bam

Position paper on the use of biofuels

BAM UK & Ireland December 2022

Introduction

Royal BAM Group has put sustainability front and centre as part of its 'building a sustainable tomorrow' business strategy and amongst other objectives, features an enhanced and challenging set of carbon reduction targets built on the back of tangible actions and robust carbon accounting. BAM was an early adopter of the Science Based Targets initiative (SBTi[1]) which is considered the highest standard when it comes to verifying an organisation's carbon targets against the 1.5°C and 2.0°C climate models. The latest Royal BAM Group decarbonisation targets[2] are as follows;

80% reduction in normalised scope 1, 2 and select scope 3 emissions [3] by 2026 compared to a 2015 baseline.

50% reduction in absolute scope 3 emissions by 2030 compared to a 2019 baseline.

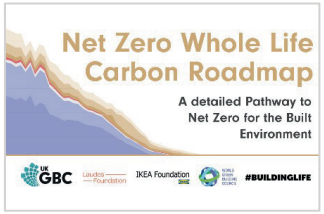
In the UK & Ireland Division of BAM, the decision has been made to set a net zero carbon target for 2026[4] against its direct scope 1 and 2 emissions and a further subset of scope 3 emissions [5] over which we have significant influence. Our track record on carbon reduction has exceeded all previous targets set since 2008 and this is testament to the culture of our people to strive for continual improvement, but also the ongoing developments across the construction industry more widely.

Since 2015 Royal BAM Group has recorded a normalised carbon reduction of 41% against its scope 1,2 and selected scope 3 emissions. The majority of this is evidenced and attributed to tangible actions BAM has taken throughout its operations. A selection of these actions are detailed on page 7 of this paper.

BAM recognises that it is a part of an industry that is responsible for circa 40% of emissions globally making it a critically important sector to decarbonise. BAM has long been a partner to the UK and Ireland Green Building Councils (UKGBC) and Supply Chain Sustainability School (SCSS) ensuring we are at the forefront of driving industry-wide policy and thought leadership. In recent years BAM has contributed and committed to a number of key industry led initiatives including but not limited to;

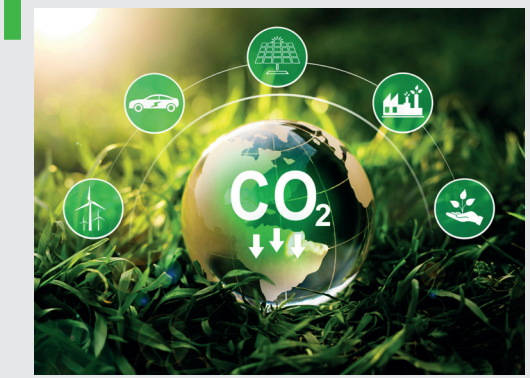
- Contractors Declare
- UKGBC's Advancing Net Zero programme
- UKGBC's Whole Life Carbon roadmap
- Construction Leadership Councils (CLC) Co2nstruct Zero initiative.

All of these things demonstrate that we prioritise decarbonisation and consider it a key aspect of overall business strategy in the long term.



The decarbonisation of fossil fuels in particular has sparked a great deal of debate and action within the construction and transport sectors in recent years. However, measures involving the ongoing use of internal combustion engines have polarised the industry with debate centred on proving the true sustainability of apparently lower carbon bio-based and gaseous-based fuels.

This position paper provides the reasoning behind BAM's support of alternatives to fossil fuels, in particular the use of biofuels such as Hydrotreated Vegetable Oil (HVO) as a transition fuel towards greater electrification through the use of battery and hydrogen technologies.



Net zero by 2026

The UK & Ireland Division of BAM have set a net zero carbon target for 2026[4] against its direct scope 1 and 2 emissions and a further subset of scope 3 emissions.

1. Science Based Targets Initiative, Ambitious corporate climate action - Science Based Targets
2. Note that Royal BAM Group published its updated decarbonisation targets in 2022 and these are yet to be updated with SBTi although both are more ambitious than previously set. Reducing scope 1 and 2 footprint (direct operations) | Koninklijke BAM Groep / Royal BAM Group
3. Selected scope 3 emissions include staff travel related emissions from air travel, company vehicles and private vehicles
4. BAM accelerates UK and Ireland carbon reductions to net zero by 2026 | Koninklijke BAM Groep / Royal BAM Group
5. UK & Ireland Net Zero target includes further scope 3 emissions sources including; Scope 1&2 well to tank emissions, hotels, rail travel, third party energy and fuel use and water.

Biofuels landscape

What is Biofuel?

Biofuel is considered to be any fuel that is produced from biomass. The main types of biofuels in use today are wood including wood pellets, bioethanol, biomethane, biodiesel and HVO. These fuels acquire their calorific potential through the process of photosynthesis that sequesters carbon within primary biofuel feedstocks (biomass) which include trees and cultivated crops such as soy, rape, palm and corn to name a few. Since biomass can be used as a fuel directly, some people use the words biomass and biofuel interchangeably.

Carbon reduction potential of renewable biofuels

The use of fossil fuels is the main contributing factor to a rapid net gain in Greenhouse Gas emissions (GHG[6]) in the Earth's atmosphere which is unsustainable for the planet's ecosystems. This is leading to acute and disruptive climate change that is expected to worsen[7] unless fossil fuel consumption is curtailed rapidly towards a global net zero position by 2050.

As an alternative to fossil fuels, biofuels due to their relatively short lifecycle contribute substantially less net gain in GHGs because by their nature the GHG emissions from their final combustion have already been sequestered through the growth phase of the feedstocks used to produce it. Therefore even when factoring in emissions from biofuel refining, distribution and estimated Land Use Change (LUC), the net carbon emissions for biofuels are typically between 40% and 69% less than from equivalent fossil-based liquid fuels. This increases to between 79% and 86% if the biomass used is from the wastes from other industries, according to a recent study published by the American Chemical Society[8]. Furthermore, DEFRA publishes annual carbon emissions factors[9] for all GHG scopes for all commonly used fuels and in 2022 shows that HVO used in the UK has an 85% reduction compared to average diesel.[10]

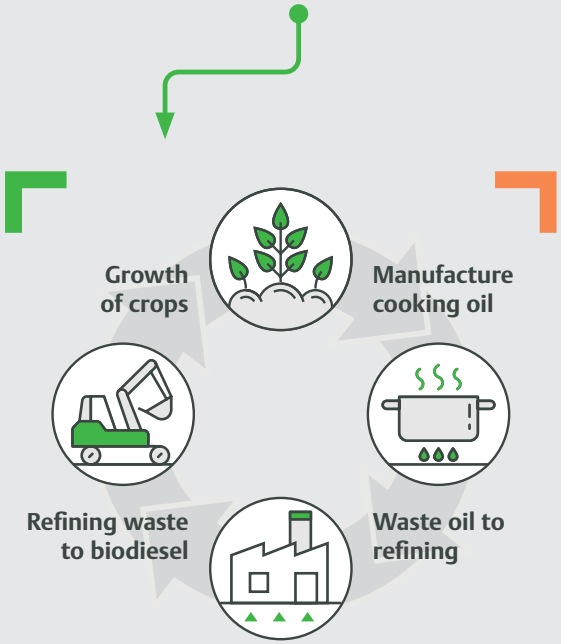
The NNFCC[11] go as far to say;

> **The GHG reduction delivered by Used Cooking Oil (UCO)-derived renewable fuels are significant (typically of the order of 80-90% compared to fossil fuel). As the feedstock is classed as a waste in the EU, only the energy used in its transportation and the biofuel conversion process are used to calculate its GHG efficiency. Undoubtedly, the use of legitimate UCO waste streams in biodiesel production offer an excellent pathway for reducing GHG emissions.**[12]

Biofuels that are produced from waste biomass as opposed to primary biomass have been the preferred option for companies wishing to switch to greener alternative fuels as they offer greater carbon reductions. HVO in particular appears to be the most prevalent biofuel in Europe as it is more commercially viable, is sourced from 100% waste biomass, and is predominately certified through International Sustainability & Carbon Certification (ISCC).

For biofuels more generally, it is recognised that there can be variability in the carbon reductions achieved when factoring in the Indirect Land Use Change (ILUC). Globally it has been extremely challenging to definitively calculate the impact of this owing to the fact that supply chains are spread across multiple jurisdictions and support different sectors (several studies have been undertaken in recent years to try and provide more clarity on the issue).

It is generally accepted that the use of biofuels, specifically those from waste biomass such as UCO, do not contribute to LUC or ILUC because they utilise a waste product from other industries (in this case the food industry). Claims of ILUC when using biofuels centre around the assumption



The net carbon emissions for biofuels are typically between 40% and 69% less than from equivalent fossil-based liquid fuels. This increases to between 79% and 86% if the biomass used is from the wastes from other industries.

6. Greenhouse Gas Protocol | (ghgprotocol.org)
7. Climate Change 2022: Impacts, Adaptation and Vulnerability | Climate Change 2022: Impacts, Adaptation and Vulnerability (ipcc.ch)
8. Life Cycle Greenhouse Gas Emissions of Biodiesel and Renewable Diesel Production in the United States | Environmental Science & Technology (acs.org)
9. Greenhouse gas reporting: conversion factors 2022 - GOV.UK (www.gov.uk)
10. Includes Scope 1 and Scope 3 WTT emissions but excludes the 'out of scopes emissions' category which is not relevant for comparison as these biogenic emissions are deemed to have been sequestered in the growth phase of biomass feedstock.
11. NNFCC - The Bioeconomy Consultants
12. UCO Report.pdf (nnfcc.co.uk)

that diverting the UCO from the supply chain for agriculture (where UCO is used as part of the feedstock for animal feeds) would be required to source feedstock from primary biomass elsewhere in its place. However despite being a frequently quoted argument against the use of HVO, our research points to the fact that in reality the practice of using UCO (including so called 'gutter oils') in animal feed manufacture has largely been outlawed by most countries including China. This is due to concerns around human health due to the risk of bioaccumulation of negative effects passed down the food chain from the direct or indirect consumption of UCO.

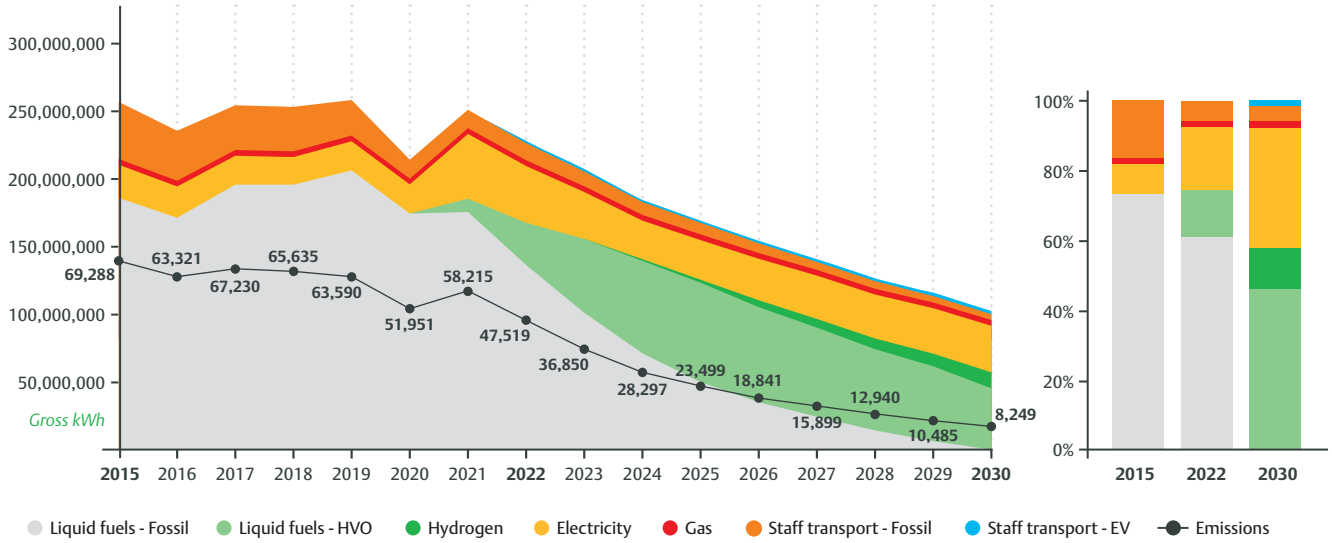
BAM accepts that ILUC concerns may persist for biofuels manufactured from primary feedstocks as acknowledged in a 2015 report[13] commissioned by the EU. However, this is something that BAM is monitoring closely, in line with our due diligence processes and recommendations from the UK Government policy on biomass[14]. Ultimately, BAM ensures that all of the HVO it procures is from 100% waste biomass sources and therefore has no impact on LUC or ILUC.

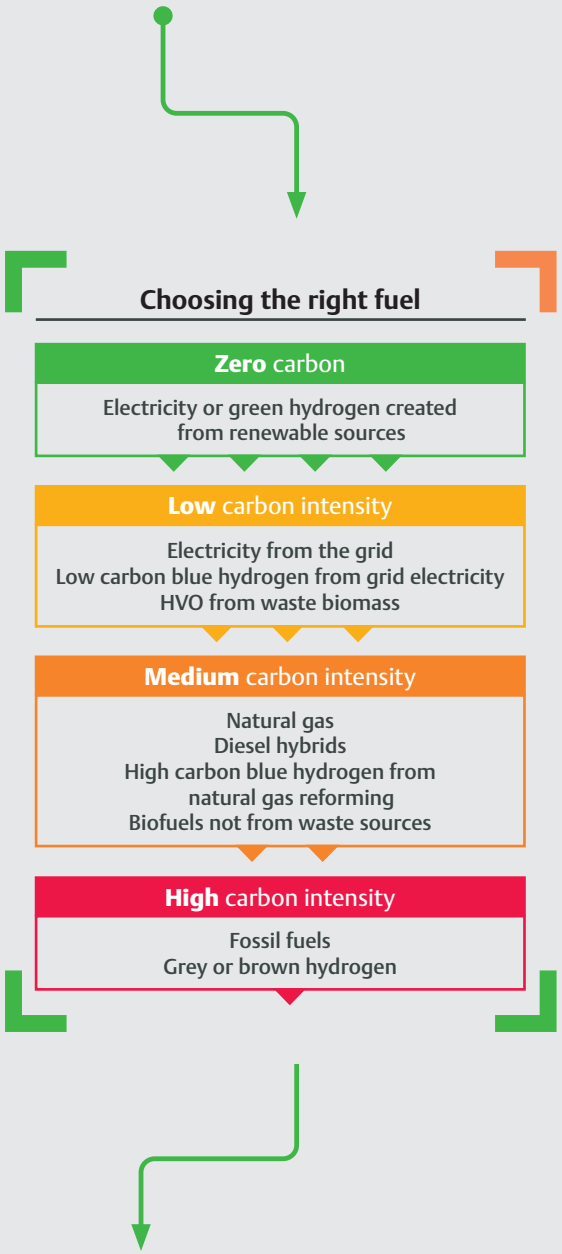
Biofuels place in the energy hierarchy

Biofuels are just one type of energy vector available to us amongst a number of other including; existing fossil fuels, electricity and other non-fossil gaseous fuels such as hydrogen. Their carbon emissions impacts can be illustrated in terms of an energy hierarchy which prioritises the lowest carbon options and is something that BAM incorporates in to its guidance. The hierarchy is shown on the right and is based on 2022 Defra conversion factors for scopes 1, 2 and 3 across a range of commonly used energy vectors.

With the energy hierarchy in mind, it is clear that HVO has a role to play. Therefore we have produced an energy transition pathway out to 2030 to illustrate what role we expect HVO to play as we move towards electrification and hydrogen based systems, shown below. The pathway doesn't just show how our energy mix will shift from fossil-based diesel towards cleaner, renewable sources, it also shows that the gross amount of energy used to deliver our work also decreases over time and this is the result of shifting to electrification which is significantly more energy efficient than burning fuel in a combustion engine.

Energy Transition Pathway





13. Final Report_GLOBIOM_publication.pdf (europa.eu)
14. Biomass policy statement (publishing.service.gov.uk)

Due diligence

Like with any commodity which claims to be from a sustainable source, there is an expectation that those products come with an appropriate level of assurance to back up those claims being made. BAM continually monitors products within its supply chain to ensure they comply with the relevant standards and that they do not contradict our sustainability policies.

Besides our general sustainable procurement policy, additional due diligence is undertaken on a product by product basis appropriate to the level of sustainability risk associated with that product. For example, for timber BAM has a policy that stipulates that only timber from verified sustainable sources preferably with the FSC and/or PEFC certification are used on our projects and this must be evidenced with every purchase that is made. The process is further enhanced with an internal surveillance audit programme to ensure no unsustainable timber is used. Despite this the FSC and PEFC schemes are not a guarantee that timber is 100% sustainably sourced and there are weaknesses in the auditing system[15]. However this is not viewed as a material issue to consumers at present and end users generally accept the certifications on face value.

In the case of biofuels, BAM undertook extensive research before promoting them as our preferred fuel of choice. We engaged with and continue to engage with our peers, clients, supply chains and industry and certification bodies, and consulted numerous research papers, to ensure we have the most up to date knowledge of these products and openly share insights with the industry.

Through this research it is clear that the renewable biofuel HVO provides the optimum benefit in terms of carbon reduction and environmental impact in comparison to fossil fuels. In terms of certifications for HVO, we are satisfied with those given to us through our fuel suppliers from the following organisations;

- The ISCC[16] are an internationally recognised sustainability certification body covering all sustainable feedstocks. They undertake assessments of feedstock providers and issue certificates to biofuel manufacturers, distributors and end users.
- ZEMO[17] undertake additional and independent auditing of biofuel suppliers and issue batch-level certifications to end users on behalf of distributors. They have established an independent assurance approach directly supporting fleet operators to obtain enhanced assurances for the use of biofuels. This is known as the Renewable Fuels Assurance Scheme[18] and complements the UK Governments Renewable Transport Fuel Obligation.

Both of these organisations have demonstrated that they are diligent and transparent in their approach to auditing associated supply chains for biofuels. However, we remain vigilant of any new information that would contradict the validity of any of these existing certifications.

UK Statistics

The Department for Transport (DfT) produces a quarterly report as part of the RTFO scheme detailing many statistics associated with the UK's use of renewable biofuels. In it's most recent report[19] it shows that in 2022 to date, 100% of biodiesel consumed in the UK (including HVO) originated from waste biomass with 93% of that comprising of UCO. Statistics such as these give further confidence that we are using biofuels which are only from waste biomass and that the assurances provided under the RFAS are robust.

15. Open letter: FSC is no longer fit for purpose and must urgently reform | Earthsight
16. Solutions for sustainable and deforestation free supply chains › ISCC System (iscc-system.org)
17. Zemo Partnership | Accelerating Transport to Zero Emissions
18. Renewable Fuels Assurance Scheme | Zemo Partnership
19. Renewable fuel statistics 2022: First provisional report - GOV.UK (www.gov.uk)

UK Government policy

The UK government has been supportive of introducing and scaling up the use of biomass for subsequent use as bioenergy and biofuels for many years. In 2008 it created the RTFO scheme which mandates that fuel supplies to the transport industry (and applies to industries using Non Road Mobile Machinery (NRMM) such as construction and agriculture), include a minimum amount of biofuel content as part of their supply. This has seen typical forecourt diesel in the UK increase its biofuel content from virtually 0 at the turn of this century to 7% today and is set to increase to over 12% by 2032. More recently the requirements under the RTFO scheme have been complimented with the release of the aforementioned biomass policy[20] which recognises the importance of taking a wholistic view when opting to use biomass from any source. Chapter 2.1 of the policy states:

> **"Recognising that sustainable biomass is a limited resource, it is important to ensure that biomass is prioritised within the economy where it offers the greatest opportunity to reduce greenhouse gas (GHG) emissions in 'hard to abate' sectors where there are fewer options to decarbonise through alternative low carbon technologies".**[21]

The policy also sets out the short, medium and long term principles for the incorporation of biomass into the overall UK fuel mix. This includes a clear statement of due diligence that is expected of producers of biomass feedstock entering the supply chain in order to mitigate ILUC.

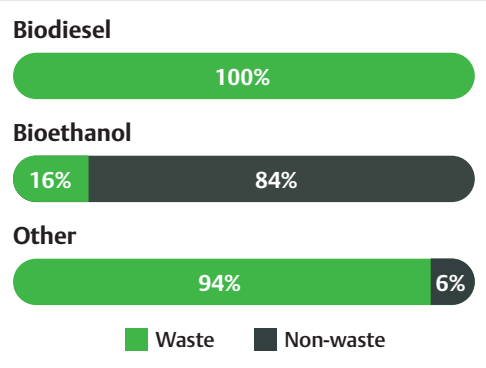
In late 2022 the government is expected to publish its biomass strategy which will build on the bioenergy strategy published in 2012[22]. Any new information pertinant to the sustainable credentials of biofuels will be incorporated into our and our supply chains procurement processes.

European Union (EU) policy

In 2018 The Renewable Energy Directive II (RED II)[23] from which previous UK Government policies have been sub-ordinate to, sets out tougher requirements on member states to increase the proportion of renewable energy to 32% overall, and to increase renewable fuels use to 14% by 2030. However it too recognises the challenges of ILUC associated with certain biofuel feedstocks and has included tougher criteria[24] to assess their suitability. This includes but is not limited to the complete phasing out of all palm oil and palm oil waste residues from biofuels supplied to and made by the EU by 2030. Assurances for biofuel feedstocks used across the EU are considered to be the most stringent in the world and have improved sustainability criteria demonstrably over the past decade.

The European Waste-based & Advanced Biofuels Association (EWABA)[25] is an important independent not-for-profit body who represent the waste-based and advanced biofuels industries. Their work brings together evidence from the entire biofuels supply chain to inform EU policy and improve the transparency of the market overall. In a recent press release it cites an important development in the ability to track and trace biofuel feedstocks[26]. This so-called Bioledger is set to become operational in 2023 and will provide even greater transparency helping end users make an informed choice and goes beyond the assurances the ISCC and ZEMO undertake.

In the DfT's most recent report[17] it shows that in 2022 so far, 100% of biodiesel consumed in the UK (including HVO) was from waste biomass with 93% of that comprising of used cooking oil.



Proportion of waste and non-waste feedstocks amongst verified renewable fuel

20. 2021 UK Gove - Biomass policy statement (publishing.service.gov.uk)
21. Chapter 2.1 page 20 - Biomass policy statement (publishing.service.gov.uk)
22. UK Bioenergy Strategy - GOV.UK (www.gov.uk)
23. Renewable Energy – Recast to 2030 (RED II) (europa.eu)
24. Sustainability criteria for biofuels specified (europa.eu)
25. EWABA | European Waste-based & Advanced Biofuels Association
26. EWABAPressreleaseonIAforrevisedcertschemestandards14March22.pdf

Supplier assurance & industry perspectives

BAM has consulted with its suppliers and our industry peers continually on the sustainability of biofuels – specifically HVO and they have provided the following statements;

"CECA has given careful consideration to the use of HVO fuel and remains satisfied that it is a necessary and suitable transition fuel enabling the wider industry to cut emissions from fossil-based liquid fuels today.

Further, we would expect all CECA members to apply the appropriate due diligence when using HVO fuels and that they are very clearly evidenced as sourced from 100% waste feedstocks; do not contain any palm oil or derivative thereof; do not contribute to deforestation and that they can be shown to have a positive effect on the Net Zero journey."

Civil Engineering Contractors Association (CECA)

"The Renewable Fuels Assurance Scheme (RFAS) is an initiative designed and managed by Zemo Partnership.

The scheme aims to increase the adoption of renewable fuels by heavy-duty vehicle and equipment operators, by providing independent assurance of the GHG emissions and sustainability performance of renewable fuels sold in the UK. HVO in particular offers an immediate and more sustainable route to decarbonising industries reliant on fossil fuels whilst they transition away from them ultimately towards electrification and green hydrogen".

Jackie Savage
Project Officer, RFAS (ZEMO partnership)

"All of Crown Oil's HVO is Used Cooking Oil (UCO) based, we do not purchase HVO manufactured from virgin crop, Palm oil mill effluent or SEBO. The steps involved within the Crown HVO supply chain are:

- All feedstocks and final fuel must, by UK law, adhere to the Renewable Energy Directive
- UCO suppliers must be registered with an independent auditor. In the case of Crown HVO this is ISCC.
- That auditor must audit (yearly) the supply chain and each tank
- UCO transported for the manufacture of renewable fuel in Europe and the UK must be accompanied with a Proof of Sustainability document (POS)
- Manufacturers of fuel must be registered with an independent auditor and all production sites and individual raw material and finished product tanks audited on a product in vs out basis
- As a receiver of Fuel, Crown Oil must first have the POS for the fuel imported approved by the department of transport
- All sales must be verified independently and the results of the verification confirmed to the DfT
- As well as the above checks and balances, Crown oil is a member of the Renewable Fuel Assurance scheme. This means that we must declare sales of our fuel, it's feedstock credentials and carbon loading to both our customers and Zemo (the administrator of the scheme) quarterly. We are then independently verified on an annual basis.

Simon Lawford
Health, Safety & Environmental Officer, Crown Oil

Other considerations associated with alternatives to fossil fuels

The recent debate has been heavily biased towards vilifying biofuels without much context to the emissions and wider environmental impact of fossil fuels and other widely promoted 'green' alternative technologies such as electric and hydrogen. Therefore, it is important to consider additional advantages and disadvantages of all motive power technologies;

Cost

PROS

Pros

+ HVO biofuel is decoupled from the oil and gas market therefore giving greater price certainty and the ability to fix the price for a specific quantity.
+ It could be inferred that the more expensive fuel cost is partially mitigated by reduced plant maintenance and potentially even spillage remediation costs.

CONS

Cons

− HVO biofuel is around 30% more expensive than diesel at the time of writing which is a major factor to consider. The effective cost per tonne/CO2e saved using HVO is approximately £90 making it less competitive than many alternative carbon offsetting measures available on the market today.
− The increase in spend for biofuels could be viewed as detracting from investments into other carbon saving initiatives such as electric, hydrogen and other e-fuels. However, there are a great many initiatives and investments being made in the private and public sector to drive growth in these areas. i.e. via UK Governments hydrogen strategy, RDR competition, BAM's own investments in alternatives.

Practical

PROS

+ Biofuels are drop-in fuel alternative requiring no modifications to the vast majority of engines or storage tanks.
+ The higher cetane results in cleaner combustion which benefits engine performance and decreases soot build up.
+ Alternatives for decarbonising construction equipment are not available in the market yet but are in their development stages. Therefore discounting lower carbon biofuels now means prolonging fossil fuel use.

CONS

− None

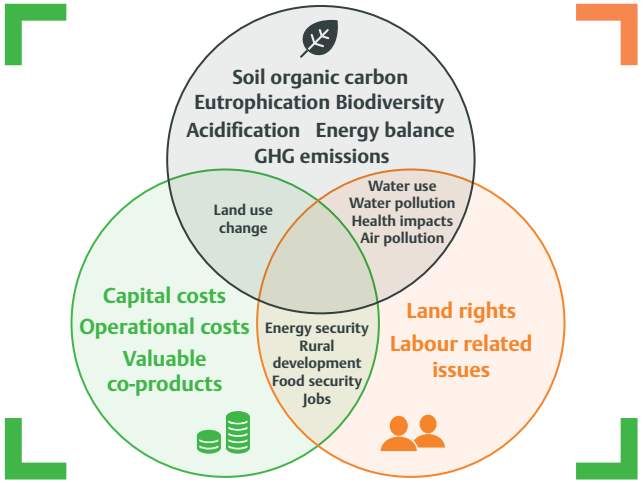
Environmental

PROS

+ Biofuels by their nature are inherently less toxic to the environment than fossil derived liquid fuels which reduces direct hydrocarbon pollution in the event of spillages. A recent article from the BBC arising from the COP27[27] summit in Egypt highlights the severe and largely unreported impacts of oil contamination in marine environments leading to an acceleration of the decline of coral reefs[28]
+ A cleaner burn is achieved when combusted owing to greatly reduced levels of contaminants and Particulate Matter (PM). This is a particularly important consideration when using in urban environments which often have stringent air quality pollution limits.

CONS

− If careful selection and scrutiny is not undertaken, feedstocks originating from unsustainable sources may be present in some biofuels. In the worst case this may lead to a net increase in lifecycle emissions compared to fossil fuels. Careful and targeted selection of biofuels with feedstocks from waste process mitigates this issue. The use of recognised certification bodies such as ISCC and ZEMO give a high degree of confidence of feedstock origin.



Societal

PROS

+ Switching to using biofuel can be seen as a positive action with demonstrable carbon and environmental benefits aiding public relations for organisations using it. Several studies referred to in this paper show that utilising biofuels from waste biomass feedstocks is more sustainable than ongoing fossil fuel usage particularly given that other alternatives to fossil fuels are not yet available at scale.
+ Biofuels are directly less polluting at the tailpipe compared to fossil fuels benefitting air quality which is particularly important in urban areas.

CONS

− Several studies have been undertaken which highlight a potential for biofuels to be linked to unsustainable biomass production associated with LUC. When these studies are picked up by main-stream media, they provide an opportunity to spread controversy which is favourable for audience attention. Therefore, using biofuels could also be perceived in a negative way by society even if there is no or very little LUC impact.

Our position

BAM has given careful consideration to the use of HVO fuel and remains satisfied that it is a necessary and suitable transition fuel enabling us and the wider industry to cut emissions from fossil-based liquid fuels today. Since we commenced the use of HVO in mid-2021, BAM continues to view HVO as a transition fuel towards electrification of construction site operations and we've taken a pragmatic and collaborative approach to the undertaking of due diligence concerning HVO's sustainability credentials.

Our commitment to ensuring HVO is only sourced from 100% waste feedstocks is absolute and crystalised in our supplier agreements who must provide batch-level certification for every litre of HVO supplied to BAM projects. We believe that these batch-level certifications provided by ZEMO through the RFAS and those provided by the ISCC give reasonable assurance to us and our customers that HVO is sourced sustainably and amounts to the same level of due diligence given to other products requiring enhanced responsible sourcing such as timber.

In addition we have enhanced our supplier selection criteria for fuels introducing contractual obligations which prohibit supply of unsustainable HVO, I.e. that which is not from 100% waste feedstocks.

Up to October 2022, BAM has mitigated over 8ktCO2e of emissions through the use of HVO and amongst other initiatives, forms a key part of our decarbonisation pathway therefore benefiting our clients as well as ourselves.

We do not consider its use as a hinderance to the development and investment into longer term low carbon technologies. BAM is continuing to invest in alternatives in both our plant fleet and fixed premises and is a partner to the H2Construction consortium[29] developing a case for the provision of truly green hydrogen for the construction industry.

BAM recognises the ongoing concerns surrounding the sustainability of HVO and biofuels more generally and the situation remains under constant review.

Powered by Plants
Since mid-2021 BAM began switching to HVO and up to October 2022, this has mitigated 8ktCO2e, reduced environmental risk due to greatly reduced eco-toxicity and reduced tailpipe air pollution such as PM10, PM2.5, SOx, NOx and soot.

27. Conference of the Parties (COP) is an annual conference where nations set climate targets and agree common mitigation measures UN Climate Change Conference (UNFCCC COP 27) (unep.org)
28. Oil pollution: Investigation reveals Egypt's 'super coral' at risk - BBC News
29. In 2022 The H2Construction consortium were successful in securing government funding under the Red Diesel Replacement scheme which seeks to drive green hydrogen production for use in the construction sector

Actions towards Net Zero Carbon

BAM has a strong track record of emissions reduction and prioritises carbon reduction throughout every step of project delivery. Within our UK & Ireland Division, we have published Carbon Reduction Plans[30] that set out in detail our emissions inventories and how we intend to reach net zero carbon, mirroring how BAM Group will meet its wider decarbonation targets.

Alongside the use of HVO, the following are several key saving activities we have deployed in recent years cutting across emissions from scope 1, 2 and 3.

Artists impression the finished bridge

3D staircases being installed

Value engineering at Great Yarmouth Third River Crossing

In 2021 BAM commenced work on a £90M project in Great Yarmouth to construct a 50m bascule bridge and associated highway infrastructure. Throughout the development of the design, BAM identified a significant opportunity to minimise the weight of the bridge leaves by 4,000t compared to the tendered design. This equated to a 9,800tCO2e saving from the outset and will yield further savings throughout its life through lower operational energy use and unlocking transport efficiencies for subsequent road users. Further to this 50,000t of demolition wastes have been successfully incorporated into the permanent works saving a further circa 500tCO2e compared to not using imported primary aggregates.

M8 Footbridge 3D printed concrete steps

In 2022 BAM installed Scotland's first and the UK's largest 3D printed concrete staircase. The 28 individual staircase units were manufactured in the Netherlands by Weber Beamix and were transported to the site by sea.

In total, 40% of the concrete volume was saved compared to traditional precast staircase units, mitigating around 100tCO2e associated with concrete reduction, installation efficiency and reduced waste.

3D printing of concrete is the next step in modularising our construction processes and offers the ability to manufacture evermore complex structures which are quicker to install and save on raw material as well as minimising waste.

Sky Studios embodied and operational carbon reductions

In 2020 BAM began work on the new Sky Studios in Elstree, UK. Working with developer Legal and General and Sky, the project is aiming to be the most sustainable film studios in the world. All buildings on the site will be fully electric and use air source heat pumps for all heating and cooling. Energy demand has been driven down below building regulation requirements and an extensive onsite solar PV installation will provide over 30% of energy requirements. Embodied carbon has been assessed from RIBA Stage 2 with a target of 15% reduction. Following BAM's involvement from RIBA Stage 3 and by end of RIBA Stage 4, a 24% reduction in embodied carbon has been achieved, totalling 12,300 tCO2 e. A significant proportion (11%) has been achieved through redesign and optimisation of structures across the site.

30. Carbon Reduction Plans: BAM Nuttall, BAM Construct

The worlds' first fully electric asphalt paver


Pour of low carbon concrete at Dawlish


CEMFree concrete pour at Chatham

BAM's investment in electric plant

Alternatives to combustion engine powered equipment are beginning to be utilised across the construction industry. There are now many options for 100% battery-electric plant although typically limited to equipment upto circa 6t. Equipment above this size becomes more challenging to fully electrify due to the size of the batteries required to run the equipment for a typical days' operation becoming impractical.

Research and development for heavy plant is typically focussed on utilising alternative fuels such as HVO, hydrogen and other novel e-fuels. However, BAM's plant division in the Netherlands is attempting to build full battery-electric machines for mid-range sized plant (between 6t and 20t). To date, it has constructed the world's first fully electric roller, a 14t road/rail excavator and an asphalt paver. During operation it is expected that the electric paver alone will save more than 93tCO2e/ annum.

Low carbon concrete at Dawlish Sea Wall

The Dawlish sea wall on the south coast of Devon is a sea defence which also serves as a retaining wall for the South Western Railway. In 2014 part of the sea wall was destroyed by a storm event and following that event plans were put in place to build a new £80M 415m wall capable of withstanding a 1:200 year storm event. This requirement meant that vast quantities of concrete and steel would be required with much of the concrete being used as mass fill between the new and old walls.

Besides the carbon saving associated with the use of pre-cast concrete weathering panels and copings, the scheme identified an opportunity to use an ultra-low carbon concrete mix for the mass fill between the old and new walls. Through negotiation with the client and the supplier, approval was given to pour over 11,000m³ of this alternative concrete which contained 85% cement replacement utilising GGBS[31]. The use of this alternative mitigated the release of just over 1,000tCO2e.

Cement free concrete at Chatham railway station

The Chatham Access for All (AfA) scheme completed in 2022 involved the creation of an inter-platform access structure comprising the installation of lifts and a bridge over the railway. During construction, it was necessary to undertake a mass-fill of a disused basement under the platform totalling 300m³.

Instead of opting to use a standard concrete mix, BAM's delivery team, through it's concrete supplier Hanson, had been introduced to a cement-free alternative to conventional concrete called Cemfree, produced by DB Group. Cemfree falls within the general product category of alkali-activated cementitious materials (AACMs). Replacing 100% of the ordinary Portland cement (OPC) with a Cemfree binder results in embodied CO2 that is up to 80% lower than OPC-based concretes.

As a result the project was able to make a 62tCO2e saving without impacting on the cost. Also due to the slower curing speed, this reduced the likelihood of excess heat build up leading to cracking – something that is a common issue when pouring large quantities of concrete at once.

Closing remarks

We all have a responsibility to deliver a more sustainable built environment and reducing our reliance on fossil fuels is of paramount importance. The exchanging of fossil fuels in favour of renewable biomass-derived alternatives today is an appropriate step to take as the industry moves towards emission-free technologies such as electrification, green hydrogen and other novel 'e-fuels'

The certification mechanisms cited above provide a high degree of assurance that renewable biofuels are sourced sustainably in the UK and across the EU. In the case of renewable biofuels there is a high degree of confidence that their use is a less damaging and readily deployable alternative compared to fossil fuels today. The introduction of the Bioledger in 2023 will help to give full transparency of feedstocks for and renewable biofuels enabling businesses to make more informed choices about its fuel mix.

To discount renewable biofuels and contradict current UK and EU policy in what is a 'hard to decarbonise sector' would overall reflect negatively on BAM's and the wider industries decarbonisation efforts. However, it's clear that ILUC as well as other social-environmental aspects need to be continuously and carefully reviewed. A recent investigation by the BBC concerning unsustainable wood pellet use at the UK's Drax power station[32] is a firm reminder that opting for biofuels needs to come with robust assurances of its feedstocks. The launch of the biomass tracking solution anticipated in 2023 will go a long way to providing the additional assurances required to mitigate traceability concerns.

It's also not clear to what extent the oil and gas industry may be influencing the debate.

The very fact we have felt it necessary to produce this paper, as have other organisations across our sector, proves we take the issue of climate change and sustainability very seriously and if anything has provided some excellent insights into the landscape for biofuels. Going forward it is highly likely that this debate will continue to evolve although it is hoped that a consistent approach to the treatment of biofuels will prevail across our sector. We anticipate that the UK Governments Biomass Strategy due for publication in late 2022 will provide further clarity on biomass usage as part of the transition to net zero carbon.

Red diesel replacement

BAM and Motive Fuels have been awarded more than £350,000 of funding to help develop hydrogen-fuelled construction equipment as part of a government competition to help the sector adapt to the red-diesel ban[33]

31. GGBS is Ground Granulated Blast Furnace Slag and is a waste product from steel manufacture
32. BBC One - Panorama, The Green Energy Scandal Exposed
33. Red diesel replacement

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