

# Commercializing Conventional and Advanced Liquid Biofuels from Biomass

**Task 39**  
IEA Bioenergy

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## From the Task

*By Susan van Dyk, Jack Saddler and Jim McMillan*

This issue of the newsletter highlights biofuels developments of likely interest to Task 39 stakeholders, including some of the task’s activities.

The next meeting of Task 39 will be held in Rotorua, New Zealand on 8 November 2016. This meeting will be combined with a workshop on Drop-in Aviation and Marine Biofuels organized by IEA Bioenergy’s Executive Committee (ExCo). Task 39 will also participate in the Bioenergy Australia conference to be held on 14-16 November 2016 in Brisbane, Australia, with several Task members giving talks at this meeting. Appropriately, this edition of the Newsletter also features an article on the latest biofuels developments in Australia. We would like to thank Dr Stephen Schuck, Australia’s representative to the IEA Bioenergy ExCo and Manager of Bioenergy Australia, for preparing an informative, interesting article on the latest biofuels developments in Australia.

The Task continues to progress several ongoing deliverables, including projects on Advanced Fuels in Advanced Engines; an update on the status and prospects of algae for bioenergy; and an assessment and comparison of leading LCA models being used to assess the sustainability of biofuels production pathways. Associated reports will be completed and made publicly available over the coming months.

Since our last newsletter, a number of new reports have published that are relevant to biofuels (see the news section for links to download these reports). One of the most prominent is the 2016 “Billion-Ton” report documenting that the United States has the potential to annually produce by 2040 over 1 billion dry tons of non-food biomass.



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The US Department of Agriculture’s Foreign Agricultural Service publishes valuable reports on the status of biofuels in countries around the world and during the past few months has published reports on the European Union, Japan, Canada, Brazil, India, Philippines, Colombia, Indonesia, Thailand, Argentina, Australia and Malaysia (find links to the reports in the News section).

Climate change mitigation has arguably become the biggest driver for biofuels development worldwide and thus the potential emission reductions that can be achieved using biofuels, in addition to overall sustainability measures, is an important topic in several reports. A new study by consultants Ricardo Energy & Environment found that higher use of ethanol in Europe could reduce GHG emissions in European transport by 14.1%, even after taking into account possible land use change (ILUC-related) emissions. A [new consensus report from the Coordinating Research Council](#) also documents growing evidence supporting biodiesel as a low carbon fuel.

Debates about the “food versus fuel” issue continue. In Washington, a group of researchers from 10 institutions led by IFPRI released [a report finding](#) that bioenergy can actually support food security, challenging the “fuel vs. food” argument that biofuels exacerbate food scarcity and global hunger. The effects of bioenergy policies on food security could be strongly positive, the report concludes, “if designed in the right way, and could help attract the kind of investments in agriculture that are sorely lacking in many of the developing countries that currently experience high-levels of hunger and poverty.”

In a drive to promote sustainable biofuels, a new global initiative called below50 has debuted, backed by the World Business Council for Sustainable Development, Roundtable for Sustainable Biomaterials and Sustainable Energy for All, to promote fuels that can achieve GHG reductions of 50% or greater, and scale up their development and use. Any company who produces, uses and/or invests in fuels that are at least 50% less carbon intensive than the fossil fuels they displace can join below50. Companies must publicly commit to the campaign, show evidence that supports their claim, and disclose their progress towards achieving this goal. (<http://below50.org/>)



We welcome your feedback. Please direct your comments to [Susan van Dyk](#)

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From a policy perspective, the last four months have seen regulatory developments in several countries to promote the advancement of biofuels, namely in Mexico, Hawaii (USA), Ethiopia, Malaysia and Thailand. (See the news section for more details).

Several new biofuels facilities, conventional and advanced, were announced, some nearing completion while others are progressing to detailed planning stage. New Zealand is opening its first biodiesel facility, while other projects in Zambia and Thailand are moving forward. (Details in the News section)

Biojet fuel remains prominent in the news. A recently published report by the White House's National Science and Technology Council called the *Federal Alternative Jet Fuels Research and Development Strategy* outlines the federal government's plans to lower the cost of alternative jet fuels through coordinated, targeted research and development by agencies including the Energy Department, the U.S. Department of Agriculture, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency. The ASTM certification of the isobutanol-to-jet pathway took place since the last newsletter was published and Alaska Air have since undertaken several flights using biojet based on this conversion technology. The complexity of biojet fuels are discussed in practical terms in an interesting article in the Biofuels Digest entitled [\*Renewable jet fuel. Why everything is so up in the air.\*](#) In further biojet news, Boeing and South African Airways celebrated Africa's first passenger flights using aviation biofuel blend containing 30% biojet produced from nicotine-free tobacco feedstock with hydroprocessing of the oils into drop-in biofuels..

As always, we appreciate your feedback and suggestions. Please share any ideas about increasing the value of these Task 39 newsletters. We hope to hear from you.

*Jim, Jack and Susan*

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# Biofuels developments in Australia

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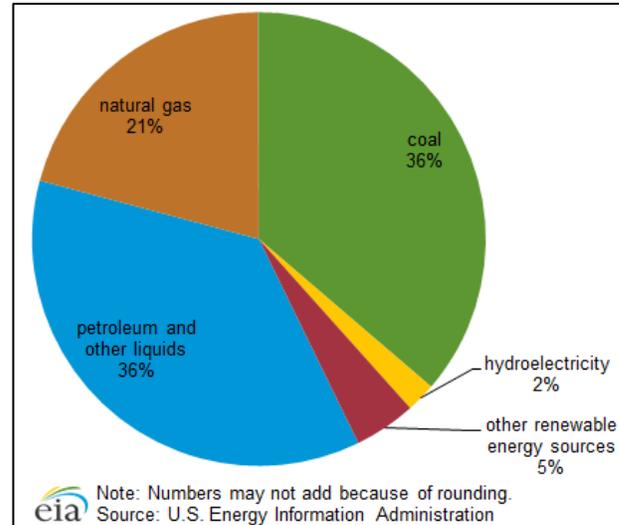


## Introduction

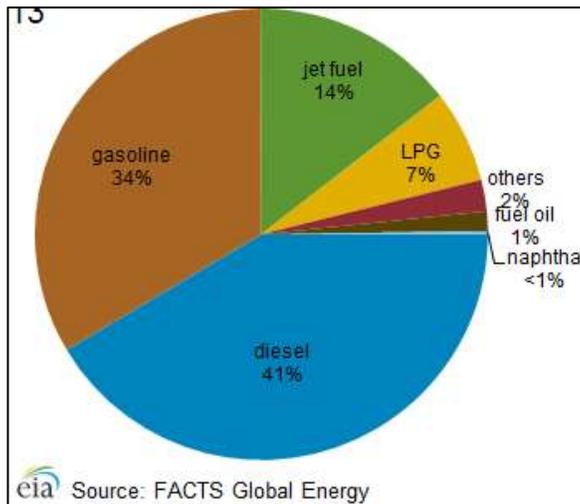
Australia's primary energy consumption is heavily dependent on fossil fuels, with renewables contributing about 7% (including hydroelectricity, wind, solar and biomass) (Figure 1) (US EIA).

While Australia has large energy resources, it is a net importer of crude oil and refined petroleum products. In 2013, net product imports were 325,000 bbl/d, according to the Australia Bureau of Statistics data (US EIA).

Petroleum demand by product is shown in Figure 2. The share of gasoline in the transport fuel mix has decreased slowly over recent decades, outstripped by growth in diesel and aviation fuel. This reflects fuel switching and increased demand for diesel, particularly associated with greater mining and air transport. Alternative transport fuels accounted for 5 percent of energy consumption in 2012–13, comprising liquefied petroleum gas (LPG) (2.7 percent), natural gas (1.6 percent) and biofuels (0.6 percent) (USDA, 2015).



**Figure 1. Australia's primary energy consumption, 2012 (US EIA)**



**Figure 2. Australia's petroleum demand by product, 2013 (US EIA)**

## Renewable Energy Target

The Australian Government has set a national target for 20 percent of Australia's electricity to be renewable energy sourced by 2020. The primary mechanism for achieving this target is the Renewable Energy Target (RET) which originally required an additional 45,000 GWh (162 PJ) per year of renewable energy by 2020, with the RET applying until 2030. The RET is administered by the Federal Government's Office of the Clean Energy Regulator and operates through the creation and surrender of Renewable Energy Certificates, each certificate being for one MWh of compliant renewable energy. Under the scheme, energy retailers and large energy users must purchase a proportion of their energy requirements from renewable energy sources.

In June 2015, the Australian government reduced the Renewable Energy Target for large-scale renewable energy generation by 2020 from 41,000 GWh to 33,000 GWh. The RET

was also amended to reinstate biomass from native forest wood waste as an eligible source of renewable energy, including the same safeguards that were in place prior to removal of this source from eligibility in late 2011.

In 2012, Australia implemented a carbon tax to be paid by the top emitting companies as part of the country's goal to reduce emissions by 5% in 2020 from 2000 levels (US EIA). This policy was expected to lead to a reduction in coal-based electricity and an increase in renewables and natural gas use. However, a change in government in mid-2013

led to a repeal of the carbon tax policy in 2014. This change in policy impacted the development of renewables and biofuels.

The most recent general election took place July 2, 2016 and returned the former government to power however with a reduced electoral margin. It is not yet clear what impact this will have on development of biofuels and renewables.

In some circles there is great optimism for the growth of biofuels following on the UNFCCC COP21 agreement reached in Paris in December 2015 ([Read more](#)).

## Biofuels

In 2015, annual biofuels production in Australia was estimated to be 330 million litres, divided between 265 million litres of ethanol and 65 million litres of biodiesel (USDA, 2015). This represents less than one percent of Australia's total liquid fuels consumption.

Legislative and regulatory responsibility for energy and liquid biofuels is shared between the Australian Federal Government and the governments of Australia's six States and the Territories. The Federal Government has carriage of taxation and excise, international covenants relating to the United Nations and climate change, while it is the States that generally set fuel usage mandates.

The Federal Government's objective is to allow consumers access to the broadest possible range of transport fuels at the lowest price. Consequently the government has no specific consumption targets for biofuels or other fuels. However, in recognition of the potential benefits of biofuels, the government's policy is to discount the excise rate on ethanol and biodiesel fuels by 50 percent. Transitional arrangements from zero effective excise rate commenced on 1 July 2015. For ethanol, excise rates will continue to increase until July 1 2020 when they reach 32.77 percent of the petrol excise rate. For biodiesel, excise rates will continue to increase until July 1 2030 when they reach 50 percent of the diesel excise rate.

Through its Australian Renewable Energy Agency (ARENA), the Federal government supports research and commercialisation of renewable fuels. To date, ARENA has provided A\$46 million for 19 bioenergy projects. More information about specific projects can be found at <http://arena.gov.au/projects/bioenergy/>.

The New South Wales (NSW) government has a legislated ethanol supply mandate of 6 percent for wholesale companies and a requirement for retailers with 20 or more outlets to offer ethanol-blended fuel for sale. Currently, only 4 percent has been reached. The *NSW Biofuels Act 2007* facilitated a roll-out of retail and distribution infrastructure which has allowed wider distribution of ethanol-blended fuels, with most of the fuel ethanol produced by the three Australian producers sold on the NSW market as E10 blend petrol. The NSW government is preparing an A\$4.5 million 'mythbusting' campaign for 2017 and 2018 when it hopes to boost demand for E10 to 6 percent of fuel consumption. Currently only 3% of fuel consumed is E10, partly blamed because it is only a few cents cheaper than regular unleaded, but that hardly compares with sharp demand increase in far more expensive premium unleaded to 40% of the market. Concerns remain about which cars are compatible with E10 and addressing this will be part of the communications campaign beginning in 2017.

The Queensland State government aimed to commence a two percent biofuels target on 1 July 2016. However, the parliament of Queensland, in Australia's northeast, passed legislation on December 1 mandating that ethanol make up 3% of regular gasoline sales in the state from July 1, 2017, rising to 4% on July 1, 2018. The Liquid Fuel Supply (Ethanol and Other Biofuels Mandate) Amendment Act 2015 also requires biodiesel and renewable diesel to make up 0.5% of total diesel sales in Queensland from mid-2017. The ethanol mandate goes further than the 2% proposed under the bill which went to parliament, but the implementation time frame has been delayed by a year to give

consumers and fuel retailers time to prepare for the change. The government is also currently conducting public consultation over options to increase the mandates going forward. ([Read more](#))

A newly launched Queensland Biofutures 10-Year Roadmap and Action Plan has four key initiatives to boost Queensland's support for industrial biotechnology and bioproducts. These are:

- A\$5 million for a Biofutures Industry Development Fund to financially assist companies complete due diligence and achieve financial close to allow better access to venture capital markets.
- A\$4 million for a Biofutures Acceleration Program to identify strategic catalytic investment opportunities and attract a signature keystone investor(s) to Queensland.
- A\$5 million for a Biofutures Commercialisation Program that will specifically assist businesses, in partnership with a Queensland research organisation, manage the significant risk of developing and scaling up technology.
- A\$5 million for the establishment of Biofutures Queensland, a dedicated industry sectoral unit that will be the State's focal point for biofutures industry support.

The main measure that has supported the biofuels industry is an excise on biofuels that is levied on both local production and imports of ethanol, with local producers receiving a rebate. Changes to this assistance to the biofuels industry were announced in the 2014 Federal budget and in subsequent statements, with the excise rebate for local production of ethanol now being phased down by mid-2016 and with imports of biodiesel not eligible for the excise rebate from mid-2015.

The Ethanol Production Grants (EPG) program that supported production and deployment of ethanol as a sustainable alternative transport fuel in Australia ceased in June 2015. This program had provided full excise reimbursement, at the current excise rate, to ethanol producers for ethanol produced and supplied for transport use in Australia from locally derived feedstock. Prior to the 2014 Budget, ethanol fuel had been subject to an excise of A38cents per liter.

The Australian Government reduced the excise on domestic production of ethanol and biodiesel to zero with implementation from 1 July 2016 (See Table 1 below) and terminated the Ethanol Producer Grants and Clean Fuels Grants schemes. Instead, these alternative fuels will become partly liable to excise under a sliding scale. The rates of excise duty for domestically manufactured fuel ethanol will increase annually by 6.55 percent until the final schedule rate of 32.77 percent of the excise rate for petrol is attained. Imported ethanol will maintain an excise rate equivalent to that of petrol. (Table 1.)

**Table 1: Schedule of changes to the excise on ethanol, 2016 to 2030**

Financial Year (from July 1st)	Excise rate for domestic ethanol (%)	Excise rate for imported ethanol (%)
July 1 2015 - July 30 2016	0	100
July 1 2016 - July 30 2017	6.554	100
July 1 2017 - July 30 2018	13.108	100
July 1 2018 - July 30 2019	19.662	100
July 1 2019 - July 30 2020	26.216	100
July 1 2020 - July 30 2021	32.77	100

The ethanol industry in Australia comprises three producers in New South Wales and Queensland, with an installed production capacity of 440 million liters (ML). In 2014, there were three ethanol fuel manufacturing plants, each distilling different feedstocks (See Table 2). The largest ethanol producer, in NSW, uses wheat starch and has an annual capacity to make 300 million liters of ethanol. The second largest producer, in Dalby, Queensland, uses red sorghum and has an annual capacity of 80 million liters, while the third largest, in Sarina, Queensland, uses molasses from sugar and has an annual production capacity of 60 million liters. The use of lower cost residue feedstock from other production processes such as flour milling or sugar refining can lower overall costs compared to using commercially sold grains as feedstocks. Actual production is considerably below capacity but firm-specific output is not available.

A group of Korean investors led by Dongmun IRS recently proposed an A\$90 million ethanol plant with a capacity of 110 megalitres of ethanol each year for Deniliquin, NSW. This plant is reported to have received planning approval from the NSW Government. The feedstock would be grain sourced within a 400 kilometre radius of Deniliquin. The company has indicated that a recent bilateral free trade agreement with Korea, which removes a 20 percent tariff on imported oil, has made the project – known as Dongmun Greentec – a viable investment. Most of the plant's output will be exported to Korea.

Ethanol use has been declining in recent years in Australia because of concern over possible engine damage from using the fuel, declining availability of E10 pumps and a consumer preference for regular unleaded over E10 (USDA, 2015). The lack of a price differential between E10 and regular petrol has contributed to the decline. As noted above, the NSW government is striving to stimulate ethanol use in that state.

**Table 2. Fuel ethanol production facilities in Australia, 2012 (Biofuels Association of Australia)**

Location	Capacity (ML/pa)	Feedstocks
Manildra Ethanol Plant, NSW	300	Waste starch
Dalby Biorefinery, QLD	80	Sorghum (grain)
Sarina Distilleries, QLD	60	Molasses

Most diesel fuel in Australia is sold in bulk long-term contracts to commercial/industrial customers such as mining and transport companies, with only 25 percent sold through retail outlets. Of this retailed amount, 80 percent is bought by the long-haul trucking industry, with only a small proportion sold to other private customers.

Australian production of biodiesel has fallen in recent years with the closure of a number of plants. Only four of the eight biodiesel plants in Australia are currently operating, with the industry association estimating total annual production at 65 ML, well below the total installed production capacity of around 300 ML. Production and capacity utilization varies considerable by plant. One major producer mothballed its 100 million liter biodiesel plant in 2013 because it was unable to secure long-term contracts with established petroleum refiners and fuel distributors.

Australia's largest biodiesel plant is located in the Northern Territory and has a rated capacity of 140 million litres per year. Designed to use palm oil and food-grade vegetable oil, it closed in 2009 and then was acquired in early 2014 by a U.S. biofuels and energy company that plans to restart it using a broader range of feedstocks, including lower quality tallow, used cooking oil and palm sludge oil.

**Table 3. Biodiesel facilities** (<http://biofuelsassociation.com.au/biofuels/biodiesel/biodiesel-in-australia/>)

BIODIESEL PLANT	LOCATION	OWNER (* BAA MEMBER)	TOTAL INSTALLED CAPACITY (ML) (01.06.15)	FEEDSTOCK	STATUS (01.06.15)
ARfuels Barnawartha	Barnawartha, VIC	Australian Renewable Fuels*	60	Tallow, Used cooking oil	In production
ARfuels Largs Bay	Largs Bay, SA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	Mothballed
ARfuels Picton	Picton, WA	Australian Renewable Fuels*	45	Tallow, Used cooking oil	Mothballed
ASHOIL	Tom Price, WA	Ashburton Aboriginal Corporation*	Unknown	Used cooking oil	In production
Biodiesel Industries	Rutherford, NSW	Biodiesel Industries Australia Pty Ltd*	20	Used cooking oil, Vegetable oil	In production
Ecofuels Australia	Echuca, VIC	Ecofuels Australia Pty Ltd	1.5	Canola oil	In production
EcoTech BioDiesel	Narangba, QLD	Gull Group*	30	Tallow, Used cooking oil	In production
Macquarie Oil	Cressy, TAS	Macquarie Oil Co	15	Poppy Seed Oil & Waste Vegetable Oil	In production
Neutral Fuels	Dandenong, VIC	Neutral Fuels (Melbourne) Pty Ltd	Unknown	Used cooking oil	Closed
Smorgon Fuels – BioMax Plant	Laverton, VIC	Smorgon Fuels Pty Ltd	N/A (Prior to closure 15-100)	Tallow, Canola Oil and Juncea Oil	Closed
Territory Biofuels	Darwin, NT	Territory Biofuels Ltd	140	Refined, Bleached & Deodorised (RBD) Palm Oil, Tallow, Used Cooking Oil	Closed
TOTAL INSTALLED CAPACITY (ML)			217		

## Advanced biofuels

Although there are currently no commercial facilities producing advanced biofuels in Australia, a number of Australian companies are exploring producing advanced biofuel from woody biomass and algae feedstocks. Licella uses hydrothermal liquefaction technology to produce a biocrude which can be upgraded into advanced biofuels. This company is profiled in the Companies and Facilities section of this article, below.

In March 2016, Southern Oil Refining announced plans to construct a \$16 million biofuels pilot plant near Gladstone, Queensland, giving a major boost to the Queensland Government's plans to make the state a centre for Australia's biofuels industry. Queensland had offered an additional grant to cover the costs of setting up in Gladstone, while no incentives were offered in NSW. If this new Northern Oil Advanced Biofuels Pilot Plant is successful it could expand into a \$150 million commercial-scale refinery capable of annually producing 200 million litres of advanced biofuel suitable for military, marine and/or aviation use. ([Read more](#))

## Agencies and funding

The Australian Renewable Energy Agency (ARENA, <http://arena.gov.au/>) was established in July 2012 to:

- improve the competitiveness of renewable energy technologies
- increase the supply of renewable energy in Australia.

The Australian Renewable Energy Agency has supported development of advanced biofuels, so far providing over A\$25 million to projects developing various advanced biofuel technologies (USDA, 2015). In the 2014 Budget, the Australian Government announced its intention to abolish ARENA but did not obtain Parliamentary support for this. The Australian Government announced on 23 March 2016 its intention to create a new Clean Energy Innovation Fund, to be jointly managed by ARENA and the Clean Energy Finance Corporation (CEFC). The Fund was set to be formalised on 1 July 2016, with up to \$100 million each year allocated to commercialise innovative renewable energy projects using equity and debt instruments. Once the fund is established, ARENA will assess project proposals and make recommendations for funding to the CEFC for approval (<http://arena.gov.au/>).

Current projects funded by ARENA are listed in Table 4. (<http://arena.gov.au/projects/bioenergy/>)

**Table 4: Current ARENA funded projects**

Lead organisation	Project	ARENA funding provided / committed	Total project cost
Southern Oil Refining Pty Ltd (Southern Oil Refining or SOR)	Australia's first advanced biofuel laboratory	\$2,416,000	\$5,379,928
Renewable Developments Australia Pty Ltd	Pentland Bioenergy Project	\$3,000,000	\$13,100,000
Queensland University of Technology	Utilising biogas in sugarcane transport and milling	\$2,100,000	\$5,700,000
Rural Industries Research and Development Corporation	The Australian biomass for bioenergy assessment project	\$3,000,000	\$6,269,000
Renergi Pty Ltd	A low emission biofuel technology	\$5,173,000	\$12,891,182
Bioenergy Australia	Participation in the International Energy Agency's Bioenergy program	\$360,000	\$1,098,700
Biosystems Engineering Pty Ltd	Woody biomass harvester	\$1,940,000	\$3,481,089
Renergi Pty Ltd	Advanced biomass gasification technology	\$3,624,253	\$6,729,553

In November 2015, the Pentland Bioenergy Project announced the proposed construction of Australia's largest integrated biofuel facility, near Charters Towers in North Queensland. ([Read more](#)). This proposed plant would produce up to 350 million litres of fuel grade bioethanol per annum and would incorporate a 32 megawatt co-generation power plant, with excess lignin sold as biofuel pellets. Funding of \$3 million from ARENA will be used to determine the technical and commercial viability of the proposed facility. ARENA's funding will support growing and irrigation trials, due diligence activities required for financial close and preliminary work to support the procurement of engineering and construction services ([Read more](#)). The business case is due for completion by November 2016.

In June 2016, ARENA announced approved funding of A\$2.4 million to help create a A\$5.3 million biofuel laboratory in Yarwun, near Gladstone, under development by Southern Oil Refining (SOR) and due to be completed by March 2019. This project will help inform the feasibility and design of a proposed commercial

scale biorefinery to produce renewable diesel fuel, jet fuel and marine fuel. ([Read more](#)).

## Renewable aviation biofuels (biojet)

A number of studies have been carried out on the potential for biojet production and development in Australia as detailed in the USDA's GAIN report on Australia (USDA, 2015).

In 2011, the Commonwealth Scientific and Industrial Research Organization (CSIRO) drafted a roadmap, "Flightpath to sustainable aviation" for establishing sustainable aviation fuels (SAF) in Australia and New Zealand with the support of airlines, airline manufacturers and engine producers. This roadmap summarizes key challenges and makes recommendations for productive actions that can be made by both the public and private sectors.

A 2012 study coordinated by Qantas and Shell evaluated the potential for biofuels produced by hydroprocessing natural oils and animal fats (i.e., via the HEFA pathway) in Australia (Qantas and Shell, 2013). This study assessed the commercial viability of a potential A\$1 billion biojet facility having an annual production capacity of one million barrels of renewable hydrocarbons (diesel, biojet, naphtha and refinery gas). It found that such a plant was not commercially viable as long as the price of feedstock generally remains higher than the price of the end fuel products, such as diesel and biojet. This Qantas/Shell study also assessed the potential for producing biojet via the already certified Fischer-Tropsch (FT) pathway, finding that this route was not also not yet commercially viable.

In 2012, Qantas operated Australia's first commercial SAF flight from Sydney to Adelaide using a 50 percent blend of biojet with fossil jet fuel in one engine.

The Australian Initiative for Sustainable Aviation Fuels (AISAF) was founded in 2012 with the aim to create a platform for the promotion of SAF and to collaborate with the USA in line with the Memorandum of Understanding signed by the Australian Government in September 2011. Members include Qantas, Virgin Australia, and other stakeholders from the aviation industry. In August 2014, due to the cessation of government funding, AISAF reverted to being an initiative of the Sustainability Program at the United States Studies Centre.

In 2013, Virgin Australia, Brisbane Airport and SkyNRG announced plans for a feasibility study on establishing a “bioport” at Brisbane Airport that would permit aircraft to be fuelled with renewable biofuels. Virgin Australia indicated that the bioport could contribute to its goal of obtaining five per cent of its jet fuels from renewable sources by 2020. ([Read more](#))

In March 2015, Air New Zealand and Virgin Australia announced a partnership to investigate options for locally produced aviation biofuel. ([Read more](#))

## Research and development

Research and development (R&D) activities in Australia have focussed on alternative feedstock development and also on new biofuel production technologies. Some leading examples of biofuels R&D are summarized here.

Ethanol Technologies Ltd (Ethtec) has been developing a concentrated sulfuric acid hydrolysis technology for cellulosic ethanol production. It has a pilot plant operating at the Harwood Sugar Mill on the NSW north coast. This technology has also been the subject of a prefeasibility study for a proposed 30 ML/a plant at Scottsdale, Tasmania (<http://www.ethtec.com.au>)

The University of Sydney has been conducting research on the hydrothermal decomposition of a variety of feedstocks for biocrude production using sub- and supercritical water. This technology is now being commercialised by Licella (see below). Professor Thomas Maschmeyer, who has led this research, is one of the founders of Licella.

The University of Queensland in Brisbane has been developing alternative feedstocks and innovative biofuel production methods. The Australian Research Council Centre of Excellence for Integrative Legume Research has been developing *Pongamia pinnata*, whose seed pods have high oil content, as a new biofuel feedstock. Two separate



**Figure 3: *Pongamia pinnata* Seed Pods**

facilities for algae biofuels development and for solar biofuels (Solar Biofuels Consortium <http://www.solarbiofuels.org>) are located at Pinjarra Hills on the western outskirts of Brisbane. Other feedstocks related to agriculture and forestry are being progressed at The University of Queensland through the Queensland Alliance for Agricultural and Food Innovation (QAAFI - <http://www.qaafi.uq.edu.au>).

The Commonwealth Scientific and Industrial Research Organisation has conducted breakthrough research by engineering plant leaf oil content to approach that of oil seeds. Initial trials were conducted on tobacco leaves.

Australian company, Algae.Tec has been developing an algae feedstock production technology based on using shipping container photo-bioreactors. A trial has been ongoing at Manildra near Nowra, NSW using fermentation generated CO<sub>2</sub> from the adjacent ethanol plant. This technology has now been taken offshore for commercialisation.

ARENA is funding two Renergi Pty Ltd projects, one on low emission biofuels from pyrolysis liquids and the other on gasification technology for power production. Renergi Pty Ltd was established in late 2012 to commercialise renewable energy technologies developed at Curtin University of Technology in Perth, Western Australia (<http://www.renergi.net>).

The Queensland University of Technology (QUT) recently formalised a collaboration with the U.S.'s Pacific Northwest National Laboratory to enhance bioenergy research, promote education, and develop new industry and viable bioenergy solutions for their respective countries, with special emphasis on adaptive bioprocesses. Both institutions work in advanced thermochemical conversion of biomass to create biofuels, plant-derived chemicals and other bioproducts. The partnership will focus on work that aims to reduce GHG emissions and provide low-carbon energy solutions for both countries.

Biosystems Engineering has also been the recipient of ARENA funding to further develop a harvester for oil mallee to make it into a practical and economically viable bioenergy feedstock. (Oil mallee is a type of eucalyptus with multiple stems and containing high oil bearing leaves, identified as a prospective woody energy crop for multiple bioenergy products.)

A consortium of state government agencies and two universities, led by the Rural Industries Research and Development Corporation (<http://www.rirdc.gov.au>), is quantifying and mapping nation-wide biomass resources in the Australian Biomass for Bioenergy Assessment project (ABBA), a A\$6.3 million project co-funded by ARENA.

## Companies and Facilities

Australia's main ethanol and biodiesel facilities are listed in Tables 2 and 3, respectively. As a comparison of these tables shows, there is a greater diversity of biodiesel production plants with the predominant feedstocks being waste vegetable oil, tallow and to a lesser extent virgin vegetable oils.

Australia's biggest biodiesel producer, Australian Renewable Fuels (ARF) (Figure 4), reportedly went into voluntary administration (insolvency) in January 2016 as a result of the slump in the global oil prices coupled with changes in the Federal Government's taxation policy for domestically produced biodiesel that also occurred at that time ([Read more](#)). At this point, it is unclear whether or not ARF will continue trading following being placed into administration.

It is expected that the EcoTec biodiesel plant will provide a visit as part of the Bioenergy Australia 2016 conference in November 2016 (see below under Bioenergy Australia).

Licella (<http://www.licella.com.au/>) in partnership with the University of Sydney has developed Catalytic Hydrothermal Reactor (Cat-HTR™) technology to convert a wide variety of low-cost, non-edible, waste biomasses into biocrude oil. Over the past nine years, Licella has invested A\$60 million in this technology development (Figure 5). The ITQ laboratory in Valencia, Spain has demonstrated the feasibility of upgrading Licella's biocrude to kerosene and renewable diesel using standard refinery infrastructure.



Figure 4: ARF Picton, Western Australia Biodiesel plant – past tour visit



Figure 5: Licella pilot plant at Somersby, NSW

Licella recently announced a joint venture with a Canadian company, Canfor Pulp, that will be called, “Licella Pulp Joint Venture,” and have the objective of integrating Licella’s proprietary Cat-HTR™ technology platform into Canfor Pulp’s kraft and mechanical pulp mills to economically convert biomass, including wood residues from Canfor Pulp’s kraft pulping processes, into biocrude oil, to be used to produce next generation biofuels and biochemicals.

(<http://www.licella.com.au/licella-pulp-joint-venture-3-in-the-top-10-australian-bioeconomy-stories-of-2016/>)

## Bioenergy Australia

Bioenergy Australia (<http://www.bioenergyaustralia.org>) is a nation-wide information and networking forum fostering the use of biomass for heat, power, fuels and other value-added biobased products. It has approximately 50 member organisations and is the vehicle for Australia’s participation in IEA Bioenergy, with funding support from ARENA’s Emerging Renewables Program. One of its major activities is convening Australia’s largest annual conference covering biomass and bioenergy. The 17<sup>th</sup> annual Bioenergy Australia conference will be held in Brisbane, Queensland from 14-15 November, with a technical excursion on 16 November to bioenergy facilities in the region. IEA Bioenergy Task 39 will be participating in this conference, providing a session on ‘drop-in’ biofuels as part of the program. This conference is typically attended by 200-300 delegates and has several sessions on advanced feedstocks and biofuels.



## References and Further Reading

1. US EIA (2014) Australia. International energy data and analysis. August 28. ([Download full report](#))
2. USDA Foreign Agricultural Service (2015) Australia. Biofuels Annual. GAIN Report Number: AS1516
3. Stucley. *et al.* (2012) Bioenergy in Australia: Status and Opportunities. Available at: <http://www.bioenergyaustralia.org>.
4. Biomass Producer, <http://www.biomassproducer.com.au>
5. Bioenergy Australia, <http://www.bioenergyaustralia.org>
6. Biofuels Association of Australia, <http://www.biofuelsassociation.com.au>
7. Australian Renewable Energy Agency, <http://www.arena.gov.au>

## In the News

### Reports and Research

The USDA Foreign Agricultural Service publishes regular GAIN reports on biofuels in countries around the world. Some of the recent reports included the European Union ([download](#)), Japan ([download](#)), Philippines ([download](#)), Brazil ([download](#)), Colombia ([download](#)), Canada ([download](#)), Thailand ([download](#)), Indonesia ([download](#)), Malaysia ([download](#)), Argentina ([download](#)) and Australia ([download](#)).

August 25 – A University of Michigan study claims that biofuels created from crops account for more carbon dioxide emissions than gasoline. [Renewable fuels advocates](#) are questioning the methodology of the study, and note that the research was funded by the American Petroleum Institute. ([Read more](#), and [here](#))

August 17 - A new report by the White House's National Science and Technology Council entitled, [Federal Alternative Jet Fuels Research and Development Strategy](#), outlines the federal government's plans to lower the cost of [alternative jet fuels](#) through coordinated, targeted R&D by U.S. government agencies including the departments of Energy, Agriculture, and Transportation as well as the U.S. Environmental Protection Agency (EPA). ([Download report](#))

July 20 – The European Commission released a report, on “A European Strategy for Low-Emission Mobility” ([Download report](#)). This report explores policy options to decarbonize transport beyond 2020.

July 12 – The 2016 Billion-Ton Report, jointly released by the U.S. Department of Energy and Oak Ridge National Laboratory, concludes that the United States has the potential to sustainably produce at least 1 billion dry tons of nonfood biomass resources annually by 2040. (Read more [here](#))

July 7 - Global biodiesel production and consumption is forecast to rise by 14% from 2016 to 2020, driven by the fulfillment of current biofuel policies in the US, Argentina, Brazil, Indonesia and the EU, according to an Agricultural Outlook issued by the Organization for Economic Cooperation and Development (OECD) and the UN's Food and Agriculture Organization (FAO). The growth in waste-based biodiesel is expected to continue mainly in the EU and the US. The OECD projects a more modest 5% increase in global ethanol production and consumption, with production rising to 125.1 billion liters from 119.3 billion liters and consumption increasing to 126.1 billion liters from 119.9 billion liters, with sugar cane ethanol production in Brazil and Thailand making up around half of this growth. ([Read more](#)) The full report can be [read online](#).

July 5 – A new study by Ricardo Energy & Environment finds that higher use of ethanol in Europe could contribute to a 14.1% GHG emission reduction in European transport, even after possible land use change (ILUC) emissions have been taken into account. (Read [more](#)) Access to [full report here](#).

July 5 – The USDA's report on India projects that [the country will only manage to blend 2% ethanol in 2017](#), up only slightly from the 1.9% it expects to be blended this year, well below the country's blending mandate of 10%.

July 3 - In Washington, the USDA's Economic Research Service released a [new report](#) entitled, “Brazil's Agricultural Land Use and Trade: Effects of Changes in Oil Prices and Ethanol Demand.”

June 27 - In Washington, [the National Resource Defense Council released its 2016 Aviation Biofuel Sustainability Scorecard](#), with six airlines assessed to be in the “leading category”: KLM/Air France, British Airways, Cathay Pacific, Scandinavian Airlines, South African Airways and United Airlines.

June 18 - In the EU, ePURE launched its Policy Roadmap for Decarbonizing Transport to 2030. Ahead of the European Commission's publication of a Communication to decarbonize transport post- 2020, ePURE said that the Commission should propose clear, consistent and binding measures that increase the climate performance of transport fuels.

Incentives for the deployment of sustainable low carbon fuels are essential if Europe is to meet its 2030 climate goals. ([Read more](#)) ([Download report](#))

June 18 - In Washington, a group of researchers from 10 institutions led by IFPRI released [a report \(access the complete report here\)](#) concluding that bioenergy done well can actually support food security. This challenges the “fuel vs. food” argument that biofuels contribute to global hunger. The effects of bioenergy policies on food security could be strongly positive, the study found, “if designed in the right way, and could help attract the kind of investments in agriculture that are sorely lacking in many of the developing countries that currently experience high-levels of hunger and poverty.” ([Read more](#))

June 16 - A new report from the International Council on Clean Transportation estimates that currently less than 50,000 tons of used cooking oil (UCO) gets collected per year from households across Europe. At the same time, potential resources are estimated to be at the level of 800,000 – 900,000 tons per year. This means that there is around 800,000 tons of UCO that potentially can still be captured. ([Download report](#))

June 7 - In the UAE, the International Renewable Energy Agency (IRENA) released its annual renewable jobs report, showing that bioenergy remains a key employer on a global level, with liquid biofuels accounting for 1.7 million jobs, biomass production for 822,000 jobs and biogas plants for another 382,000 jobs. Overall, however, biofuel employment declined by 6% from 2014-2015 due to increased mechanization in some countries such as Brazil and the US and lower biofuel production in others. On the upside, jobs increased in the EU, Malaysia and Thailand. ([Download report](#))

June 6 - [a new report from the European Maritime Safety Agency \(EMSA\) concludes that methanol and ethanol are good potential alternatives](#) for reducing both the emissions and carbon footprint of shipping operations. Use of sulphur-free methanol- or ethanol-based fuel would ensure compliance with the European Commission Sulphur Directive. ([Read more](#))

June 5 - REN21 publishes its comprehensive annual overview of the state of renewable energy. ([Read report](#))

May 11 - In California, the Consortium for Algal Biofuel Commercialization (CAB-Comm), led by the University of California, San Diego, released its final report, detailing the many accomplishments and impactful contributions achieved in its six years of operation. ([Read more](#)) Access the [full report](#)

May - Scientific experts agree that biodiesel holds significant promise to reduce carbon emissions. Last year, biodiesel use in the U.S. cut greenhouse gas (GHG) emissions by 18 million tons, or the equivalent carbon dioxide emissions of 3.8 million cars. A [new consensus report from the Coordinating Research Council](#) now adds to the growing evidence in support of biodiesel as a low carbon fuel. ([Read more](#)) [Workshop report](#)

May - In Washington, the U.S. Energy Information Administration (EIA) posted a summary of two cases of energy projections covering 2015 to 2040 obtained from its forthcoming [Annual Energy Outlook 2016](#) (AEO2016).

### Policy and Regulatory Developments

August 29 – Mexico allows up to 5.8% ethanol blending in three major cities, Mexico City, Guadalajara and Monterrey. This is Mexico’s first biofuel policy. ([Read more](#))

July 11 - Hawaii State Act 202 is a nonrefundable tax credit for the production of renewable fuels, including biodiesel, which will take effect for five years beginning in 2017. The annual amount of the tax credit is equal to US\$ 20 cents per 76,000 Btu of renewable fuel (the equivalent of one gallon of ethanol). This tax credit is capped at \$3 million per year. ([Read more](#))

July 7 - In South Dakota, the Farmers Union is taking an innovative approach to get drivers to fill up with E30, offering a 30-cent per gallon rebate on E30 purchased through its “30-For-30” campaign. The Farmers Union wants to

encourage people to support their local farming communities who supply corn to ethanol plants by ensuring they know that filling up with ethanol, especially higher blends of ethanol like E30, helps to create demand for local farmers. ([Read more](#))

June 8 - In Ethiopia, the government has set up a state-owned Mineral, Petroleum and Biofuel Corporation with the goal of establishing biofuel production as well as fossil fuel production and mining operations in the country. Currently, the vast majority of biofuels used in the country come from molasses-based ethanol following failed attempts at using jatropha and castor oil seeds for biodiesel production. Biofuels and renewable energy remain a key part of this landlocked country's policies to achieve energy independence. ([Read more](#))

May 31 - In Malaysia, the biodiesel blending mandate for transport will increase to B10 from the current B7 on June 1, while the industrial sector will have to boost its consumption to 7% biodiesel. As a result, domestic annual consumption of crude palm oil will increase to 709,000 metric tons. ([Read more](#))

May 19 – In Washington, the EPA released its draft Renewable Fuel Standard (RFS) renewable volume obligations (RVOs) for 2017. The agency proposed renewable fuel volumes totalling 18.8 billion gallons. ([Read more](#))

May - In Thailand, the Ministry of Energy has been instructed to quickly begin testing B10 in order to facilitate commercial introduction of this blend across the country in 2018. Such a blend would boost biodiesel consumption to 14 million liters per day. ([Read more](#))

### Sustainability

August 24 - Enerkem Inc., a Canadian waste-to-biofuels and chemicals producer, obtained certification from the International Sustainability and Carbon Certification (ISCC) system for the biomass-based methanol produced at its full-scale Enerkem Alberta Biofuels facility in Edmonton, Canada. This biorefinery therefore becomes the first ISCC certified plant in the world converting municipal solid waste (MSW) into methanol ([Read more](#))

May 31 - In 2014, 45% of all the palm oil used in Europe ended up in the tanks of cars and trucks, based on data from the EU vegetable oil industry association Fediol and obtained by green group Transport & Environment. ([Read more](#))

### Industry News

August 19 – Celtic Renewables Ltd has submitted a planning application to build a commercial biobutanol facility in Grangemouth using byproducts of whiskey fermentation. (<http://www.falkirkherald.co.uk/news/business/biofuel-firm-s-plans-for-grangemouth-1-4207221>)

August 17 – Queensland Premier Anastacia Palaszczuk and United States Deputy Under Secretary of the Navy for Management Thomas Hicks signed a Statement of Cooperation as part of the Great Green Fleet initiative. The agreement, signed at a Parliament House ceremony, outlines the parties' commitment to jointly explore the research, development, supply and sale of advanced "drop-in" alternative fuels. ([Read more](#))

August 17 – In Kaduna, Nigeria, the Petroleum Technology Development Fund (PTDF) will establish a national coordination centre for research on development of biofuel and other attractive regional resources. [Read more](#)

August 12 - In Washington, the US Department of Energy (DOE) announced up to \$11.3 million for three projects that support the development of [biomass](#)-to-hydrocarbon biofuels conversion pathways that, as the DOE remarked, "can produce variable amounts of fuels and/or products based on external factors, such as market demand." The Dow Chemical Company, in partnership with LanzaTech and Northwestern University, will develop a process for converting biomass-derived synthesis gas (syngas) to fatty alcohols as a new pathway to liquid biofuels. Amyris, in cooperation with Renmatix and Total New Energies, will develop a manufacturing-ready process to produce farnesene from wood at the same cost as from sugarcane syrup. Research Triangle Institute will partner with Arkema and AECOM to investigate the technical feasibility and economic potential, as well as the environmental and sustainability benefits,

of recovering mixed methoxyphenols from biocrude as building block chemicals that can be co-produced alongside the production of biofuels. ([Read more](#))

August 11 - India is targeting a more than sevenfold expansion in its biofuels market over the next six years, stepping up the country's efforts to cut its reliance on energy imports. ([Read more](#))

August 8 – In the UK, the Renewable Energy Association reported that, for the first time since the start of the UK's Renewable Transport Fuel Obligation in 2008, no palm oil has been used in the renewable biodiesel that is blended into fossil diesel, according to official figures. ([Read more](#))

August 8 – The US Navy completed a sea trial with 100 percent renewable diesel, using ReadiDiesel developed by Applied Research Associates Inc. and Chevron Lummus Global, as a drop-in replacement for petroleum F-76 marine diesel. ([Read more](#))

August 5 - Global Green Chemicals, a Thai oleochemicals company, announced plans to increase its biodiesel production capacity by setting up a second methyl-ester plant in Chon Buri province, located in the southeast of Bangkok ([Read more](#))

August 3 - UPS, a package delivery giant, announced it will invest more than \$750 million (€670m) for its alternative fuel and advanced technology vehicles by the end of 2016. In 2015, UPS increased its commitment to renewable fuels, with plans to purchase up to an additional 60 million gallons of renewable diesel and renewable natural gas (RNG) over the next several years. ([Read more](#))

August 2 – New Zealand's first commercial biodiesel plant prepares to open. ([Read more](#))

July 27 – China New Energy moves ahead with Zambian bioethanol project. ([Read more](#))

July 17 In South Africa, Boeing, South African Airways and low-cost carrier Mango celebrated Africa's first passenger flights with renewable aviation biofuel. The SAA and Mango flights carried 300 passengers from Johannesburg to Cape Town on Boeing 737-800s using a blend of 30 percent aviation biofuel produced from Sunchem's nicotine-free tobacco plant Solaris, refined by AltAir Fuels and supplied by SkyNRG. ([Read more](#))

July 17 - In New York, Toyota Tsusho was identified as a multinational strategic equity investor in Anellotech and a corporate partner in the renewable aromatic chemicals supply chain. ([Read more](#))

July 14 - The U.S. DOE announced up to \$15 million in funding for three projects aimed at reducing the production costs of algae-based biofuels and bioproducts through improvements in algal biomass yields. These projects will develop highly productive algal cultivation systems and couple these systems with effective, energy-efficient, and low-cost harvesting and processing technologies. This funding will advance the research and development of advanced biofuel technologies and help speed the commercialization of renewable, domestically produced, and affordable fossil-fuel replacements. ([Read more](#))

July 13 - Ensyn announced ground-breaking on a new 10.5 million gallon biocrude project in Port-Cartier Quebec. This facility will be 50% owned by Ensyn and will receive financing support from Sustainable Development Technology Canada. ([Read more](#))

July 10 - In Australia, Algae.Tec received a \$1 million investment from Gencor Pacific, in the form of a secured convertible note with an exercise price of \$0.10, which represents a 100% premium over the current trading price, with a term of 18 months and an interest rate of 10% per annum. ([Read more](#))

July 5 - In Washington, the U.S. DOE recently announced nearly \$16 million in funding to help businesses move promising energy technologies from DOE's national laboratories into the marketplace. This first Department-wide

round of funding through the Technology Commercialization Fund (TCF) will support 54 projects across 12 national labs and involving 52 private-sector partners. ([Read more](#))

July 2 – Canfor formed a joint venture with Australian biofuel production start-up Licella to explore the economic possibilities for large-scale biocrude production plants. ([Read more](#))

June 20 – Converting ethanol into ethyl acetate. In California, Greenyug said it will build an industrial-scale ethyl acetate manufacturing facility adjacent to Archer Daniels Midland Company's wet mill corn processing facilities in Columbus, Nebraska. ([Read more](#))

June 13 - In California, Amyris announced that on May 29, 2016 Cathay Pacific commenced a two-year program of flights from Toulouse to Hong Kong using Amyris' renewable jet fuel. Cathay took delivery of a new Airbus A350-900 that flew from the Airbus facility in Toulouse, France, to Hong Kong using a 10% biofuel jet blend provided by Amyris with the commercial and industrial support of Total S.A. The combination of the new airplane's improvements in fuel efficiency (about 25% better than current aircraft) and the fuel's properties resulted in an estimated 30% reduction in CO2 emissions according to Cathay when compared to comparable flights in recent-generation aircraft using fossil fuels. All of Cathay's upcoming A350-900 aircraft deliveries over the next two years will use the Amyris/Total Biojet fuel. ([Read more](#))

June 8 – Alaska Air flies on Gevo alcohol to jet. ([Read more](#))

June 7 - In Italy, UCO collection rose 44% in 2015 to reach 62,000 metric tons of which 85% went to biodiesel production. Much of the remainder was used for cosmetics production. Producing biodiesel led to an estimated savings of €17 million on fossil fuel costs, GHG emissions reductions of 152,000 tons and lowered water consumption by 62,000 cubic meters. Starting January 1, 2017 household UCO oil collection will become mandatory so production is expected to increase significantly. Household production in Italy is estimated to be 64% of total UCO. ([Read more](#))

June 6 - In Australia, the Queensland premier announced A\$20 million in funding to develop the state's biofuels industry in hopes of converting this current A\$100 million sector into a A\$1 billion sector within 10 years, to become the future Asia-Pacific hub for biofuels. ([Read more](#))

May 24 - In Washington, USDA Farm Service Agency Administrator Val Dolcini announced that incentives resume this month for farmers and foresters who grow and harvest biomass for renewable energy and biobased products. These funds come through the Biomass Crop Assistance Program (BCAP), which was reauthorized by the 2014 Farm Bill. BCAP provides financial assistance to farmers and ranchers who establish and maintain new biomass energy crops, or who harvest and deliver forest or agricultural residues to a USDA-approved facility that creates energy or biobased products. ([Read more](#))

May 24 - In Washington, the U.S. EPA reported nearly 16.6 million D3 cellulosic RINs were generated in April, out of a total 1.511 billion RINs generated during the month. Renewable CNG and renewable LNG remain the vast majority of D3 RINs generated, with just 1.38 million coming from ethanol. D3 RINs for the year through April have reached 46.81 million. Of the total, 4.74 million were imported. No D4 cellulosic diesel RINs were generated in April, with the total for the year so far reaching only 114,835, all of which were produced in March from cellulosic heating oil. ([Read more](#))

May 24 - In India, Sunlight Fuels signed a Front End Loading license agreement for IH2 Technology with CRI Catalyst, a division of Shell. The proposed plant will be designed with the potential to convert 500 tonnes/day of dry bagasse into approximately 150 tonnes/day of liquid hydrocarbon transportation fuel. ([Read more](#))

May 19 - In Colorado (USA), Gevo Inc. announced that it has entered into an agreement with Clariant Corp., one of the world's leading specialty chemical companies, to develop catalysts to enable Gevo's ethanol-to-olefins (ETO) technology. ([Read more](#))

May 17 - In India, Numaligarh Refinery Limited signed its term sheet with Finland based company Chempolis for a joint venture to develop the country's first biorefinery that will produce 49,000 metric tonnes of ethanol annually along with furfural and acetic acid. Bamboo will be the feedstock used. ([Read more](#))

## Upcoming Meetings & Conferences

### 9<sup>th</sup> Biofuels International Conference

2016, September 20-22, Ghent, Belgium

### The European Forum for Industrial Biotechnology and the Bioeconomy

2016, October 18-20, Glasgow, Scotland

### Bioenergy Australia Conference 2016

2016, November 14-16, Brisbane, Queensland

### American Institute of Chemical Engineers – 2016 Annual Meeting

2016, November 13-18, San Francisco, California, USA.

### ICBB 2016: 18<sup>th</sup> International Conference on Biofuels and Bioenergy

2016, December 29-30, Paris, France

For more events visit [www.task39.org](http://www.task39.org)

## IEA Bioenergy Task 39 Meetings

The following is an abbreviated tentative schedule of Task 39 events and meetings planned over the next 9 months. Please [contact us](#) for more detailed information:

- Task 39 meeting in Rotorua, New Zealand, 8-9 November 2016
- Task 39 participation in Bioenergy Australia conference, Brisbane, Australia, 14-16 November 2016