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

From the Task

By Mahmood Ebadian, Jim McMillan and Jack Saddler

Since publishing our last newsletter in December 2020, IEA Bioenergy Task 39 has continued its work to advance the commercialization of lower carbon intensity biofuels used to decarbonize the transport sector (particularly long-distance transport segments where electrification is more challenging, i.e., marine, aviation, rail and trucking). This issue of the newsletter provides an update of Task 39's recent business meetings, publications and information dissemination activities. It also summarizes some recent reports and news articles of interest to biofuels stakeholders. **We are grateful to Adrian O'Connell and Shane Malone for authoring this newsletter's feature article on biofuels-related developments in Ireland**.

Task 39 "Brainstorming" Session on Project Ideas for 2022-2024 Triennium, 2 February 2021

Task 39 held a virtual brainstorming session on February 2nd, 2021, using Zoom, to discuss what projects and dissemination activities Task 39 might tackle in the coming triennium that will span calendar years 2022-2024. Three main topics were discussed: 1) current projects running in the 2019-2021 triennium that will likely continue in the next triennium; 2) new projects not currently included in Task 39 activities to consider for the next triennium; and 3) information dissemination activities.

Based on the suggestions and ideas that were shared in advance of and during this brainstorming session, the Task's proposed program of work for the next triennium will continue to span technology, policy, sustainability and commercialization issues related to transport biofuels. The program of work will benefit from and leverage Task 39's already established strong and active participating network of experts from within industry, academia and government research institutions. During the 2022-2024 triennium, the Task intends to:

- Continue to lead and coordinate activities in the Task's four main program areas (i.e., technology, commercialization, sustainability and policy), seeking to leverage related activities occurring in member countries to the greatest extent possible.
- Continue to address the technical and commercial aspects of producing and using low carbon intensity (CI) liquid and gaseous biofuels for transport, including both "conventional" and "advanced" biofuels. The focus will remain on advanced biofuels for the long-distance transport sector, especially on low CI biofuels that can be used in the particularly hard to decarbonize aviation and marine transport subsectors.
- As sustainability and carbon intensity metrics are playing an ever-increasing role in policies used to incentivise development and use biofuels, the sustainability/LCA assessment of advanced biofuels pathways remains essential and will also continue to be a Task priority.
- Policies continue to greatly influence the rate and extent of development, deployment and use of biofuels. Comparing and contrasting the successes of member country policies for fostering expanded biofuels production and use will continue to be a key focus area.

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

- We will continue to build and grow a strong stakeholder network and to promote the active, strong participation of industry.
- We will continue efforts to expand Task membership. As the addition of India during the current triennium has confirmed, there are multiple benefits of bringing on additional enthusiastic members. Accordingly, the Task will continue trying to re-recruit past country members (e.g., Finland, Italy and the UK) to rejoin and to recruit new members (e.g., China, Chile, France, Indonesia, Malaysia, Mexico and Thailand) to join IEA Bioenergy and Task 39.
- We will maintain the Task's strength in disseminating reliable, relevant information via its highly accessed website, publishing three newsletters a year, publishing timely commissioned reports on our website, publishing selected papers in the peer reviewed literature and attending and participating in biofuels-related conferences and workshops.
- Continued collaboration with other IEA Bioenergy Tasks in areas of mutual interest will continue, for example:
  - Tasks 33 and 34: Thermochemical routes to low CI transport biofuels: with Task 33 on routes based on gasification, and with Task 34 on routes based on pyrolysis/HTL and co-processing of biocrudes
  - Task 37: Anaerobic digestion (AD) of biomass feedstocks to biogas/biomethane (renewable natural gas, RNG) to be used as transportation fuels
  - Task 43: Sustainable oleaginous and lignocellulosic feedstocks, residues and wastes
  - Tasks 40, 43 and 45: Sustainability and scalability of biofuels supply chains
  - Task 44: Potential of electrofuels (power-to-liquids/gases, PTL/G, including hydrogen) and for industrial symbiosis
- Joint work and coordination with other IEA Technology Collaboration Programs (TCPs) and other allied international organizations, networks and engaged industries is also envisioned, for example:
  - International stakeholder groups such as IEA HQ, IRENA, FAO, GBEP, other IEA TCP's (e.g., AMF, Hydrogen, etc.) as well as various regional and national programs
  - The Task will continue to benefit from extensive industry knowledge through the involvement of international companies and institutions at the forefront of biofuels development such as Boeing, Borregaard DSM, ENI, Neste, REG, GoodFuels, IATA, IFPEN, ISCC, Novozymes, UPM, etc.

The Task's draft prolongation proposal program of work was submitted to the IEA Bioenergy Executive Committee (ExCo) in late March 2021 for their review and comments. The Task is currently working with its members to finalize its future program of work, including proposed projects, reports and dissemination activities for the upcoming 2022-2024 triennium.

Task 39 Business Meeting, 19-21 April 2021

The Task's first business meeting of 2021 was held virtually 19-21 April. (The originally planned physical meeting in Denmark was cancelled due to the ongoing global COVID-19 pandemic.) The first day and a half focussed on country updates of biofuels-related developments, especially in policies and biofuels production and use statistics, in member countries. In the balance of the meeting, the various project leaders gave status reports on their projects and highlighting any remaining steps to be taken to complete the projects by the end of the triennium. (A descriptive listing of the Task's projects for the 2019-2021 triennium was provided in Newsletter #54). Upcoming meetings and newsletters as well as future projects and Task structure and Task leadership for the next triennium were also discussed.

The vast majority of Task members support the Task continuing many of its ongoing activities. All of the project "champions" who have been leading the various Task projects are interested in continuing in these roles. Specific projects that Task membership strongly supports continuing in the 2022-2024 triennium include: Low CI marine biofuels, SAF/biojet fuel aviation, lessons learned (Inter-Task), biofuels status and opportunities in non-IEA Bioenergy countries/emerging economies and the periodic compare and contrast of biofuels policies reporting project.

Recent publications, conferences, and information dissemination activities (January-May 2021)

Task 39 contributions to the Biofuture Summit II / BBEST2021 Virtual Conference (24-26 May 2021)

Task 39 continues to actively organize and participate in virtual webinars and conferences with the goal of sharing the networks insights on how decarbonization of the transport sector can contribute to a "green economic recovery". On 24-26 May 2021, Glaucia Mendes Souza, Brazil's representative to Task 39 and her colleagues, Luiz Augusto Horta Nogueira and Renato Godinho co-chaired The Biofuture Summit II / BBEST2021 Virtual Conference. The conference was organized by the Brazilian Ministry of Foreign Affairs via the Biofuture Platform, the Bioenergy Research Program, (BIOEN) of the State of São Paulo Science Research Foundation (FAPESP), with support from the APEX-Brazil trade promotion agency and the International Energy Agency (IEA), as well as several other partners. The conference's program scope covered all aspects of bioenergy, i.e., policy, sustainability, biomass feedstocks, biorefineries, biofuels technologies and biofuels engines and applications, and the importance of bioenergy to meeting global "net zero" targets was highlighted. A total of 40 sessions were presented The opening session, the wrap-up final session, closing ceremony and the four major keynotes are publicly available through YouTube. More than 640 attendees and 212 speakers from 40 countries participated in the event.

Task 39 hosted a session on "The commercialization of biofuels" plus various Task members participated in other sessions of the BBEST 2020-21/Biofuture Summit II conference. The topics that were presented in the IEA Bioenergy Task 39 session included, (1) Co-processing as a way of making lower carbon intensive fuels and more sustainable aviation fuels (SAF); (2) Further CO2 reductions when making corn-derived-ethanol; (3) Comparison and harmonization of the LCA models used to measure the carbon intensity of biofuels; (4) Comparison of electrification, improvements in efficiency and use of biofuels in the transport sector, and (5) Overview of the power-to-gas options.

Marine biofuels and Biojet/SAF commissioned reports

Low CI drop-in biofuels continue to be a priority for Task 39 and the Task is fortunate to have the active participation of leading companies spanning industries ranging from producer "refineries" to user "customers" (i.e., aviation, marine). The Task is currently finalizing its marine biofuels and biojet commissioned reports respectively entitled "Progress towards biofuels for marine shipping" and "Progress in commercialization of biojet/Sustainable Aviation

Fuels (SAF): Technologies, potential and challenges." These reports will become publicly available in the July-to-September timeframe. IEA Bioenergy webinars are also planned to summarise each of these reports.

As always, we appreciate your readership and value your input and feedback. Please email us your ideas or suggestions on how we can increase the newsletter's value. Thank you for reading and participating in the IEA Bioenergy Task 39 network!

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Biofuels Policies and Market in Ireland

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Summary Box

- Overall, renewable energy supply in Ireland represents 11% of its gross final consumption. Ireland has a binding EU target for renewable energy of 16% by 2020, and while much progress has been made, Ireland is not on track to meet its 2020 renewable energy targets.
- The use of renewable energy in Ireland successfully displaced 2 million tonnes of fossil fuels and avoided 4.9 million tonnes of CO_2 emissions, equivalent to 13% of total energy-related CO_2 emissions.
- In the transport sector, more than 98% of the renewable energy consumed came from biofuels; almost 88% was biodiesel and 10% biogasoline (i.e., bioethanol).
- Ireland continues to rely heavily on imports, importing 82% of the liquid biofuels it uses in transport.
- To help Ireland meet the renewable energy transport target of the RED, Ireland implemented the Biofuel Obligation Scheme (BOS). The BOS places an obligation on the suppliers of mineral oil to ensure that 12.359% (by volume) of the gasoline and diesel placed on the road transport market in Ireland is produced from renewable sources, e.g., bioethanol and biodiesel. The obligation was increased to this level for 2020, having previously been 11.111%.
- Excise duty requirements on transport fuels consumed in Ireland are administered via a mineral oil tax. Biofuels, which are counted as having zero tailpipe emissions, are not liable for the carbon component of the mineral oil tax. A carbon tax was introduced in Ireland in 2010 based on a charge of €10 per tonne of CO_2 emitted. It has increased steadily over the years and was increased to €33.50 per tonne in Ireland's most recent national budget (applying from October 2020).

1. Introduction

In 2018, the overall share of renewable energy in the Irish energy mix was 11%, while in transport and heat it accounted for 7.2% and 6.5%, respectively. With regard to electricity production, Ireland produced 33.3% of its electricity from renewable sources. While considerable, these renewable energy shares do not meet the EU Renewable Energy Directive (2009/28/EC) – the RED – 2020 targets (i.e., 16% overall, 10% transport, 12% heat and 40% electricity). Nonetheless, renewable energy penetration has been increasing steadily over time. Figure 1 shows the historical use of renewable energy in Ireland over the period of 2010-2018.

According to Ireland's Sustainable Energy Authority (SEAI), most of this growth in renewable energy has come from wind, which provided 55% of all renewable energy used in Ireland in 2018. Solid biomass and bioliquids were the next largest sources of growth. Bioenergy, including biomass, landfill gas, biogas and bioliquids, collectively accounted for 36% of renewable energy used in 2018 (SEAI, 2020).

As a member of the EU, Ireland is subject to the requirements of the RED, which established a mandatory minimum renewable energy target of 10% for the share of all petrol, diesel, biofuels and electricity consumed in road and rail transport by 2020. The RED also specifies a number of "weightings" (or multipliers) that can be applied to certain fuels. The weightings help to incentivise these fuels, by making it easier to meet the renewable energy in transport target (the RES-T). A weighting factor of 2 is applied to advanced biofuels, i.e.,

biofuels typically produced from wastes and residues. The primary feedstock used to produce biofuel consumed in Ireland is used cooking oil (UCO) – it accounted for 62% of the biofuel placed on the market in 2018, and 68% in 2019 (NORA, 2020). A weighting of 2.5 is applied to electricity produced from renewable energy sources consumed by electric rail transport, and a weighting of 5 is applied to electricity produced from renewable sources consumed by electric cars. The share of electricity that comes from renewable sources in a particular year is taken to be the share that was measured two years before the year in question.

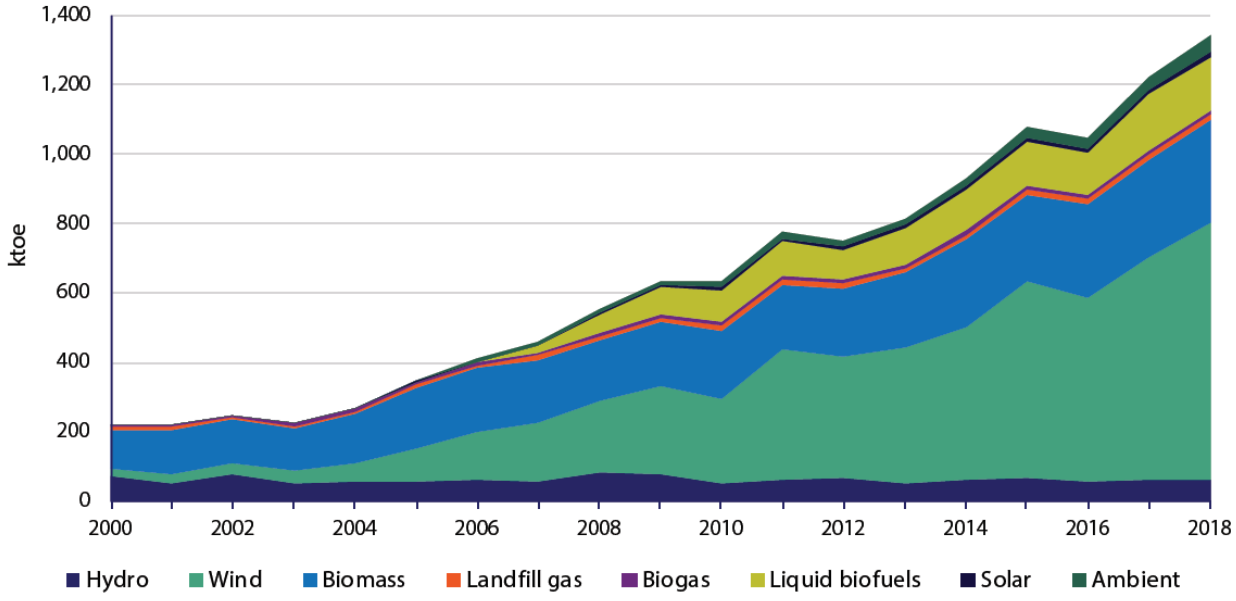

Figure 1. Growth in Renewable Energy Use in Ireland, 2000 to 2018 (Source: SEAI, 2020)

Figure 2 shows the progress towards the RES-T target, with and without the weightings applied. In 2018, the RES-T stood at 7.2%, compared to the 2020 target of 10% (SEAI, 2020).

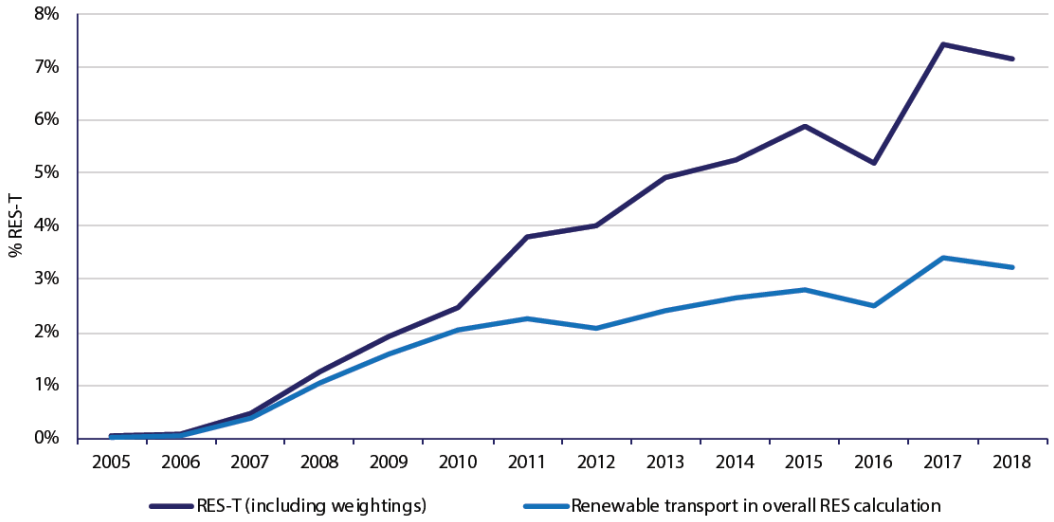

Figure 2. Growth in Renewable Energy Use in Transport in Ireland, 2005 to 2018 (Source: SEAI, 2020)

The total amount of renewable energy consumed in transport was approximately 156 ktoe in 2018. Over 81% of this amount came from biodiesel and 17% from biogasoline, with minor contributions from pure plant oil and renewable electricity (SEAI, 2020).

2. Main drivers for biofuels policy

RED is one of the main drivers for current biofuels policy in Ireland. Its transport related requirements were transposed into Irish law by the Energy (Biofuels Obligation and Miscellaneous Provisions) Act 2010 and several subsequent regulations. While the RED is the primary driver for increasing the penetration of renewables in the transport sector, Article 7a of the EU Fuel Quality Directive (FQD) and the Alternative Fuel Infrastructure Directive (3) also support increasing use of renewables. The RED and FQD establish mandatory targets for the penetration of sustainable biofuel and for reducing the carbon intensity of energy consumed in the transport sector. Article 7a of the FQD sets a target for suppliers of transport fuels to reduce the lifecycle carbon intensity of the fuels they supply by 6% relative to a 2010 baseline[1], by 2020.

Ireland's domestic policy (White Paper[2], National Mitigation Plan[3] and National Policy Framework on Alternative Fuels[4]) caters to these Directives, primarily through the Biofuel Obligation Scheme (BOS) and promoting electric vehicles. There are other measures, however they are generally aimed at improving energy efficiency rather than increasing the penetration of renewable energy and low carbon intensity fuels.

Meeting the RED and FQD targets in 2020 has been very challenging, particularly because of a much lower uptake of electric vehicle than was predicted. Consequently, the burden for reaching the 2020 targets has rested primarily on substituting sustainable biofuels for fossil fuels.

In the post-2020 period, the recast RED (RED II) will play a central role with respect to renewable fuels in transport. The recast Directive, published in December 2018, sets a specific target for the transport sector along with similar sub-targets and constraints already introduced by amendments to the RED.

RED II sets a target of 14% for renewable energy in transport (RES-T) by 2030. There are various sub-targets and constraints that are designed to transition the biofuel market away from crop-based biofuels, and from used cooking oil (UCO) and tallow-derived biofuels, to advanced biofuels. The 6% carbon intensity reduction target of the FQD will also continue to apply.

In addition to RED II, there are national policy objectives, which are generally driven by EU and international agreements such as the Paris Agreement. The Energy White Paper, the National Mitigation Plan, and the National Energy & Climate Plan (NECP) 2021-2030[5], set out Ireland's vision for, *inter alia*, decarbonising the transport system and increasing the incorporation of renewable energy. The NECP includes two 'with

[1] The fuel baseline standard (FBS) is 94.1 gCO_{2eq}/MJ.
[2] Department of Communications, Energy and Natural Resources. The Energy White Paper. *Ireland's Transition to a Low Carbon Energy Future, 2015-2030.* 2015
[3] Department of Communications, Climate Action and Environment. *National Mitigation Plan.* 2017
[4] Department of Transport, Tourism and Sport. National Policy Framework. *National Policy Framework Alternative Fuels Infrastructure for Transport in Ireland 2017 to 2030*. 2017
[5] Department of Environment, Climate and Communications. *Ireland's national Energy and Climate Plan 2021 – 2030.* 2020.

additional measures' scenarios that incorporate a move to E10[6] and B12[7] in 2030 – if this was to be achieved, Ireland would exceed the 14% RED II RES-T target.

In March 2021, the Irish government published the new "Climate Action and Low Carbon Development (Amendment) Bill 2021". When enacted, the Bill will commit the Irish government to moving to a climate resilient and climate neutral economy by the end of 2050. The Bill is described as "an ambitious piece of legislation", and commits to moving Ireland to a climate resilient and climate neutral economy by 2050. In its programme, the Irish Government has committed to a 7% average yearly reduction in overall GHG emissions over the next decade, and to net zero emissions by 2050. The 2021 Bill plans to implement various policies to help Ireland reach these goals. This includes a new system of 5-year economy-wide carbon budgets (albeit subject to further government approval), with a ceiling for total greenhouse gas emissions. It hopes to show Irish businesses, farmers and the community in general that climate action can be positive for the economy, i.e., allowing Ireland to reach its climate targets while creating jobs and sustainable growth in new sectors (GOV, 2020). Given that a large fraction of Ireland's overall GHG emissions comes from its transport sector, if Ireland is to push towards the higher GHG emission reductions envisaged in the Climate Bill, it will necessitate the increased use of renewable energy (biofuels, electricity and other lower carbon intensity fuels) in the transport sector.

3. Biofuels policy

3.1. Biofuels obligations

To help Ireland meet the renewable energy transport target of the RED, Ireland implemented the Biofuel Obligation Scheme (BOS), which was given effect in law by the Energy (Biofuel Obligation and Miscellaneous Provisions) Act 2010. This Scheme is one aspect of a twin approach to try and meet the EU target for the use of renewable energy in transport. The second was to encourage the accelerated development and usage of electric vehicles, for which Ireland originally had a target of 10% of vehicles by 2020. The BOS places an obligation on the suppliers of mineral oil to ensure that 12.359% (by volume) of all gasoline and diesel placed on the road transport market in Ireland is produced from renewable sources, e.g., bioethanol and biodiesel. The BOS was increased to this level for 2020, having previously been 11.111% (NORA, 2020).

The BOS was modified in 2018 and 2019 to incorporate the administration of transport fuel suppliers' compliance with Article 7a of the FQD, which was transposed into Irish law by Statutory Instrument No. 160 of 2017 (SI 160). Article 7a of the FQD has a broader scope than the RED and also includes fuels consumed in non-road mobile machinery (e.g., trains, tractors and mobile farm machinery) and inland waterway vessels. Designated fuel suppliers in Ireland, which are typically the same companies that are obligated under Ireland's BOS, are also required to comply with SI 160 and reduce the carbon intensity of the fuels they supply to transport by 6% by 2020.

It is expected that sustainable biofuels will play a significant role in supporting companies to meet both the RES-T target (10% renewable energy penetration requirement) and the carbon intensity reduction target of SI 160. However, the biofuel obligation, which implements the 10% RES-T of the RED, is not aligned with the

[6] Gasoline with 10% bioethanol by volume.
[7] Diesel with 12% biodiesel by volume.

6% carbon intensity reduction target of the FQD, i.e., reaching the 10% renewable energy target does not ensure that the 6% carbon intensity reduction target is achieved. In Ireland, reaching the 10% RES-T using sustainable biofuel (and a very small portion of renewable electricity), would give rise to a carbon intensity reduction of between 3% and 3.5% (NORA, 2020).

While achieving the 6% carbon intensity reduction target may necessitate additional biofuel being placed on the market in 2020 (based on available statistics at time of writing) and in the early part of the next decade (i.e., more biofuel than required to comply with the RES-T), the penalty contained in SI 160 for not complying with the 6% target is low, so it is not clear if it will be sufficient to incentivise increased biofuel blending. In addition, compliance with SI 160 can also be achieved by using carbon savings generated by electricity supplied to electric road vehicles and upstream emission reductions (UERs) (both additional mechanisms are allowed for in the FQD). The quantity of electricity supplied to electric vehicles is currently very small, because the number of electric vehicles in the Irish fleet is low. UERs are currently an unknown entity and their potential contribution towards the 6% carbon intensity reduction target is currently undetermined.

3.2. Excise duty reductions

Excise duty requirements on transport fuels consumed in Ireland are administered via a mineral oil tax. There are two components of the mineral oil tax: a carbon component and a non-carbon component. The non-carbon component depends on the type of fuel; the carbon component depends on the carbon emissions from the fuel when consumed. Thus, biofuels, which are counted as having zero tailpipe emissions, are not liable for the carbon component of the mineral oil tax.

The carbon tax was introduced in Ireland in 2010 and was based on a charge of €10 per tonne of CO_2 emitted. It has increased steadily over the years and was increased to €33.50 per tonne in Ireland's most recent national budget (applying from October 2020). This level of carbon tax equates to a cost of €77.52 per 1,000 litres of gasoline and €89.66 per 1,000 litres of diesel. The non-carbon component applies to both bio- and fossil-based fuels and is €541.84 per 1,000 litres of gasoline and €425.72 per 1,000 litres of diesel.

3.3. Fiscal incentives

Ireland's aforementioned BOS operates by awarding certificates for biofuels that have been demonstrated to be sustainable. One certificate is awarded for every litre of sustainable biofuel and two certificates are awarded when it can be demonstrated that the biofuel was manufactured from a waste or residue. At the end of each year, obligated parties are required to surrender sufficient BOS certificates to meet their obligations (i.e, 12.359% in 2020). Surplus BOS certificates can be traded between companies participating in the scheme. A buy-out charge of €0.45 per litre is payable at year-end if a company does not surrender sufficient certificates (BOC, 2020).

As discussed previously, SI 160 contains a requirement to decrease the carbon intensity of transport fuels in Ireland. Carbon savings can be claimed for sustainable biofuels, electricity consumed by road vehicles and by UERs. The quantity of carbon savings generated by biofuels depends on their lifecycle carbon intensity. For example, 1,000 MJ of biodiesel with a carbon intensity of 14 gCO_{2eq}/MJ will generate carbon savings of 80 kg CO_{2eq} (the fuel baseline standard is 94.1 gCO_{2eq}/MJ). Similar to BOS certificates, surplus carbon savings can

be traded between companies participating in the scheme (NORA, 2020). There is no buy-out charge contained in SI 160, but a maximum fine of €250,000 for non-compliance may be applied.

4. Market development and policy effectiveness

As shown in Figure 3, there has been a relatively consistent growth in the use of liquid biofuels, in particular biodiesel, in the Irish road transport sector. The trajectory matches to a large extent the increasing biofuel obligation. Occasional reductions in the quantities of biofuels placed on the market from year-to-year can be explained by the fact that Ireland's BOS allows obligated parties to carry forward excess certificates for a period of two years (there is a limit on how many certificates carried forward from previous periods can be used to discharge the obligation). This affords the obligated parties some flexibility in their biofuel blending strategies and to marginally reduce the quantity of biofuel placed on the market in a given year while maintaining compliance with the obligation.

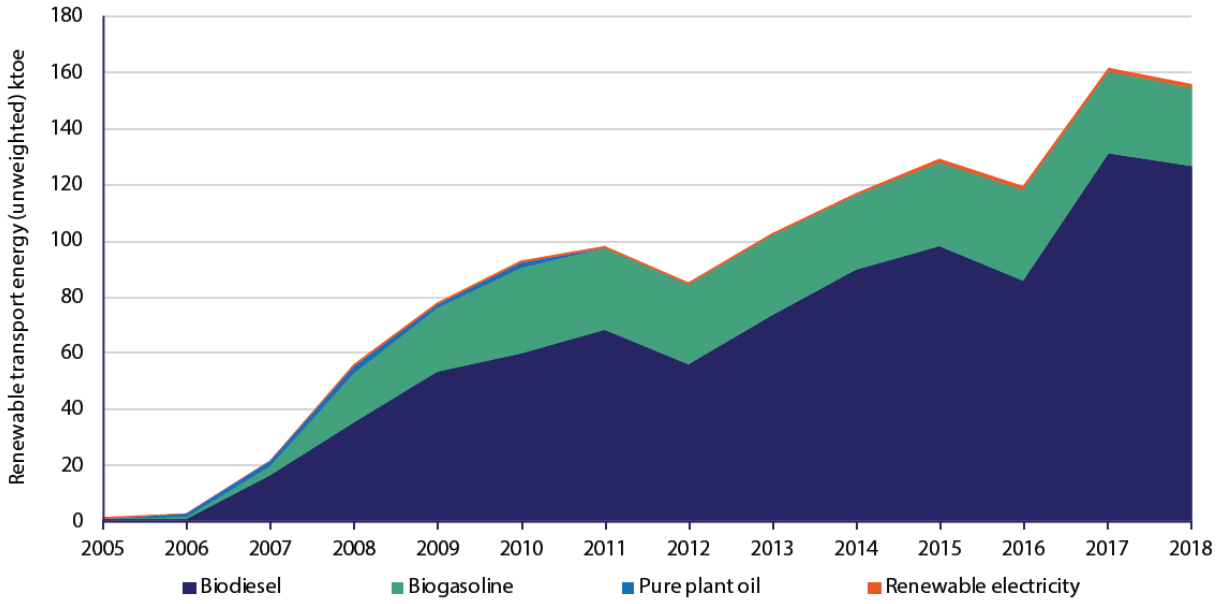

Figure 3. Growth in Biofuels Use in Transport in Ireland, 2005 to 2018 (Source: SEAI, 2020)

By a considerable margin, biofuels are the dominant source of renewable energy used in transport in Ireland. Biodiesel in particular is relied upon because the road transport market is dominated by a diesel fleet, and, to a lesser extent, because Ireland's fuel suppliers have continued to supply E5 to the gasoline fleet rather than beginning to supply E10. Reliance on biodiesel has intensified over the years because biodiesel is the most efficient way of meeting the biofuels obligation; this is because the vast majority of the biodiesel placed on the market in Ireland is produced from UCO and Category 1 tallow, which are both widely available feedstocks that generate two certificates per litre of produced biofuel.

In terms of indigenous biofuels production, the current biodiesel capacity is approximately 60 million litres (c. 47 ktoe); all of it is produced from UCO or tallow. Some bioethanol for the transport market is also produced indigenously from whey permeate (a residue from cheese production) (NORA, 2020), albeit in relatively small quantities (c. 4 ktoe in 2019).

In addition to bioethanol and biodiesel, bioLPG (i.e.,biopropane) is also supplied to the transport market in Ireland, albeit in relatively small quantities. Compressed natural gas (CNG) is also supplied via a small number of retail forecourts and to some captive road transport fleets. It is worth noting that biogas/biomethane (i.e., renewable natural gas, RNG) has long been identified as having considerable potential to augment the volumes of renewable energy entering the Irish transport system (Murphy et al., 2013, and IEA Bioenergy, 2018).

Sources

BÓC, 2020. Development of Ireland's biofuels obligation scheme; http://boc.ie/Case-Studies/Development-of-biofuels-obligation-scheme

Citizens Information, 2020. Statutory body supporting the provision of information, advice and advocacy on a broad range of public and social services in Ireland. Carbon Tax page; https://www.citizensinformation.ie/en/money_and_tax/tax/motor_carbon_other_taxes/carbon_tax.html

GOV, 2020. Official Irish Government website; https://www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2020/

IEA Bioenergy, 2018. Ireland Country Report, 09/2018; https://www.ieabioenergy.com/wp-content/uploads/2018/10/CountryReport2018_Ireland_final.pdf

IEA Bioenergy, 2018a. Green Gas. Facilitating a future green gas grid through the production of renewable gas. IEA Bioenergy Task 37, 2018:2; https://www.ieabioenergy.com/wp-content/uploads/2018/04/green_gas_web_end.pdf

Murphy, J.D., Korres, N.E., Singh, A., Smyth, B., Nizami, A.S. and Thamsiriroj, T. 2013. The Potential for Grass Biomethane as a BiofuelCompressed Biomethane Generated from Grass,Utilised as a Transport Biofuel. Report prepared for the Irish Environmental Protection Agency; https://www.epa.ie/pubs/reports/research/climate/ccrp11-thepotentialforgrassbiomethaneasabiofuel.html

NORA, 2020. Irish National Oil Reserves Agency. Biofuels Obligation Scheme; https://www.nora.ie/biofuels-obligation-scheme.141.html

SEAI, 2020. Renewable Energy In Ireland, Updated April 2020; https://www.seai.ie/publications/2020-Renewable-Energy-in-Ireland-Report.pdf

In the News

Reports and Research

- January – Co-Optima research develops roadmap for biofuels design. As Oak Ridge National Laboratory's fuel properties technical lead for the U.S. Department of Energy's Co-Optimization of Fuel and Engines, or Co-Optima, initiative, Jim Szybist has been on a quest to identify the most significant indicators for predicting how a fuel will perform in engines designed for light-duty vehicles such as passenger cars and pickup trucks (Read more).
- February – New analysis from a renowned carbon accounting firm finds that the greenhouse gas (GHG) emission reductions achieved under the U.S. Renewable Fuel Standard far exceed the reductions originally projected by EPA. Between 2008 and 2020, the use of biofuels under the RFS resulted in cumulative savings of 980 million metric tons of carbon dioxide-equivalent GHG emissions (Read more).
- March – An IEA Bioenergy News Bulletin was released with a feature article entitled "Contribution of sustainable biomass and bioenergy in industry transitions towards a circular economy – Summary and conclusions". This bulletin also summarizes activities that are recently completed or underway within different IEA Bioenergy Tasks and the future ExCo meeting and IEA Bioenergy End-of-Triennium Conference 2021 (Read more).
- March – The U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO) hosted its virtual 2021 Project Peer Review wherein projects within BETO's research and development portfolio were presented to the public and systematically reviewed by external subject-matter experts from industry, academia, and federal agencies. The agenda and a searchable database of presentations are available now and a 2021 Project Peer Review Report will be published at a later date (Read more).
- April – The Co-Optima FY20 review report was released, highlighting the most significant breakthroughs of the last year in the U.S. DOE's Co-Optimization of Fuels & Engines (Co-Optima) initiative, with details on findings that could translate into significant GHG and tailpipe emissions reductions (Read more).
- May – The U.S. Department of Agriculture (USDA) published a 90-Day Progress Report on Climate-Smart Agriculture and Forestry. This report is in response to President Biden's Executive Order on Tackling the Climate Crisis at Home and Abroad, which directed USDA to collect stakeholder input on how to best use its programs, funding and financing capacities to encourage the voluntary adoption of climate-smart agricultural practices (Read more).
- May – The International Energy Agency (IEA) released a roadmap for realizing net-zero carbon dioxide (CO_2) emissions in the energy sector by 2050. This report outlines the essential conditions for the global energy sector to reach net-zero CO_2 emissions by 2050 and presents the "most technically feasible, cost-effective and socially acceptable pathway" for achieving this (Read more).

Policy and Regulatory Developments

- December – The Canadian federal Department of Environment and Climate Change, which has focused its new Clean Fuel Standard on liquid fossil fuels, released its updated climate and clean growth plan entitled, "A Healthy Environment and a Healthy Economy" (Read more).
- December – In Canada, effective Jan. 1, 2021, the amount of ethanol required in gasoline in the province of Manitoba will increase to 9.25% from 8.5%. It will further grow to 10% on Jan. 1, 2022. The biodiesel requirement will increase to 3.5% from 2% on Jan. 1, 2021, and will further rise to 5% on Jan. 1, 2022 (Read more).
- December – In Thailand, after several delays, E20 is set to become the standard gasoline at the pump across the country by July 2021. Currently, E10 is the standard fuel at the pump, with both 91 and 95 octane options available. E20 will be 95 octane only. The most recent delays to this policy shift were due to the priority placed on ethanol for hand sanitizers to battle COVID-19 rather than blending with fuel (Read more).

- December – In France, the country's parliament is looking to implement a 2% biofuel blending mandate for aviation by 2025 in an effort to create demand for sustainable aviation fuel (SAF) that will lead to increased SAF production and lower fuel prices. The policy would then call for 5% blending by 2030 followed by 50% blending in 2050. Total has called for similar policies across the European Union as well as internationally to facilitate the energy transition (Read more).
- January – The U.S. Environmental Protection Agency finalized GHG emission standards that apply to certain new commercial airplanes, including all large passenger jets. These standards match the international airplane CO_2 standards adopted by the International Civil Aviation Organization in 2017 (Read more).
- January – In India, the country has officially brought back the implementation of its 20% ethanol blending mandate to 2024/25, five years earlier than previously planned, in an effort to more quickly reduce fossil fuel imports. A 10% blending target for 2022 remains in place, up from less than 1% blending against a 5% mandate in 2014. A total of 10 billion liters of ethanol production will be required to achieve the 20% blending mandate (Read more).
- April – In conjunction with U.S. President Biden's Leaders Summit on Climate, Canada and the United States announced a new initiative to engage governments around the world in greening government operations. Leading by example, the two countries also announced they will collaborate as they each work towards their shared goal of net-zero emissions government (Read more).
- April – The European Commission has confirmed that the upcoming ReFuelEU Aviation initiative will impose a sustainable aviation fuel (SAF) blending mandate, with the EU executive suggesting it will apply to all flights taking off from European airports, regardless of whether their destination is inside or outside the EU bloc (Read more).
- April – In Colombia, RCN Radio announced Colombia's government has increased its biodiesel blend to 12% from 10% in contrast to Brazil, which has reduced its biodiesel blend to 10% from 12%. Many parts of Columbia will see the higher blend as of April, while the states of Amazonas, Archipelago of San Andrés, Providencia and Santa Catalina, Chocó, Nariño and Putumayo will get B12 in October. Other states will see gradual ramping up of the blend level through 2022, including those that currently only have 2% blending (Read more).
- May – In the U.S., state of Washington Governor Jay Inslee signed legislation that will create a state-wide Clean Fuel Standard that will limit the aggregate, overall GHG emissions per unit of transportation fuel energy to 20 percent below 2017 levels by 2035 (Read more).
- May – in the U.S., the Biodiesel, Renewable Diesel and Alternative Fuels Extension Act of 2021 was introduced, which would extend and phase down the existing tax credits for these fuels. The bill, H.R. 3272, aims to extend the existing 40A tax credit for biodiesel and renewable diesel through the end of 2025. The credit is currently in place through the end of 2022. The credit would be maintained at its existing $1 per gallon value through the end of 2022, and phase down to 75 cents per gallon in 2023 and 50 cents per gallon in 2024 and 2025 (Read more).
- May – In the U.S., the Sustainable Aviation Fuel Act was introduced, which aims to incentivize the production of SAF and establish an aviation-only Low Carbon Fuel Standard. The bill, S. 1608, introduced by Senator Sheldon Whitehouse (D-R.I.) aims to create a grant program authorized at $1 billion over five years to expand the number of facilities producing SAF and build out the necessary supporting infrastructure. (Read more).
- May – In the U.S., the Sustainable Skies Act was introduced, which aims to create a tax credit to encourage blending of SAF. The credit's value would be based on GHG emissions reductions and would be in place through the end of 2031. The credit, starting at $1.50 per gallon, would be available to blenders of SAF that can demonstrate 50% or

greater lifecycle GHG emissions reductions compared to standard fossil-based jet fuel. An additional 1 cent per gallon could be claimed for each percentage the fuel reduces emissions over 50% (Read more).

- May – In the U.S., for the first time in four years, EPA relaunched its Climate Change Indicators on its public website. The site features interactive data-exploration tools offering a closer look at graphs, maps, and figures, the importance of indicators and how climate change can affect human health and the environment (Read more).

- May – The U.S. Department of Energy (DOE) announced more than $61 million for technologies and processes that produce low-cost, low-carbon biofuels made from renewable resources to power heavy-duty vehicles that are difficult to electrify with current technologies—including airplanes and ships—to help accelerate America's path to a net-zero emissions economy by 2050 (Read more).

Industry Developments

- December – In the U.S., Gevo, Inc. announced it has supplied SAF to further support carbon neutrality goals in the aviation industry. Gevo's customer and global fuel supplier, Avfuel Corporation, delivered a demonstrative load of SAF to fixed-base operator Leading Edge Jet Center's Seattle, Washington facility (Read more).

- December – In Finland, UPM Biofuels joined the BIKE project that promotes low-ILUC risk biofuels production for European Bioeconomy. The project brings together companies and research organizations who believe that novel, safe and reliable biomass value chains can be deployed to produce food, feed, biofuels and biomaterials with a low risk of generating indirect land use change (Read more).

- December – In the U.S., Neste signed an agreement to supply SAF to DHL Express in California. DHL Express is the express service arm of Deutsche Post DHL Group, the world's leading mail and logistics company, renowned as a pioneer of green logistics. Through this agreement Neste has commenced supply of SAF with immediate effect to DHL Express at San Francisco International Airport (SFO) (Read more).

- January – In the Netherlands, the FLITE consortium, led by SkyNRG and with LanzaTech as the technology provider, will build the first-of-its-kind LanzaJet Alcohol to Jet (AtJ) facility. The facility will convert waste-based ethanol to SAF at a scale of over 30,000 tons/yr. The project received €20 million in grant funding from the EU H2020 program and is a major milestone on the path to achieving net-zero emission for the aviation industry (Read more).

- January – In Canada, Shell will have a 40% interest in a plant using technology developed by Enerkem. Enerkem announced the project in December 2020, subject to finalization of commercial agreements. The approximately C$875 million commercial-scale facility will be constructed in Varennes, Québec, and will produce low-carbon fuels and renewable chemicals products from non-recyclable wastes using Enerkem's proprietary technology. The first phase of facility commissioning is scheduled for 2023. Critical investment in the plant comes from Shell, Enerkem, Suncor, Proman and Hydro-Québec, as well as from the Québec and Canadian governments (Read more).

- January – In the U.S., Honeywell announced that it has introduced a single-stage UOP Ecofining technology offering for the production of renewable diesel fuel. The new single-stage technology is a fast-to-market, lower capital cost solution that is ideal for repurposing underutilized hydrotreating or hydrocracking units, producing higher yields of renewable diesel fuel than other single-stage technologies (Read more).

- January – In France, Bolloré Logistics has joined the SAF program of Air France KLM Martinair Cargo (AFKLMP Cargo) for its 2021 shipments between Paris Charles de Gaulle and New York John F. Kennedy airports. This first of its kind collaboration illustrates the ambition of these two historical partners to tackle the environmental challenge of airfreight transportation (Read more).

- January – In the U.S. state of Washington, Boeing is setting an ambitious target to advance the long-term sustainability of commercial aviation, committing that its commercial airplanes will be capable and certified to fly on 100% sustainable aviation fuels by 2030. Boeing has previously conducted successful test flights replacing petroleum jet fuel with 100% sustainable fuels to address the urgent challenge of climate change (Read more).

- January – In Denmark, a CVR Energy, Inc.'s subsidiary has selected Haldor Topsoe's HydroFlex technology for its revamp of an Oklahoma refinery to renewable diesel production. Construction has already begun on the $110 million project that will see 100 million gallons of renewable diesel production annually starting from July 2021. The project will convert an existing hydrocracker for the production of low-carbon renewable diesel from soybean oil, resulting in a reduction of GHG emissions compared to fossil hydrocarbon diesel (Read more).

- January – In the U.S., LanzaTech said that a commercial ethanol facility in China that utilizes LanzaTech technology, is the only commercial Roundtable on Sustainable Biomaterials (RSB)-certified facility in China, and the first of its kind anywhere to receive this key certification for carbon capture and utilization (Read more).

- February – In Finland, UPM is moving forward with biofuels growth plans and started the basic engineering phase of a next generation biorefinery. The potential biorefinery would have an annual capacity of 500,000 metric tons of high-quality renewable fuels including sustainable jet fuel. The products would significantly reduce carbon footprints in the road transport and aviation sectors, as well as replace fossil raw materials with renewable alternatives in chemicals and bioplastics (Read more).

- February – In the UK, Velocys plc has signed a collaboration agreement with Toyo Engineering Corporation (Toyo) to start the development of their commercial projects to produce Sustainable Aviation Fuel (SAF) and other renewable fuels in Japan (Read more).

- February – In the UK, British Airways is investing in SAF technology provider and producer LanzaJet as the company builds its first commercial scale plant in Georgia, USA. British Airways will purchase SAF from LanzaJet's US plant to power a number of airline flights from late 2022. The deal also involves LanzaJet conducting early-stage planning for a potential large scale commercial SAF biorefinery in the UK (Read more).

- April – In France, Total began producing SAF at its La Mède biorefinery in southern France and its Oudalle facility near Le Havre. The biojet fuel, made from used cooking oil, will be delivered to French airports starting in April 2021. Total will also be able to produce SAF from 2024 at its zero-crude Grandpuits plant southeast of Paris (Read more).

- April – In the U.S., Worley has been awarded a front-end engineering services contract by Phillips 66 to convert its San Francisco refinery in Rodeo, California into a renewable fuels manufacturing facility. This project will reconfigure the refinery to produce up to 650 million gallons per year of renewable transportation fuels from used cooking oils, fats, greases and vegetable oils. Once built, this renewable fuels facility is expected to be one of the world's largest of its kind (Read more).

- April – In Canada, Topsoe signed a contract with Tidewater for delivery of Topsoe's HydroFlex technology in Canada. The technology will be utilized in a new 3,000 barrels per day renewable diesel facility that, subject to receipt of Tidewater's final investment decision, will be constructed at the site of Tidewater's existing Prince George refinery in British Columbia, Canada. When operational, the facility is expected to be Canada's first commercial-scale stand-alone renewable diesel plant (Read more).

- April – In the Netherlands, Neste will modify its existing renewables production capacity in Rotterdam to enable production of SAF. Currently the refinery produces mainly Neste MY Renewable Diesel™. The modifications to the

refinery, an investment of approximately EUR 190 million, will enable Neste to optionally produce up to 500,000 tons of SAF per annum as part of the existing capacity (Read more).

- April – In Singapore, BHP, Oldendorff Carriers, and GoodFuels, with the support of the Maritime and Port Authority of Singapore (MPA), conducted the first marine biofuel trial involving an ocean-going vessel bunkered in Singapore (Read more).

- May – In France, Technip has been awarded two contracts by Neste for work on the development of their renewables production platform in Rotterdam, the Netherlands, as part of the existing Partnership Agreement between Neste and Technip Energies (Read more).

- May – In Sweden, Topsoe and Preem have together finished revamping Preem's Gothenburg refinery, which is part of Preem's endeavors to reduce Sweden's total carbon emissions by 20%. This is the second revamp of the hydrotreater, following a revamp in 2010 that upgraded the unit to co-process 30% renewable feedstock using Topsoe's HydroFlex™ technology. The unit was one of the first in the world capable of processing renewable feedstock. With this second revamp, Preem and Topsoe have achieved 85% co-processing of renewable feedstock, continuing to advance renewable fuel production. Preem uses tallow and raw tall oil as main feedstocks (Read more).

Upcoming Meetings, Conferences & Webinars

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

June
- Oleofuels 2021, 9-10 June 2021, Marseille, France
- 13th ICIS World Oleochemicals Conference, 23-24 June 2021, Online event
- World Sustainable Energy Days, 21-25 June 2021, Wels, Austria

July
- Argus Live: Carbon Markets and Regulation, 15-16 July 2021, Online event

August
- 19th International Conference on Biofuels & Bioenergy, 16-17 August 2021, Amsterdam, Netherlands

September
- 17th International Conference on Renewable Resources and Biorefineries (RRB), 6-8 September, Aveiro, Portugal
- World Circular Economy Forum 2021, 13-15 September 2021, Toronto, Canada
- Expobiomassa 2021, 21-23 September 2021, Valladolid, Spain
- Progress in Biogas V, 22-24 September 2021, Stuttgart, Germany
- 2021 Algae Biomass Summit, 28 September 2021, Online event

October
- International Conference on Biofuels, Bioenergy and Bioeconomy, 4-6 October 2021, Vancouver, Canada
- Future of Biofuels 2021, 5-6 October 2021, Copenhagen, Denmark
- Biofuels International Conference & Expo, 19-10 October 2021, Brussels, Belgium
- Future of Biogas Europe, 27-28 October 2021, Berlin, Germany
- ABLC 2021, 27-29 October 2021, San Francisco, USA

November
- Bioenergy for Future, 1 November 2021, Online event

- COP26 (26th UN Climate Change Conference of the Parties), 1-12 November, Glasgow, United Kingdom

Upcoming 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 affecting travel and in person "gatherings". Task 39 will likely hold its next business meeting in a virtual or hybrid format in November 2021. The expected focus of the meeting will be updates on Task projects recently completed or almost completed as well as finalizing the Task's program of work for the coming triennium. More details will be provided in the next newsletter.

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