Commercializing Conventional and Advanced Transport Biofuels from Biomass and Other Renewable Feedstocks

IEA Bioenergy Technology Collaboration Programme

Task 39 IEA Bioenergy

Inside this Issue

From the Task

By Mahmood Ebadian, Jim McMillan and Jack Saddler

Since publishing our last Newsletter in October 2020, IEA Bioenergy Task 39 has continued its work to advance the commercialization of renewable lower carbon intensity biofuels to decarbonize the transport sector, particularly long-distance transport segments (i.e., marine, aviation, rail and trucking) where electrification is more challenging.

Task 39 Business Virtual Meeting, 23-24 November 2020

The third Task 39 business meeting of 2020 was held on November 23-24, virtually using Zoom. The main goal of the meeting was for project leaders to provide progress updates and describe next steps for their respective projects. Eleven current and developing projects were presented by their respective project leader(s). A listing of Task 39's projects for the 2019-2021 triennium and their short descriptions was provided in Task 39 Newsletter #54. This virtual meeting also provided a forum for Task 39 members to share questions, thoughts and ideas regarding the scope, objectives, methodology and interim findings of each project.

Task 39 invited Adam Brown of Energy Insights Ltd to kick off the meeting by updating the group on recent activities at IEA headquarters concerning renewable energy and the Biofuture Platform initiative. He highlighted biofuels-related findings in IEA's recently published "IEA Energy Technology Perspectives (ETP) 2020" and "Renewables 2020" reports. The ETP 2020 report updates forecasts for the role of biofuels in future lower carbon intensity transport, which emphasises combining biofuel production and carbon capture, utilization or storage (CCUS). Adam also updated the group on the government-led, multi-stakeholder "Biofuture Platform (BFP)" initiative, which is a 20-plus country effort to promote a sustainable, innovative and scalable advanced low carbon bioeconomy. The BFP has recently changed its organizational structure and been incorporated within the global Clean Energy Ministerial (CEM) initiative to better encourage additional country membership and more industry engagement. Adam also described the BFP's 5 COVID-19 principals and the policy blueprint being used to strengthen policies to encourage greater production and use of modern bioenergy.

The country of India is the newest member of Task 39 for the 2019-2021 triennium. Ravi P. Gupta, India's new lead representative to Task 39, provided an overview of India's energy use and activities underway and planned to reduce the carbon intensity of its energy sector. As in many other jurisdictions, fossil fuels remain the primary source of energy in India with a total share of 91% of primary energy consumption. As Ravi explained, India's total GHG emissions are the third largest in the world although per capita emissions remain well below the global average. Increasing the use of biofuels and other renewable energies is being championed by the government as a major strategy to reduce the dependence on imported fuels and reduce national GHG emissions. The primary policy tool is the country's recently adopted "National Biofuel Policy 2018" that includes the ambitious goal of increasing ethanol blending in gasoline from a current level of 4.3% to 8-10 % by 2021.

Image Source: esf.edu.com

Image Source: Canola Council of Canada

We welcome your feedback. Please direct your comments to Mahmood Ebadian

Task 39-Task 44 Joint Workshop, 25 November 2020

Due to increasing production of electricity from fluctuating renewable sources like wind and solar, the future role of bioenergy in the electricity sector should be more flexible to aid grid stabilisation and secure supply. On the other hand, surplus power can be used in biofuels production and biorefinery processes to increase conversion rates and fuels output. Several concepts to produce heat, electricity, fuels and other products in single high-efficiency processing plants are under development. This workshop's objective was to provide an overview on the flexibility options, get insights into concepts for more flexible biofuel and biopower production, discuss the challenges and success factors to implement these concepts in energy systems with high shares of renewables, and explore potential Task 39-Task 44 collaborations related to the future role of biofuels-producing biorefineries in grid balancing. A key challenge identified in the workshop is the generally higher capital costs required for biorefinery designs that enable greater grid flexibility. For example, increased costs are required to install additional feedstock handling, power generation or hydrogen production capacities that will only be used to balance the grid some of the time. Discussions highlighted the need for further research into compelling schemes as well as the potential for industrial symbiosis-oriented plant designs to mitigate cost barriers, for example by leveraging existing "stranded" capital or co-locating adjacent complementary facilities to help to reduce the otherwise higher capital cost of provisioning biorefineries for increased grid balancing capability.

Task 39 also continues to actively organize and participate in virtual webinars and conferences to foster awareness and share insights on how biofuels for decarbonising the transport sector can help to contribute to a "green economic recovery".

Task 39 contributed to IEA Bioenergy InterTask project, "The Role of Renewable Transport Fuels in Decarbonizing Road Transport"

Experts from the IEA Bioenergy and Advanced Motor Fuels Technology Collaboration Programmes with support from the European Commission's Directorate General for Energy recently completed a study on the role of renewable fuels in reducing the climate impact of road transport for a number of countries, including Brazil, Germany, Finland Sweden, and the USA. The analysis considered developments up to 2050 based on national policies, vehicle fleet projections, and the availability of renewable transport fuels. The objective of the assessment was to quantify the role that renewable transport fuels play in decarbonising road transport as well as to provide insights to policy makers about how individual countries differ from one another, which options for decarbonisation they have, and to provide best practice examples of successful policies. Dina Bacovsky, Austria's representative to Task 39, led this study and participated in the IEA Bioenergy webinar held on November 17, 2020 to present the study's main conclusions and recommendations.

IEA Bioenergy TCP webinar held 17 November 2020

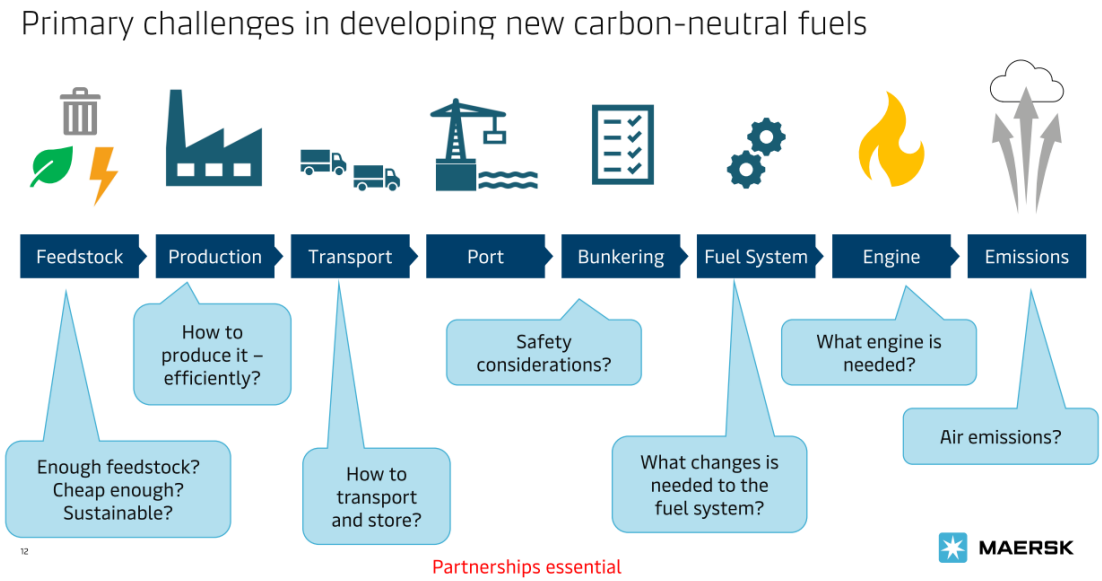
The report documenting this study was completed on November 23, 2020, and is available on the IEA Bioenergy website (here). Task 39 contributed to three chapters in this report (1) Role of policy on production and use of emerging biofuels; 2) Availability and costs of sustainable bioenergy feedstocks; and 3) GHG emissions of emerging biofuels pathways) as well as assisted with finalizing the report.

Virtual BC-SMART Biofuels Consortium/IEA Bioenergy Task 39-Hosted Panel Discussion, "Decarbonising the Marine Sector: Progress and Aspirations", 4 December 2020

The BC-SMART Biofuels Consortium and IEA Bioenergy Task 39 co-sponsored a free "virtual" panel discussion on decarbonizing the marine sector on 4 December, 2020. The panel was comprised of global leaders in the marine sector representing ports, shipping and logistics, lower carbon intensity fuel production, and renewable fuel policy development. During these unprecedented times, when the world is hoping for an effective post-COVID-19 economic recovery, panel members were asked to discuss progress and future aspirations for reducing marine sector emissions.

The marine sector is large, both in terms of trade volumes and monetary value, and it provides a key linkage for maintaining a highly interconnected international trading value chain. Despite widespread economic turmoil caused by the COVID-19 pandemic, the shipping sector remains responsible for 80-90% of global trade, employing millions worldwide, and is aptly described as the "lifeblood of the global economy". However, while shipping is recognized as a cost-effective, lower carbon-intensity mode of transport, it still accounts for more than 900 million tonnes (2-3%) of annual global GHG emissions as well as large amounts of sulfur and particulate emissions.

The panel discussion highlighted several success factors that will be critical to substantially decarbonising the marine sector. First, active participation of all sector members will be essential if the sector is to effectively decarbonise. Key players, including the panelists' organizations, are making significant efforts to decarbonise through collaborative projects involving the participation of multiple stakeholders. Second, biofuels will play an important role in decreasing sector emissions and continuing progress in biofuels use in the sector is anticipated. However, there are also challenges for wider biofuels use such as limited volumes/availability of sustainable biofuels/biofuels feedstocks, the costs of such feedstocks as well as overall logistical challenges. Finally, it was recognised that strong policy support will be needed to incentivise and de-risk the marine sector's decarbonisation effort.



As repeatedly highlighted by panel members, active participation by all supply chain players will be essential for the marine sector to tackle the challenges of developing and deploying commercial volumes of lower carbon intensity fuels.

About 110 participants attended the webinar, mainly from North America, South America and Europe. The list of panel members and their short bios are posted on Task 39's website (link), and hyperlinks to meeting minutes and a recording of the panel discussion are available on the BC Smart Biofuels Consortium's website (here).

In closing, we are grateful to Ravi Gupta and his colleagues at the Indian Oil Corporation Limited for authoring this newsletter's feature article on biofuels-related developments in India.

As always, we appreciate your readership and value your input and feedback. Please email us any ideas or suggestions for increasing this newsletter's value.

Thanks for reading and participating in the IEA Bioenergy Task 39 network.

Mahmood, Jim, and Jack

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India Biofuel economy roadmap- Challenges & Prospects

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1. Introduction

India is one of the fastest growing economies and the third largest consumer of primary energy in the world after the US and China. The BP Energy Outlook 2019 projects India's share of total global primary energy demand to roughly double to ~11% by 2040, underpinned by strong population growth and economic development:

- India accounts for more than a quarter of net global primary energy demand growth between 2017-2040.
- 42% of this new energy demand is met through coal, meaning CO_2 emissions roughly double by 2040.
- Gas production grows but fails to keep pace with demand, implying a significant growth in gas imports.

While fossil fuels may continue to play a dominant role in the energy scenario of India over the next few decades, conventional fossil fuel resources are limited, non-renewable, polluting and need to be used prudently. Fluctuations in crude oil prices severely strain the Indian economy, particularly its current account deficit due to its major dependency on imported crude. India's fuel energy security will remain vulnerable until alternative fuels are developed based on renewable feedstocks.

The government of India has emphasized improving energy security by, among other measures, reducing import dependence, with a target of decreasing fossil fuels use by 10% from current levels by the year 2022; it also targets reducing the country's carbon footprint by 30-35% by the year 2030. These targets will be achieved through a five-pronged strategy which includes: Increasing domestic production, adopting biofuels and renewables, implementing energy efficiency norms, improving refinery processes and achieving demand substitution. This strategy envisages a strategic role for biofuels in the Indian energy basket. The growing concern about import dependence for fuel supplies in tandem with environmental pollution issues are driving the development of alternative fuels that have superior environment benefits and can be economically competitive with fossil fuels.

India is endowed with abundant indigenous, non-polluting and virtually inexhaustible renewable energy resources. The government of India has proposed a target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030.

The following alternative fuels and technologies need special attention to make India's energy system sustainable:

- Biofuels: Ethanol, HVO (Hydrotreated vegetable oils) and BioCNG (Bio Compressed Natural gas) etc.
- Hydrogen as fuel of the future and hydrogen-powered fuel cell vehicles
- Chemical energy sources (fuel cells)
- Battery operated electric vehicles
- Solar and wind energies
- Municipal solid waste (MSW) to drop-in fuels
- Methanol from domestic coal

2. Energy outlook

India's industry and transport sectors are the largest end users of energy, accounting for half of total consumption. The main fuels supplying this demand are coal (in industry), petroleum (in transport), and electricity (in buildings, industry, and agriculture). Growth in the transport sector will continue to increase petroleum consumption. Transportation consumes close to 70% of the total diesel supply, 66% of which is used by passenger and commercial vehicles. Gasoline is also used for light-duty transportation, 60% for two-wheelers such as motorcycles and scooters. Currently, diesel alone meets an estimated 46% of transportation fuel demand, followed by gasoline at 24%. Gasoline and on-road diesel

consumption combined are forecast to rise over the next 5 years from the current estimate of 98 billion liters in 2018 to 126 billion liters by 2023.

Robust growth in prosperity and population size drives a massive increase in India's primary energy consumption, which is projected to expand by 1.2 billion tonnes of oil equivalent or 156% by 2040, making India by far the largest source of energy demand growth in BP's 2019 Energy Outlook. By 2040, India's population increases by more than 267 million, and the economy nearly triples in size, meaning income per capita roughly doubles. This projected growth in absolute terms means India's share of global primary energy demand jumps from 6% today to 11% by 2040. Power generation increases by 207% to 4,781 TWh by 2040, accounting for 61% of primary energy demand growth. Industry is the strongest source of final energy demand growth (+238 Mtoe) followed by transport (+144 Mtoe) and non-combusted uses (+64 Mtoe).

Coal is projected to meet ~42% of India's new energy demand, increasing by 493 Mtoe by 2040. The majority (84%) of this additional consumption is met through increased domestic production. Renewable energy consumption surges from ~20 Mtoe today to ~300 Mtoe by 2040 – concentrated mainly in the power sector and driven largely by growth in solar energy capacity. Despite this large growth in renewables, coal is projected to continue to dominate India's power generation mix, accounting for 80% of output by 2040. As a result, although the carbon intensity of India's power grid declines 29% by 2040, it remains 58% above the global average. India's total net CO_2 emissions roughly double to 5 Gigatonne (Gt) by 2040, meaning India's share of global emissions increases from 7% today to 14% by 2040. Although gas production increases modestly to ~75 billion cubic metres (Bcm), demand surges 240% to reach 185 Bcm by 2040, meaning India's reliance on gas imports continues to grow significantly. Nuclear energy capacity continues to grow slowly and accounts for 4% of total power generation by 2040. Table 1 shows the projected breakdown of primary energy consumption in India over the period 2017-2040.

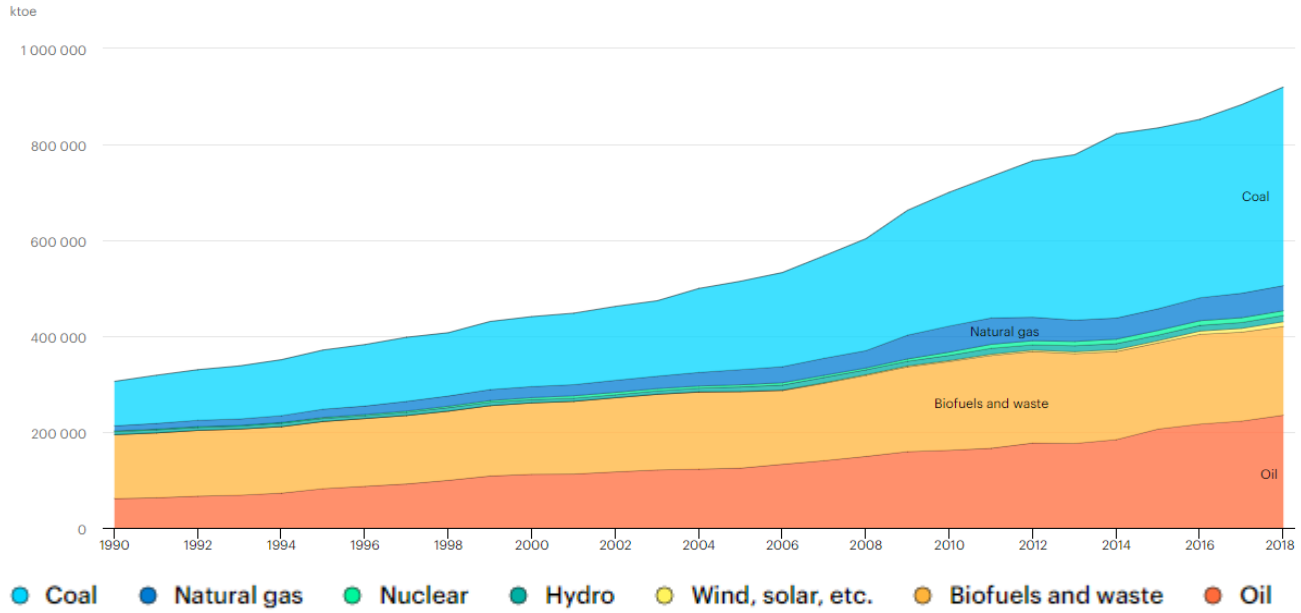
Table 1. Primary energy consumption (units in Mtoe unless otherwise noted) (BP Energy Outlook 2019)

Category	Level		Shares		Change (absolute)		Change (%)		Change (annual)*	
	2017	2040	2017	2040	1995-2017	2017-2040	1995-2017	2017-2040	1995-2017	2017-2040
Primary energy consumption (units in Mtoe unless otherwise noted)										
Total	754	1928			501	1174	199%	156%	5.1%	4.2%
Oil† (Mb/d)	5	9	29%	23%	3	5	196%	101%	5.1%	3.1%
Gas (Bcm)	54	185	6%	8%	36	131	200%	242%	5.1%	5.5%
Coal	424	917	56%	48%	284	493	202%	116%	5.2%	3.4%
Nuclear	8	43	1%	2%	7	35	391%	412%	7.5%	7.4%
Hydro	31	56	4%	3%	14	25	79%	81%	2.7%	2.6%
Renewables (including biofuels)	22	306	3%	16%	22	283	>1000%	>1000%	>10%	>10%
Transport	104	253	14%	13%	76	149	279%	144%	6.2%	4.0%
Industry	382	990	51%	51%	257	608	207%	159%	5.2%	4.2%
Non-combusted	50	114	7%	6%	31	64	165%	130%	4.5%	3.7%
Buildings	218	571	29%	30%	136	353	167%	162%	4.6%	4.3%
Power	373	1087	49%	56%	252	714	208%	191%	5.2%	4.8%
Production										
Oil† (Mb/d)	1	1			0	0	32%	-19%	1.3%	-0.9%
Gas (Bcm)	29	74			10	45	58%	159%	2.1%	4.2%
Coal	294	708			161	414	121%	141%	3.7%	3.9%

* Compound annual growth rate.

† Oil supply includes crude oil, shale oil, oil sands, natural gas liquids, liquid fuels derived from coal and gas, and refinery gains, but excludes biofuels. Oil demand includes consumption of all liquid hydrocarbons.

India has also been prioritizing access to electricity and clean cooking. Progress in both have been remarkable: 700 million people gained access to electricity since 2000, and 80 million new liquefied petroleum gas (LPG) connections for cleaner cooking were created. The government of India is continuing to focus on providing secure, affordable and sustainable energy, while achieving its ambitious renewable energy targets and reducing local air pollution. Figure 1 shows the growth in India's total energy supply over 1990-2018.



(Source https://www.iea.org/countries/india#overview)
Figure 1. Total energy supply (TES) by source, 1990-2018 (IEA, 2018)

Final energy consumption is the direct amount of energy consumed by end users while primary energy consumption includes final consumption plus the energy required to produce and deliver electricity. In India, primary energy consumption is 4.2-fold higher than final energy consumption; this multiple is relatively high because of high transmission losses. Figure 2 shows India's primary energy consumption by source in 2017.

In 2020, the transportation sector is projected to account for 21% of total final energy use and 14% of primary energy use, versus 16% of total final energy use and 12% of primary energy use in 2005.

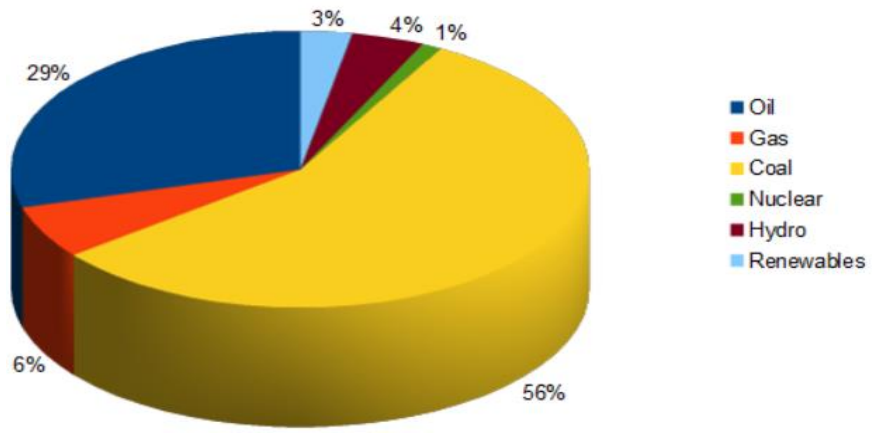


Figure 2. Primary consumption in India by source, 2017 (BP Energy Review 2017)

3. Biofuel programme in India and new biofuel policies

Biofuels are an appealing alternate energy options because they are renewable and have the potential to lower carbon emissions and environmental impacts while also cutting import dependence. Considering these prospective benefits, India began piloting a 5% ethanol blending (E5) program in 2001 and in 2003 formulated the National Mission on Biodiesel to achieve 20% biodiesel blends by 2011–2012 (Government of India, 2002, 2003). In 2009, a National Policy on Biofuels was developed by the Ministry of New and Renewable Energy that proposed a non-mandatory target of 20% blending for both biodiesel and ethanol by 2017, and outlined a broad strategy for the biofuels program and policy measures to be considered to support the program. Similar to many countries around the world, however, India's biofuel programs have experienced setbacks, primarily because of supply shortages and global concerns over food security. In addition, Oil Marketing Companies (OMCs) in India have not yet been able to accept offers to tenders for required quantities of ethanol due to a variety of constraints including state specific and supplier related issues as well as ethanol pricing issues.

The Indian approach to producing biofuels is based solely on using non-food feedstocks obtained from degraded lands or wastelands not suitable for agriculture, thus avoiding a possible conflict of fuel vs. food security. The government has enhanced the ethanol procurement price and encouraged non-conventional production from cellulosic and lignocellulosic materials as well as via the historical petrochemical route.

The government plans to increase ethanol blending in gasoline from 4.3% (2020) to 8-10% by (2021). For 10% ethanol blending, India will require about 4.5 billion litres of ethanol per year, which represents about Rs 23,000 crore (US$ 3 billion) in terms of value. In order to augment feedstock availability and promote biofuels, the government announced a new National Policy on Biofuels 2018 on 8th June 2018. This policy encourages innovation in biofuels production technologies, providing thrust to research and development (R&D) and demonstration activities that utilize developed/emerging technologies. The policy focuses on the development of next generation biofuel conversion technologies based on new feedstocks and promotes wider exploration of domestically available feedstocks given the Country's tremendous biodiversity. The policy aims to provide financial and fiscal incentives specific to biofuel type, categorized as first generation (1G), second generation (2G) and third generation (3G) fuels. The first generation category of biofuels includes conventional ethanol and biodiesel. The second generation comprises ethanol from lignocellulosic biomass, non-food crops, industrial wastes and residues streams as well as drop-in fuels from biomass, MSW, plastics and industrial wastes. The third generation includes compressed BioCNG from food wastes, biomass, MSW, sewage water, etc.

The new policy adds many newly permissible raw materials for 1G ethanol production including sugarcane juice, sugar containing materials like sugar beet, starch containing materials like corn, cassava as well as damaged food grains like wheat, broken rice and rotten potatoes which are expected to increase the availability of 1G ethanol. However, even these additional raw materials for 1G ethanol will not be able to substantially improve the supply of ethanol to be able to enable E10 gasoline on pan India basis. Therefore, production of ethanol from 2G technologies will also be essential to meet the OMC's demand for ethanol for fuel blending. Biomass is abundantly available in India, therefore research in the area of conversion of biomass to various biofuels such as ethanol, methanol, BioCNG is considered essential to India's energy security. Moreover, technologies to convert abundantly available MSW, industrial plastic waste, flue gases, etc., to valuable energy carriers will be highly beneficial to India.

With a thrust on advanced biofuels, the policy provides a viability gap funding scheme for 2G ethanol bio-refineries of Rs 1950 crore (US $260 million) over 6 years in addition to additional tax incentives and higher purchase prices as compared to 1G biofuels. The policy also encourages setting up supply chains for biodiesel production from non-edible oilseeds, used cooking oils and short gestation crops. Oil marketing companies will offer 100% offtake guarantees to

biofuel manufacturers. These measures are expected to enable the industry to reach Rs 100,000 crore (US $13.5 billion) total turnover by 2030.

The expected benefits of India's ethanol blending mandates include:

- **Reduce Import Dependency**: One crore (10 million) litres of E10 saves Rs.28 crore (US $3.8 million) of foreign exchange (forex) at current rates. The ethanol supply for supply year 2017-18 is likely to be around 150 crore litres (1.5 billion litres) which will result in forex savings of over Rs.4000 crore (US $540 million).
- **Cleaner Environment**: One crore litres of E10 saves around 20,000 ton of CO_2 emissions. For the ethanol supply year 2017-18, CO_2 emissions will be reduced by 30 lakh (3 million) ton. Reducing crop burning and converting agricultural residues/wastes to biofuels will further reduce greenhouse gas (GHG) emissions.
- **Health Benefits**: Prolonged reuse of cooking oil for preparing food, particularly in deep-frying, is a potential health hazard and can lead to many diseases. Used cooking oil (UCO) is a potential feedstock for biodiesel and its use for making biodiesel prevents reuse of UCO within the food industry.
- **MSW Management**: It is estimated that annually 62 MMT of MSW is generated in India. There are technologies available which can convert MSW and plastics/other wastes to drop-in fuels. One ton of such waste has the potential to yield around 0.20 tons of drop-in fuels.
- **Infrastructural Investment in Rural Areas**: It is estimated that one 100 Kilolitre per day (KLPD) biorefinery will require a capital investment around Rs. 1000 crore (US $135 million). At present, Oil Marketing Companies are in the process of setting up twelve 2G biorefineries with a total investment of around Rs.14,000 crore (US $ 1.9 billion). Establishing additional 2G biorefineries across the country will spur infrastructural investment in rural areas.
- **Employment Generation**: One 100 KLPD 2G biorefinery can contribute 1200 jobs across plant operations, village level entrepreneurs and supply chain management.
- **Additional Income to Farmers**: By adopting 2G technologies, agricultural residues/wastes that otherwise are burnt can be converted to ethanol. Farmers can realise an additional revenue source if markets are developed for these residues/wastes. Also, farmers risk not receiving appropriate prices for their products when production surpluses occur. Conversion of surplus grains and agricultural biomasses can help stabilize prices and farmers' incomes.

4. Indian government measures for stimulating the implementation of biofuels

The government of India's Ministry of Science and Technology, through its Department of Biotechnology (DBT), has been supporting feedstock development and improved biofuel production technology, with a major focus on cellulosic ethanol (2G) technology development. For the past eight years, DBT also has been promoting cutting edge research and innovation in biofuels production and use through its Center of Excellence as well as through a variety of fellowships, training programs and international collaborations. Beyond 2G ethanol, it focuses R&D on topics such as lignin valorization, algal biofuels, waste biomass to energy (and value-added bioproducts), biobutanol and biohydrogen, among others, generally in a biorefinery context and including life cycle analysis (LCA). More than US $30 million has been invested to date, and cellulosic ethanol production technology has been successfully demonstrated by one of its bioenergy centers. Many cost-effective biofuel production technologies are being developed and demonstrated at pilot scale.

Targeted areas of intensive R&D work include: 1) biofuels feedstocks production; 2) advanced conversion technologies for identified feedstocks; 3) technologies for end-use applications including modifications for biofuels; and 4) utilization of biofuels production byproducts.

Major government of India funding agencies supporting biofuels R&D and demonstration include:

- Department of Biotechnology (DBT), Ministry of Science & Technology
- Centre for High Technology (CHT), Ministry of Petroleum & Natural Gas
- Ministry of New & Renewable Energy (MNRE)

Major programs supporting the development of biofuels production and use in India include:

- Viable gap funding (VGF) for commercial scale 2G ethanol plants under Pradhan Mantri JI-VAN Yojana from CHT, MoP&NG
- Financial assistance for demonstration scale 2G integrated bioethanol under Pradhan Mantri JI-VAN Yojana from CHT, MoP&NG
- Grants for research and development from DBT to 5 Centres for Excellence in the Bioenergy area

5. Government initiatives in promotion of advanced biofuels in India

The National Policy on Biofuels 2018 specifically promotes advanced biofuels to achieve a target of 20% blending of biofuels with fossil-based fuels by 2030. Life cycle analyses (LCA) are carried out for all technologies and also are part of environment clearance for advanced biofuels commercial and demonstration projects to determine the CO_2 emissions reductions provided by different technology pathways.

In India, there are two operational advanced biofuel facilities - one pilot and one demonstration plant - with a combined production capacity of 1.75 million litres per year of cellulosic ethanol. There are several other advanced biofuels plants in development. Indian Glycols built the first plant in the country in 2016 at their Kashipur site in Uttarakhand. Their cellulosic ethanol pilot plant uses technology developed by the Center for Energy Biosciences at the Mumbai Institute of Chemical Technology (DBT-ICT). It has a 750,000 liter (0.75 million litres) annual production capacity. Praj Biofuels built the country's second facility in 2017, an integrated cellulosic ethanol biorefinery, which once in full operation will produce 1 million liters of ethanol per year from agricultural residues such as rice straw, wheat straw, cotton stalk and bagasse. In 2018, Shell Bangalore completed a demonstration plant which will use an innovative waste-to-fuels technology and is expected to produce 50 million liters per year. In 2018, Chempolis, Fortum and Numaligarh Refinery also announced forming a joint venture to build a biorefinery in Assam that will convert bamboo into ethanol, furfural, acetic acid and biocoal (Biofuture platform, 2018).

Table 2 lists India's operational, recently completed and planned advanced biofuels plants.

India's new biofuel policy encourages the use of "wastelands" for increased production of feedstocks such as non-edible oilseed bearing trees and crops such as *Pongamia pinnata* (Karanja), *Melia azadirachta* (Neem), castor, *Jatropha curcas*, *Calophylum inophylum*, *Simarouba glauca*, and *Hibiscus cannabinu*s in order to augment current domestic feedstock supply for biodiesel production. It is noted that the National Biodiesel Mission (NBM) had previously identified jatropha (*Jatropha curcas*) as the most suitable inedible oilseed feedstock to help reach the proposed biodiesel blend level of 20%. However, using jatropha has so far proved to be untenable due to a host of agronomic and economic constraints.

Table 2. Operational, recently completed and planned advanced biofuels plants (Biofuture Platform, 2018)

Name of company / Year	Status (planned; operational; closed)	Scale / Technology / Technology Developer	Production capacity (ML/year)
Indian Glycols Kashipur / 2016	Operational	Demo / Cellulosic ethanol / DBT ICT	0.75
Praj Biofuels / 2017	Operational	Demo / Cellulosic ethanol / Praj	1.0
Shell Bangalore / 2018	Operational	Demo / Drop-in fuels / Shell	0.6
NRL[1] Numaligarh / 2018	Planned	Commercial / Cellulosic ethanol / Chempolis	60
IOCL[2] Panipat	Planned	Commercial / Cellulosic ethanol / Praj	30
BPCL[3] Bargarh	Planned	Commercial / Cellulosic ethanol / Praj	30
HPCL[4] Bhatinda	Planned	Commercial / Cellulosic ethanol / Praj	30
IOCL Panipat	Planned	Demo / Cellulosic ethanol / IOCL R&D	0.75
CSIR-IIP[5], Dehradun	Operational	Pilot / HEFA Biojet / CSIR IIP	0.01
IOCL Panipat	Planned	Commercial/ 3G ethanol/LanzaTech, USA	33

[1] Numaligarh Refinery Limited
[2] Indian Oil Corporation Limited (IOCL)
[3] Bharat Petroleum Corporation Limited (BPCL)
[4] Hindustan Petroleum Corporation Limited (HPCL)
[5] Council of Scientific and Industrial Research- Indian Institute of Petroleum (CSIR-IIP)

Farmers have been encouraged to grow a variety of different biomass crops including oilseeds on their marginal lands as inter-crops, and as a second crop wherever only one crop is historically cultivated under rain-fed conditions. Suitable supply chain mechanisms, feedstock collection centers, and fair price mechanisms for the engaged communities are planned for development in coordination with local bodies, states, and concerned stakeholders. In addition, Oil Marketing Companies (OMCs) have agreed to sign Ethanol Purchase Agreements (EPAs) with cellulosic ethanol suppliers for a period of 15 years to provide a more secure market outlook for private investors and stakeholders as well as to support cellulosic ethanol production initiatives. Bio-compressed natural gas (Bio-CNG) is one of the major potential byproducts of cellulosic ethanol biorefineries and can also be used as a transport fuel, so it will also be provided with offtake assurances by public sector gas marketing companies.

According to the Technology Information, Forecasting and Assessment Council's (TIFAC) 2018 report estimating surplus crop residues in India available for biofuel production, the total dry biomass generated in India is about 683 MT across the major eleven crops. Out of this total, however, only 178 MT (26%) was found to be surplus. The total annual

cellulosic ethanol (2G) production potential of the country is estimated to be 51.35 billion litres (BL) based on this 178 MT of surplus crop biomass.

All three of India's OMCs (IOCL, HPCL and BPCL) have recently conducted surveys of used cooking oil (UCO) potential in the country. An expression of interest for supply of biodiesel produced from UCO, from plants processing used cooking oil and providing the produced biodiesel to various terminals locations and retail outlets of IndianOil, BPCL and HPCL across the country was floated on 10th August 2019. Apart from biodiesel production, UCO has been considered for the production of renewable diesel and biojet fuels. An annual quantity of 300 kilotonnes of UCO may be available for producing biodiesel or biojet fuels in India. India imports about 70% or 16 million tonnes of its annual 24 million tonnes of edible oil requirements.

The government recently expressed interest in the procurement of biodiesel from used cooking oil across 100 cities and asked companies to submit Expressions of Interest (EOI). The purpose of inviting these EOIs is to encourage applicants to set up biodiesel production plants based on UCO feedstocks and further utilizing the existing potential of UCO based biodiesel in India. The National Policy on Biofuels 2018 envisions production of biofuel from UCO with a target of 5% blending in High speed diesel (HSD) by 2030, and the Food Safety and Standards Authority of India (FSSAI) is implementing a strategy to divert UCO from the food value chain and curb current illegal usage. In order to achieve the 5% blending target, 500 crore (5 billion) litres of biodiesel will be required per year. In India, approximately, 22.7 million metric tonnes per annum (MMTPA) (27 billion litres of cooking oil is used, out of which 1.2 MMTPA (1.40 billion litres) of UCO can be collected from bulk consumers such as hotels, restaurants, canteens, etc. for conversion, which will yield approximately 1.1. billion litres of biodiesel per year). Presently there is no established collection chain for UCO (Biofuels Digest, 2019).

According to the Chhattisgarh Biofuel Development Authority (CBDA), India has enormous potential of oilseed production from Tree Borne Oil (TBO) seed species. TBO species grow on their own naturally and are or can be established on all kinds of land and in varied agro-climatic conditions even those not suitable for conventional agriculture. About 1.22 million tonnes of TBO oil may be available for producing biodiesel or biojet fuels in India. However, establishing a robust rural network for collection of TBO oilseeds and their processing remains a challenge.

Substantial work has been done in the area of biojet fuel production by various global and indigenous research institutes since the beginning of the 21st century. In India, a consortium involving IIP-Dehradun, IOCL, HPCL, Indian Institutes of Technology (IIT) Kanpur and Indian Institute of Science (IISc) has carried out lot of research work in collaboration with a consortium from Canada involving Pratt & Whitney (P&W), McGill University, Ryerson University, Laval University and, Institute of Aerospace Research, Canada (NRC IAR). During this collaborative work, a process for the production of biojet fuels from vegetable oils was developed and the fuels shown to be fit-for-purpose with engine performance studies completed.

The working group on biofuels under the government's Ministry of Petroleum & Natural Gas (MoP&NG) constituted a subcommittee on biojet fuel comprising members from the OMCs, IIT Kanpur, Council of Scientific and Industrial Research (CSIR)-IIP, Chhattisgarh Biofuel Development Authority (CBDA), Department of Science & Technology (DST), Directorate General of Civil Aviation (DGCA), and SpiceJet to consolidate these efforts and scale up the work in this field.

In August 2019, the MOP&NG also constituted committees to give impetus to the India's biojet fuels (Bio-ATF) program. The committee's mandate was to look into the availability of feedstocks across India for the production of biojet fuels, current demand for biojet fuels, estimate future requirements and production costs, etc., in view of Carbon Offsetting and Reduction Scheme for International Aviation's (CORSIA) policy on emissions. The committee suggested that feedstock availability and production costs are the key drivers towards sustainable commercial production and successful implementation of biojet fuels in India. Biojet fuels production technologies meeting desired quality are available nationally and internationally. CSIR-IIP Dehradun has developed hydroprocessed esters and fatty acids technology (HEFA) using non-edible vegetable oils including UCO up to pilot scale. IIP has also demonstrated biojet fuel

performance in ATF in Spicejet commercial flight. However, limited availability of raw material such as vegetable oils, UCO, tree borne oils, etc., along with high production costs and competing biodiesel technologies remains a challenge for sustainable commercial production of HEFA-based biojet fuels in India. Alcohol to jet fuel (ATJ) drop-in fuels also have great potential in India as new technologies such as gas fermentation efficiently convert plentiful wastes such as steel mill off-gases, gases from oil refineries and residues from agricultural processes to ethanol are being established in India to improve ethanol availability for this process. However, process economics remain a challenge due to high current cost for ethanol and processing in India. Economies of scale for HEFA/ATJ processes as well as policy interventions such as subsidies, feedstock incentives, VGF funding and differential fuel pricing may accelerate the adoption of biojet fuels in India.

According to the MoP&NG, the approximate ethanol availability in India is 300 crore (3 billion) litres per year. Of this, about 130 crore (1.3 billion) litres goes into making liquor, which is non-negotiable for states in which liquor is a major revenue source. This means that around 170 crore (1.7 billion) litres remains available, out of which about 60 to 80 crore (0.6-0.8 billion) litres goes into making chemicals. Thus, about 100 to 120 crore (1.0-1.2 billion) litres are available for blending in gasoline or for use in ATJ processes.

Compared to the Ethanol Blending Programme (EBP), a limited number of suppliers produce biodiesel, and most of their production capacities are under-utilized due to insufficient feedstock availability. The majority of the biodiesel produced is consumed by informal groups at the local level, much of it used for power generation. Indian's Ethanol and Biodiesel Blending Performance over the past five year are shown in Tables 3 and 4, respectively.

Table 3. India's Ethanol Blending Programme (EBP) Performance

Period	Actual Blending Level (%)*	Volume of Ethanol (Million Litres)	Total MS / EBMS (Motor Spirit / Ethanol Blended Motor Spirit) Sales (Million Litres)
Apr'14-Mar'15	1.69	187.9	10918
Apr'15-Mar'16	3.46	422.9	12218
Apr'16-Mar'17	3.54	486.4	13722
Apr'17-Mar'18	2.80	406.1	14527
Apr'18-Mar'19	5.25	804.5	15331
Apr'19-Mar'20	4.44	758	17066
April-20	6.14	365	5946

*Ethanol percentage in gasoline on pan India basis

Table 4. India's Biodiesel Blending Performance in Kilolitre (KL)

Period	Actual blending level (%)*	Volume of B100 procured (KL)	Total B-5/B-7 Blended Sales (KL)	Total B100 Blended sale in (KL)
Apr'14-Mar'15	0.00	0	0	0
Apr'15-Mar'16	0.09	5103	81872	4094
Apr'16-Mar'17	0.04	19181	383843	19192
Apr'17-Mar'18	0.05	24021	459975	22999
Apr'18-Mar'19	0.08	39575	750175	37509
Apr'19-Mar'20 (7%)	0.10	41454	597323	41813
Apr-20	0	236	0	0

*Biodiesel percentage in diesel on pan India basis

The new Ethanol Blending Program (EBP) stipulates procurement of ethanol produced directly from B-heavy molasses, sugarcane juice, and damaged food grains such as those of wheat and broken rice. A surplus sugar season coupled with a stronger financial incentive to convert excess sugar to ethanol helped the OMCs to achieve the highest fuel ethanol market penetration at 5% in 2018-19 compared to the previous record 4.22% in 2017-18 as shown in Table 5.

Table 5. Ethanol procurement and blending by Public Sector Undertakings (PSU) Oil Marketing Companies (OMCs) in India

Ethanol Supply Year	Tendered Quantity (Million Litres)	Quantity Allocated (Million Litres)	Quantity Supplied* (Million Litres)	Blending % PSU OMCs
2012-13	1030	320	154	0.67%
2013-14	1150	704	380	1.53%
2014-15	1280	865	674	2.33%
2015-16	2660	1305	1114	3.51%
2016-17	2800	807	665	2.07%
2017-18	3130	1610.4	1505	4.22%
2018-19	3290	2689.9	1886	5.00%
2019-20 (up to 18.05.20)	5110	1865.4	726	4.71%

*Ethanol quantity supplied to OMCs and blended

In contrast, biodiesel market penetration will remain stuck at last year's level (0.10%) due to limited supply, insufficient feedstocks, supply chain constraints, and restrictions on imports. Buyers of such blended diesel are limited to some retail outlets of OMCs, the Indian railways, State Road Transport Corporations of different states, fleet owners of road transport companies, and port authorities.

CSIR-IIP Dehradun has a pilot-scale biojet fuel production plant (0.3 Tons per day -TPD feed processing) which has so far produced approximately 4000 litres of bio-aviation fuel. This biojet fuel has been supplied to Spicejet Ltd. for India's first biofuel flight, which occurred on August, 27, 2018 using a Bombardier Q-400 turboprop aircraft with PW150A twin engines and using a 25% biojet fuel blend in one engine. This biojet fuel has also been supplied to the Indian Air Force (IAF) for testing on a Russian Antonov AN-32 medium-range military transport aircraft with Ivchenko AI-20 Soviet turboprop twin-engine using a 10% biojet fuel blend.

The main concern over further biofuels deployment in India is availability of indigenous feedstocks for conventional (1G) biofuel production and uncertainty of future biomass supply due to the absence of established supply chain logistics networks operating at the required scales. Ethanol sourced from sugarcane-derived molasses remains the main biofuel used for blending in gasoline. For biodiesel, the majority of production comes from palm stearin, a non-edible by-product of palm oil production. Depending upon availability of domestic feedstocks and blending requirements, the import of feedstocks for producing biodiesel will be permitted to the extent necessary. Feedstock import requirements under this policy will be decided by the National Biofuel Coordination Committee (NBCC). As domestic availability of biofuels is much lower than India's requirements, export of biofuels will not be allowed.

6. Conclusions

India has a ray of hope for biofuels to improve energy security as well as the environment by reducing carbon emissions. The use of biofuels in the transportation sector has become compelling in view of tightening automotive vehicle emission standards to curb air pollution. As biofuels are derived from renewable biomass resources, it may provide strategic advantage for India to promote their sustainable development to supplement conventional energy sources in

meeting the rapidly increasing transportation fuel requirements associated with high economic growth. Biofuels also help in increasing farmer income while meeting the energy needs of India's vast rural population in an environmentally more benign and cost effective manner.

Since 2014, the government has introduced multiple initiatives to increase indigenous production of ethanol, including opening up alternative routes for ethanol production, establishing the new National Policy on Biofuels 2018, increasing the scope of raw materials allowed for ethanol production, introducing a new interest subvention scheme to enhance and augment ethanol production capacity, and extending the EBP Programme to the entire country (excepting the islands of Andaman Nicobar and Lakshadweep).

Ethanol procurement prices for ethanol (1G) produced from sugarcane based raw materials – B and C heavy molasses, sugarcane juice, sugar and sugar syrup – are fixed by the government every year based on the required ethanol supply. The price of ethanol derived from damaged and surplus food grains will also be fixed. The government is promoting UCO as raw material for biodiesel production in India to improve biodiesel availability and a policy has also been framed for this.

Feedstock availability and production cost are the key drivers towards sustainable and commercial production and implementation of biofuels in India. A strong focus on technology is imperative for the development of second generation and other advanced biofuels utilizing domestic feedstocks. A collective effort from all involved organizations will lead to effective and full implementation of India's biofuels blending programme.

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In the News

Reports and Research

- September - The IEA Bioenergy News Bulletin (September 2020) featured articles on "The use of forest biomass for climate change mitigation: Dispelling some misconceptions" and "Coal combustion in Copenhagen is history". It also summarized activities that are recently completed or underway within different Tasks (Read more).
- September - Renewable energy continues to bring socio-economic benefits worldwide through job creation according to the latest figures released by the International Renewable Energy Agency (IRENA). The seventh edition of Renewable Energy and Jobs – Annual Review shows that jobs in the sector reached 11.5 million globally last year, led by solar PV with some 3.8 million jobs, or a third of the total, followed by bioenergy with 3.58 million jobs. In the 2019 report, bioenergy jobs totaled 3.18 million. For liquid biofuels, the 2020 report estimates 2.475 million jobs with more than a third of them in Brazil followed by the US and Europe (Read more).
- December - Oak Ridge National Laboratory researchers working with Co-Optima collaborators from the National Renewable Energy Laboratory, Sandia National Laboratory and Argonne National Laboratory, determined it's not so much the chemistry of a fuel that predicts performance, but rather its physical properties that hold the key to identifying a candidate with the potential for success, which will help the biofuels industry more quickly identify viable candidates for high-performance, bio-based fuels (Read more).

Policy and Regulatory Developments

- September - In China, the country plans to move forward with its ethanol expansion plans for 2020 with an eye towards promoting large-scale cellulosic ethanol production using straw and forestry waste but no mention was made of the E10 mandate originally planned and later put on hold. Huge corn harvests back-to-back have left the government with little choice but to divert it to ethanol production while hopes that 30% of the 400 million tons of straw and forestry waste produced every year could eventually become 20 million tons of biofuel (Read more).
- September - The USDA announced making $7 million available under its Advanced Biofuel Payment Program. The agency will accept applications from advanced biofuel producers during the month of October. The Advanced Biofuel Payment Program provides quarterly payments to producers of advanced biofuels based on actual production volumes (Read more).
- September - The USDA is soliciting applications for two different cycles of the Biorefinery, Renewable Chemical, and Biobased Product Manufacturing Assistance Program. The first cycle closes October 1st, while the second is open through April 1, 2021. This program aims to assist in the development of new and emerging technologies for production of advanced biofuels, renewable chemicals or biobased products manufacturing (Read more).
- September - The U.S. Department of Energy issued its fiscal year (FY) 2021 solicitation for the Technology Commercialization Fund, which aims to advance the commercialization of promising energy technologies and deploy lab-developed technologies to the marketplace (Read more).
- November - In Brazil, the government has given the green light to use imported soy as feedstock for biodiesel in light of the ongoing supply shortage nationally. Soybean and soy oil stocks are at 20-year lows which have pushed up prices significantly (Read more).
- November- In India, the Food Ministry has approved up to $1.68 billion in soft loans for 185 sugarcane mills and distillers to set up standalone ethanol production, four times the volume of loans approved under the program in the past two years. Once installed, the new projects represent an increase of nearly 4.7 billion liters of additional ethanol production capacity from molasses. The government is also looking at how to promote ethanol production from surplus rice and corn (Read more).
- November - In Brazil, the Biofuture Platform, a multi-stakeholder initiative facilitated by the International Energy Agency (IEA) and designed to take action on climate change by promoting international coordination on the

- sustainable low-carbon bioeconomy, has responded to the almost 12% drop in biofuel output in 2020 announced in the IEA's Renewables 2020 report (Read more).

- November - The European Commission launched a public consultation on the European Union's review of its Renewable Energy Directive (RED II) focused on aligning RED II targets with the European Green Deal and reviewing sustainability criteria for forestry biomass (Read more).

- November - The U.K. government issued its 10-point plan for a green industrial revolution, which among other measures includes sustainable aviation fuels (SAF) and an accelerated phase-out of the sale of new gasoline- and diesel-fueled vehicles (Read more).

- November - Congresswoman Julia Brownley introduced the Sustainable Aviation Fuel Act, a bill that aims to incentivize the production of sustainable aviation fuel (SAF) and help the aviation sector reduce carbon emissions (Read more).

- November - In Colombia, at a recent oil chamber annual summit, former mines and energy minister German Arce pointed out the "huge price disparity" between diesel and biodiesel, "one with guaranteed supply and the other with no guarantee" and noted the country's biodiesel blend mandate will rise to 12% from 10% in Q1 2021. The government is encouraging the voluntary use of higher biofuel blends. In Medellin, Primax is participating in a 20% biodiesel blend test, in which participating vehicles are not subject to circulation restrictions (Read more).

- November - In Washington, Congresswoman Cheri Bustos and Congressman Jim Hagedorn introduced bipartisan, bicameral legislation that would lower greenhouse gas emissions and encourage low-carbon fuel production. The Streamlining Advanced Biofuels Registration Act would help biofuels plants cut through red tape in order to increase production of cellulosic biomass into renewable fuels (Read more).

- December - In Canada, the Ontario government is making gasoline that drivers use every day cleaner by becoming the first province to require fuel suppliers to increase the amount of renewable content in regular-grade gasoline to 15%. This change is expected to result in an annual reduction of up to one megaton of greenhouse gas emissions in 2030 – the equivalent of taking 300,000 cars off the road every year (Read more).

- December - In Canada, the Quebec government has awarded funding totaling $4.55 million to non-profit organization Bioénergie La Tuque (BELT) under a program called Technoclimat from Transition Énergétique Québec (TEQ) for a project to develop and demonstrate the potential of producing advanced biofuels from locally-sourced forestry waste in La Tuque, Quebec, Canada. The funding will be used to continue project development and plant design, which are key enablers for making further decisions regarding the potential of building a renewable fuels plant in the area (Read more).

- December - In Indonesia, the government is working hard to find ways to keep its biodiesel program alive in the face of ongoing cheap oil prices and rising palm oil prices in 2020. There is an $865 million deficit in the biodiesel program's budget due to the increasing gap between fossil oil and palm oil, currently four times last year's at $400 per metric ton (Read more).

- December - The U.S. Department of Energy (DOE) announced up to $35 million in funding for bioenergy feedstock technologies and algae research and development. This funding opportunity announcement (FOA) supports the White House priority to advance the domestic bioeconomy, as well as the Bioenergy Technologies Office's (BETO's) goals to improve the performance and lower the cost and risk of technologies that can be used to produce biofuels, biopower, and bioproducts (Read more).

- December - Sustainable Aviation Fuel (SAF) producers and airlines are now able demonstrate compliance with Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) requirements and RSB's best-in-class

- sustainability certification, widely recognised by NGOs and other groups as the most robust, credible and practical approach for sustainability certification in the bio-based and circular economy (Read more).

- December - Several biofuel and bioenergy groups are among nearly 70 trade organizations that sent a letter to congressional leadership last month urging the passage of tax extenders legislation before the 116th Congress adjourns sine die (Read more).

Industry News

- September - In the Netherlands, Neste, the world's largest producer of renewable diesel, celebrated reaching the milestone of 100 Neste MY Renewable Diesel sales points in the Netherlands. Neste MY Renewable Diesel, produced from 100% renewable raw materials, was launched on the Dutch market in October 2019 (Read more).

- September - In Sweden, Preem has cancelled plans to expand refinery capacity at Lysekil intended for producing low sulfur petroleum products and will instead redirect the would-be investment towards expanding renewable fuel production. The company is already the country's largest renewable fuel producer and aims to increase that position. It plans to submit an environmental permit application this fall to support this expansion. Preem is already expanding renewable diesel and sustainable aviation fuel at its refinery in Gothenburg (Read more).

- September - In Germany, DHL Global Forwarding, the air and ocean freight specialist of Deutsche Post DHL Group, will be neutralizing the carbon emissions of all less-than-container load (LCL) ocean freight shipments from January 1, 2021. As one of the leading ocean freight forwarders worldwide, and in line with Deutsche Post DHL Group's "Mission 2050 – Zero Emissions", DHL is committed to lead the transition to clean and sustainable sea freight transport (Read more).

- September - In France, within the framework of its net zero strategy, Total will convert its Grandpuits refinery (Seine-et-Marne) into a zero-crude platform. By 2024, following an investment totaling more than €500 million, the platform will focus on four new industrial activities: 1) Production of renewable diesel primarily intended for the aviation industry; 2) Production of bioplastics; 3) Plastics recycling; and 4) Operation of two photovoltaic solar power plants (Read more).

- October - In Finland, Neste is committed to reaching carbon-neutral production by 2035. This commitment complements Neste's other strategic climate commitment to reduce customers' greenhouse gas emissions by at least 20 million tons annually by 2030 (Read more).

- October - In California, although Marathon Energy is still evaluating the potential refit of its Martinez oil refinery to produce renewable diesel, the company has applied for permits in hopes of moving the process forward. The company aims to commission production in 2022 and reach full capacity in 2023, if it makes the decision to proceed with the project. Using animal fats and vegetable oils, the facility would produce 736 million gallons per year (Read more).

- October - Shell Aviation has agreed on a purchase agreement for sustainable aviation fuel (SAF) with Colorado-based Red Rock Biofuels. Red Rock expects its biorefinery under construction in Lakeview, Oregon—which will be the first commercial-scale plant to use woody biomass feedstock—will begin operation in the second quarter of 2021. It will have an initial annual capacity to turn approximately 166,000 dry tons of waste woody biomass into 16.1 million gallons of low-carbon, renewable jet and diesel fuels (Read more).

- October - In Australia and Canada, Licella has entered into a new joint venture with Canadian Forest Products Ltd, known as Canfor — the JV is called Arbios Biotech. Arbios will be principally focused on the advanced biofuel sector in the short-to-medium term, reflecting its favorable environmental footprint as well as the current market stimulus for low-carbon liquid transportation fuels in various parts of North America and Canada. Longer term, Arbios believes its proprietary technology will enable it to expand into other highly attractive opportunities such as the biochemical and biomaterial sectors (Read more).

- October - In Singapore, Eastern Pacific Shipping (EPS) selected GoodFuels to supply biofuel bunkers for its 2010-built 47,377 deadweight ton MR tanker M/T Pacific Beryl. The successful bunkering, which took place on October 9 in Dutch waters, is in line with EPS' Environmental, Social & Governance (ESG) Policy. GoodFuels supplied EPS with a residual-fuel equivalent Bio-Fuel Oil (BFO) (Read more).

- October - In Sweden, Alfa Laval has won an order to supply a processing line to HollyFrontier Corporation to support the production of renewable diesel in the US. The order has a value of approximately $15 million and is booked in the Food Systems unit of the Food & Water Division. Delivery of equipment is scheduled for 2021 (Read more).

- October - In Belgium, Cargill is constructing a $150 million multi waste- and residues-based biodiesel plant at its existing integrated oilseeds crush and Bioro biodiesel site in Ghent, Belgium. The plant will use very latest technology of BDI-BioEnergy International GmbH that enables the processing of all types of liquid waste oils and fats, including by-products from food processing, wastes from the food industry, and non-food crops grown on marginal land (Read more).

- October - In Sweden, conversion of Preem's refinery in Lysekil has begun. In the latest update to the refinery's environmental permit, Preem will apply to establish large-scale renewable fuels production capacity at the refinery, which is estimated will enable GHG emissions to be reduced by up to 1.7 million tons annually (Read more).

- October - In Japan, Neste and All Nippon Airways (ANA) are entering into a sustainable aviation fuel (SAF) supply agreement. This groundbreaking partnership will see ANA become the first airline to use SAF on flights departing from Japan and also represents Neste's first SAF supply to an Asian airline. Initial operations will begin from October 2020 as ANA plans SAF-fueled flights from both Haneda International airport and Narita International Airport (Read more).

- October - In Spain, Repsol will build the first production plant for advanced biofuels in Spain at its Cartagena refinery. From this new facility, the multi-energy company, committed to the circular economy as a tool for efficient resource use and emissions reduction, will annually supply 250,000 tons of advanced biofuels for aircraft, trucks, and cars (Read more).

- October – The Diamond Green Diesel joint venture of Darling Ingredients and a subsidiary of Valero Energy Corporation has received necessary air permits for its proposed renewable diesel plant in Port Arthur, Texas. A final investment decision is expected to be reached soon. The joint venture currently operates a 275 MMgy renewable diesel in Norco, Louisiana, near a Valero refinery, that is undergoing an expansion to 675 MMgy expected to be completed next year (Read more).

- November - In Ohio, the Marathon Petroleum Corporation (MPC) says its Dickinson, North Dakota renewable fuels facility is starting up. At full capacity, this facility is expected to produce 12,000 barrels per day of renewable diesel from corn and soybean oil. MPC intends to sell the renewable diesel into the California market to benefit from California's Low Carbon Fuel Standard (Read more).

- November - In the Netherlands, Neste will acquire Bunge's Loders Croklaan refinery plant located in Rotterdam, the Netherlands for a purchase price of EUR258 million. This refinery is located next to Neste's existing biorefinery and includes a pretreatment facility, tank farm, jetties and a pipeline connection to Neste's site (Read more).

- November - CVR Energy is progressing with plans to convert one production unit at its Wynnewood refinery in Oklahoma to renewable diesel production and is considering the implementation of a similar project at the company's refinery in Coffeyville, Kansas (Read more).

- November - In Sweden, for the first time, renewable raw materials are being converted to Swedish Environmental Class 1 diesel at Preem's refinery in Lysekil. The aim is to annually produce up to 950,000 cubic meters of renewable fuel by 2024 (Read more).

- November - In the Netherlands, GoodFuels and Volkswagen Group have successfully started their partnership involving GoodFuels' supplying advanced Bio-Fuel Oil (MR1-100 or BFO) at Vlissingen, the Netherlands – another major step for sustainable shipping in the car carrier segment (Read more).

- December - Neste, the world's leading provider of renewable diesel and sustainable aviation fuel, has acquired a minority stake in Aircraft Fuel Supply B.V. (AFS). AFS is the owner and operator of the Amsterdam Airport Schiphol fuel storage company (Read more).

- December - In Romania, Clariant reports good progress in constructing its cellulosic ethanol production plant in Podari, in the southwestern part of Romania, with construction set for completion by the end of 2021. While the COVID-19 pandemic continues to present a challenging situation, Clariant's team was able to ensure that work on the construction site continues while maintaining full compliance with all pandemic precaution regulations established by the Romanian authorities (Read more).

- December - In Quebec, Enerkem, Shell, Suncor and Proman have proposed to construct a $669 million biofuel plant in Varennes, Québec, in partnership with the Québec and Canadian governments. The project would use more than 200,000 tonnes of non-recyclable waste and wood waste to annually produce nearly 125 million litres of biofuels, and would include constructing one of the world's largest renewable hydrogen and oxygen production facilities with an 87-megawatt electrolyzer leveraging Quebec's green electricity (Read more).

- December - In France, Air France KLM Martinair (AFKLMP) Cargo launched the Cargo SAF Program, enabling freight forwarders and shippers to reduce shipments' carbon footprints. By participating in this program, customers are investing in the development and use of sustainable aviation fuel (SAF), thereby contributing to a cleaner future for air transport. This is the first program in the air cargo sector in which an airline and its customers structurally work together to reduce carbon emissions (Read more).

Upcoming Meetings, Conferences & Webinars

Note: Due to ongoing coronavirus pandemic-related severe restrictions on travel and physical meetings, the dates of the following conferences and meetings may change. Please check websites to learn about the latest status of these conferences and meetings.

2021

January

- 11th International Conference on Biomolecular Engineering, 6-9 January, 2021, Virtual
- International Conference on Recent Advances in Biofuels and Biochemicals Production, 11-12 January, 2021, Singapore, Singapore
- International Conference on Biofuels and Environmental Impacts, 18-19 January, 2021, Bangkok, Thailand
- Fuels of The Future 2021, 18-19 January
- International Conference on Biofuels and Hybrid Energy Systems, 21-22 January, 2021, Amsterdam, Netherlands
- International Conference on Biofuels and Environmental Pollution, 25-26 January, 2021, Paris, France
- Nordic Pellets Conference 2021, 27-28 January, Varberg, Sweden
- International Conference on Microalgae-Based Biofuels, 28-29 January, 2021, Sydney, Australia

February

- Food-Energy-Water Nexus, 10-12 February, 2021, Virtual
- International Conference on Biofuels and Energy Conservation, 11-12 February, 2021, Barcelona, Spain
- 14th International Conference on Biofuels and Bioenergy, 15-16 February, 2021
- International Conference on Biomass Conversion and Biofuels, 22-23 February, 2021, Paris, France

March

- U.S. Department of Energy's Bioenergy Technologies Office (BETO) virtual 2021 Project Peer Review, 8-16 and 22-26 March, 2021
- International Conference Progress in Biogas, 10-12 March, Stuttgart, Germany
- International Conference on Bioenergy, Biofuels and Environmental Sustainability, 22-23 March, 2021, Istanbul, Turkey
- Biofuels International Conference and Expo, 23-24 March, Brussels, Belgium

April

- International Conference on Biofuels and Biochemicals Production, 05-06 April, 2021, Dubai, United Arab Emirates
- American Chemical Society (ACS) Spring 2021, 5-16 April, 2021, Virtual
- International Conference on Algal Biomass, Biofuels and Bioproducts, 22-23 April, 2021, New York, United States
- 43rd Symposium on Biomaterials, Fuels and Chemicals (SBFC), 26-28 April 2021, Virtual

May

- 18th International Conference on Biofuels & Bioenergy, 17-18 May, 2021
- 5th World Congress on Biofuels and Bioenergy, 24-25 May, 2021
- Biofuture Summit II/BBEST 2021, 24-26 May, 2021, São Paulo, Brazil

IEA Bioenergy Task 39 Meetings

IEA Bioenergy Task 39 is reviewing its plans for future meetings in light of the ongoing global COVID-19 pandemic during which travel and gatherings continue to be highly curtailed. Task 39 has decided to hold its the next business meeting virtually on 21-23 April, 2021 with a likely focus on member country updates using information from its now in draft updated Implementation Agendas report as the basis; this meeting was originally planned to be held in Denmark. Task 39 also plans to hold a virtual meeting in late January/early February, 2021 to discuss possible new project ideas to propose for the next triennium (2022-2024). It also plans to participate in the BIofuture Summit II/BBEST 2021 meeting being held in late May, 2021.

Please contact us for more detailed information about the Task's future business meetings.