



### **News Review**

Issue Fifty-Eight January 2017

Each month we review the latest news and select key announcements and commentary from across the biofuels sector.



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# Foreword

A warm welcome to the January 2017 edition of the NNFCC's Biofuels News review.

Recently, biofuels policy has been under the spotlight on both sides of the pond, for different reasons. Here in Europe, the European Commission has announced its updated energy policy running through to 2030, detailing how the EU can reduce emissions in the energy sector. However, it has stripped all emissions reduction targets for road fuel, and not announced any new ones, in a move that many in the biofuels sector believe could be hugely damaging. German bioethanol company CropEnergies has criticised the EC, claiming that this new directive will see an increase in fossil fuel usage and associated increase in emissions. They also argue that the EC's increased focus on advanced biofuels, instead of those produced directly from crops, will result in a reduction in available animal feed – a common by-product of primary biofuel production. The legislation is also set to hit farmers, for whom the biofuels industry provides €6.6bn annually, but with the apparent dropping of support for primary biofuels, this could well decrease. This, coupled with the accompanying reduction in available animal feed, would have negative consequences unless something was done to mitigate them.

Meanwhile, on the other side of the Atlantic, a fresh new administration is shaking up many things, but biofuels is one area that may remain untouched (at least, directly), as President Trump's appointment for head of the EPA has pledged to stand by the Agency's biofuels program, which sets quotas for how much biofuel should be produced in the country per year. He has said he is open to modifying the policy, but will not scrap it. However, that self-same policy is causing controversy among fuel manufacturers who claim they cannot feasibly reach this year's target. A petition to have it relaxed has been denied on the grounds that surplus from previous years can make up the difference between actual production and targeted production, but it is clear that manufacturers are feeling the pressure, and this issue may well resurface as the deadline approaches.

Read on for the latest biofuels news.

# Policy

# Farms under threat from biofuels reduction



The production of biofuels contributes at least €6.6 billion in direct revenue per year to EU farmers. But ethanol's importance to agriculture — and its usefulness in the drive for EU decarbonization — is now under threat from a lack of government support at EU and UK level. The Commission's recent proposal to phase out conventional biofuels would unravel market support for ethanol production, a move that couldn't come at a worse time for struggling European farmers.

In 2015, Europe's ethanol and biodiesel producers bought 28 million tonnes of feedstock from farmers across the continent, delivering a key revenue lifeline of almost €7 billion.

In Europe, virtually all (99.7 percent) the crops used to produce ethanol are grown in sustainable conditions within the continent using less than 1 percent of EU agricultural land — it is a homegrown solution. Across Europe, only 2 percent of Europe's total cereals are used to produce ethanol — not enough to have any negative impact on the market or food prices. In fact, the global price of cereals has dropped by 40 percent since 2008 during a period of unprecedented expansion of global biofuels production and the introduction of the EU's biofuels policy. The phase-out of conventional biofuels currently under consideration at EU-level will discourage investment in new technologies, threaten financial support to many otherwise prosperous biorefineries, rob Europe's farmers of vital farm income and increase Europe's reliance on imported animal feed. The consequences of this to farmers are catastrophic — the market for 28 million tonnes of crops and 5 million tonnes of animal feed will be put at risk.

Click <u>here</u> for more information.

### New head of EPA stands by current Biofuels program

Oklahoma Attorney General Scott Pruitt, President-elect Donald Trump's choice to lead the Environmental Protection Agency, said in January he would honour the intent of the U.S. biofuels program, but remained open to tweaking it.

The Renewable Fuel Standard requires the EPA set annual quotas for the use of ethanol and biodiesel in transportation fuels. The standard is fiercely defended by the U.S. corn industry that provides most of the ethanol, but it has been a source of frustration for oil refiners. They say the goals are unrealistic without an overhaul in automobiles and infrastructure, and are calling for changes.

Pruitt said during his confirmation hearing on Wednesday that he was committed to Congress' plan, laid out in 2007, to annually increase the amount of ethanol and other renewables blended with petroleum fuels. He said the waivers that EPA has already used to set requirements below those targets to accommodate market conditions should be used "judiciously".

He explained his view that the EPA should not use those waivers to "undermine commitments" from Congress but that they are needed in some cases, including when there is lower-than-expected fuel demand.

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### EPA denies petition for waiver of 2016 biofuel quota

On Jan. 17, the U.S. EPA sent a letter to the American Petrochemical and Fuel Manufacturers denying its petition for a partial supplemental waiver of the 2016 cellulosic biofuel standard under the renewable fuel standard (RFS).

APFM filed the petition on Dec. 28, asking the agency to waive a portion of 2016 RFS cellulosic volume obligation, citing a shortfall in 2016 cellulosic production.

In its petition, AFPM projects that 173.8-190 million gallons of cellulosic biofuel were produced last year, approximately 40-60million gallons short of the 230 million gallons assumed necessary for compliance with the 2016 cellulosic biofuel standard. According to the AFPM, if its refining members are unable to acquire enough cellulosic biofuel RINs, these obligated parties will need to purchase cellulosic waiver credits (CWCs) in order to meet compliance obligations. AFPM estimates the cost to purchase these CWCs at approximately \$50-75 million.

In its response, the EPA said that although the 2016 cellulosic biofuel percentage standard was based on a projected production volume of 230 million gallons, the actual number of cellulosic RINs or waiver credits that will need to be retired for compliance will not be known until the compliance deadline, when obligated parties report their gasoline and diesel production and import volumes to the EPA.

In total, the EPA said the 197 million cellulosic RINs it expects to be generated for 2016, when combined with the estimated 39 million carryover RINs, means a total of 236 million RINS should be available to meet the 2016 standard. That number is more than the 227 million RINs expected to be necessary for compliance.

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#### **Germany ups Climate Protection Rate**

The 'climate protection rate' in Germany is set to rise this year from 3.5 to 4% and biofuels is set to benefit from this, according to Germany's biofuels trade association Verband der Deutschen Biofuelindustrie (VDB).

According to this rise, oil companies will have to reduce greenhouse gas emissions from their fuels by 4% from this year, for example, by adding biodiesel or bioethanol.

Biofuels reduce greenhouse gas emissions by an average of 70% compared to fossil fuels, as the competent Federal Institute for Agriculture and Food (BLE) stated in an October report.

Biodiesel and bioethanol accounted for 5.2% of the German fuel market in 2015.

However, the full potential for climate protection through biofuels is not exhausted, according to VDB. In the past, a much higher proportion of biofuels has already been used. This development is particularly drastic in sales of diesel fuel, which in Germany has risen from 32.5 to 36.8 million tonnes in 2015, or 13.2%. At the same time, the share of biodiesel fell by 26.6%, according to the trade body.

The biofuels industry has long demanded that the climate protection rate increase by 2020 in small steps. It argues that the affected economy can adapt itself to the development and better assess the market situation and the implementation is achieved reliably.

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# Widespread Biomass deployment will boost Dutch economy

To meet the emission targets, the Dutch government expects that a large-scale deployment of biomass is needed but the macroeconomic impacts on the Dutch economy are unknown. This study analyses the impacts of the bio-based economy at both system and macroeconomic levels and shows that large-scale deployment of biomass up to 2030 positively contributes to the Dutch economy, contributes to meeting the emission reduction targets and to reducing its macroeconomic costs. High technological change and global markets are important to achieve these impacts, but low fossil energy prices reduce the macroeconomic benefits. To achieve the positive macroeconomic impacts and emission reduction, a stimulus by policies is necessary.

In 2013, the bioeconomy sectors contributed 7.7% to national turnover, 4.9% to national value added and national employment. With a share of 80 to 85% in the total bio-based economy in all these three categories, the contribution of the primary, food and feed sectors was dominant. Wood, paper and textile accounted for 10% and new, energy-intensive and labour-extensive, bio-based sectors (bioelectricity, bio-based chemicals, biofuels) contributed about 5%.

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2015. Bioenergy and waste accounted for 1.9 million metric tons of oil equivalent, 3.2 percent lower than 2015 quarter three. Primary electricity output in the third quarter of 2016 was 14.4 percent higher than in the prior year period.

In regards to U.K. biofuels, the share of liquid biofuels of petrol and diesel consumed in road transport was 3.4 percent, up from 3.3 percent in Q3 2015. Liquid biofuels consumption rose by 6 percent, from 282 million litres (74.5 million gallons) in 2015 Q3 to 405 million litres in Q3 of 2016. This was driven by a 21 percent hike in biodiesel consumption from 177 million litres to 215 million litres. Bioethanol consumption decreased by 7.3 percent from 205 million litres in 2015 guarter three to 190 million litres in 2016 quarter three. In 2016 Q3, biodiesel contributed the largest share of biofuels consumption at 53 percent, unchanged from the previous quarter, and bioethanol represented 47 percent of biofuels consumption.

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### Markets

### UK Biofuels consumption increases in Q3 of 2016

At the end of 2016, the Department for Business, Energy & Industrial Strategy released Energy Trends and Energy Prices publications, covering new data for the third quarter of the year. One of the main points to take away from the third quarter results was the fall of coal's share (3.6 percent) of electricity generated during the quarter due to reduced capacity, including the closures of Ferrybridge C and Longannet in March, with the conversion of a unit at Drax from coal to high-range cofiring (85 percent or more biomass).

Total energy production in the third quarter of 2016 was 29.9 million metric tons of oil equivalent, 8 percent higher than in the comparable period in

# Research & Development

### Neste partners with Bioenergy La Tuque

Neste and Bioenergy La Tuque have started R&D cooperation with the objective of studying the potential of using forest residues as a raw material in biofuel production in La Tuque, Canada. The cooperation supports Neste's goals to expand the raw material selection available and increase the use of waste and residues. Currently, the company is capable of using more than 10 different raw materials to produce renewable products.

The agreement focuses on the technological and economic feasibility of the project and will assess the biomass availability at a competitive cost, identify technology bottlenecks in process lines, and validate the acceptable level of risk.

Click here for more information.

#### **Bacterial process converts CO2 to CO**

Using a novel approach involving a key enzyme that helps regulate global nitrogen, University of California, Irvine molecular biologists have discovered an effective way to convert carbon dioxide (CO2) to carbon monoxide (CO) that can be adapted for commercial applications like biofuel synthesis.

Led by Yilin Hu, UCI assistant professor of molecular biology & biochemistry at the Ayala School of Biological Sciences, the researchers found that they could successfully express the reductase component of the nitrogenase enzyme alone in the bacterium Azotobacter vinelandii and directly use this bacterium to convert CO2 to CO. The intracellular environment of the bacterium was shown to favour the conversion of CO2 in a way that would be more applicable to the future development of strategies for large-scale production of CO. The findings were surprising to the group, as nitrogenase was only previously believed to convert nitrogen (N2) to ammonia (NH3) within the bacterium under similar conditions. The full study can be found online in Nature Chemical Biology.

Hu and her colleagues knew that the intracellular environment of the bacterium Azotobacter vinelandii favours other reduction reactions, due in part to its well-known oxygen protection mechanisms and presence of physiological electron donors. But they were unsure if the intracellular environment would support the conversion of CO2 to CO.

They were excited to discover that the bacterium could reduce CO2 and release CO as a product, which makes it an attractive whole-cell system that could be explored further for new ways of recycling atmospheric CO2 into biofuels and other commercial chemical products. These findings of Hu's group establish the nitrogenase enzyme as a fascinating template for developing approaches to energy-efficient and environmentally-friendly fuel production.

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#### \$12.9m for Bioeconomy projects

The U.S. Department of Energy (DOE) announced the selection of six projects to receive \$12.9 million in federal funding for work related to biofuels, bioproducts, biopower and/or refinerycompatible intermediates.

The funding opportunity announcement (FOA) is titled Project Definition for Pilot- and Demonstration-Scale Manufacturing of Biofuels, Bioproducts, and Biopower. Participants are required to share at least 50 percent of the cost and be evaluated in two phases.

Phase one will consist of designing and planning. In phase two, award recipients will construct and operate a demonstration or pilot. Participation in phase two is dependent on an evaluation of phase one progress and will likely commence in 2018. Pilot-scale projects could receive up to \$15 million in additional federal funding. Demonstration-scale facilities could receive an extra \$45 million.

Two award recipients, AVAPCO, LLC and LanzaTech, Inc. will develop demonstration-scale integrated biorefineries. AVAPCO will produce jet fuel and other products from woody biomass. LanzaTech will convert industrial waste gases into low-carbon jet and diesel fuel.

Global Algae Innovations and ThermoChem Recovery International, Inc. (Baltimore, Maryland) will use the funds for pilot-scale integrated biorefineries. Global Algae Innovations will use algae while ThermoChem Recovery International's project will use woody waste and/or agricultural feedstock.

Two participants will work on pilot-scale waste-toenergy projects. Rialto Bioenergy, LLC will convert biomass into fertilizer and biopower. Water

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Environment & Reuse Foundation will use wastewater treatment plant sludge to produce biocrude oil, biogas and fertilizer.

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### Supercritical Water Gasification of Peach Scraps produces intermediates of bio-based chemical synthesis



The aim of the paper is to evaluate the bioenergy and bio-based material recovery from fruit scraps through an innovative process, e.g., supercritical water gasification, which presents several advantages in comparison to the traditional processes for energy and matter recovery. In particular, experimental tests of peach scraps were carried out using bench-scale plant plug flow reactor type, in which the selected liquid matter can be pumped until 300 bar and heated until 600 °C to achieve the supercritical water condition of the water. The main results showed that, in the range of the feed flow rate of 5-30 mL/min and at fixed operative conditions of T and P (T = 550 °C, and P = 250 bar), it is possible to obtain tar-free syngas with a higher heating value of 14-16 MJ/kgdry basis. The influence of the residence time was studied for the gaseous and liquid phases. For each one of them, it was possible to highlight a specific trend. In the liquid phase, the main components were acetic acid, hydroquinone, and syringaldehyde that are intermediates for the chemical synthesis of interesting bio-based chemicals and biochemicals.

Click here for more information.

### **Bio-Based Membrane developed for ETBE Purification**

Ethyl tert-butyl ether (ETBE) is a fuel octane enhancer considered as a major bio-fuel in Europe. Blended with gasoline fuels, ETBE improves fuel combustion and reduces toxic hydrocarbon emissions. ETBE industrial synthesis leads to an azeotropic mixture EtOH/ETBE (20/80 wt%), which cannot be separated by simple distillation. According to former works, cellulose acetate (CA) membranes were extremely selective with a permeate EtOH content of 100% but their flux was too low for ETBE purification by the pervaporation (PV) membrane process. The affinity of the bio-based polylactide (PLA) for ethanol has also been reported for poly(vinyl pyrrolidone)/PLA blends for this application. In this work, new bio-based membranes were obtained by grafting CA with controlled PLA amounts by a "grafting onto" strategy. The CA-g-PLA copolymers were characterized by ATR-FTIR, 1H NMR, DSC and SAXS. Their membrane properties were investigated in terms of structuremorphology-property relationships for the sorption and pervaporation of the targeted EtOH/ETBE mixture. PLA grafting onto CA strongly improved the flux (×12) while the ethanol permeate content remained in the very high range (C'>90 wt%) for ETBE purification by pervaporation.

Click here for more information.

# Bioethanol

#### Leaf opens yeast drying facility in US

Lesaffre has celebrated a major milestone with the inauguration of its first yeast drying facility in the United States. The drying facility is located in Headland, Alabama where Lesaffre and Red Star Yeast have operated a cream yeast facility since the 1990's.

On January 10, at the occasion of the grand opening of the yeast drying facility, Lesaffre Advanced Fermentations (Leaf), announced the launch of its new bioengineered yeast, ER-Xpress<sup>™</sup>, a robust enzyme expressing yeast specifically developed for the US bioethanol industry. This new strain will be produced and dried in the new facility.

Click here for more information.

#### CropEnergies criticises European Commission biofuel proposals

Biofuels international reports that German bioethanol producer CropEnergies has criticised the European Commission's (EC) revised renewable energy directive (RED) proposals.

In the company's third quarter forecast, CropEnergies chief executive Joachim Lutz said the EC could impair further progress, warning proposals to cut the amount of biofuels made from crops make no sense when it wants to increase alternative fuels' market share.

The European Council decided greenhouse gas emissions have to be reduced by 40% by 2030.

This year these proposals will be negotiated in the Council and in the Parliament.

CropEnergies has recently restarted the production of its bioethanol plant in Wilton, UK, by which CropEnergies increased bioethanol production from 618,000 to 735,000 cubic meters in the third quarter reporting period.

Click <u>here</u> for more information.

approved the pathway for isobutanol produced at Gevo's Luverne, Minnesota plant to be an advanced biofuel under the Renewable Fuel Standard (RFS) Programme.

This is the first time that the EPA has approved a pathway for an advanced biofuel that uses starch from feed corn to produce an alcohol. With a partial substitution of fossil based energy sources that are currently used at Luverne with green energy sources, such as biogas, it should be possible for Gevo to achieve the 50% or greater greenhouse gas emissions reduction needed to claim the advanced D5 Renewable Identification Number (RIN) according to the pathway approval.

A RIN is a serial number assigned to biofuels for the purpose of tracking their production, use and trading, as required under the RFS. RINs can be sold and traded, and as a result carry a monetary value, which is linked to the biofuels that generate the RINs.

Gevo's isobutanol from feed corn starch currently generates D6 RINs, and with this approval, Gevo's isobutanol could generate D5 RINs as well. D5 RIN credits have historically had greater value in the marketplace than D6 RINs, potentially making Gevo's isobutanol more valuable in the future. Isobutanol, used as a gasoline blend stock, generates 1.3 RINs per gallon.

Therefore, at these current values, a gallon of isobutanol would generate RIN value of \$1.30 per gallon if it qualified for a D5 RIN, as compared to \$0.98 per gallon under a D6 RIN, or an additional \$0.32 per gallon.

Isobutanol can also be converted into renewable jet fuel and gasoline. Each of these products would also qualify for RINs.

Click <u>here</u> for more information.

#### **EPA** approves bio-isobutanol as fuel

US renewable chemicals and advanced biofuels company Gevo has announced that the US Environmental Protection Agency (EPA) has

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# Biodiesel

# Increase in Yeast sugar-to-oil conversion efficiency

Biomass magazine reports on work by MIT engineers who have genetically reprogrammed a strain of yeast so that it converts sugars to fats much more efficiently, an advance that could make possible the renewable production of highenergy diesel fuels.

The researchers, led by Gregory Stephanopoulos, the Willard Henry Dow Professor of Chemical Engineering and Biotechnology at MIT, modified the metabolic pathways of yeast that naturally produce large quantities of lipids, to make them about 30 percent more efficient.

To achieve this, Stephanopoulos and his colleagues began working with a yeast known as Yarrowia lipolytica, which naturally produces large quantities of lipids. Using the improved synthetic pathway, the yeast cells require only two-thirds of the amount of glucose needed by unmodified yeast cells to produce the same amount of oil.

This new glucose-to-lipid conversion process could be economically feasible at current prices for corn starch, the researchers are hoping to make the process even more efficient.

Click here for more information.

### GM unveils biodiesel option on new cars

When it comes to reducing emissions, fleet operators generally have fewer options than individual buyers of passenger cars.

There are fewer zero-emission vehicle options for vehicles that see commercial use, although those vehicles often cover more miles every year than the average passenger car. But fleet buyers have embraced alternative carbon-based fuels to some degree, including biodiesel.

To encourage greater use of biodiesel in fleet markets, General Motors recently announced an expansion of its lineup of B20 biodieselcompatible vehicles.

B20 is a blend of 20 percent biodiesel and 80 percent conventional diesel fuel, and can be used interchangeably with fossil diesel in the updated engines.

GM will offer B20-compatible cars, crossovers, pickup trucks, and vans for fleets across the Chevrolet and GMC brands.

The biodiesel push follows the introduction of compressed natural gas (CNG) and liquefied petroleum gas (LPG) options for Chevy and GMC heavy-duty pickup trucks and full-size vans.

Click here for more information.

# ExxonMobil & Synthetic Genomics continue Algae biofuel research

Synthetic Genomics, Inc. and ExxonMobil announced today that they have extended their agreement to conduct joint research into advanced algae biofuels after making significant progress in understanding algae genetics, growth characteristics and increasing oil production.

ExxonMobil and Synthetic Genomics have been jointly researching and developing oil from algae for use as a renewable, lower-emission alternative to traditional transportation fuels since launching the program in 2009. Work continues toward developing strains of algae that demonstrate significantly improved photosynthetic efficiency and oil production through selection and genetic engineering of higher-performance algae strains. The agreement continues to focus on Synthetic Genomics' core strengths in synthetic biology and builds on recent discoveries of biological pathways regulating lipid production and growth in advanced algal strains. The development of algae biofuels and a path toward commercial-scale production remain key components of ExxonMobil's suite of research projects focused on producing energy to meet global demand while reducing greenhouse gas emissions to mitigate the risk of climate change.

ExxonMobil is engaged in a broad range of research on advanced biofuels, partnering with universities and other companies. The purpose of these research and development programs is to explore new technologies and seek the best pathways toward scalable and cost-effective production of advanced biofuels.

Click here for more information.

# **Aviation Fuel**

# LanzaTech receives DoE grant for jet fuel facility



Carbon recycling company, LanzaTech has been selected by the Department of Energy's Bioenergy Technologies Office (BETO) to receive a \$4M award to design and plan a demonstration-scale facility using industrial off gases to produce 3M gallons/year of low carbon jet and diesel fuels.

The facility will recycle industrial waste gases from steel manufacturing to produce a low-cost ethanol intermediate "Lanzanol". Both Lanzanol and cellulosic ethanol will then be converted to jet fuel via the "Alcohol to Jet" (ATJ) process developed by LanzaTech and the Pacific Northwest National Laboratory (PNNL). The ATJ technology was initially developed with DOE funding by PNNL and subsequently scaled-up by LanzaTech to produce 4000 gallons of sustainable jet fuel from Lanzanol and other sources, as well as 600 gallons of diesel fuel, for fuel quality testing, certification and a proving flight with Virgin Atlantic.

LanzaTech is currently building its first commercial ethanol facilities using waste gases, including one in China with China's largest steel company, Shougang, and one in Belgium with the world's largest steel manufacturer, ArcelorMittal. In the DOE funded project, LanzaTech will work with ArcelorMittal to evaluate US opportunities for leveraging this expertise to demonstrate an entirely new pathway to low carbon fuels from industrial wastes that are either flared or underutilized.

To demonstrate process versatility, ethanol from other waste gas streams will be converted, including cellulosic ethanol produced via fermentation of biomass syngas by Aemetis. Ambitech, an Illinois-based engineering company, will be LanzaTech's engineering partner with additional engineering contributions from Aemetis. Other project partners include PNNL; technology providers Petron Scientech, CRI Catalyst Company, Nexceris and Gardner Denver Nash; Michigan Technological University, who will be evaluating the environmental footprint of the fuels being produced; and Audi, who will support by evaluating diesel and gasoline fuel properties. In addition, the project has received support from Airlines for America (A4A) and the Commercial Aviation Alternative Fuels Initiative (CAAFI), an aviation industry consortium focused on the nearterm development and commercialization of sustainable alternative jet fuel for the aviation enterprise.

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# Turkey's bio-based jet fuel demand forecasted

Turkey's ambitious Vision 2023 agenda foresees a significant growth in the country's aviation sector. However, forecasts for Turkey's jet fuel demand in the view of Vision 2023 are not available in the published literature. Also, there is no information about the country's potential bio-based jet fuel demand after 2020, when it is plausible to become a mandatory supplement to kerosene. As a result, for the first time in this study, semi-empirical models were generated to provide Turkey's jet fuel and bio-based jet fuel forecasts based on the country's Vision 2023 energy targets. These models were generated taking current market dynamics, business as usual, and the possibility of enhanced economic growth for Turkey based on Vision 2023 energy and economic targets. As a result, Turkey's jet fuel demand in 2023 was estimated at between 4.230 and 7.880 billion litres. Also, it was calculated that Turkey could need up to 0.307 billion litres of bio-based jet fuel in 2023, if its consumption becomes mandatory after 2020.

Click <u>here</u> for more information.

# **Price Information**

Historical spot prices of liquid fossil fuels and liquid biofuels. Five years prices and up to November 2014 are given in \$ per barrel.



Prices of Crude oil, diesel, gasoline, and jet fuel are recorded from <u>www.indexmundi.com</u>; Price of ethanol from <u>www.neo.ne.gov</u>; Biodiesel spot prices from <u>http://www.kingsman.com</u>

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