Julie's Bicycle
SUSTAINING CREATIVITY

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ARTS COUNCIL ENGLAND

Powering live events with BIOFUELS

What to know, ask and do

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Powering live events with BIOFUELS

With event organisers increasingly keen to reduce the environmental impact of events, energy consumption has become one of the priority areas of concern[1]. In particular, the use of alternative fuels, including biofuels, is increasing due to better price competitiveness, availability and the ease of newer fuel types being 'drop-in' solutions.

The EU's Renewable Energy Directive (RED) is seen as one of the largest drivers of biofuel usage. However, the EU framework has been met with criticism as there are still no requirements that address social issues such as displacement of locally affordable oils, food or land security, and water and air quality.

1 What are Biofuels?

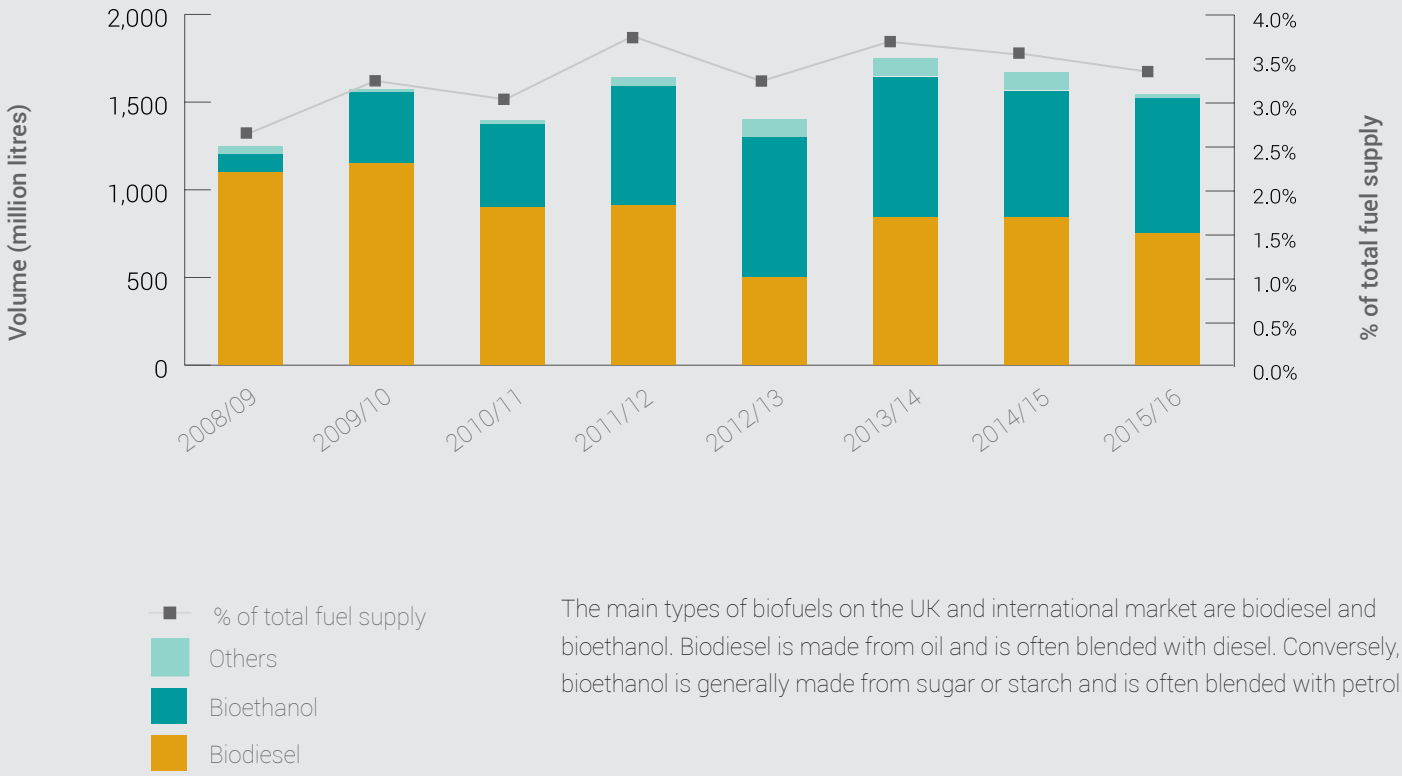
Biofuels are essentially fuels that are made from any plant-like or organic material, known as biomass. Normally, they are separated into three main categories, called 'generations', according to the type of material used.

Table 1: Biofuel types

	1st Generation biofuels	2nd Generation biofuels	3rd Generation biofuels
What are they made from?	Sugary, starchy and oily plants that are also edible food sources. e.g. corn or rapeseed	Wastes or Woody and oily plants that are not edible food sources. e.g. grass or waste oil	Algae
Are they economically viable yet?	Yes	In most cases, no. Especially not at scale.	No
So what's the problem?	• Competition with food production • Spikes in food prices • Displacement of crops • Deforestation • Loss of biodiversity • Displacement of local communities • Carbon emissions from clearing forests, soil erosion, fertiliser use and transport of feedstocks	• Conversion of woody plants to bioethanol is complex and too expensive. • Collection of used cooking oil is difficult and costly as it is sparsely and widely distributed throughout homes and restaurants	• Requires large amounts of water, nitrogen and phosphorus to grow. • More GHG emitted making the fertilisers needed than GHG saved by not using fossil fuels

[1] *In the Powerful Thinking Industry Green Survey 2015, 2016 and 2017, energy is ranked as one of the three priorities for event organisers in managing their environmental impacts.*

Chart 1: Supply of biofuels in the UK by fuel type[2]



The main types of biofuels on the UK and international market are biodiesel and bioethanol. Biodiesel is made from oil and is often blended with diesel. Conversely, bioethanol is generally made from sugar or starch and is often blended with petrol.

Table 2: About fuel types

Scientific Name	Other Names	Description
Fatty Acid Methyl Esters or FAME biodiesel	Biodiesel, WVO (when made from waste material), traditional biodiesel	A type of biofuel produced by reacting animal fats or vegetable oils (e.g. soya bean, palm or waste vegetable oils) with methanol and a catalyst (e.g. sodium hydroxide) to produce a methyl ester.
Hydrotreated Vegetable Oil or HVO	Green diesel, Renewable diesel. Biodiesels are named after their feedstock as their physical attributes take after the underlying feedstock – PME (Palm methyl esters), SME (Soya methyl esters), RME (Rape seed methyl Esters,) and UCOME (Used cooking oil methyl esters).	A type of renewable diesel fuel produced by hydro-treating vegetable oils, such as rapeseed. Unlike regular biodiesel, hydrogen is used as the catalyst in the creation process instead of methanol. Can also be called green diesel or renewable diesel.

[2]Government of UK, Biofuels Statistics (February 2018)

FACT

Of the 50 participating festivals in the annual UK Industry Green Survey 2017, 20% said they are using sustainably sourced HVO fuel and 20% are now using hybrid technology

Because pure bioethanol can only be used in specially adapted engines, the two most common types of pure biofuels on the UK and EU market are traditional biodiesel and HVO diesel. These biofuels are both used in diesel engines but differ in their chemical composition due a different refining process used in their manufacture.

2 Understanding the Environmental Impact

There are potential benefits of using biofuels to help reduce our dependency on fossil fuels and reduce associated greenhouse gas emissions. However, there are valid concerns that some biofuels do more harm than good, and can event cause more emissions than fossil diesel.

The most controversial are '1st generation' biofuels. Aside from issues with food security, spikes in food prices and dedicated energy crops displacing local communities and casuing destruction of areas of natural environment, the production of some 1st generation biofuels leads to more greenhouse gas emissions than if the equivalent amount of fossil fuel was burnt. Use of these biofuels not only defeats the original aim of reducing carbon emissions, but can also lead to harmful environmental impacts on biodiversity, conservation and land, water, air quality as well as harmful social impacts.

FACT

Biofuels are considered 'carbon-neutral' as they absorb the same amount of carbon dioxide when they grow, as the carbon dioxide released when they are burned.

However...
All biofuels have indirect emissions from their production and transportation. This can vary significantly among different biofuels.

Exhaust Emissions

The use of biofuels generates various pollutants, similar to those of conventional fuels:

- Particle matter (PM)
- Carbon monoxide (CO)
- Nitrogen oxides (NOx)
- Unburned hydrocarbons (HC)
- Volatile organic compounds (VOCs)

Unlike conventional fuels, biofuels do not contain sulphates and so do not emit sulphur dioxide, a major cause of acid rain. Unburned hydrocarbons, NOx and VOCs contribute to smog and ground level smog formation. These pollutants have also been linked to adverse health effects, especially in urban areas.

Generally bioethanol leads to more complete fuel combustion and fewer emissions than biodiesel. However, whereas diesel engines can use pure biodiesel or HVO, bioethanol is generally blended with conventional petrol for use in petrol engines.

Table 3: Bioethanol and biodiesel emissions in comparison with conventional fuels[3,4]

	PROS		CONS	
Bioethanol Blends (E5 to E15)	Lower levels of CO and PM	Comparative levels of NOx	Higher levels of acetaldehyde (precursor to VOCs)	
Bioethanol Blends (E85)	Comparative or slightly lower levels of PM, NOx and CO		Five to 10 times higher levels of acetaldehyde - precursor to VOCs	
Biodiesel Blends	Negligible differences in emissions (Blends of 5%-20%)			
Pure Biodiesel (B100)	Lower levels of PM, CO, hydrocarbons and VOCs		Higher NOx emissions	Higher proportion of ultra-fine particles
HVO Diesel	Initial studies show lower levels of all emissions in comparison with conventional fuels. HVO is comparable to regular biodiesels for PMs. Further research is currently underway in this area.			

Consistent testing of tailpipe emissions is also a significant challenge since they are affected by many different parameters, including the type of engine and how it is run (the operational drive cycle), vehicle age and maintenance, the quality of the base fuel and exhaust after treatment. Therefore the topic of air quality and health impacts from biofuels remains open to debate, requiring further research and evidence.

[3]Royal Academy of Engineering, Sustainability of Liquid Biofuels (July 2017)
[4]SAE International, Hydrotreated Vegetable Oil (HVO) as a Renewable Diesel Fuel, 2008, Aatola H. et al

Supply Chain Emissions

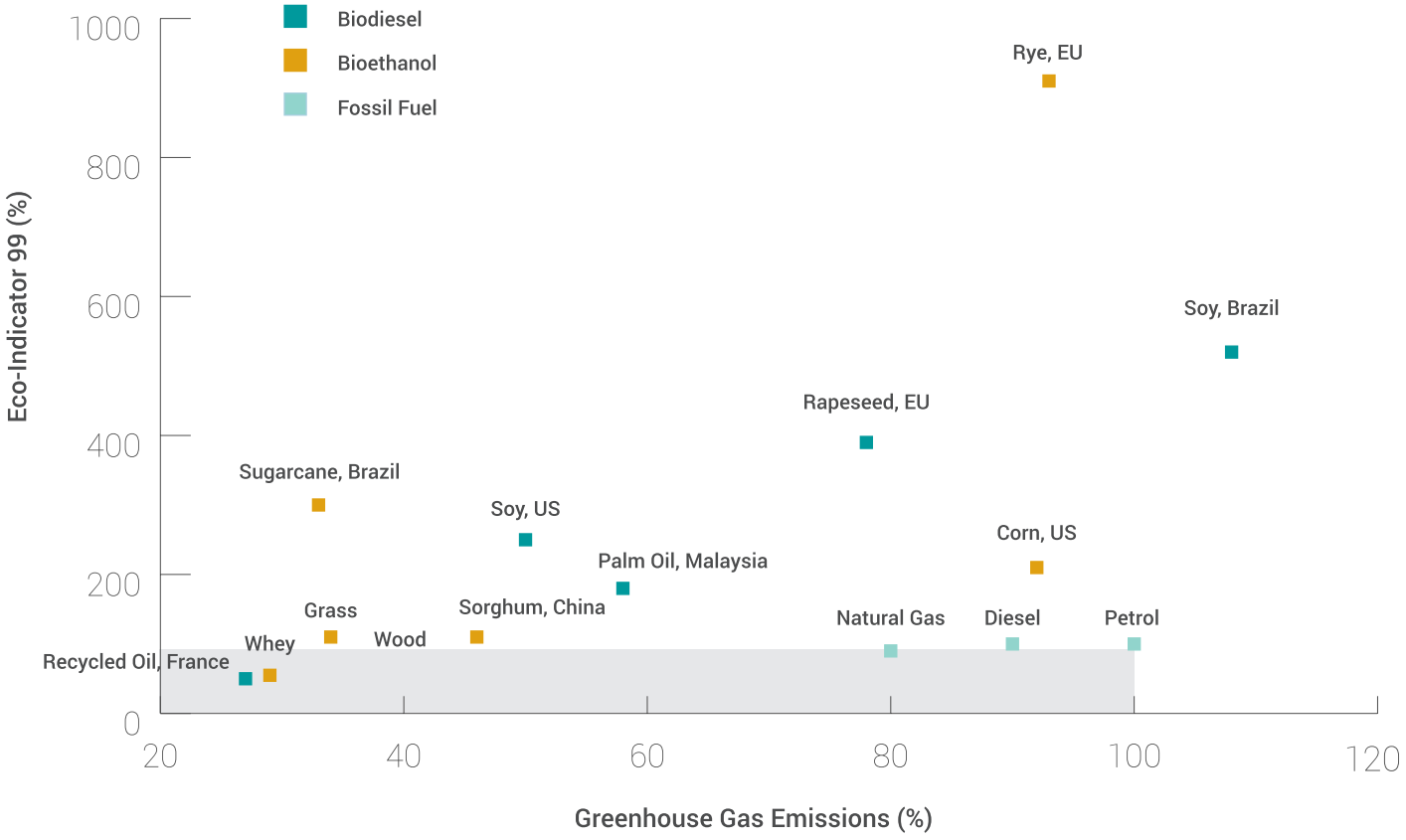
It must also be noted that the long-range transport of biofuels and feedstocks result in additional GHG and other emissions, especially from the low-grade fuels used shipping, including sulphur dioxide (SO_2), nitrogen oxides (NOx) and particulate matter (PM). Its is estimated that transport of biofuels can contribute 7-38% to the total carbon footprints, for biofuels that are transported over 10,000 km.

Comparing Biofuels by Environmental Impacts

To really know if a specific biofuel is 'greener' than oil, all the environmental impacts across the entire production chain and life-span of that biofuel need to be assessed, usually in the form of a 'Life Cycle Analysis' (LCA). This is a lengthy and complicated process, which luckily Swiss researchers have already conducted and neatly summarised with two key indicators; Greenhouse Gas Emissions and Overall Environmental Impact (Eco-indicator 99).

If you want to choose a biofuel with less carbon emissions and a lower environmental impact than petrol, then you can check whether they lie in the grey box of the graph below.

Chart 2: Greenhouse Gas Emissions vs. environmental impacts for several biofuels according to Feedstocks (Source: Zah, R. et al., 2007)

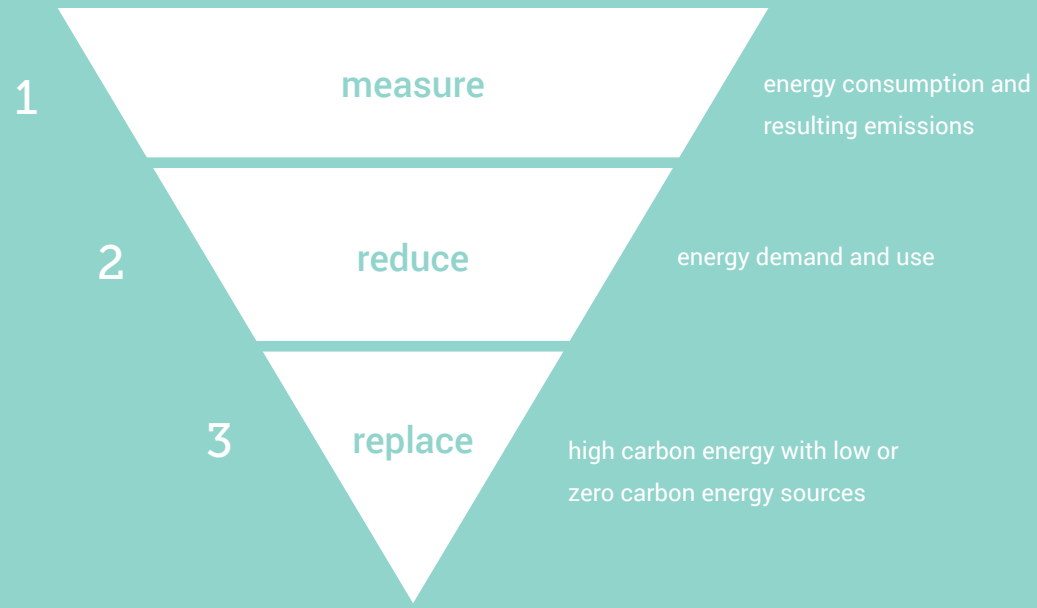


Firstly, not all biofuels are better than fossil fuels, and biofuels alone will not solve our addiction to fossil fuels due to limited supply. However, biofuels that are genuinely made from **waste products** and not virgin crops typically cause less emissions and have fewer associated environmental impacts than other choices, so are recommended as usually the best option. You can check your fuel type in **Chart 2**.

Whether you are able to use a sustainable biofuel or not, **energy efficiency** and **reducing your fuel use** remains an important and effective way to reduce your environmental impact, with many events in recent years achieving savings of up to 40%.

See the **Smart Energy for Festivals and Event guide** (Powerful Thinking, 2017) for comprehensive information about how to manage energy sustainably at events.

Energy Use Hierarchy



3 The Legislative Landscape

Because most biofuels are still more expensive than fossil fuels, both the UK and EU use subsidies and mandates to increase their deployment.

The EU's Renewable Energy Directive (RED) is seen as one of the largest drivers of biofuel usage. Part of this framework includes a mandatory national target which sets a minimum share of 10% of renewable energy in transport by 2020. This is considered achievable only through a substantial use of biofuels as the scope for electrification in the transport sector, at least for several decades, is limited.

This EU directive is blamed by many campaigners, such as Greenpeace, for the rapid growth of environmentally damaging biofuels on the market. To address these concerns, the EU has set a number of sustainability criteria to be met for the biofuels that contribute to national targets.

- A minimum level of greenhouse gas savings compared to using fossil fuels – which, in 2017 rose from 35% to 50%.
- Land criteria that excludes biofuels made from crops grown on peat lands or land with high levels of biodiversity.
- Good agricultural practices protecting soil, water and air are applied.

Unfortunately there are still no requirements that address social issues such as displacement of locally affordable oils, food or land security, and water and air quality.

FACT

In 2017, 63% of all UK biofuel supply was demonstrated to meet RED sustainability criteria. This is equal to 491 million litres (Government of UK, 2018)

The EU legislation was changed again in 2015 to cap the contributions from food-based crops to 7%, for the 10% renewable fuel target. The UK has gone further than the EU and mandated a 2% only by 2032 down from 4% now for the use of food-based crops for biofuels. Second Generation biofuels were also incentivised as they now must supply at least 0.5% of the overall 10% share, and their contributions to the EU mandate are 'double-counted'. This means only half the volume of biofuels are needed to meet this target, if they come from wastes, residues or other non-food smaterials.

In 2008, the UK brought into force the Renewable Transport Fuel Obligation (RTFO) to deliver the objectives set out in RED. Any company supplying more that 450,000 litres of fuel to the UK market must conform to the RTFO.

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IN FOCUS

Palm Oil Based Biodiesel

> On the EU-27 scale, the biofuels industry has increased its use of palm oil by 365% over 2006-2012, which can be linked primarily to the growth in biodiesel production stimulated by government policies during the same period.
>
> (International Institute for Sustainable Development, 2013)

In January 2018, the EU parliament voted to approve a proposal that bans the use of palm oil in fuels from 2021, and also bans any food-based biofuels from 2030. Palm oil is the second most popular biodiesel feedstock in the EU and the its use for biofuels is increasing. However, there are many concerns that this demand for palm oil is driving plantation expansion and deforestation in countries such as Malaysia and Indonesia.

EU suppliers of biodiesel often source a range of palm based material for their biodiesel, including; Palm Fatty Acid Distillate (PFAD), Palm Oil Mill Effluent (POME), palm oil olein, palm kernel oil, palm stearin and bleached earth clays. In the UK, POME and empty palm fruit bunches are the only palm based feedstocks that are classified as a waste or residue. Though many companies claim PFAD is also a residue, this is considered controversial as PFAD can be used for a wide range of products including soaps, candles and animal feed.

The new EU proposal to ban palm based feedstocks has been welcomed by environmental campaigners as there have been many compliance concerns regarding the existing palm oil sustainability schemes such as of the Roundtable for Sustainable Palm Oil (RSPO) or the Indonesian Palm Oil Council (GAKPI). Analysis by the Zoological society of London found that nearly a million hectares of undisclosed land owned by the world's major palm oil companies had gone missing from the inventories. Greenpeace has also claimed that government regulation in palm oil producing countries, such as Indonesia, cannot be relied on because of political corruption.

If carbon-rich forest is cleared and swamps drained to make way for palm plantations, this would clearly undermine efforts to reduce GHG emissions through the use of biofuels. Therefore, it is crucial that there is transparency and traceability across the biofuel's supply chain, ensuring that the palm oil purchased is from a producer with a strict no-deforestation policy.

To meet growing demand, palm oil is a popular choice to supplement feedstocks used in HVO production, owing to its higher melting point and low cost. Neste Oil is currently the largest producer of HVO diesel in the global and EU market, with an annual production of 2.4 million tonnes and a market share of 69%. Though Neste have significantly reduced their consumption of palm oil for HVO production, palm oil still accounts for 20% of their raw material feedstock. Other large producers of HVO in Europe are UPM (Finland), Preem (Sweden), ENI/UOP and Total.

The Roundtable on Sustainable Biomaterials (RSB) is a certification scheme that is widely recognised as the strongest and most trusted of its kind. This is an independent, global multi-stakeholder coalition that verifies ethical, sustainable and credible sourcing of biomaterials.

If you want to hold your biofuel supplier to account when procuring biofuels, the best questions to ask are:

- If you are using palm-based products, ask the supplier do they or when will they have an independently verified full supply chain down to the plantation level?
- Do you have certification recognised by the European Commission and can you get RSB certification for all of the materials used to make your biofuels?

FACT

Many EU biofuel producers report to use only waste products derived from palm oil, including Palm Fatty Acid Distillate or PFAD. However, the UK government does not classify PFAD as a waste or residue.

4 Advice on How to Source Biofuels Responsibly

How do I know if the biofuel I choose is sustainable?

Not all biofuels on the EU or UK market meet the above sustainability criteria. All biofuels in the UK that have been awarded the Renewable Transport Fuel Certificate (RTFC) meet both the RED (Renewable Energy Directive) and RTFO (Renewable Transport Fuel Obligation).

The most important question to ask your biofuel supplier is what type of material is used to make the biofuel and where it comes from.

The types of material can be evidenced by asking for an ISCC certificate – International Sustainability and Carbon Certification – that shows that a company is certified to manufacture certain fuels and tells you the feedstocks used.

Other certification schemes recognised by the European Commission can found **here**.


Certificate
according to the
Renewable Energy Directive (RED)
complies with the requirements of the RED and the certification system
ISCC EU
(International Sustainability and Carbon Certification)
which is approved by the European Commission.
This certificate is valid from 02. June 2017 to 01. June 2018
The certified site of the system user is a (type of operation):
HVO plant and
trader with storage
Emstek, 02. June 2017
Place and date of issue
Stamp, Signature

Key Questions to Ask Your Supplier

- What is your environmental sustainability policy?
- What environmental sustainability credentials do you hold? (e.g. certifications)
- Where are your biofuels sourced?
- What is the fuel mix of the biofuels?
- What evidence can you supply of the origin of fuels?
- What are the greenhouse gas emissions per litre burned?
- What quantity of air particulates is emitted?

If Using Palm Oil Based Fuel

- What is the name of the palm product trader(s) that sell to your supplier?
- Can the palm product trader(s) independently verify their full supply chain down to the plantation level? If not, by what date will this be done?
- Does the trader provide information disclosing the sourcing of the palm product down to the plantation level? (e.g. satellite maps with the concession boundaries?)

Table 4: Pros and cons of traditional or WVO biodiesel vs. HVO biodiesel

	PROS	CONS
Traditional or WVO (Waste Vegetable Oil) Biodiesel: A type of biofuel produced by reacting animal fats or vegetable oils (e.g. soya bean, palm or waste vegetable oils) with methanol and a catalyst (e.g. sodium hydroxide) to produce a methyl ester.)	• Non-toxic & non contaminative • Listed as non-hazardous • Widely available	• More expensive than red diesel. • Although now widely available, there can be supply chain issues where bulk supplies are required at short notice. • Purchasing licenses required in some EU countries. • Causes generator issues due to high viscosity. Engine modifications are normally needed. • Poor cold-start properties. • Servicing intervals need to be increased. • Not all plant hire companies will allow its use in their generator fleet.
HVO (Hydrated Vegetable Oil) Biodiesel: A type of renewable diesel fuel produced by hydro-treating vegetable oils, such as rapeseed. Unlike regular biodiesel, hydrogen is used as the catalyst in the creation process instead of methanol. Can also be called green diesel or renewable diesel.	• Its viscosity reduces the aging of engine oil & improves cold start properties. • In the category of 'drop in' fuels. • Non-toxic & non-contaminative. • Listed as non-hazardous, so free from ADR haulage restrictions. • Now widely available	Five to 10 times higher levels of acetaldehyde – precursor to VOCs

In Summary

- HVO can be made from a virgin crop and therefore raises serious ethical questions if there is not appropriate supply chain due diligence in place about the origin.
- Locally sourced WVO or HVO made from waste materials have the lowest environmental impact.

5 Main Biofuel Suppliers

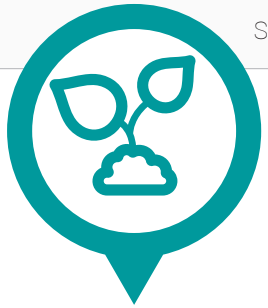
The table below provides information on the 9 largest biofuel plants in the UK. There are also a number of significantly smaller operations making biofuels from used cooking oil.

Table 5: Largest UK biofuel plants

Company	Location	Capacity (million litres/year)	Fuel type	Current feedstock mix
Vivergo	Immington, Hull	420	Bioethanol	Used cooking oil
Ensus	Wilton, Teesside	400	Bioethanol	Wheat
Greenergy	Seal Sands, Teesside	284	Biodiesel	Primarily waste oils
Greenergy	Immingham, Hull	220	Biodiesel	Waste oils
Argent Energy	Stanlow, Ellesmere Port	85	Biodiesel	Used cooking oil, tallow, sewerage grease
British Sugar	Wissington, Norfolk	70	Bioethanol	Sugar beet
Argent Energy	Motherwell, Scotland	60	Biodiesel	Used cooking oil, tallow, sewerage grease
Convert 2 Green	Middlewich, Cheshire	20	Biodiesel	Used cooking oil
Olleco	Bootle, Merseyside	16	Biodiesel	Used cooking oil

Table 6: Largest EU suppliers of HVO biofuels

Company	Location	Capacity (million tonnes)	Do they use palm oil products?
Neste	Netherlands, Finland, Singapore	2,520,000	Yes
Eni	Italy	580,000	Yes
CEPSA	Spain	180,000	Yes
Preem	Sweden	180,000	No
UPM	Finland	100,000	No
Repsol	Spain	60,000	Yes



It's important to note that only **2 of the 6** (UPM and Preem) largest EU suppliers of HVO biofuels do not source any palm oil products as a feedstock for their biofuels

Note: In the UK, the 2 main suppliers of HVO are Crown Oil and Green Biofuel. Total will be opening an HVO plant later in 2018 in France.

Resources

The Show Must Go On Report
Roundtbable on Sustainable Biofuels
Sustainability of Liquid Biofuels
Biofuels Statistics
SPOTT
Greenpeace Trader Compliance Report

About JB

Julie's Bicycle (JB) is a charity working to support the arts and cultural sector since 2007 to take action on climate change. We have supported over 2,000 organisations by reducing impacts, engaging audiences, creative programming, governance, policy development and supporting artists. We do this through running a rich programme of events, consultancy, **certification**, free online **carbon calculators**, free resources, research, network development, mentoring, and advocacy.

If you need assistance with due diligence of your biofuels supplier or with developing an environmental strategy, contact JB at **support@juliesbicycle.com**

To demonstrate your commitment to sustainability, sign up for **Creative Green**

Collaborators

Powerful Thinking is a not-for-profit industry think-tank working towards smarter energy management practices in the live events industry. We are a coalition of industry stakeholders, working together to drive positive change for businesses, audiences and the environment.

Festival Republic, part of Live Nation, is the leading UK festival promoter running a significant number of the UK's major iconic festivals, including Download, BBC Live in Hyde Park, Latitude, Leeds and Reading.

Recognised for cutting edge theatrics and performance, as well as being a think-tank of ideas, **Shambala** is an award-winning green event.

An event management company with over 20 years of experience, **Kambe's** flagship event Shambala Festival is an industry leader in sustainability.

Smart Power is a UK-based renewable energy provider specialising in solar photovoltaic energy, hybrid battery systems and thermodynamics.

ZAP Concepts offers consultancy in energy and sustainability; specialising in the design of optimal power supplies for live events.

A mapping platform offering powerful aggregated analysis, **MapHubs** specialises in mapping supply chains and monitoring deforestation.

Ennismore Consultants is a community of experts with wide ranging experience, part of an intelligent and informed transition towards a more sustainable and responsible future.

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