

WORLD NATURAL GAS RESERVES 2007; total = 181,532 billion cubic meters

World natural gas reserves are located mainly in Russia, Iran and Qatar. Data from World Oil and Gas Review 2007, Eni, 20 June 2007 (www.eni.it, Figure by Editor).

AMFI Newsletter is prepared for the members of the Implementing Agreement on Advanced Motor Fuels of the International Energy Agency (IEA/AMF).

AMFI provides four electronic Newsletters yearly describing recent news on advanced motor fuels, vehicles, energy and environmental issues in general. AMFI Newsletter is available on the website:

www.iea-amf.vtt.fi

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PUBLICATIONS

US progress in "Twenty in Ten" goal

A target to reduce 20% of U.S. gasoline consumption over the next 10 years, the so called "20-in-10" goal was unveiled in January 2007 within "2007 State of the Union Policy Initiatives". On May 14, 2007, President Bush ordered US Environmental Protection Agency (EPA) and the US Department of Energy (DOE), Transportation (DOT), and Agriculture (USDA) to take the first steps toward regulations that would cut gasoline consumption and greenhouse gas emissions from motor vehicles by increasing the supply of alternative fuels and making motor vehicles more energy efficient. This process shall be completed by the end of 2008. The administration has sent congress legislative proposals to achieve "Twenty In Ten" goal with two steps: 1) A mandatory fuels standard to require 35 billion gallons of renewable and other alternative fuels in 2017, which is nearly 5 times the 2012 target now written in the law. In 2017, this will displace 15% of projected annual gasoline use. 2) Reforming and modernizing Corporate Average Fuel Economy (CAFE) standards for cars and extending the current light truck rule to reduce projected annual gasoline use by up to 8.5 billion gallons, a 5% reduction by 2017. *Press release, 14 May 2007 (www.whitehouse.gov).*

European fuel quality directive – sustainability criteria

The European Directive on the quality of petrol and diesel fuels (98/70/EC) is under revision as described in AMFI Newsletter January 2007 (sulphur content, oxygenates, polyaromatic hydrocarbons). The proposal includes an obligation for fuel suppliers to reduce greenhouse gas emissions of their fuels by 1% annually from 2011 (base year) to 2020. Recently, a study evaluating the inclusion of sustainability criteria in the revised Fuel Quality Directive was finished. This study, carried out by TAUW/Ecofys, was requested by The European Parliament. The following three issues were discussed in the study:

1) Greenhouse gas emission reduction in the fuel quality directive: The draft directive sets 2011 as base year for calculation of annual CO₂ reduction of 1% between 2011 and 2020. This means that early actions against climate change are penalised, and obligations vary between oil companies. The study concludes that the use of one base emission figure for all oil companies would be more justified (average EU fuel mix). The briefing also proposes using a reference point from an earlier year, e.g. 2005, with adjusted reduction percentages. In addition, the definitions of emission reduction need clarification. It is not clear whether emission reductions are related to the combustion emission of fuels or to the well-to-wheel emission from the complete product mix. It is noted that well-to-wheel emissions are critical when striving for emission reductions with alternative fuels. Application of high volumes of biofuels also has physical boundaries and sustainability risks, which need to be understood and covered by legislation.

2) Inclusion of more specific sustainability criteria: The Commission proposal includes obligation to reduce the CO₂ emissions of fuels. However, this does not take into account biodiversity and nature conservation or social aspects, such as competition between fuel and food. The study concludes that inclusion of sustainability criteria (besides greenhouse gas emissions) within the Fuel Quality Directive is expected to be problematic within the WTO framework.

3) Traceability: The traceability requirements on CO₂ reduction are not clearly defined in the proposal. Which stages of fuel production, refining and transport should be included? And which impact on biodiversity, nature conservation or social relations should be included? This briefing considers the use of default parameters in the calculation of the greenhouse gas performance acceptable. At the same time, reporting parties should be encouraged to obtain (and prove) at least the most important parameters themselves. Suitable feedstock sustainability criteria can be derived from existing hallmarks. These contain several generic environment and social related criteria.

Source: Stans, J., et al. Inclusion of sustainability criteria in the Fuel quality directive. June 2007 (www.europarl.europa.eu).

European Energy Policy on biofuels

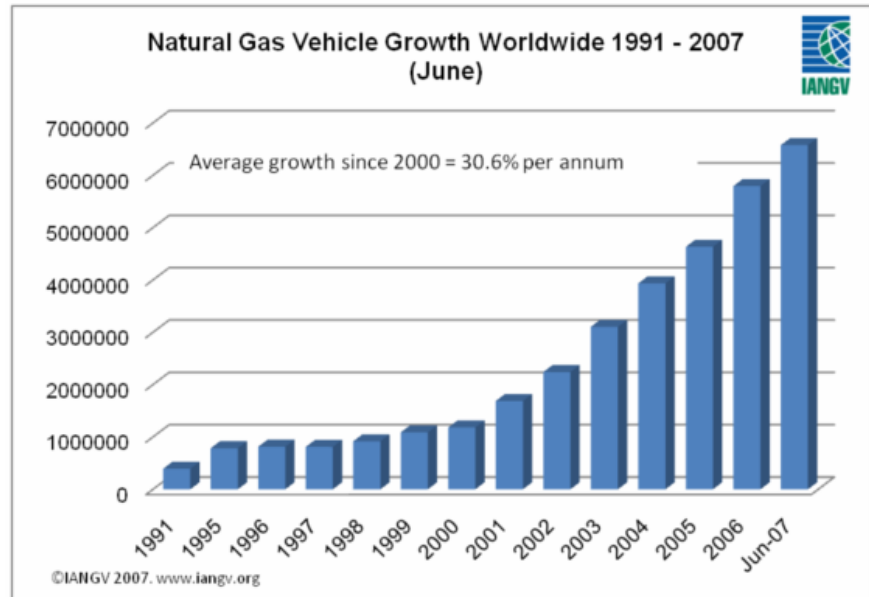
The European Commission made a proposal for a new Energy Policy for Europe in January 2007. The proposal includes a binding 20% target for the overall share of renewable energy in 2020 and a binding 10% target for the share of biofuels in petrol and diesel in each Member State in 2020. The Commission gathered views on this proposal by a public consultation, which closed on 18 June 2007. The consultation document asked views on questions such as: "How should a biofuel sustainability system be designed?", "How should overall effects on land use be monitored?", "How should the use of second-generation biofuels be encouraged?" and "What further action is needed to make it possible to achieve a 10% biofuel share?" Almost 190 consultation papers from authorities, businesses, non-governmental organisations and other interested parties are available at ec.europa.eu.

GASEOUS FUELS (NG, LPG, biogas)

IANGV upgrades online statistics

The online statistics and information system of IANGV on natural gas vehicles around the world has been updated. In addition to current data, historical NGV growth is shown (where available), as well as current rankings based on vehicle numbers and market penetration. The statistics show a 30% average industry growth over the past five years. *NGV Global, 08 August 2007. (www.iangv.org).*

In Germany, the number of NGV vehicles increased by 40% in 2006. The NGV population in Germany was 54,772 by the end of the year. Among these were 42,765 passenger cars, and 10,124 trucks. *NGV Global, May 2 2007.*



Growth of natural gas vehicles from 1991 to 2007 (www.iangv.org).

Greenhouse Gas Reductions with Natural Gas Vehicles

The University of California has published a report including technical analysis to support the state's low-carbon fuel initiative. The potential global warming impact of various conventional and alternative fuels were evaluated, and different scenarios regarding the goal of reducing the carbon intensity of transportation motor fuels by 10% by 2020 were reviewed. The report states that greenhouse gas reductions of 25-26% can be obtained by using natural gas light duty vehicles. *NGV America, 08 June 2007.*

World's Largest Natural Gas Vehicle Source

BP Shipping's Dual-fuel LNG/Diesel tanker recently started operation. This LNG/diesel-electric gas carrier at 155,000 cubic metres is the largest LNG carrier to date. *NGV Global, 25 July 2007.*

ALCOHOLS, (BIO)GASOLINE

New wood-waste ethanol plants planned

Range Fuels in Georgia, US, has been awarded a permit to construct the nation's first commercial cellulosic ethanol plant for a 100 million gallon/a (21,000 tons/a) production. The feedstock will be wood waste from Georgia's forests. Phase 1 of the plant with a production capacity of 20 million gallons/a is scheduled to be completed in 2008. Range Fuels' thermochemical conversion process firstly converts the biomass to syngas, and then the gas to ethanol. The forests of Georgia can support up to 2 billion gallons/a of cellulosic ethanol production. *Press release, 2 July 2007 (www.rangefuels.com)*

The competition is hard as Mascoma Corporation in Michigan, US, also has announced that they will build the nation's first cellulosic ethanol plant to produce ethanol from wood chips and other non-food agricultural crops on commercial scale. Mascoma Corporation is a low-carbon cellulosic biomass-to-ethanol company. *Press release, 19 July 2007 (www.mascoma.com).*

Verenium will start in 2008 production of 4 million liters/a of cellulosic ethanol from wood waste in Osaka, Japan. Verenium is using proprietary micro-organisms, called ethanologens, to ferment cellulose and hemicellulose into ethanol. Verenium also develops cocktails of high-performance enzymes (brand name Fuelzyme™-CX) that convert a variety of feedstocks to fermentable sugars. (www.verenium.com).

Scania's ethanol hybrid bus

Scania's ethanol hybrid concept bus debuted at the UITP public transport congress in Helsinki, 21-24 May 2007. The full-size, low-floor city bus fulfils the Euro 5 and EEV emission limits. Energy storage is based on supercapacitors, which are much more robust than batteries in heavy-duty operation. Hasse Johansson, Group Vice President of Research and Development stated that "With our innovative hybrid-drive concept we improve fuel economy and cut emissions by at least 25% and running on ethanol reduces fossil CO₂ emissions by up to 90%."



Scania's ethanol hybrid bus (www.scania.com).

Twelve ethanol buses equipped with Scania's hybrid-drive system will start regular operation in Stockholm in 2008 and 2009, in cooperation with the city's public transport operator SL. Scania considers ethanol to be by far the most cost-efficient renewable fuel on the market today, taking into account factors like availability, infrastructure and access to proven technology. *Press release, 15 May 2007* (www.scania.com).

Scania is currently the only manufacturer of ethanol buses, and the company has begun to supply ethanol buses for testing by public transport systems in, e.g., Great Britain, Poland, Hungary, Italy, Spain and China. *Press release, 20 June 2007* (www.scania.com). Since 1990, Scania has supplied hundreds of ethanol buses to Swedish cities, of which more than 200 are rolling in the inner city of Stockholm. (*AMFI Newsletter April 2005*). Now the Norwegian public transport company AS Oslo Sporveier is also choosing Scania's ethanol buses. In March 2008, 18 Scania ethanol buses go into service in Norway's capital, Oslo. *Press release, 20 June 2007* (www.scania.com).

PLANT OILS

Algae as biofuel feedstock

Algae is well-known e.g. as the wrapper on a sushi roll. Algae may contain as much as 60% of lipid oils, which can be used e.g. to produce biofuels. Algae can produce 50 to 100 times more oil per acre than oil crops (e.g. oil from soybean). Algae can be cultivated in "open-pond" systems, which are, however, prone to contamination by invasive species or bacteria. This can be avoided by covering the pond with a greenhouse. Algae can also be cultivated in a closed photobioreactor. Algae can be harvested using microscreens, by centrifugation, by flocculation or by froth flotation. Interrupting the CO₂ supply can cause autoflocculation. Ultrasound based methods and other methods of algae harvesting are under development. Algae oils can be extracted using chemical solvents (benzene, ether, hexane) or enzymatic extraction can be used. Dried algae can be also "pressed" out with an oil press. Osmotic shock, supercritical fluid/CO₂ extraction and ultrasonic methods are mentioned as well. Algal-oil conversion into biodiesel is similar to conversion of other oils and fats. The key issue in biodiesel production from algae is to find strains with high lipid content and fast growth without too high requirement on cultivation and harvesting. Algae can be grown to produce biomass, which can then be harvested and burned in the same manner as wood, to produce heat and electricity. Algae can be used as a biological source for the production of hydrogen. By depriving the algae of sulphur it will switch from the production of oxygen (normal photosynthesis), to the production of hydrogen. Through the use of algaculture grown organisms and cultures, various polymeric materials can be broken down into methane. Research into algae for the mass-production of oil is mainly focused on microalgae; due to its less complex structure, fast growth rate, and high oil content (for some species). Some commercial interests are looking into large scale algal-cultivation systems for coal power plants or sewage treatment facilities. (<http://en.wikipedia.org/wiki/Algaculture>)

A number of algae-to-biodiesel projects are going on. Green Star Products, Inc. (GSPI) announced in May 2007 that its Phase II Algae-To-Biodiesel Demonstration Facility (40,000 liter) has been successfully completed. GSPI reported in detail of the most important operating parameters that need to be controlled, such as daily and seasonal pond temperatures, pH, evaporation, salinity and invasion by outside organisms. Phase II testing included pushing the survival environmental envelope of the developed algae strain (zx-13). The zx-13 strain exhibited 21% oil content. The high-grade protein can be used as animal feed and organic fertilizer. Algae are capable to reproduce themselves from 1.5 to 4 times per day. GSPI harvesting techniques apply only to the algae cells larger than 2 microns, whereas smaller size algae returns to the pond to reproduce. The next step is a 100-acre production facility, which might be expanded to a facility of 500 to 1,000 acres. *Sources: GSPI press releases, May 11 and 18, 2007. Business Wire, July 9, 2007* (www.greenstarusa.com)

GPSI has announced earlier of an agreement with De Beers Fuel Limited of South Africa to build 90 biodiesel reactors. *Press release, 7 March 2007 (www.greenstarusa.com)*. GPSI announced a huge production potential for these biodiesel reactors, but no follow-up data is available from De Beers Fuel Limited (Editorial note).

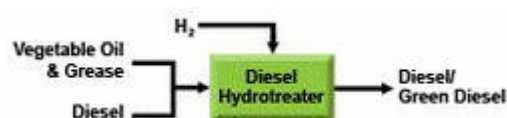
Barrie Leay from Aquaflo, New Zealand presented development status of micro-algae in the 2nd EPOBIO Workshop "Plants – from crops and forests to zero-waste biorefineries", held on 15-17 May 2007 in Athens (www.epobio.net). The idea of Aquaflo is to grow micro-algae of 1-5 microns in size from effluent management systems, EMS waste. Heavily polluted waste water can be transformed to lipid oils and water is cleaned. In May 2006, Aquaflo Bionomic announced that it had produced its first sample of bio-diesel fuel from algae in sewage ponds. The algae is processed into a pulp, then lipid oils are extracted and converted into biodiesel (www.nzherald.co.nz).

SYNTHETIC DIESEL AND RENEWABLE DIESEL

UOP and Eni S.p.A.

UOP LLC and Eni S.p.A will build a production facility in Livorno, Italy, using catalytic hydroprocessing of vegetable oils with UOP/Eni Ecofining™ technology. The production of around 300,000 tons/a will start in 2009. Eni is planning to install several Ecofining units at its refineries in Europe. UOP has also announced that it will work on development of technology to convert vegetable and algal oils to military jet fuels.

In the Ecofining process, oils and fats are fed along with diesel into a diesel hydrotreater unit. The product is paraffinic fuel, which is characterized by excellent diesel fuel properties, such as high cetane number. UOP also has announced that co-processing of vegetable oils with petroleum feedstocks in refinery FCC unit can produce gasoline and olefins. *UOP Press releases, 19 June 2007 and 28 June 2007 (www.uop.com)*.



Hydroprocessing of vegetable oils and diesel, UOP/Eni Ecofining™ technology (www.biodieselnow.com)

Dynamic Fuels and Tyson Foods

Dynamic Fuels LLC, a renewable fuels venture of Tyson Foods and Syntroleum, will produce renewable diesel, jet and military fuel markets using Syntroleum's Biofining™ process, a "flexible feed/flexible synthetic fuels" technology. Animal fats, greases, and vegetable oils supplied by Tyson will be used as feedstocks. The first facility will produce about 225,000 tons/a (75 million gallons) of synthetic fuel in the south central United States. Production will start in 2010. Biofining™ process can also upgrade Fischer-Tropsch wax. *Press release, 25 June 2007 (www.tyson.com)*. Tyson will provide ConocoPhillips with animal fat (500,000 t/a in 2009) for production of hydrotreated biodiesel production. *See AMFI Newsletter April 2007*.

Galp Energia in Portugal

Galp Energia, an oil and gas company in Portugal, and Petrobras in Brazil have a 50-50 joint venture to produce renewable diesel via hydrogenation of vegetable oils. Production volume will be 600,000 tons/a. Half of this will be for domestic use in Portugal and 50% will be exported. Portugal will require a share of 10% biofuels beginning in 2010. *Green Car Congress 2007, 4 July 2007 (www.greencarcongress.com)*. Petrobras' hydrotreatment technology produces diesel fuel from a mix of petroleum and vegetable oil (H-Bio), *See AMFI September 2006*.

Neste Oil inaugurated NExBTL plant - HVO

On 31 May 2007, Neste Oil inaugurated its new €100 million biodiesel plant at Porvoo in Finland. The plant is the first unit to produce biodiesel based on Neste Oil's proprietary NExBTL technology combining hydrotreatment and isomeration. The new plant will produce 170,000 t/a of NExBTL diesel fuel from oils and fats. Raisio in Finland will supply 10,000 tons of rapeseed oil to Neste Oil in 2007, and Neste Oil will buy about all of the tallow by-product produced in the Finnish food industry. *Press release, 31 May 2007 (www.nesteoil.com)*. The second NExBTL plant of the same size is expected on stream in late 2008.

The demonstration of high-concentration NExBTL blends will start in Finland and Sweden in autumn 2007, and is planned to be enlarged to France, Austria and Germany in 2008.

In October 2007, OKQ8 will launch Diesel ECO 20 on the market in Sweden. Diesel ECO 20



Neste Oil's NExBTL renewable diesel plant (www.nesteoil.com)

will be available in 366 OKQ8 stations in Sweden. Diesel ECO 20 contains 80% of Swedish Environmental Class 1 diesel fuel and 20% of Neste Oil's NEXBTL component. OKQ8 Press release, 15 May 2007 (www.okq8.se).

Biomass based syngas - UPM and Andritz/Carbona

The forestry company UPM and the international technology group Andritz with its associated company Carbona intend to co-operate to develop the technology for biomass gasification and syngas purification. Syngas can be processed to BTL biodiesel using the Fischer-Tropsch process. The joint testing project will start with tests using Carbona's gasification technology at the Gas Technology Institute's pilot plant in Chicago, US. Estimated total costs of the piloting are 5 to 10 million EUR. The co-operation also covers the design and supply of a commercial scale biomass gasification plants. *Press release, UPM, 23 May 2007* (w3.upm-kymmene.com).

OTHER FUELS AND VEHICLES

Hydrogen storage based on lithium

UK scientists have developed a hydrogen storage based on lithium hydride (specifically Li4BN3H10). This option involves 'chemisorption', in which atoms of a gas are absorbed into the crystal structure of a solid-state material and then released when needed. New storage material enables driving distance of over 300 miles for hydrogen fuel-cell cars. Today's prototype and demonstration FC cars have a range of around 200 miles. The team has tested thousands of solid-state compounds in search of a light, cheap, readily available material which would enable the absorption/desorption process to take place rapidly and safely at typical fuel cell operating temperatures. *Press release (22 May 2007* www.epsrc.ac.uk).

MISCELLANEOUS

- **IEA against moving from bunker oil to diesel with ships.** IEA warns that a switch to use distillate marine diesel in ship engines would increase CO₂ emissions and would be costly. IMO is considering switching to diesel by 2012 to reduce emissions related to sulphur. 14 May 2007 © Reuters News Service 2007 (www.planetark.org). CONCAWE also has analysed the option to switch to diesel with shipping, and concludes that this would lead to major disruptions in the middle distillate markets. An additional crude oil volume of 8 Mbb/d would be needed to refine sufficient middle distillate volumes. CONCAWE points out that other options, such as on-board flue gas desulphurisation should be considered. *CONCAWE review Vol. 16 No 1 Spring 2007* (www.concawe.be).
- **The 57th UITP World Congress** was held in Helsinki 20-24 May 2007. The International Association of Public Transport (UITP) welcomed over 9000 participants. Public transport is a critical element in the major societal debates such as climate change, energy efficiency or poverty alleviation. The link between urban development and public transport was formalised by a Memorandum of Understanding concluded between UN-Habitat and UITP. "An efficient urban planning is closely linked with strong urban policies." highlighted Hans Rat, UITP Secretary General. "UITP believes that a clear definition of roles between the actors is essential." The Urban Decision-Makers summit that concluded the week welcomed over 40 mayors and national and regional ministers from all continents. By their participation they formalised their commitment to build urban mobility for future generations. *Source: Press Release 31 May 2007* (www.uitp.com) In the exhibition of the Congress several bus manufacturers displayed hybrid buses.
- **Euro 5/6 emission regulation, No. 715/2007**, for passenger cars has been published. The Euro 5 requirements enter into force from 1 Sept. 2009 for new type-approvals and from 1 Jan. 2011 for all new vehicles. The implementation dates for Euro 6 are 1 Sept. 2014 and 1 Sept. 2015, accordingly. The new regulation points out that the Commission shall consider including methane emissions in the calculation of CO₂, and shall propose a limit for methane emissions. In addition, after the completion of the UN/ECE PMP Programme, at the latest for the Euro 6, the Commission shall recalibrate the PM limit values, and introduce particle number based limit values, and adopt revised measurement procedures, respectively. In addition to emission limits, the regulation includes requirements for manufacturers to give information on the OBD systems for vehicle repair and maintenance services. *EC Regulation No. 715/2007, 29 June 2007* (eur-lex.europa.eu). The proposal for PM emission limit (PMP method) is expected to be 3 mg/km and particle number emission 5 x 10¹¹ km⁻¹, which can be fulfilled only by using particulate filter. *DieselNet Update, May 2007. 29 June 2007.*

Annex XXIX "Evaluation of Duty Cycles for Heavy-Duty Urban Vehicles."

The final report of IEA/AMF Annex XXIX is now available in the public domain (www.iea-amf.vtt.fi). Three laboratories, VTT, Environment Canada and West Virginia University measured standard size urban buses driving various duty cycles on chassis dynamometers. Both European and North American diesel and natural gas vehicles were represented. Environment Canada performed a comparison of a conventional diesel vehicle and a diesel-electric hybrid vehicle. The fuel consumption and exhaust emissions varied not only by test cycle, but also by vehicle technology. In the most cases, vehicles emissions can be directly proportioned to the amount of fuel consumed. However, NO_x-emissions from SCR-vehicles form an exception, as well as particle emissions from vehicles producing very low absolute particle emission levels. Scaling factors to be used for comparing emission results generated with different duty cycles were developed. Most of the evaluated test cycles provide coherent fuel consumption and emission results. Some specific test cycles result in abnormalities, and must therefore not be considered representative for buses. (www.iea-amf.vtt.fi).

Annex XXX Biodiesel from Specified Risk Material Tallow: 3rd public report

From Annex XXX, the report "Safety of Animal Fats for Biodiesel Production: A critical Review of Literature" (Volume 3) is now in public domain (www.atfc.com, www.iea-amf.vtt.fi). The reports "Biodiesel from Specified Risk Material Tallow: An Appraisal of TSE Risks and their Reduction, Volume 1" and "Detection of Prion Proteins and TSE Infectivity in the Rendering and Biodiesel Manufacture Processes, Volume 2" were available already earlier (AMFI Newsletter 2/2007).

**IEA AMF
34th Executive Committee
Meeting**

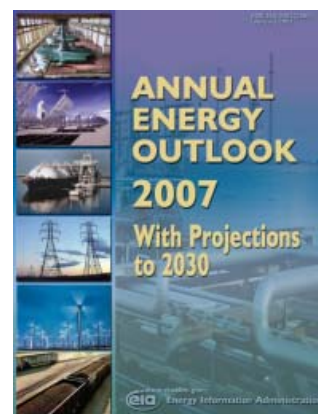
Honolulu, Hawaii. 13-15 November 2007

IEA "Energy Technologies at the Cutting Edge"

The IEA/AMF Agreement is described on page 52 of 2007 edition of Energy Technologies at the Cutting Edge, which is a publication including profiles of the 41 international "Implementing Agreement" R&D programmes within the IEA's collaborative network, their current activities, innovations and recent achievements. *Energy Technologies at the Cutting Edge* © OECD/IEA, 2007 (www.iea.org).

PUBLICATIONS

- **IEA/AMF Annex XXIX:** Evaluation of duty cycles for heavy-duty urban vehicles. Final public report of IEA AMF Annex XXIX. Nylund, N-O., Erkkilä, K., Clark, N. & Rideout, G. August 2007. (www.iea-amf.vtt.fi).
- **IEA/AMF Annex XXX:** " Safety of Animal Fats for Biodiesel Production: A critical Review of Literature (Volume 3)", Greene, A. et al., at website in May 2007 (www.iea-amf.vtt.fi).
- **IEA Bioenergy News**, Volume 19, #1, July 2007 (www.ieabioenergy.com)
- **World Oil and Gas Review 2007**, Eni, 20 June 2007 (www.eni.it)
- **BP Statistical Review of World Energy**, June 2007 (www.bp.com)
- **EIA Annual Energy Outlook 2007 with Projections to 2030** (www.eia.doe.gov)
- **2nd EPOBIO Workshop:** Products from Plants – from crops and forests to zero-waste biorefineries. 15-17 May 2007. Presentations at www.epobio.net.
- **WWF report:** Rain Forest for Biodiesel? April 2007. (www.wwf.de)



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