooperate with you in any matters going forward and expect to actively participate in your public forums. We believe the City can achieve its goal of using a lower cost, locally produce low carbon fuel, without sacrificing quality.

Sincerely,

Paul Lacourciere
CEO, Sirona Fuels Inc.
### Ethanol Futures

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### Ethanol Market Overview: Quiet Week Leaves Little Change

Ethanol markets had a very slow week, but prices that moved around basically held within recent ranges with talks shifting on the latest corn moves or vacillations in the petroleum market.

Spot ethanol in Chicago for what was left of May was still available at $1.59/gal at last word, right about where it could be done a week ago. Ratable June ethanol traded $1.605/gal and any-June at around $1.60-$1.61/gal eased off midweek highs while indicating little overall change for the week.

New York Harbor ethanol barges and West Coast railcar volume bounced off the lowest levels traded earlier in the week, taking prices back near week-ago levels. Blending indications remained firm, with profitable economics for ethanol while the latter-week rebound in gasoline prices only enhanced that relationship. Weekly DOE data indicated conventional gasoline blended with ethanol at 4.757 million b/d, down only slightly from the all-time high reported the previous week and up almost 32% against the same time last year.

Meantime, monthly DOE data released late in the week had U.S. ethanol production reaching a new all-time high in March. Domestic plants pumped out 847,000 b/d for the month, up 1.7% from February and 32% above the same time last year. Overall output also reached a new record, at 20.27 million bbl in March, beating the previous high recorded in January by more than 3.4%.

DOE also had March ethanol stockpiles at 19.691 million bbl nationwide, moving up 794,000 bbl, or about 4.2% month-to-month and nearly 26% more than the same time in 2009.

### U.S. RINs

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### Brazil

- Anhydrous Ethanol: 1.941-1.954
- Hydrous Ethanol: 1.79-1.77

(FOB Santos, 5/27/10)
**Wholesale (Rack) Biodiesel Prices**

Prices include confirmed moves through May 27, 2010

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**OPIS Biodiesel prices are excluding any taxes or tax incentives. =Out of Product, d=Not In Average **

**Calculated Price, AF = Antifreeze Fuel, RME = Rapsed Methyl Esters, SME = Soy Methyl Esters, YGME = Yellow Grease Methyl Esters.**

**OPIS Market index values reflect a percentage based calculation of the proportionate amount of B100 and the OPIS average price of the designated Blendstock product. The B100 prices are an average of all B100 postings in the market. Photocopying this material is illegal. It is a violation of federal law to reproduce any part of OPIS Ethanol & Biodiesel Information Service without permission. Civil fines of $10,000 will be sought for violations. Additional copies of OPIS Ethanol & Biodiesel Information Service are available at reduced rates. Call 503-297-2695.**

May 31, 2010

OPIS Ethanol & Biodiesel Information Service
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**Note:** All prices are subject to change without notice. Prices are in U.S. dollars per gallon. B100 is 100% pure biodiesel. **Terms** are subject to change and may vary by location. **Price** is the wholesale price at the pump. **Grade** indicates the quality of the fuel. **Date** indicates the date of the price. **Location** indicates the city where the price is valid. **OPIS Product Key:** LSNO = LS No. 2, LSNPD = LS No. 2 Premix, HSN = LS No. 1, HSND = LS No. 1 Premix, DNC = CARB No. 2, DNC2 = CARB No. 2 Premix, CULS = CARB Ultra LS, CULSD = CARB Ultra LS Dyed.
### Wholesale (Rack) Biodiesel Prices

Prices include confirmed moves through May 27, 2010

| Location | Date | AVG B | AVG D | AVG C | AVG L | AVG R | AVG B | AVG D | AVG C | AVG L | AVG R | AVG B | AVG D | AVG C | AVG L | AVG R | AVG B | AVG D | AVG C | AVG L | AVG R | AVG B | AVG D | AVG C | AVG L | AVG R |
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**Note:** Prices are subject to change without notice.

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OPIS Biodiesel prices are excluding any taxes or tax incentives. Out of Product, d=Not In Average. e=Calculated Price. AF = Animal Fat. RME = Rapped Methyl Esters. SME = Soy Methyl Esters. YGME = Yellow Grease Methyl Esters. OPIS Market Index values reflect a percentage based calculation of the proportionate amount of B100 and the OPIS average price of the designated Blendstock product. The B100 prices are an average of all B100 posters in the market. Photocopying this material is illegal. It is a violation of federal law to reproduce any part of OPIS Ethanol & Biodiesel Information Service without prior written permission. Civil fines of $1,000 will be sought for violations. Additional copies of OPIS Ethanol & Biodiesel Information Service are available at reduced rates. Call 301-287-9555.
Wholesale (Rack) Biodiesel Prices

Prices include confirmed moves through May 27, 2010

OPIS Product Key: LSN2 = LS No.2, LSNP2 = LS No.2 Premium, LS1 = LS No.1, HB1 = HS No.1, SN2D = LS No.2 Dyed, SN2PD = LS No.2 Prem Dyed, LS1ND = LS No.1 Dyed, CN2 = CARB No.2, CN2D = CARB No.2 Dyed, CULS = CARB Ultra LS, CULSD = CARB Ultra LS Dyed

SAN FRANCISCO, CA
05/27/2010

Term CNX Move

OPIS Biodiesel B200 Move

CEAC - March 3, 2011

Page 56 - OPIS Ethanol & Biodiesel Information Service

May 31, 2011

OPIS Biodiesel prices are excluding any taxes or tax incentives. dOut of Product, dNot in Average *Calculated Price, FA = Arsenic Fat, RME = Rapsessed Methyl Esters, SME = Soy Methyl Esters, YGME = Yellow Grease Methyl Esters. *OPIS Market Index values reflect a percentage based calculation of the proportionate amount of $100 and the OPIS average price of the designated Blended product. The $100 prices are an average of all $100 postings in the market. Photocopying this material is illegal. It is a violation of federal law to reproduce any part of OPIS Ethanol & Biodiesel Information Service without permission. Citrines of $100,000 will be sought for violations. Additional copies of OPIS Ethanol & Biodiesel Information are available at reduced rates. Call 301-267-2625.
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#### SAN FRANCISCO, CA

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#### SAN JOSE, CA

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Date: 08-07-09
Report Number: 09-219-2172 v2
Batch No: B072109

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**WEEKLY BIODIESEL**

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<td>bab-08/07</td>
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REPORT OF ANALYSIS
Report Number: 09-219-2172 v2

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Notes:
n.d. - Not Detected.

For questions contact
Heather Ramig
Client Service Representative
heather@midwestlabs.com (402) 829-9891

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### REPORT OF ANALYSIS

**For:** (21149) BLUE SKY BIO-FUELS LLC  
(510)868-9229

**WEEKLY BIODIESEL**

**Date Reported:** 08/14/09  
**Date Received:** 08/11/09  
**Date Sampled:** Not Supplied  
**Time Sampled:** Not Supplied

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**Lab number:** 1610017  
**Sample ID:** BIODIESEL

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**REPORT OF ANALYSIS**

Report Number: 09-226-2227

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Notes:
- n.d. - Not Detected.

For questions contact

Heather Ramig
Client Service Representative
heather@midwestlabs.com (402) 829-9891

---

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**Biodiesel Analysis**

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<th>Analysis</th>
<th>Level</th>
<th>Units</th>
<th>Detection Limit</th>
<th>Method</th>
<th>Analyst Date</th>
<th>Verified Date</th>
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<tbody>
<tr>
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<td>deg C</td>
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<tr>
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<td>hours</td>
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<td>jlc-04/05</td>
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<tr>
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**Notes:**
- n.d. - Not Detected.

---

For questions contact

Heather Ramig  
Client Service Representative  
heather@midwestlabs.com (402)829-9691
**WEEKLY BIODIESEL**

**Analysis**

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<thead>
<tr>
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**Detection**

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<td>ASTM D2500</td>
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**Notes:**

n.d. - Not Detected.

For questions contact

Heather Ramig
Client Service Representative
heather@midwestlabs.com (402)829-9691

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### Analysis

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<th>Verified-Date</th>
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<td>jlc-04/20</td>
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Notes:
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For questions contact

Heather Ramig
Client Service Representative
heather@midwestlabs.com (402)823-9891
WEEKLY BIODIESEL

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</tbody>
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Notes:
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For questions contact
Heather Ramig
Client Service Representative
heather@midwestlabs.com (402)829-9691

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Midwest Laboratories Inc.
13611 "B" Street • Omaha, Nebraska 68144-3693 • (402) 334-7770 • FAX (402) 334-9121
www.midwestlabs.com

REPORT OF ANALYSIS
For: (21149) BLUE SKY BIO-FUELS LLC
(510)868-9229

Date Reported: 04/23/10
Date Received: 04/22/10
Date Sampled: 04/21/10

BIODIESEL ANALYSIS

Level Found Units Detection Limit Method
Flashpoint > 150 deg C 4 ASTM D93
Cloud Point 0.0 deg C ASTM D2500
Oxidation Stability 13.4 hours 0.1 EN14112
Acid Number 0.26 mg KOH/g 0.05 ASTM D664
Cold Soak Test 106 sec 20 ASTM D 7501-09
Total Glycerin 0.183 % mass 0.001 ASTM D6584
Free Glycerin n.d. % mass 0.001 ASTM D6584
Triglycerides as Triolein 0.045 % 0.001 ASTM D6584
Diglyceride as Diolein 0.062 % 0.001 ASTM D6584
Monoglyceride as Monoolein 0.076 % 0.001 ASTM D6584

Notes:
- n.d. - Not Detected.

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Client Service Representative
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Late Communication - Sirona  
CEAC - March 3, 2011

WEEKLY BIODIESEL

Analysis

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<th>Detection Limit</th>
<th>Method</th>
<th>Analyst-Date</th>
<th>Verified-Date</th>
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<tr>
<td>Monoglyceride as Monoolein</td>
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<td>%</td>
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<td>jlc-04/27</td>
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</tbody>
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**Weekly Biodiesel**

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Notes:
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www.midwestlabs.com

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**REPORT OF ANALYSIS**

For: (21149) BLUE SKY BIO-FUELS LLC  
(510)868-9229

**WEEKLY BIODIESEL**

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**Notes:**  
- n.d. - Not Detected.

---

For questions contact  
Heather Ramig  
Client Service Representative  
heather@midwestlabs.com (402)829-9891

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Lab number: 1710004    Sample ID: BIODIESEL

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Notes:
- n.d. - Not Detected.

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Heather Ramig
Client Service Representative
heather@midwestlabs.com (402)829-9891

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Mail to: BLUE SKY BIO-FUELS LLC  
4200 PARK BLVD 153  
OAKLAND CA  94602  

Lab number: 1711043  Sample ID: BIODIESEL

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Notes:  
n.d. - Not Detected.
**REPORT OF ANALYSIS**

**For:** (21149) BLUE SKY BIO-FUELS LLC  
(510)868-9229

**WEEKLY BIODIESEL**

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Notes:  
n.d. - Not Detected.

For questions contact  
Heather Ramig  
Client Service Representative  
heather@midwestlabs.com (402)829-9091
### Analysis

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**Notes:**
- n.d. - Not Detected.

For questions contact

Heather Ramig
Client Service Representative
heather@midwestlabs.com (402)828-9891
**REPORT OF ANALYSIS**

For: (21149) BLUE SKY BIO-FUELS LLC  
(510)868-9229

Date Reported: 05/25/10  
Date Received: 05/24/10

**BIODIESEL ANALYSIS**

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