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

IEA Bioenergy Task 39, (Liquid Biofuels) recently completed an update of the "Advanced biofuels Demonstration Database". This is available on the web and can be accessed at http://demoplants.bioenergy2020.eu/. The Task also completed an updated report entitled, "State of Technology Review -Algae Bioenergy", with a webinar (on January 25) held in conjunction with the reports release. Lieve Laurens and Jim McMillan from NREL were the presenters.

As described in the report itself and covered in the associated webinar, some of the reports key conclusions were:

- Algae exhibit high photosynthetic efficiency and high yields (~55 tonnes ha-1yr-1), at least twice that of terrestrial plants. Thus, algae remain an attractive target for bioenergy applications;
- Petroleum and natural gas price declines coupled with a lack of carbon pricing are challenging the ability of liquid biofuels and other bioenergy products to be cost-competitive and are restricting economically viable algae-based fuel production in the near-to mid-term;
- The algae-based products industry is expanding rapidly, providing near term opportunities (multi-product biorefinery). However, it is also resulting in greater competition in algal products markets and competition for suitable land for developing commercial fascilities;
- Recent technology developments have helped facilitate the use of all algal biomass components. Thus groups are no longer just focused on valorizing the lipid fraction;
- Resources (water, land, sunlight) and nutrients (N, P) remain key constraints and drivers for economic and environmental sustainability, where integration with wastewater treatment provides near-term opportunities;

Task 39 Members - ExCo* and Country Leads+ and Task Representatives

Australia
Stephen Schuck*
Les Edye
Steve Rogers

Austria
Theodor Zillner*
Dina Bacovsky

Brazil
Ricardo Dornelles*
Paulo Barbosa
Antonio Maria Bonomi
Eduardo Barcelos Platte

Canada
Alex MacLeod*
Jack Saddler
Warren Mabee
Steve Price

Denmark
Jan Bunger*
Claus Felby
Michael Persson
Henning Jørgensen
Anders Kristoffersen

European Commission
Kyriakos Maniatis*
Luisa Marelli
Jacopo Giuntoli

Germany
Birger Kerckow*
Franziska Müller-Langer
Nicolaus Dahmen

Japan
Takahisa Yano*
Shiro Saka
Satoshi Aramaki

Netherlands
Kees Kwant*
Timo Gerlagh
Johan van Doesum

New Zealand
Paul Bennett*
Ian Suckling

South Africa
Thembakazi Mali*
Emile van Zyl

South Korea
Kwon-sung Kim*
Jin Suk Lee
Kyu Young Kang
Seonghun Park

Sweden
Asa Forsum*
Tomas Ekbom

United States
Jim Spaeth*
Jim McMillan

Image Source: esf.edu.com

- Macroalgae have potential to contribute biogas, chemicals and biofuels from cultivated and cast seaweed, with yields between 5 and 30 tonnes.ha^{-1}yr^{-1};
- There is a clear and urgent need for open data sharing and harmonization of analytical approaches from cultivation to product isolation to TEA and LCA modeling. This will help identify and prioritize the barriers that need to be overcome for commercialization.

The report can be downloaded (for free) from the Task 39 website http://www.task39.org/publications.

A summary of the report was also published in Algal Research and can be downloaded from the Task website (http://www.task39.org/publications)

Since publication of our last Newsletter, several interesting biofuels developments have taken place arround the world. (Some items are briefly described on page 11).

In particular there has been some controversy regarding the sustainability of biofuels and bioenergy (some ongoing discussions involving some controversial and inaccurate reports). One example is the relatively recent Chatham House Report on the impact of bioenergy on climate change, with the report stating, "Although most renewable energy policy frameworks treat biomass as carbon-neutral at the point of combustion, biomass emits more carbon per unit of energy than most fossil fuels."

This precipitated IEA Bioenergy to send in the following response: IEA Bioenergy, together with 125 scientists, strongly disagree …and urge Chatham House to reconsider their recommendations. "*We invite Chatham House to engage in a more thoughtful and substantive discussion with technical experts like IEA Bioenergy and review the recommendations. The development of bioenergy and the bioeconomy as a whole are critical in order to realise a low carbon economy*", said Kees Kwant, Chairman of IEA Bioenergy. (the full response from IEA Bioenergy and links to the documents can be found here)

In a similar vein, some other reports have criticised the benefits of biofuels, specifically first generation biofuels. These reports elicited some strong reactions from the biofuels community, as discussed in detail in the linked Biofuels Digest editorial (Read more)

We welcome your feedback. Please direct your comments to Susan van Dyk

Task 39 Management:

Operating Agent (Agency):	**Alex MacLeod** (Natural Resources Canada)
Task Leader (Agency):	**Jim McMillan** (National Renewable Energy Lab)
Co-Task Leader (Agency):	**Jack Saddler** (Univ. of British Columbia)
Subtask Leaders:	
(Biochemical conversion, N. America)	**Jim McMillan (NREL, USA)**
(Biochemical conversion, EU):	**Christian Koolloos**
(Link to Advanced Motor Fuels IA):	**Franziska Mueller-Langer** (DBFZ, Germany)
(Policy issues, EU):	**Michael Persson** (Denmark)
(Policy issues, North America):	**Warren Mabee** (Queen's U, Canada)
(Implementation Issues):	
Task Coordination:	**Susan van Dyk** (Univ. of British Columbia)

Another report, funded by the National Wildlife Foundation in the USA, claimed that , millions of acres of wildlife habitat are being lost to crop production, and claimed to find a strong link between the location of corn ethanol refineries and the conversion of wildlife habitat and other land types into crop production. However, this was countered by a follow-up report, using USDA data, that showed, to the contrary, a decrease in croplands occurred between 1997-2012. (Read more and find the full report here)

Similarly, Fediol published a report on the Impact of phasing out the EU mandate for 1st gen biofuels. The study quantified the huge financial losses that a slowdown or halt in rapeseed production would trigger throughout the production chain. Cutting a total of 16 million tons of rapeseed crush as well as 2.7 million tons of soybean crush out of production would cause the closure of almost half of the EU crushing plants, representing around 10,000 direct jobs. The cumulative loss in turnover would be in the order of €16.9 billion for farmers, €22.5 billion for crushers and €11.7 billion for compound feed manufacturers over the assessed 5-year period.

See the News Section on Page 11 for further items of interest.

This mid-year issue of the Newsletter features an article on biofuels developments in South Korea. We want to thank our Korean colleagues, Jin-Suk Lee and Kyu-Young Kang, for preparing this informative report.

As always, we appreciate your feedback. Please send us any ideas on how we might increase the value of these Task 39 newsletters. We hope to hear from you via email to get your feedback and suggestions.

Jim, Jack and Susan

Progress on Transport Biofuels in Korea

Jin-Suk Lee, bmjslee@kier.re.kr, Biomass and Waste Energy Laboratory, Korea Institute of Energy Research, South Korea; **Kyu-Young Kang**, kykang@dongguk.edu, Department of Biological and Environmental Science, Dongguk University-Seoul, South Korea

Introduction

Since Korea imports over 95% of its energy demand, thus energy security has always been an important driver in the national agenda. In addition, CO_2 mitigation has become another important driver as a globally significant issue. The Korea Ministry of Environment (KMOE) announced the revised CO_2 mitigation plan in December 2015 (Figure 1) with a target to reduce CO_2 emissions by 37% by 2030.

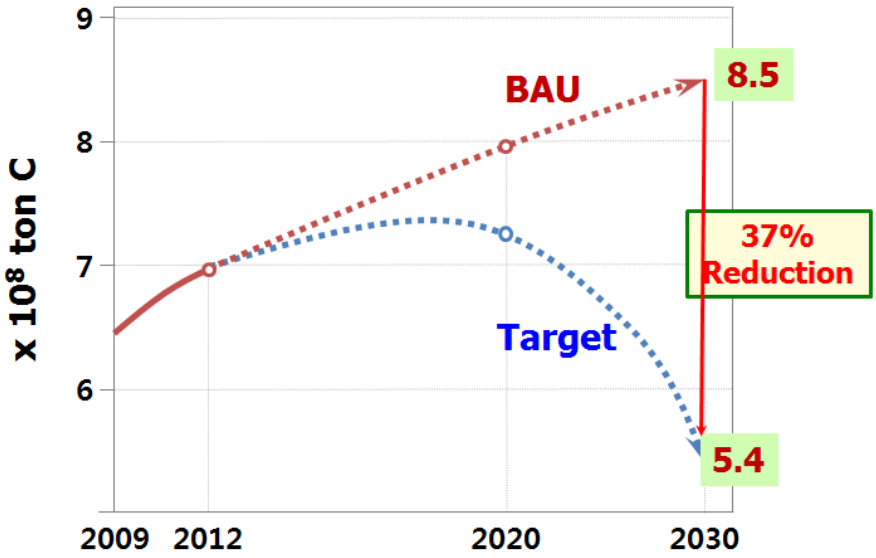

Figure 1. CO_2 mitigation plan in Korea (KMOE, 2015).

To resolve the energy security and CO_2 mitigation issues, various means like energy saving, energy efficient technologies and alternative energies will be employed. Among them, renewable energy including bioenergy will play a key role. The Korea Ministry of Trade, Industry and Energy (KMOTIE) issued the 4th New & Renewable Energy supply plan (4th RE Plan) targeting the share of renewable energy in the energy mix to be 11% of the country's primary energy consumption by 2035. Bioenergy supply in 2035 is projected to be 5.65 Mtoe which will be 4.8 times greater than in 2012 (Figure 2).

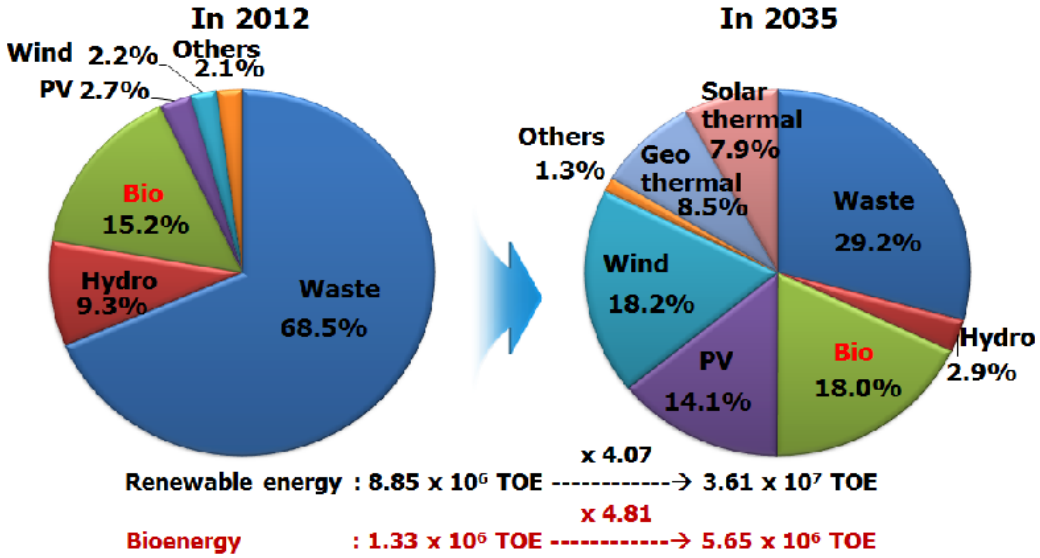

Figure 2. Targets for renewable energy and bioenergy implementation, 2035 (4th RE Plan, 2014)

About 80% of total bioenergy supply in 2035 will be heat (Figure 3). The role of bioenergy for power generation is rather small because other renewable energies such as PV and wind may play a more prominent role. The target for transport biofuels will be 1.41 x 10^6 toe in 2035, 2.8 times greater than biodiesel supply in 2015.

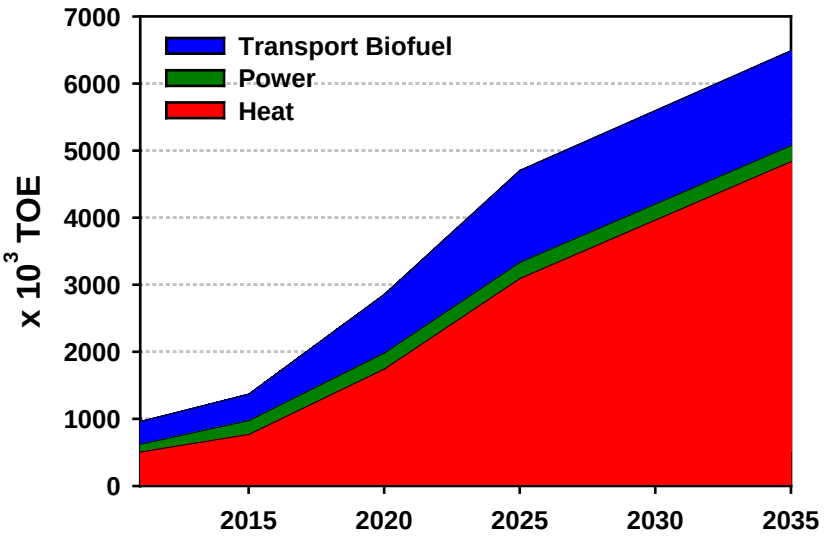

Figure 3. Status and prospects of bioenergy supply in Korea (KMOTIE, 2014)

The target of transport biofuels in 2035 indicated in the 4th RE Plan is only a third of the original target set in 3rd New & Renewable supply plan (3rd RE Plan) (Figure 4). The decrease in the target for transport biofuels in Korea is mainly due to the projected poor availability of suitable feedstocks.

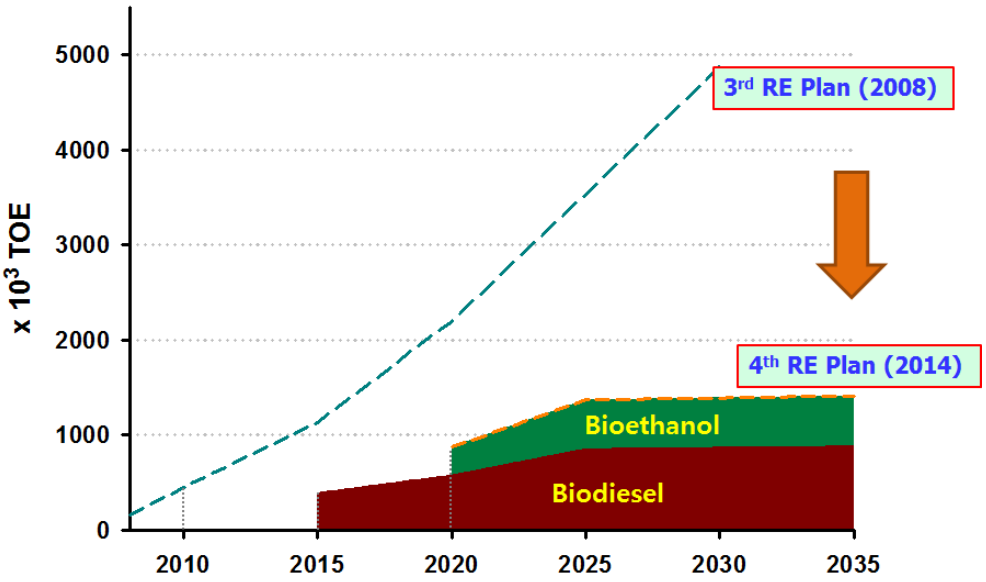

Figure 4. Targets for transport biofuels supply in Korea

The Biodiesel (FAME) market development

In Korea, biodiesel is used as transportation fuel either as a low-blend (B2) or high blend (B20). For low-blends use, biodiesel (B100) is supplied to all Korean oil refineries for blending and sold as a low blend (B2) at all public filling stations (Figure 5). Some fleet users are allowed to use high blends (B20) on a voluntary basis. However, since there is no additional incentive for using high blends of biodiesel, their use is negligible.

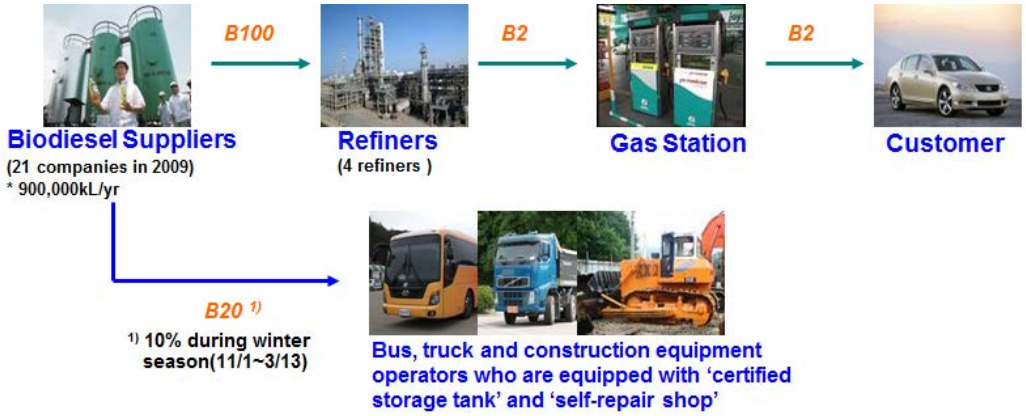

Figure 5. Biodiesel distribution infrastructure in Korea (Kpetro, 2014).

To support implementation of transport biofuels, a Renewable Fuel Standard (RFS) action plan was also prepared (Figure 6). According to the plan, the blending % of biodiesel in fossil diesel would be increased to 4% (scenario 2) or 5% (scenario 1) in 2020 and bioethanol blending (E3) would commence in 2017.

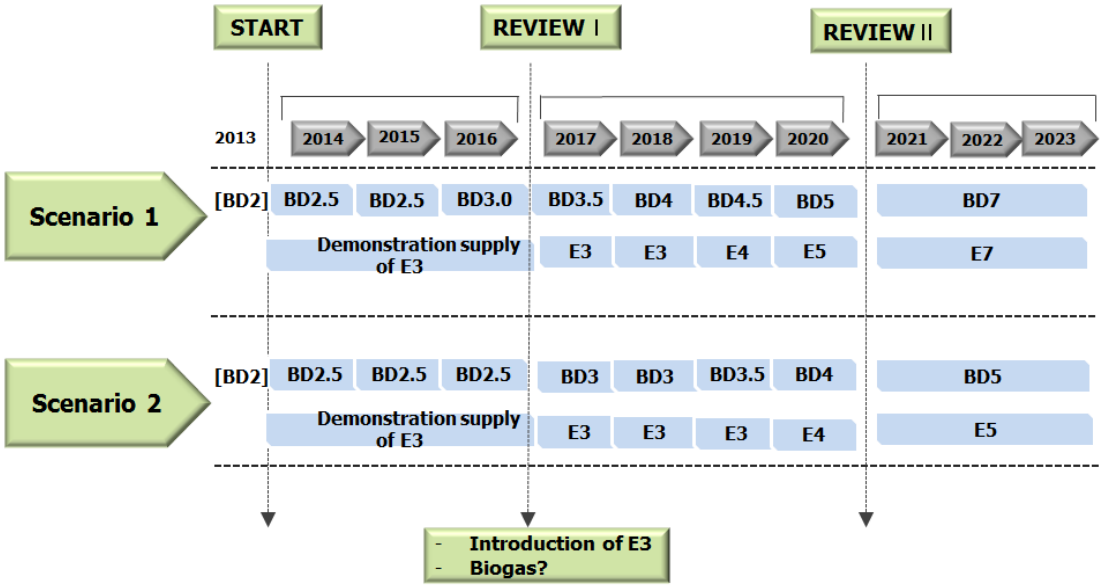

Figure 6. Scenarios for RFS in Korea (Public Hearing of RFS by Kpetro, 2013).

With strong support from the Korean government, the FAME market grew steadily between 2006 and 2010. Since then, a shortage of feedstock became the major barrier for increasing the FAME supply, and blend levels were kept at B2 (Figure 7). The RFS for biodiesel was introduced in August 2015. About $5.5x10^5$ kL biodiesel, equivalent to a half million toe, was produced in 2016.

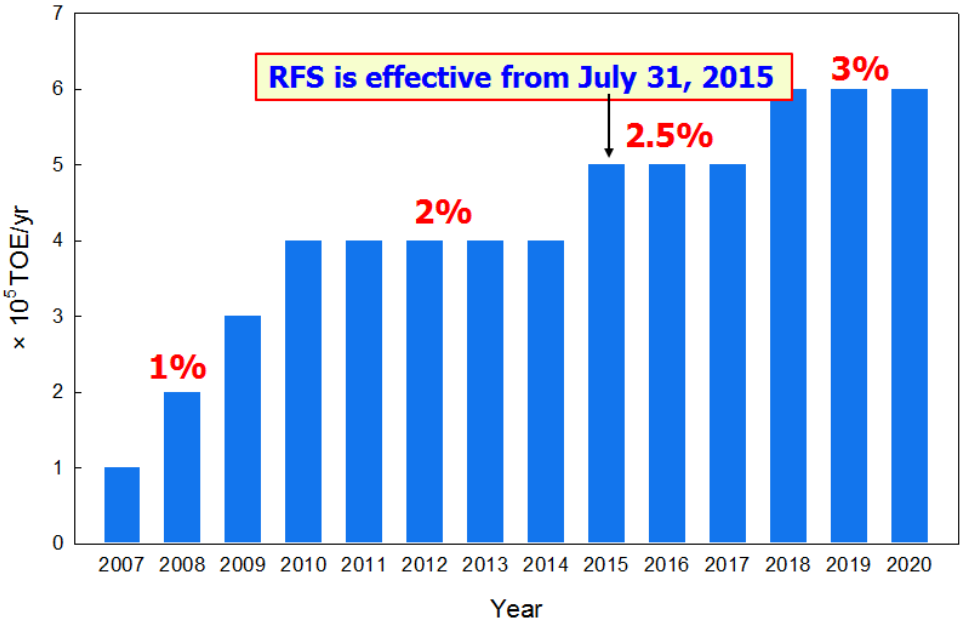

Figure 7. Biodiesel supply in Korea.

Major feedstocks used for FAME production are waste fats such as used cooking oil and palm fatty acid distillates (PFAD) (Figure 8). While the free fatty acid contents in used cooking oil is commonly lower than 5%, PFAD has very high acid contents over 90%. So different technologies have been adopted in the FAME production processes. All biodiesel plants except SK Chemical convert feedstocks with low acid contents into FAME with conventional alkaline catalysts. SK chemical developed its own non-catalytic process to convert the free fatty acids into FAME and currently operates the largest plant in Korea. Nine companies produce FAME and the total production capacity is $1.109x10^6$ kL (Table 1).

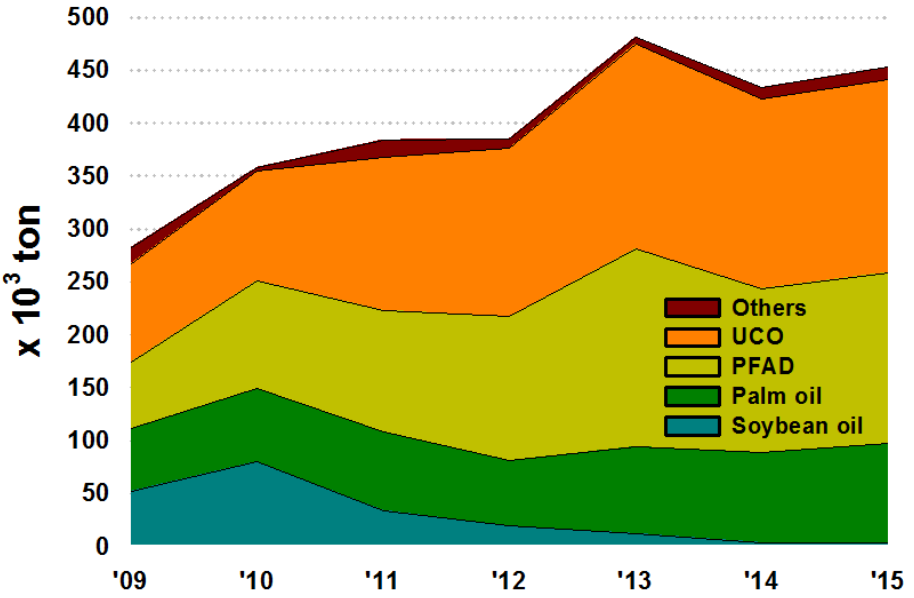

Figure 8. Feedstocks for biodiesel production in Korea (Source: Korea Bioenergy Association).

Table 1. **Biodiesel Production facilities, 2015 (Bioenergy Association of Korea)**

Biodiesel Plant	Location	Installed capacity [kL/yr]	Feedstock	Status
M Energy	Pyongtaek	100,000 48,000	Used cooking oil	Mothballed
Danseok Industry	Siheung Pyongtaek	113,000 80,000	Vegetable oil, Used cooking oil	In production
Emac Bio	Soonchun Jeongeup	50,000 32,000	Used cooking oil	Mothballed
SK Chemcial.	Ulsan	136,000	Palm fatty acid distillate (PFAD)	In production
JC Chemical	Ulsan	120,000	Used cooking oil	In production
Aekyung Petrochem	Ulsan	130,000	Used cooking oil	In production
GS Bio	Yeosu	120,000	Vegetable oil, used cooking oil	In production
Eco solution	Jeongeup	120,000	Used cooking oil, tallow	In production
Bioenergy Holdings	Yeoju	60,000	Used cooking oil, tallow	Mothballed
Total		1,109,000		

Recently a biodiesel company, Bioenergy holdings, has developed a new technology employing a bi-functional solid catalyst that may convert triglycerides (TG) and free fatty acids (FFA) in the waste fats simultaneously into FAME. The company built a semi-commercial plant (capacity: 10,000 ton/year) and successfully demonstrated the performance of the technology (Figure 9). The technology is licensed to Welcron Hantech Engineering, a Korean Engineering company which is constructing a full scale FAME plant (capacity: 50,000 ton/year) in Nanjing, China that will come into operation in late 2017. The main feedstocks for the FAME plant will be acid oils derived from cotton and rapeseeds. This is going to be the first full-scale plant applying the solid catalyst for FAME production from waste fats.

Figure 9. Biodiesel plant employing solid catalyst at Yeoju. Reference: SM-POT

Demonstration projects

Besides biodiesel, some demonstration projects have been carried out for bioethanol and biogas.

Bioethanol

For ethanol, the major issue has been the compatibility of the established transport infrastructure including fuel distribution and vehicles. Following projects on compatibility of fuel distribution infrastructure, a compatibility study of gasohols (E3, E5, E10) and ETBE10 with engine parts were conducted by Korea Petroleum Quality & Distribution Authority (KPetro) for two years, 2013-2014. Subsequently, KPetro is carrying out a demonstration project to identify the proper implementation plan for ethanol blended fuels in Korea. Thirty gas stations in Jeju island are participating in an E3 demonstration supply project. The other thirty gas stations in Yeosu and Ulsan Chemical complex are participating in the trials for ETBE10 supply. The project will be continued until the end of 2018 after which the implementation plan for bioethanol, direct blending of ethanol (E3 or E5) or ETBE10 will be determined.

Biogas

Biogas collected from landfill sites and anaerobic digestion plants are mainly used for heat and power generation. However, two demonstration projects for utilizing biogas as motor fuel have been conducted. The first project was started at Sudogwon landfill sites in Incheon from 2011 that produce 370 m^3/hr to fuel 220 CNG buses. Biomethane is produced by a Pressure Swing Adsorption (PSA) process. The other project was started from 2009 at Seonam sewage treatment facility located near Seoul. Biogas is purified by a water scrubbing process licensed from Swedish Biogas International (SBI) and the production capacity of the plant is 180 m^3/hr. Biomethane produced is used to fuel thirty CNG buses. The status of the transport biofuels are summarized in Table 2.

Table 2. Summary for status of transport biofuels in Korea

Transport biofuel	Status
Biodiesel	B2.5 effective (0.55 million kL/year)
Bioethanol	Compatibility of E3, E5 and ETBE10 with the transport infrastructure under study
Biogas	Under fleet tests

Advanced biofuels

Although there are currently no commercial facilities producing advanced biofuels in Korea, active R&D projects are under way to develop new biofuel production technologies and alternative feedstock.

Biobutanol

GS-Caltex, one of the leading oil refineries in Korea, has been developing a concentrated sulfuric acid hydrolysis technology for cellulosic bio-butanol production. In September 2016, the company announced construction of a $45 million pilot plant having the capacity of 400 ton butanol/year at Yeosu, Chonnam Province which is aimed for completion in late 2017. The main feedstocks used for bio-butanol production are going to be waste wood and imported palm residues. If this new GS-Caltex bio-butanol pilot plant is successful, it could expand into a full-scale commercial plant to produce bio-butanol. The company has also signed an MOU with Biomass Green Technology (BGT) in Malaysia for conducting a feasibility study for construction of the first commercial scale cellulosic bio-butanol plant in Sabah, Malaysia. Since the biomass resource availability in Korea is poor, utilization of foreign biomass may be the only option to achieve the implementation target for transportation biofuels. Among various possible candidates, palm residues available in Southeast Asia region may be the most important. A business model for transport biofuels based on palm residues is shown in Figure 10.

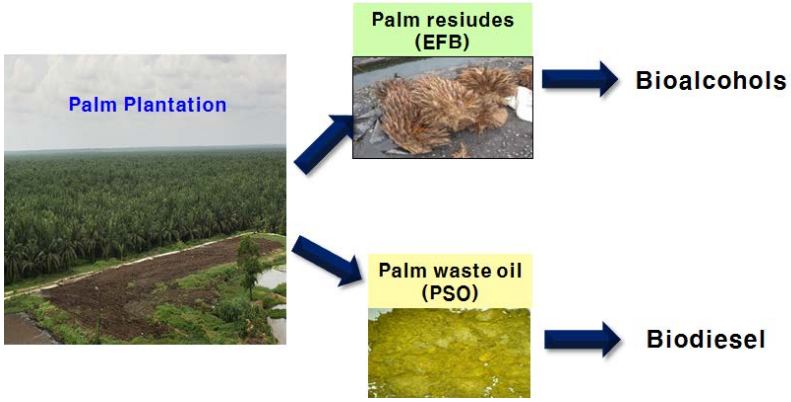

Figure 10. Scenario for biofuels' production from palm residues.

Biojet fuel

Consumption of jet fuel in 2015 was 3.4×10^6 kL, about 12% of total transport fuels consumed. However, the growth in jet fuel consumption is the highest among the transport fuels, about 7%/year. So interest in bio-jet fuel to reduce CO_2 emissions in aviation sector is growing. The Institute of Advanced Engineering (IAE) has just started a project to establish a pilot process having a production capacity of 50 kL/yr. The production facility will be constructed and in operation by late 2018 and the biojet fuel produced will be tested with a jet turbine engine for military application. Other research on biojet fuel production from ethanol is also underway.

Algal biofuels

The other resource for biofuels production considered in Korea is algal biomass, micro- and macroalgae. Active research projects are under way not only to improve the productivity of biomass but to develop conversion technologies. However, time to commercialization may be lengthy.

Acknowledgements

This work was supported by Korea New and Renewable Energy Center (KNREC).

In the News

Reports and Research

April 24 – Recent data from the U.S. Energy Information Administration (EIA) confirm that the so-called "blend wall"—the point at which ethanol makes up 10% of the U.S. gasoline supply—was exceeded nationwide for the first time ever in 2016. The report suggests that the data dispel the myth that 10% is the marketplace "limit" for ethanol content in U.S. gasoline, and demonstrate that the "blend wall" is not a real constraint on ethanol consumption. (Read report and more)

March 29 – The US Renewable Fuel Association published the 2017 Ethanol Industry Outlook (Download Report and read more)

March 20 - The International Renewable Energy Agency released a report finding that "global energy-related carbon dioxide emissions can be reduced by 70% by 2050 and completely phased-out by 2060 with a net positive economic outlook". However, the required capex is daunting - $29 trillion between now and 2050. (Download report and read more)

March 20 - In a study from NASA a research team found that "compared to using conventional fuels, biofuel blending reduces particle number and mass emissions immediately behind the aircraft by 50 to 70 per cent". The study sampled the exhaust of engines onboard a NASA DC-8 aircraft as they burned conventional Jet A fuel and a 50:50 (by volume) blend of Jet A fuel and a biofuel derived from Camelina oil. (Download study) A similar type of study is currently being conducted by Air Canada (Read more)

March 8 The UK Government published a report on Use of high carbon North American woody biomass in UK electricity generation (Read more)

February 26 – The European Aviation Environmental report 2016 was published (Read here), confirming the important role of sustainable aviation biofuels for the future (Read more)

February 23 – The contribution of the ethanol industry to the economy of the United States in 2016 was published in a report by ABF Economics (Read here)

Jan 12 – A new report from ICF found that greenhouse gas emission reductions from typical corn-based ethanol production have soared to 43 percent compared to 2005-era gasoline. The report projects that by 2022, corn-based ethanol will achieve a 50 percent reduction, and could reach "76 percent in 2022 if there is more widespread adoption of optimal crop production and biorefinery efficiency." (Read more and download the report)

Jan 5 – The Raymond James Report on Cleantech was published (Read more and download full report

Policy and Regulatory Developments

April 25 - The Brazilian government is evaluating a RIN system similar to the USA, setting biofuel mandates to fuel distributors while ethanol and biodiesel mills would issue certificates of emissions reductions (CERs) that would be transferred to fuel distributors when they buy the biofuels. Each distributor would be required to hold a certain number of CERs at the end of a year, according to mandates that would be set by the government. (Read more)

March 14 – With the expected implementation of a B10 mandate, biodiesel production in Malaysia is expected to soar this year to as much as 900,000 metric tons from just 500,000 tons in 2016 (Read more)

March – Vietnam announces a move to E5. (Read more)

Jan 16 – China imposes tariff on ethanol imports from the US (Read more)

Sustainability

March 15 – A new NASA led study shows that using biofuels to help power jet engines reduces particle emissions in their exhaust by as much as 50 to 70 percent (Read more)

March 13 - The European Parliament's committee on Environment, Public Health and Food Safety voted in favor of a report that says the European Union should phase out the use of palm oil in biofuels by 2020 because industry has not yet been able to definitively prove that the oils it uses have not led to deforestation. The report's author was quick to point out that all first generation biofuels should not be phased out, just those that lead to deforestation. (Read more)

Industry News

April 19 – China to boost conventional ethanol production from corn as it uses up the 250 million metric tonne stockpile of corn (Read more)

April 19 – Petrobras, Brazil, has divested from biofuels in its attempt to raise funds to pay off massive $100 billion debt, and has come out against the government's new RenovaBio program meant to raise biofuel production and consumption, claiming that biofuels negatively impact forests and threaten food production. (Read more)

April 12 - POET-DSM's Project Liberty announced that it was reaching its production goals after coming online about a year ago with current yields of 70 gallons of cellulosic per ton of corn stover, near its goal of 72 gallons. (Read more)

April 11 –The city of Surrey, Canada announced construction of a renewable natural gas facility for fueling of garbage collection trucks with municipal solid waste as feedstock. (Read more)

April 10 - In Sweden, the Gripen single engine fighter plane has undergone a series of test flights with 100% biofuel conducted at the Saab facilities in Linköping. The tested fuel (CHCJ-5) was made from rapeseed oil. (Read more)

April 9 - Archer Daniels Midland commenced operations at their Illinois Industrial Carbon Capture and Storage (ICCS) project, a partnership to safely and permanently store more than 1 million tons of carbon dioxide a year. (Read more)

April 7 – According to Syngenta, approximately 12 million tons of corn kernel fiber feedstock was already available at U.S. dry grind ethanol plants each year and could potentially produce 1.5 billion gallons of additional, cellulosic ethanol (Read more)

April 6 - In South Africa, Lamo Fuel is developing a 5 million liter per year biodiesel facility that will use domestically-produced sunflower oil as feedstock. The plant is expected to come online for 2019 and aims to supply the mining industry in the Northern Cape and North West provinces. (Read more)

April 6 - In Canada, Integrated Grain Processors Co-Operative is set to invest C$100 million to double its ethanol production capacity to 378 million liters. (Read more)

March 29 - In Colombia, the country's only dedicated ethanol producer, owned by Ecopetrol, Bioenergy achieved continuous production on March 18 at its 504,000 liters per day facility in El Alcaraván. The firm also produces its own electricity in order to be self-sustaining. Bioenergy plans to sell any excess supply through a generator that is already connected to Colombia's national electric grid. (Read more)

March 26 – At Borregaard in Norway, the BALI demonstration plant operated by the BIOFOREVER project reports the successful scale-up and operation in a semi-commercial scale suggesting that the BALI technology is at TRL (Technology Readiness Level) 6-7. (Read more)

March 21 - The International Organisation for Standardisation has launched a new class of marine fuel specifications to provide standards for higher quantities of biofuels to be blended into marine distillates, and making reporting of cloud point mandatory in their updated marine gasoil grades. In the newly defined "class F" grades, up to 7% fatty acid methyl ester (FAME) is allowed. (Read more)

March 20 - In Minnesota, Enerkem is moving forward with the $200 million MSW-to-ethanol plant. The facility could be online as soon as 2020 using much of the county's 400,000 tons of MSW per year. (Read more)

March 19 - In Louisiana, the Diamond Green Diesel facility in Norco will expand its annual production capacity of renewable diesel from 10,000 barrels per day to 18,000 bpd (275 million gallons per year), using Honeywell UOP's Ecofining process technology. (http://www.biofuelsdigest.com/bdigest/2017/03/19/diamond-green-diesel-expanding-to-275m-gallon-capacity-to-meet-booming-renewable-diesel-demand/)

March 15 - In Sweden, Preem and Vattenfall have concluded an agreement to investigate the potential of using climate-smart hydrogen gas in the large scale production of biofuel for the Swedish market. The raw materials for this process are forestry by-products and hydrogen gas. The aim is to boost Preem's production of biodiesel and other fossil-free biofuels (from tall oil) to 3 million cubic metres annually by 2030 with hydrogen produced by electrolysis. (Read more)

March 14 - In Canada, Forge Hydrocarbons is building a 25 million liter biodiesel plant to produce 25 million liters per year of renewable diesel from waste fats, scaling up technology developed at the University of Alberta currently used in a pilot plant it has in Edmonton. Production of the fuel, that reduces GHG emissions by 90% compared to fossil diesel, is expected to start during the second half of 2018. (Read more)

March 9 – The Port of Amsterdam announced the fleet-wide use of advanced marine biofuel from GoodFuels Marine which will reduce the CO2 footprint by 25%. The vessels will now run on fuel containing 30% exceptionally high-quality biodiesel. (Read more)

March 3 - REG announced its acquisition of Petrotec, the leading used cooking oil to biodiesel producer in Continental Europe. This expansion into Europe increases REG's worldwide nameplate capacity to over 500 million gallons annually. (Read more)

March 3 - Licella (through its subsidiary Cat-HTR Plastics) and Armstrong Chemicals unveiled a joint venture to build the world's first commercial-scale hydrothermal upgrading plants for End of Life Plastic to chemicals. The plant will come on line in 2018. (Read more)

Jan 16 - In Washington state, the Port of Seattle, Boeing and Alaska Airlines released a first-of-its-kind study that identifies the best infrastructure options for delivering aviation biofuel to Seattle-Tacoma International Airport in pursuit of its goal to power every flight at Sea-Tac with sustainable aviation biofuel. (Read more) Download a copy of report.

Jan 11 - UK announces funding for low and zero emission vehicles including biogas and methane. The funding, announced at the Sustainable Road Transport Conference, in central London, is being given to 20 firms who set out plans for innovative ways to deploy low and zero emission vehicles. (Read more)

Jan 5 - In Thailand, Toray Industries has teamed with Mitsui to produce cellulosic sugars from bagasse leftover from the sugar production process at Thai sugar mills. The companies will invest up to $51 million to build one of the world's largest bagasse-based ethanol plants. Producing 1,400 tons of cellulosic sugar annually that will be used as feedstock for ethanol, it will also produce 450 tons of oligosaccharides and 250 tons of polyphenol for foods and fodder when it comes online in August 2018. (Read more)

Upcoming Meetings & Conferences

2017

May

- Symposium on Biotechnology for Fuels & Chemicals — May 1-4, 2017 — San Francisco, CA
- International Biogas Study Tour in Germany — May 2-5, 2017 — Stuttgart, Germany
- Dropet Ethanol Conference — May 10-11, 2017 — Marbella, Spain
- 3rd International Advanced Biofuels Conference — May 17-19, 2017 — Gothenburg, Sweden
- Alternative Fuels Conference — May 24-26, 2017 — Italy

June

- RRB-13, the 13th International Conference on Renewable Resources and Biorefineries — June 7-9, 2017 Wroclaw, Poland
- EUBCE 2017 – 25th European Biomass Conference and Exhibition — June 12-15, 2017 — Stockholmsmaässan, Stockholm, Sweden
- The 7th International Conference on Algal Biomass, Biofuels and Bioproducts — June 18-21, 2017 — Miami, FL
- 2017 National Advanced Biofuels Conference & Expo — June 19-21, 2017 — Minneapolis, MN
- Fuel Ethanol Workshop (FEW) — June 19-21, 2017 — Minneapolis, MN
- 2017 BIO International Convention — June 19-22, 2017 — San Diego, CA
- Ethanol Summit 2017 — June 26-27, 2017 — São Paulo, Brazil
- Oleofuels 2017 — June 28-29, 2017 — Krakow, Poland

July

- BIO World Congress on Industrial Biotechnology — July 23-26,2017 — Montréal, Canada

August

- UC San Diego Extension's Microbial Fermentation Workshop — August 16-18, 2017 — San Diego, CA
- Biochar: Production, Characterization and Applications — August 20-25, 2017 — Alba, Italy

September

- 2017 Technology Challenges and Opportunities in Commercializing Industrial Biotechnology — September 17-19, 2017 — San Diego, CA
- F.O. Licht's Sugar and Ethanol Africa — September 19-21, 2017 — Nairobi, Kenya
- 6th International Conference on Ethanol from Lignocellulosics (6ICLE) Brussels, 27-28 September 2017

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 co-sponsored special topics session on international progress at 39th SBFC, May 1-4, San Francisco, CA.
- Task 39 business meeting in Gothenburg, Sweden later in May, 2017, in conjunction with the ExCo79 meeting being held May 16-18 and the Advanced Biofuels Conference being held May 18-19, 2017.
- The Task will likely hold its next business meeting in association with the 6th International Conference on Ethanol from Lignocellulosics (6ICLE) Brussels, 27-28 September 2017. The Task 39 meeting will be held on the 25/26 Se ptember, 2017.