AD&BIORESOURCES NEWS
THE UK ANAEROBIC DIGESTION & BIORESOURCES TRADE ASSOCIATION'S QUARTERLY MAGAZINE

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RIVER RESCUE

AD HAS LEADING ROLE TO PLAY IN STEMMING THE CRISIS OF NUTRIENT OVERLOAD

BIOGAS UK – BIGGER THAN NUCLEAR BY 2029

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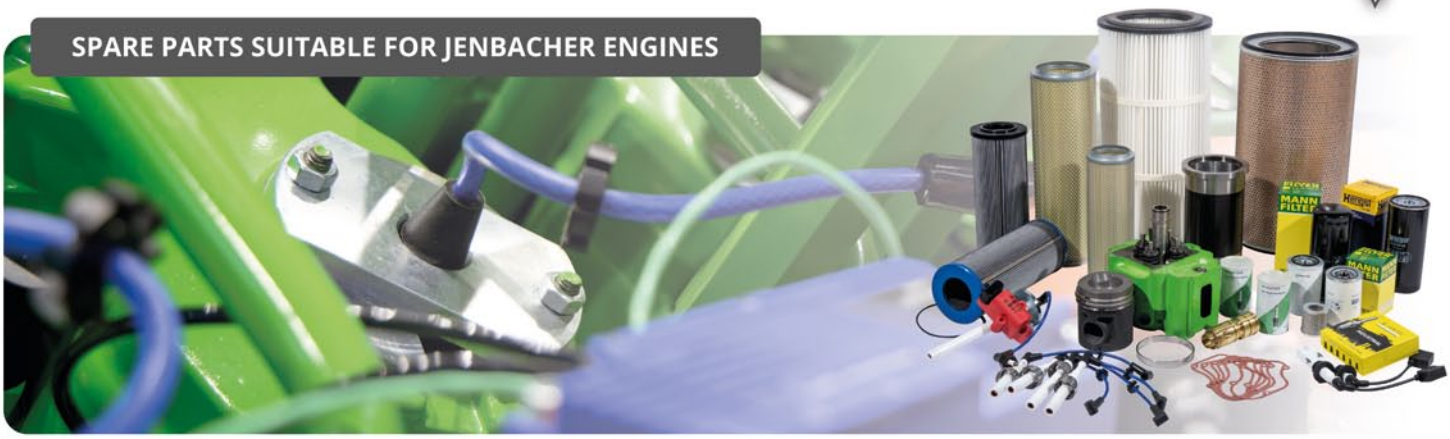

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EDITORIAL:

To be considered for inclusion in a future issue, contact jon.hughes@adbioresources.org

Forward Features:

AD – Critical Infrastructure
Critical infrastructure is the term used to describe assets, systems, and networks, that are considered vital to the functioning of a country. Energy, food and farming, waste management, water and wastewater treatment are key components of critical infrastructure. AD represents a key solution to the challenges we face.

AI and AD
Artificial intelligence holds crucial promise for the optimisation and future expansion of AD biogas production. Find out how.

O&M: LDAR
Leak detection and repair strategies to track down and prevent fugitive emissions.

H&S: The Big quiz 2
Test your knowledge of working in confined spaces and COSHH

+ the latest round up of important policy, regulatory, association and member news.

NB: If there is an issue you'd like to see explored – across the areas of policy, regulation, technology and operation - please contact me, jon.hughes@adbioresources.org

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ADBA | Anaerobic Digestion and Bioresources Association

UNLOCKING CLIMATE FINANCE TO BACK BIOMETHANE

Government could unleash a wave of investment, says **Sead Keric**.

With just 2.5% of the UK's available organic farm waste currently used by anaerobic digestors, biomethane remains a relatively untapped resource - despite its enormous potential in helping the UK reach its ambitious 2030 and 2050 climate goals.

ADBA members know well that biomethane's versatility makes it an attractive option for hard-to-abate sectors such as power generation, heating and cooling, transportation fuel, and chemical feedstock. Its potential to decarbonise such sectors underscores its significance as a leading solution for sustainable energy in the UK. At STX, we can see a clear trend in the demand amongst those sectors.

Last year marked another significant increase in our biomethane trading activity, rising to 6 TWh supplied across 13 different countries. As the market continues to mature, we expect we will continue growing at this trajectory.

For biomethane to play its expected role in the UK's 2050 net zero ambition an even bigger scale up is needed. Even to reach the targeted 12 TWh of biomethane injected into the grid by 2030 outlined in the Carbon Budget Delivery Plan, the UK needs to nearly triple its biomethane production capacity. If all projects are greenfield sites, this would require approximately GBP 2.5-3bn in capital expenditure.

It is clear, however, that traditional sources of capital are unable to offer the financial support required to accelerate the growth this industry needs. There is an urgent need for innovative financing solutions from parties that have a deep understanding of biomethane market dynamics. That is where we believe the private sector can step in.

We have created financial mechanisms and initiated partnerships to enable a flow of capital that will help advance the growth of biomethane across Europe and the UK. This specialised tool offers working capital funding in exchange for environmental certificates, which provide financial flexibility by allowing STX to temporarily hold a wide range of environmental commodities for our customers. This helped enable us to provide project financing to a Netherlands project earlier this year to increase biomethane capacity by at least 80 GWh per year.

More needs to be done by private sector players to fill the financing gap and by governments contributing to durable markets. The UK offers a production support system which helps to derisk investments, but there is not enough mandated demand in the UK to ensure that all the biomethane certificates produced are sold. As a result, important revenue streams for project developers and investors are not secured.

The UK government has an opportunity to step in and create biomethane blending mandates for grid-gas users to further secure investments and achieve decarbonisation targets for hard to abate sectors. This could also come in the form of UKA (carbon emissions allowance) offsetting, which is widespread in the EUETS; or by implementing a levy on grid-gas suppliers that do not incorporate biomethane into their natural gas supply.

The development and rapid scaling of biomethane plants is currently being held back by lengthy permitting timelines, slowing deployment of this necessary infrastructure. As DESNZ addressed in its recent call for evidence on the Future Policy Framework for Biomethane Production, there is a regulatory gap around non-waste anaerobic digestors (AD) which could restrict the ability of a future policy framework to maximise the capacity of existing AD infrastructure. By streamlining the process, reducing regulatory hurdles, and tightening guidance, we could unleash a new wave of investment and facilitate a rapid and much-needed deployment of biomethane infrastructure.

The path towards achieving the UK's biomethane goals faces some major challenges, but the potential for addressing climate change and advancing towards a greener future is significant. Only by addressing financing constraints and streamlining permitting procedures across the UK and Europe, can we truly unlock the full potential of biomethane as a cornerstone of sustainable energy strategies.

Sead Keric is Managing Partner responsible for Renewable Gases at leading environmental commodities merchant, STX Group.

DEFRA'S SIMPLER RECYCLING ANNOUNCEMENT PUTS AD IN THE SPOTLIGHT

Defra's Simpler Recycling regulation announcement – providing a specific timetable for the introduction of separate food waste collection across England - created a flurry of interest into AD's ability to transform this food waste into valuable resources. This culminated in a report featuring ADBA's Chief Executive Charlotte Morton OBE on BBC Breakfast News. The report was filmed at BioCapital's Dagenham plant. While audience data is unavailable, the report will have reached millions, which, alongside the Defra announcement itself, is great news for the industry!

http://tiny.cc/qan6yz

BBC BREAKFAST NEWS REPORT

www.youtube.com/watch?v=02tpX1fSwel&feature=youtu.be

TOP STORIES

Other leading media activities over the past few months have been ADBA's ongoing engagement with **gasworld**, which led to ADBA Chairman Chris Huhne being interviewed by its journalists on a number of issues, with the recordings promoted on the online channel for several months – cumulating an estimated reach of around 300K and still counting.

Other prominent stories gaining traction were the announcement by DESNZ of the extension to the **Green Gas Support Scheme** – with the ADBA press release being picked up in seven UK outlets with a combined reach of over 780K.

The **ADBA National Conference** drew attention from the trade press, with mentions in seven outlets totalling a reach of 390K – with particular attention being given to the Gas Goes Green initiative presented at the event.

The Parliamentary Under Secretary of State at the Department for Energy Security and Net Zero (DESNZ) Lord Callanan underscored the government's strong support for the AD industry and its vital role in achieving the UK's Net Zero targets in his address to the conference.

Finally, a more unwelcome spotlight was shed on the sector with the Cassington lightning strike incident in October, which attracted nationwide attention on mainstream channels and across social media. The response from ADBA was picked up on the BBC News website, which has a reach of 551M. ADBA has since issued guidelines to advise operators on measures to prevent a repeat.

www.bbc.com/news/uk-england-oxfordshire-67009657

ADBA MEDIA ACTIVITIES – OCTOBER 2023 – MAY 2024

3 Articles published in external outlets

5 Extensive responses to media enquiries

9 Press releases issued

2.85M Reach: (excluding BBC coverage and academic paper)

LINKEDIN IMPACT

93,179 impressions **871** new followers https://bit.ly/3vLxQvq

502 Member enquiries

106 Government engagements

37 Political stakeholder engagements

114 Industry and other stakeholder engagements

218 Operator engagements

BIGGER THAN NUCLEAR

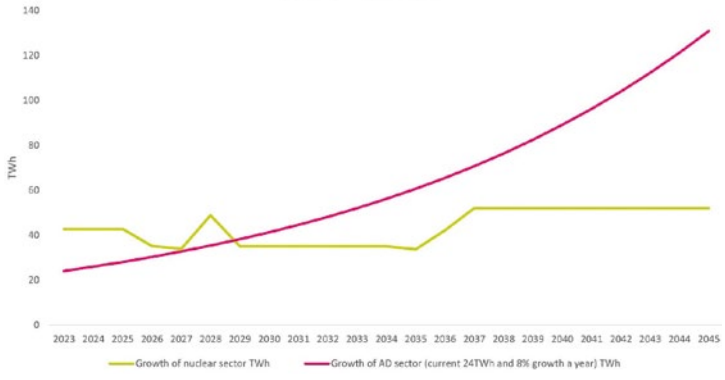
Based on growth rate and investments, the UK biogas industry is set to overtake nuclear as a green energy provider in 2029, writes ADBA Chairman **Chris Huhne**

With COP28 participants painfully but finally agreeing to put on paper the decision to move away from fossil fuels and transition to green sources of energy, the momentum towards a rapid growth of the anaerobic digestion and biogas industry in the coming years, as expected by the International Energy Agency (IEA), can only accelerate.

In its 2023 Energy Outlook report, the IEA projects that worldwide green gas will grow by between 8% and 22% a year to 2030. The share of biomethane in total biogas demand is forecast to rise in all scenarios - driven by biomethane's value as a flexible, on-demand energy source that can directly replace conventional natural gas. With its dispatchable qualities and ability to use existing gas infrastructure, biomethane is emerging as a key solution to decarbonise gas supplies across sectors.

Biogas and biomethane might be the smallest part of the bioenergy supply chain in the IEA analysis, but it is recognised to play a growing role in sustainable energy. In particular, the report highlights a sizable global potential of around 300 billion cubic meters for biogas and biomethane production from agricultural residues and wastes near major pipelines. This presents a prime opportunity for large-scale development and injection into gas grids.

The exciting news is that based on current growth rate - and as a result also of investments from major players such as BP, TotalEnergies and Shell - the AD and biogas industry in the UK is tipped to overtake nuclear in the UK by 2029.



Projected growth of nuclear compared to AD.

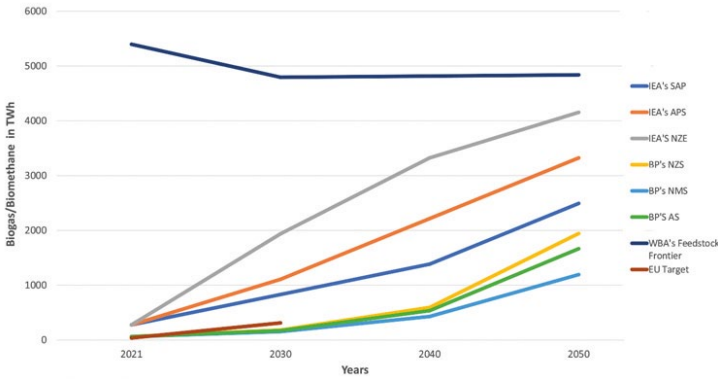
With a General Election looming in Britain, ADBA has seized the opportunity to launch an 11-point roadmap of asks and expectations for the green gas industry that politicians should integrate into their manifestoes.

Benchmarked against the average IEA growth rate projection of 14% per year, it highlights the sector's ambition to build at least 1,000 new biogas plants in Britain – in addition to the existing 723 – by 2030. The new plants will create 18,000 new jobs – and high skills – across every part of the country. This aligns with the commitment to levelling up from both the major parties.

Our message to our political leaders and policymakers, highlights the contribution AD makes to society. If our roadmap is seen through, home-grown green gas can...

- Shield consumers from sky-high energy bills
- Keep food shelves stocked by using UK-made biofertiliser
- Create thousands of jobs and new skills across the UK
- Clean up our rivers and beaches by treating farm waste
- Stop food waste from going to polluting landfill
- Curb climate change from quick-acting methane

The Government pre-COP28 U-turn on Net Zero commitments might have been disheartening, short-sighted and damaging to confidence, but the IEA's World Energy Outlook report, the positive impact of DESNZ's Biomass Strategy and extension to the Green Gas Support Scheme application deadline, alongside Defra's separate food waste collections announcement and other encouraging trends, can only fill us with optimism that the future is bright for the AD and biogas industry in the UK – and beyond.



Global Biogas Forecasts from the IEA, BP, EU, in the context of the World Biogas Association feedstock frontier.

SCOTLAND SETS AMBITIOUS GOALS FOR BIOENERGY GROWTH

The Scottish Government issued a major new consultation on its Draft Bioenergy Policy Statement in March. This lays out proposed policies and priorities for the use of bioenergy resources in Scotland through 2045 as part of achieving their net-zero targets.
www.gov.scot/publications/draft-bioenergy-policy-statement/

The consultation covers a wide range of topics highly relevant to the anaerobic digestion (AD) sector in Scotland.

It clearly recognises the current vital role of the AD sector in Scotland's circular economy, generating value from waste and by-product feedstocks to produce biogas and biomethane.

In the short-medium term out to 2035, it states an expectation that new biogas AD plants utilising currently underutilised waste resources like manures, slurries and food waste will be deployed.

Beyond 2035, it identifies biogas AD with carbon capture and storage (CCS) as having significant potential for delivering negative emissions that will be required to offset residual emissions.

Overall, this consultation lays out a potentially ambitious but still evolving role for the biogas/AD sector in contributing to Scottish bioenergy supply and net zero goals.

It sees opportunities around scaling up AD deployment using currently underutilised waste feedstocks in the short-term, while also deploying carbon capture on AD facilities and potentially using energy crops as feedstocks longer-term.

However, many of the key details around future long-term policies, commercial frameworks, and levels of government support still need to be determined through this consultation process and subsequent decisions.

The consultation closes on June 12. To feed into the consultation contact Wasundara at policysupport@adbioresources.org

NEW GGSS REGULATIONS LAID BEFORE PARLIAMENT

The Green Gas Support Scheme (Amendment) Regulations 2024 were laid before parliament on 15 May and are expected to come into force on 4 June. From that date, applicants and participants will be able to benefit from the changes to the GGSS introduced following the Mid-Scheme Review. The regulations can be viewed online here www.legislation.gov.uk/uksi/2024/642/contents/made

These regulations, once they come into force, amend the GGSS to introduce the changes committed to in our Green Gas Support Scheme Mid-Scheme Review consultation response (http://tiny.cc/89w6yz), specifically:

Extending the GGSS to 31 March 2028 to provide more time for prospective applicants to register on the scheme. We recognise that securing food waste feedstock has been a key challenge for developers looking to apply to the scheme. The extension ensures the scheme better aligns with deadlines for local authorities to implement food waste collections across England, as set out in Defra's Simpler Recycling Government Response. (http://tiny.cc/ndw6yz)

Removing penalties for the use of eligible heat pumps in the production of biomethane to incentivise scheme participants to adopt low carbon heat pumps as an alternative to fossil fuel heat sources. Scheme participants using an eligible heat pump may receive increased eligible biomethane tariff payments as a result.

Aligning with ADBA recommendations during the Review, the outcome further endorses critical proposals including maintaining current tariff guarantees and commissioning deadlines, retaining the 50% waste feedstock threshold and continuing requirements for responsible digestate management.

Announcing the progress of regulatory changes DESNZ said, "The GGSS represents a key step in continuing to support the growth of the anaerobic digestion and biomethane industry. It is essential that the GGSS achieves its objective of encouraging the deployment of biomethane plants in order to increase the proportion of green gas in the gas grid, create jobs and attract investment. By amending elements of the GGSS through these regulations, we intend to ensure that the scheme continues to deliver against this objective."

Ofgem, the administrator for the GGSS, will shortly publish revised guidance for the scheme, reflecting the scheme extension and heat pump exemption. ADBA looks forward to continued engagement with government to inform a future framework for the biomethane sector.

If you have any queries about the scheme, you can contact ADBA by e-mail at: policysupport@adbioresources.org

FIRST WIN FOR AD OPERATORS IN BUSINESS RATES CHALLENGE

AD operators are no longer to be charged business rates on the portion of energy generated and used to power the plant – one of the key issues in a class action being pursued on behalf of industry by Handel Rating Consultancy.

Last year the renewable energy practice, supported by their clients and ADBA, launched the action against the HMRC's Valuation Office Agency, challenging the way business rates for AD operators in England and Wales are calculated. As a consequence, electricity producers were facing a hike of ~30% and biomethane producers ~20%.

At the turn of the year, the Valuation Office Agency (VOA) conceded one of the issues in dispute. They agreed to fully reflect the reduction in electricity sales brought about through the parasitic load of an AD plant when calculating the rateable value.

On behalf of their clients, Handel Rating Consultancy is now working with the VOA to agree on reduced rates assessments, which in many instances will be applied retrospectively.

There remains an opportunity for other AD plant owners and operators generating electricity to benefit as well. This concession by the VOA will, however, not be applied widely unless ratepayers take steps to realise the opportunity, including registering on the VOA gateway portal and agreeing with the VOA on the facts of their plant.

The substantive issue of the class action is ensuring the operational risks of running an AD plant are fully taken account of in the VOA's valuations used to arrive at a plant's rateable value. This issue remains unresolved; therefore, Handel Rating Consultancy is pursuing two lead cases to a formal Valuation Hearing. These are expected to be scheduled for a final decision this summer.

A successful outcome would result in many operators seeing substantial reductions in their rates, in the form of rate refunds and reduced liabilities going forward. Most likely to gain will be predominantly crop-fed AD – both electrical and biomethane plants. But food and other waste plants may also benefit.

For further information please contact ADBA or Handel Rating Consultants below.
ADBA – policysupport@adbioresources.org
Handel Rating Consultants – info@handelrating.com

ADBA MAKING CASE FOR BIOMETHANE EXPORTERS

The European Commission (EC) will launch a Union Database (UDB) for gaseous fuels, after having launched one for liquid fuels this January, by no later than November 2024.

The database aims to ensure the tracing of liquid and gaseous transport fuels that are eligible for being counted towards the share of renewable energy in the transport sector in any Member State. However, the EC has expressed an intention to exclude the certification of biomethane and by extension biomethane-based fuels when these rely on transport through extra-EU grids. This decision will hinder exports of biomethane and biomethane-based fuels, such as biomethanol, into the EU.

ADBA is currently working with DESNZ to build a case for the potential impact on our members to ensure that this issue is escalated at a ministerial level if necessary. Negotiations between DESNZ officials and the EC are taking place at present.

For further information contact Giulia Ceccarelli at
giulia.ceccarelli@adbioresources.org

SCOTLAND URGED TO RETHINK APPROACH TO WASTE MANAGEMENT

ADBA has called on the Scottish government to rethink its approach to developing a *Circular Economy and Waste Route Map to 2030*, to include anaerobic digestion (AD). The technology was overlooked as a solution in the Scottish Government's proposals sent out to consultation earlier this year, despite its focus on modernising recycling, decarbonising disposal and strengthening the circular economy.

It is these very attributes that led the IEA to say AD sits at the heart of the circular economy. In its formal response ADBA strongly argued that the anaerobic digestion (AD) sector should be given greater prominence and support as a critical circular economy solution for Scotland.

The response also recommended policy support measures for AD, such as financial incentives, streamlined permitting, reduced taxes on renewable gases and minimum recycling requirements. ADBA stressed that more significant government backing for AD is vital for Scotland to achieve its net zero and circular ambitions.

The full consultation response is available for ADBA members to review – Click here to view. https://tinyurl.com/2uctxwur

AGRICULTURAL TRANSITION PLAN 2024 UPDATE PUBLISHED

Defra has published its Agricultural Transition Plan Update (2024), setting out its plans and priorities for the sector to 2028. Post-Brexit, agricultural policy has been developed through the Agricultural Transition Plan (2020). The update builds on that, offering an enhanced menu of funded actions that farmers can pick and mix from to protect the environment while increasing productivity and food security.

The potential actions fall under three schemes, the Environmental Land Management Scheme (ELMS), Countryside Stewardship (CS) and Sustainable Farming Incentive (SFI), which encompass a dizzying array of funding streams. Many of these are being kept under review to ensure they are applicable and accessible to small farms as much as large ones. The strategy aims to support farmer led innovation and improvements in agricultural productivity 'so we can maintain food production and thriving farming businesses'.

The update recognises the urgent need to address nutrient management on farms to reduce nitrogen, phosphorus and sediment loading by 40% by 2038. It says, "We know that water quality compliance requires significant investment from the sector. We are providing grants to improve slurry management for a time limited period to help businesses prepare and accelerate the pace and scale of change."

A key ambition is to support innovative approaches to slurry management, through the Farm Innovation Fund. "These will help the sector better manage slurry as a valuable resource rather than a waste product." Winter cover crops are also being supported as part of the drive to curb nutrient overload. Actions on nutrient management run through the update, positioned as key to addressing GHG emissions, water and air quality.

On greenhouse gases the report says the SFI will support "large-scale uptake of actions to reduce emissions (for example, nutrient management)" and cites the following opportunities;

Grants: development and adoption of equipment, technology, and infrastructure to make farms more efficient and reduce emissions from livestock.

R&D: funding of R&D to support new technologies and practices that will reduce greenhouse gas emissions.

Private schemes: payment for carbon reductions in agriculture that can be sold through the developing carbon trading market.

On water quality and nutrient management, SFI will support large-scale adoption of more sustainable approaches to nutrient, soil, and pest management and riparian buffers to protect rivers and lakes from runoff, soil erosion and nutrient leaching.

Grants: equipment and infrastructure to improve soil and nutrient management, improve slurry storage and management, and improve water storage and management. R&D to support the next generation of solutions to these issues, including technologies to utilise organic manure as fertiliser.

On air quality the government will use existing regulation to tackle air pollution from farming, including slurry and manure spreading and burning crop residue, heathers and grasses.

The SFI will support improved use of fertiliser and on farm nutrients, while CS will issue capital grants to reduce emissions from agriculture. Under the slurry management scheme, grants will be made available "to improve slurry storage and management, which includes reducing ammonia emissions and continued research into new technologies and practices".

The ATP Update can be seen here http://tiny.cc/vt27yz
For further information contact, policysupport@adbioresources.org

SOIL HEALTH SETBACK

The House of Commons Environment, Food and Rural Affairs (EFRA) Select Committee has expressed it disappointment at the government's response to their Soil Health Report – which advocated the use of digestate.

A key recommendation of the report was that "by mid-2025, the Government should develop an action plan setting out how it will make organic inputs a more economical choice for farmers. This should include measures that boost the availability and diversity of organic inputs to achieve soil health targets and ensure the organic recycling and agricultural sectors have the facilities and technologies to produce, store and spread a diverse range of organic inputs, including compost, digestate and biosolids. The Government also needs to support research into novel fertilisers and new technologies that can enable more use of organic inputs."

The government's response fell short of making a commitment on this and many other issues. On the plus side the Committee welcomes the Government's recognition of the value in establishing 'a shared understanding of "sustainable soil management" within the agricultural sector'. Although a year later than the Committee hoped, it is also glad to see a continued commitment to developing standardised ways of measuring soils through soil health indicators by 2025.

While the committee also welcomes the enhanced payments for farmers in support of environmental gains announced in the ATP Update (above), it adds somewhat pointedly, "the Committee hopes that more efforts like these can be replicated in the future, with a particular focus on soil health".

However, on many other recommendations, the Committee regrets that there is a vagueness in the Government's response, citing "the aims of the Environment Agency's Big Soil Stocktake lack clarity, it is unclear how the Government's farming incentive schemes and guidance for farmers will be adapted to focus more on soil health, and although reviews and reforms of soil and fertiliser regulations are mentioned, it is not known whether these will lead to meaningful change."

The Chair of the Environment, Food and Rural Affairs Committee, Sir Robert Goodwill, said, "We are disappointed that its response to our report is noncommittal on several important measures, leaving much open to an unclear review process. There is also a lack of clarity to be found … on questions such as who will be responsible for ongoing soil monitoring once a baseline is established and how this will be funded. "While we wanted the Government to be more ambitious in its targets, urging for over 90% of agricultural land to meet a definition of "sustainably managed" by 2040, we are disappointed that the Government has settled on a lower target in this area, without explaining why."

The full report can be found here: http://tiny.cc/rw27yz

ADBA TO PLAY A LEADING ROLE IN DEVELOPING THE METHANE ACTION PLAN FOR 2024-26

ADBA has been invited to help develop plans to curb methane emissions across the waste, water and agriculture sectors in England. Cutting methane emissions is one of the most effective ways to reduce near-term global warming, says the Environment Agency.

The environmental regulator has an important regulatory role in reducing methane emissions in England. The organisation's Methane Action Plan for 2024-2026 for England sets out how it will do this. It recognises that collaboration with organisations such as ADBA will be critical to "share knowledge to improve [our] collective understanding of how to enable methane reduction."

As a major contributor to climate change and global warming, curbing methane is crucial for meeting the UK's climate goals and its commitment under the Global Methane Pledge to cut emissions by at least 30% from 2020 levels by 2030. Methane represented 14% of total UK greenhouse gas (GHG) emissions in 2022, with the agriculture, waste and fuel supply sectors contributing around 49%, 30% and 8% to that total respectively (Department for Energy Security and Net Zero (DESNZ), 2024 http://tiny.cc/5z27yz).

The plan has three key objectives: improving data measurement and monitoring, maximising regulatory effectiveness to drive emissions reductions, and collaborating with external partners. Several aspects are particularly relevant for the AD industry, and align to the industry's best practice kite mark the AD Certification Scheme (ADCS). www.adcertificationscheme.co.uk

Improving data measurement and monitoring

On the data front, the EA states that it will work with ADBA and other relevant stakeholders to update emissions factors through the GHG Inventory Improvement Programme, create a national database of emissions from regulated sites, and increase quality assurance efforts. Monitoring is also a priority, with plans to utilise techniques like optical gas imaging and develop better quantification methods across sites the EA regulates. "By improving how methane is measured, monitored, reported and modelled we will make better decisions and better target our action," the EA says.

Maximising regulatory effectiveness

To drive emissions reductions through regulation, the Plan aims to make methane a priority pollutant, review permitting to ensure best available techniques (BAT) are implemented, and update BAT conclusions to address methane more comprehensively. Importantly for the AD sector, it specifies an "Improvement Programme" to review leak detection and repair (LDAR) reporting for consistency.

The report says, "Anaerobic digestion (AD) improvement programme – we are reviewing the leak detection and repair (LDAR) reports to develop consistent reporting requirements from the sector. We will collate the data to estimate losses and drive improvements. LDAR requirements are also being added to environmental permits as part of our permit review programmes. We will keep appropriate measures relevant in assessing this data and seek improvements as evidence presents." The report states, "Maximising the effectiveness of our regulation will enable and encourage operators to reduce methane emissions efficiently."

Support reduction of emissions

The report notes the while water and agriculture sectors contribute significant methane emissions the EA is working with them to reduce 'through their compliance with other existing regulatory requirements'.

For AD on wastewater treatment installations the EA says it will "progressively issue new and modified permits to ensure Best Available Techniques (BAT) are adopted for around 120 anaerobic digestion (AD) installations used to treat sewage sludge currently being operated by water companies."

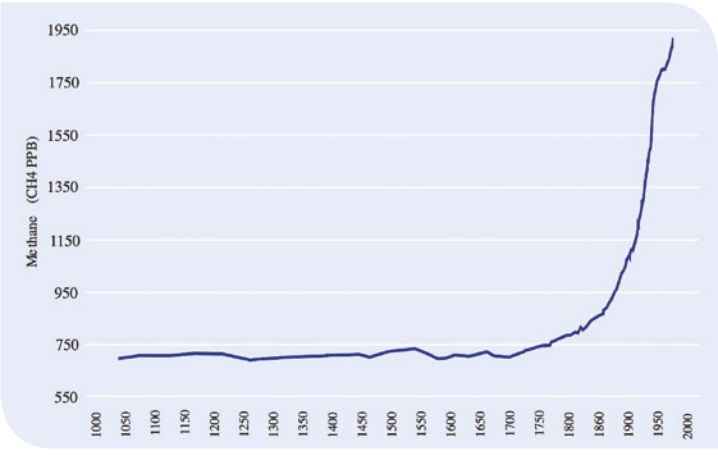
The EA aim to achieve this by March 2025 and says, "Once permitted then BAT will apply, and we can regulate to ensure compliance with requirements such as preventing or reducing fugitive emissions by covering open post-digestion storage (with collection and use of currently fugitive biogas) and requiring LDAR." In agriculture, the EA is "publishing a standard rules permit for methane capture from slurry stores, and gas upgrading plant to enable adoption of innovative farm scale methane capture plant".

Supermarkets and wider engagement

The action plan states that the EA will seek to engage third parties to assist sectors like agriculture in reducing methane emissions. "We are using our existing relationships to share evidence and information and are signposting other sectors to support to help them reduce their emissions."

It continues, "We are engaging with the AD industry trade bodies and look to widen this engagement to involve other interested parties for example supermarkets. Our engagement is targeted at evidence on incidents, case studies and so on in support of Defra policy consideration of the scope of EPR across the AD sector.

"We will engage innovative industry and universities on, for example, methane capture on farms and hydrogen conversion on AD plants converting biomethane to hydrogen." At ADBA, we look forward to working closely with the Environment Agency as it implements this Methane Action Plan. Reducing methane emissions is critical for meeting UK climate goals, and the AD industry has a major role to play as a waste management solution that produces renewable energy and biofertiliser and captures CO_2 while mitigating methane emissions.



Since pre-industrial times, methane's atmospheric concentration has more than doubled.

The clear alignment of the action plan with the objectives of the ADCS is also welcome. Drawn up by the industry, government and regulators, including the EA, it is the industry kitemark, benchmarking operational excellence. The independent audit of plants serves to consolidate the sector's green credentials and helps operators maximise their revenue streams. The equivalent of an AD MOT, the ADCS covers every aspect of biogas production from health and safety through to LDAR, BAT and lifecycle assessments. Find out more here. www.adcertificationscheme.co.uk

A FEAST FOR BILLIONS: FEEDING BIOGAS BACTERIA WELL

Any AD plant manager knows about the sheer amount of machinery that goes into creating biogas. They also know about the specifics of feedstock, and the nuances of their particular recipe. Each tiny change and addition to this balance matters when trying to increase gas yield.

After decades of working with the biogas industry and fine-tuning its feed system equipment, Vogelsang has seen some of the biggest increases coming from the most finely chopped media, regardless of what the feedstock is made from.

Wayne Carrington, National Account Manager for Vogelsang, explains. "It's easy to get caught up in the machinery side of the AD plant, but the reality is that the machinery is serving all the billions of microbes and bacteria (methanogen) inside the digesters. Once you start thinking in this way, everything you do on a plant makes a bit more sense.

"The AD equipment is essentially feeding billions of tiny mouths, keeping them warm, and encouraging them to 'pass gas'. Whilst some feedstock will naturally produce more gas from these bacteria, the plant can still make it easier for them to 'eat'.

"What we have learnt over the years is that they 'eat' in a similar way to all animals. They can't bite off more than they can chew, so milling the feedstock - regardless of how liquid or fibrous it is in the beginning - has a huge positive effect on gas production in terms of time and volume. The bacteria can digest more easily and quickly if the feedstock is very finely milled."

Machines made for extreme maceration

Vogelsang has a range of feed systems, including the popular 4-in-1 PreMix, which is designed to separate, macerate, mix and pump a wide variety of feedstock, and effectively mills medium to an optimal consistency before it goes into the digester. The macerating technology in this feed system comes from tried-and-tested RotaCut.

The RotaCut has many applications as a macerator. Fibrous and coarse matter is filtered through the cutter head of the RotaCut, with the flow of the pump medium. The sophisticated cutting screen geometry and an innovative blading-gliding system enable reliable maceration and an extremely smooth cutting result. The fluid and the solid matter it contains are turned into a pumpable, homogeneous suspension.

All of this macerating machinery in the feedline produces an exceptionally fine stock, perfect for the bacteria. Wayne adds, "The RotaCut produces such good results, that ambitious AD plants have started adding an additional machine between the feed system and the digester to ensure the finest possible medium and the highest gas yield."

Extra maceration in action

One such plant is the UK Biogas AD plant in Nomansland, Exeter. It has been operating since 2014 and produces 1.3MW of energy. It currently uses a feedstock of approx. 3,000 tonnes of chicken litter and 6,500 tonnes of maize, silage and farmyard muck per year. The plant uses a PreMix and has recently upgraded its feed system to include an additional line of a second PreMix with a Konrad Pumpe BIG-Mix hopper with an additional RotaCut.

Greg Palmer, Operations Director, UK Biogas, says, "The PreMix has been a fantastic feed system for us. It does everything we need to our feedstock to best prepare it for digestion, is simple to maintain, and parts are quickly available when we need them. I'd say we've seen an increase of 20% output from the installation of the new equipment, largely down to increased efficiency of feeding, less downtime and increased maceration."

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Biogas

PreMix®: Unique combination of four steps for efficient digester feeding

Developed for flexible treatment and processing of a wide range of feedstocks – from pulpy bio waste, residues to dung and dry renewable resources. The PreMix mashes nearly everything into a homogeneous organic suspension suitable for bacteria.

The smart 4-in-1 solid matter feeder separates out heavy material while the solids are mixed with liquid. Coarse particles are crushed and fibrous matter is macerated before the integrated pump. Right from the start, this avoids damage from foreign matter and ensures that the biomass is properly prepared for the bacteria. Its compact design makes it easy to integrate into new systems or retrofit in existing plants.

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VOGELSANG

AD AND THE FUTURE OF FERTILISER

Farmers have been placed in the front line of meeting the triple challenge of delivering food security, tackling the climate crisis and reversing nature loss. Recycling nutrients through AD is the simple solution. **Jon Hughes** reports

Nutrient management is a critical aspect of agriculture and environmental stewardship. It involves the correct application and balance of essential nutrients, typically nitrogen and phosphorus (N and P respectively), to optimise plant growth while minimising negative environmental impacts. A mounting level of evidence clearly shows we are getting the balance of use wrong to devastating effect.

Over recent years, some of the UK's most celebrated beauty spots have become the reluctant poster boys of nutrient abuse – The Wye Valley, Poole Harbour and Loch Neagh (see *Wall of Shame*). But these areas are not alone in suffering toxic algal blooms as a result of nutrient overload.

The latest report from The Rivers Trust – an umbrella association representing over 60 river trusts – is damning; our rivers are sick and in need of urgent resuscitation (see *State of Our Rivers*).

Among the principal causes is agricultural run-off from fertilisers, slurries and manures. When nitrogen and phosphorous are applied in excess to plant need they become hooligan pollutants, rampaging across land and sea.

From the Rivers to the Sea

What goes into our rivers, flows out to sea creating dead zones (see *Ocean Health Decline*). As the oceans serve to regulate the earth's climate (and are a food source for billions of people) this poses a grave threat to efforts to keep global heating below 1.5C.

A benchmark report in Nature Science journal found at the turn of the decade that the open ocean has lost an estimated 2% of its oxygen over the past 50 years, during which period ocean oxygen minimum zones (OMZs) have expanded by an area about the size of mainland Europe (4.5 million km^2) and the volume of water completely devoid of oxygen has more than quadrupled.

Meanwhile, since 1950, more than 500 sites in coastal waters have reported oxygen concentrations at a threshold often used to delineate 'hypoxia' – hypoxia refers to water conditions where the concentration of oxygen is so low that very few organisms can survive. Fewer than 10% of these systems were known to have hypoxia before 1950.

The report notes that over the same period, "Agricultural production has greatly increased to feed this growing population and meet demands for increased consumption of animal protein, resulting in a 10-fold increase in global fertiliser use over the same period. Nitrogen discharges from rivers to coastal waters increased by 43% in just 30 years from 1970 to 2000, with more than three times as much nitrogen derived from agriculture as from sewage."

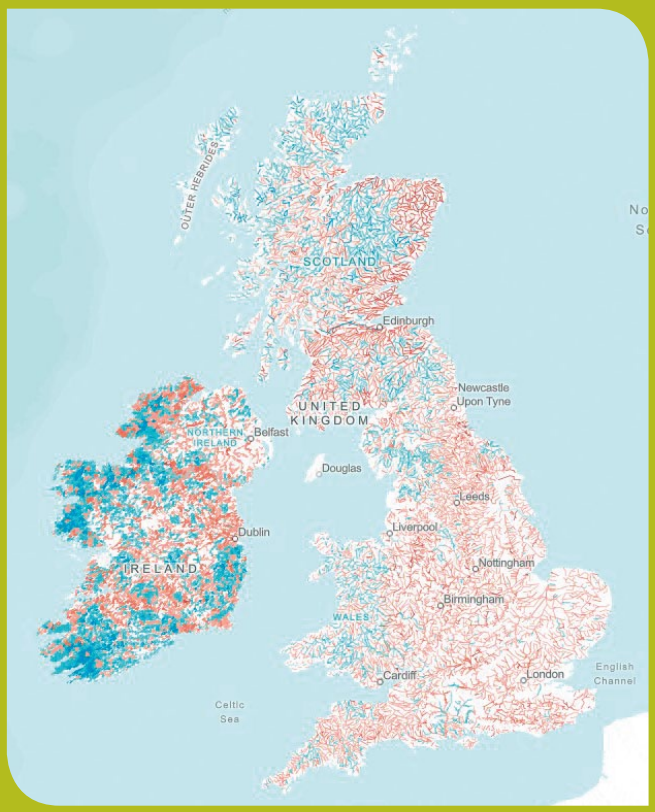
One of the key impacts of deoxygenation is it influences the movement of gases between the ocean and atmosphere. Deoxygenated deeper ocean waters produce greenhouse gases (GHGs) such as nitrous oxide (N_20), carbon dioxide (CO_2) and methane (CH_4) that can reach the ocean surface and be released into the atmosphere, contributing to further warming.

The report says, "Low-oxygen zones (including shelf and coastal areas) contribute a large fraction of the total oceanic N_2O emission to the atmosphere, and expansion of these systems may substantially enhance oceanic N2O emissions. Record air-sea N_2O fluxes have recently [c.2018] been observed above the OMZ in the eastern tropical South Pacific."

Essentially what this describes is the ocean bottom becoming a graveyard of sealife where, deprived of oxygen, it starts to produce gas under anaerobic conditions.

One of the two principal recommendations of the report is for 'Ecosystem-based mitigation to restore and protect the environment', with the instruction to

STATE OF OUR RIVERS



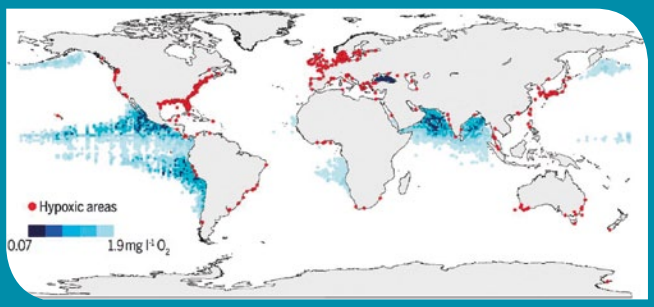
Map key: High Good Moderate Poor Bad No data

The map above shows the current ecological health of the UK's river network.

0% are in high overall status
23% are classed as in poor or bad overall status
85% of river stretches fall below good ecological standards
only **15%** achieve good or above ecological health status

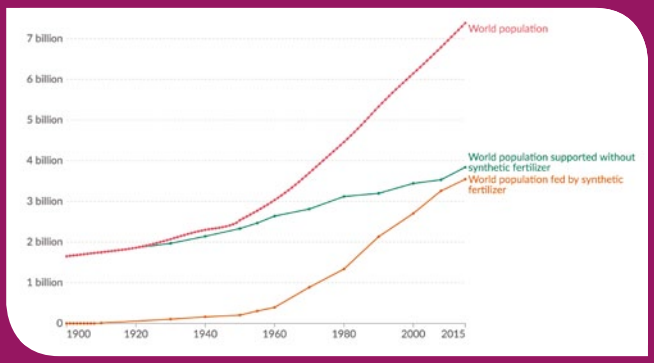
Causes of pollution:
62% of river stretches failed because of activities attributed to agriculture & rural land management (pollution from fertiliser or livestock)
54% of river stretches failed because of activities attributed to the water industry (including treated and untreated sewage discharge, and abstraction of groundwater)

OCEAN HEALTH DECLINE



Low and declining oxygen levels in the open ocean and coastal waters affect processes ranging from biogeochemistry to food security. The global map indicates coastal sites where nutrients from human activity have exacerbated or caused O_2 declines to <2mg liter- (<63 µmol liter-) (red dots), as well as ocean oxygen-minimum zones at 300 m of depth (blue shaded regions). (Global Ocean Oxygen Network, Breitburg et al.)

HABER BOSCH POPULATION



World population with and without synthetic nitrogen fertilizers
Estimates of the global population reliant on synthetic nitrogenous fertilizers, produced via the Haber-Boschprocess for food production. Best estimates project that just over half of the global population could besustained without reactive nitrogen fertilizer derived from the Haber-Bosch process.

Data source: Erisman et al. (2008); Smil (2002); Stewart (2005)
ourworldindata.org http://tiny.cc/rxc1yz

'reduce anthropogenic (man made) nutrients reaching coastal waters to reduce eutrophication-driven deoxygenation'.

Roots, shoots and fruits

In other words, manage the use of N and P. This is literally a life-and-death challenge. Nothing grows without N and P. Alongside potassium (K), they are as fundamental to the food chain as sunlight and water.

Hence the majority of mineral fertiliser applied to land in the UK (and globally) is N P K fertiliser, often marketed by the relative proportions of each mineral the product contains, i.e., 10:5:5. These primary macronutrients are respectively responsible for the production of chlorophyll (for photosynthesis), root development and reproduction. As the Royal Horticultural Society puts it: roots, shoots and fruits.

For millennia, agricultural crops relied on the limited quantity of these macronutrients that were occurring in soils and ecosystems, part of the natural process of nutrient recycling through the interaction of such things as decaying vegetation, meadow grasses with their various root lengths and leguminous vegetation, and manure from grazing animals.

This all changed when Fritz Haber and Carl Bosch worked out how to create ammonia (NH_3) from N_2, the form of nitrogen that comprises 78% of the atmosphere but cannot be processed by plants. NH_3 is a form of reactive nitrogen that plants can use. This was the gamechanger that resulted in the 'green revolution' of the 1970s – when warnings of limits to growth and mass starvation were debunked by the availability of mineral fertilisers.

Continued>>

WALL OF SHAME

The unfortunate and now infamous poster boys for nutrient overload are the River Wye, Loch Neagh and Poole Harbour – all protected areas in respect of their unique features.

River Wye
The Wye Valley is designated an area of outstanding natural beauty, an internationally important protected landscape straddling the border between England and Wales, recognised in particular for its limestone gorge scenery and dense native woodlands, as well as its wildlife, archaeological and industrial remains.
https://tinyurl.com/bdezt8d8

Loch Neagh
Lough Neagh is the largest freshwater lake in the UK and Ireland, it contains over 800 billion gallons of water. Lough Neagh has a unique and diverse habitat with many rare species of plants, bugs, waterfowl, birds and fish and is designated a Ramsar Site – this is an internationally recognised treaty for the conservation of wetlands.
http://tiny.cc/pu42yz

Poole Harbour
Poole is Europe's largest natural harbour and a site of nature conservation, a wetland teeming with wading birds with many international protections in place. It is a Ramsar site which recognises wetlands of international importance particularly for wildfoul. It is also a Site of Special Scientific Interest (SSI) which recognises the country's most spectacular and beautiful habitats and a Special Protection Area (SPA).
http://tiny.cc/yu42yz

Studies say that today at least half of the world's population owes its existence to food enabled by manmade fertilisers (see *Haber Bosch Population*). However, their overuse has resulted in N and P exceeding planetary boundaries – a widely accepted concept from the Stockholm Resilience Centre. The boundaries represent key limits within which humanity can develop and thrive.

Crossing these boundaries 'increases the risk of generating large-scale abrupt or irreversible environmental changes', as can perhaps be seen along the length and breadth of the UK's waterways and increasingly our oceans. The use of N and P is outstripping planetary boundaries two-fold, nationally and globally (see *Planetary Boundaries – Biogeochemical Flows*).

While generally applied to land simultaneously, N and P pose particular challenges that require addressing separately to successfully curb the devastation being caused by nutrient pollution.

The Nitrogen Cycle

The World Wildlife Fund (WWF) considers action on nitrogen as a key part of its mission 'to bend the curve of nature loss and tackle climate change by 2030', in particular 'to restore the connections between the economic, environmental and social dimensions of the food system'. To that end it commissioned the report *Nitrogen: Finding the Balance*, to compile comprehensive benchmark data sets and evidence for policy makers.

To meet planetary boundaries the WWF has said the UK's per capita nitrogen footprint must be slashed by more than 80% by 2030. The report found that "the overuse and waste of nitrogen across the UK agri-food chain would be worth approximately £2.3bn each year to buy as fertiliser – equivalent to around half of all annual agricultural profits".

It also found that only ~50% of the nitrogen applied to land as mineral fertiliser (1000 kt N) and animal manure (1000 kt N (approximately)) is used. The remainder either volatises into gaseous form (960 kt N annually) or runs off into aquatic systems (~712 kt annually).

The report estimates the societal cost to public health, ecosystems and climate change of N pollution to be ~£11bn – of which ~£7bn (64%) can be attributed to agricultural use of N fertiliser, "(mainly particulates from ammonia (NH_3); £2.4 billion), followed by ecosystem eutrophication and biodiversity impacts (N deposition and NH_3 and NOx gases; £4.4 billion)".

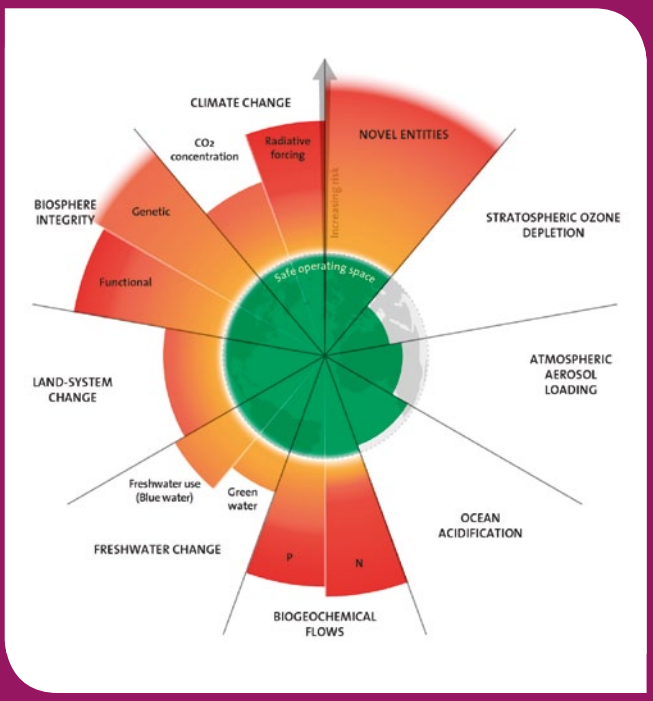
Agricultural soils are becoming a significant source of both nitric oxide (NO) and nitrous oxide (N_2O) – part of the wider family commonly referred to as NOx gases. Production of both is stimulated by the excess application of fertilisers to land. Agricultural practices in the UK are projected to be responsible for 6% of UK NOx emissions by 2030.

While not a GHG itself, NO is involved in the formation of nitrogen dioxide (NO_2) and tropospheric ozone (O_3), both of which are significant air pollutants. N_2O, however, is a GHG, with a global warming potential 265–298 times that of CO_2, with an average residence time of 100 years. UK agriculture accounts for ~60% of N_2O emissions.

Ammonia meanwhile is a pollutant which can have significant effects on both human health and the natural environment – responsible for chronic and fatal heart and lung conditions in humans and effect the composition of vegetation and species and cause biodiversity loss.

Where the excess nitrogen doesn't escape into the atmosphere, it leaches into

PLANETARY BOUNDARIES – BIOGEOCHEMICAL FLOWS



The use of nitrogen and phosphorous is outstripping planetary boundaries two-fold, nationally and globally. http://tiny.cc/ow42yz

groundwater or runs off into surface water bodies, such as streams, rivers and lakes, with the results as seen on the *Wall of Shame* and *State of Our Rivers*.

It is worth noting that the consequences include contamination of drinking water, which will require treating. The UK has maximum contaminant levels for nitrogen compounds in drinking water to protect public health, posing CAPEX, OPEX and compliance costs on water companies. Somewhat ironic given that water companies themselves are in the dock for their role in polluting the UK's waterways through the release of raw sewage, contributing to those contaminant levels they then have to address (see *Sewage*).

The UK standard for nitrate pollution in water is 50mg/L, to safeguard against methaemoglobinaemia (blue baby syndrome) in very young children. This is an exceedingly rare yet potentially fatal illness where nitrate is converted to nitrite in the infant's gut and interferes with the absorption of oxygen by the blood.

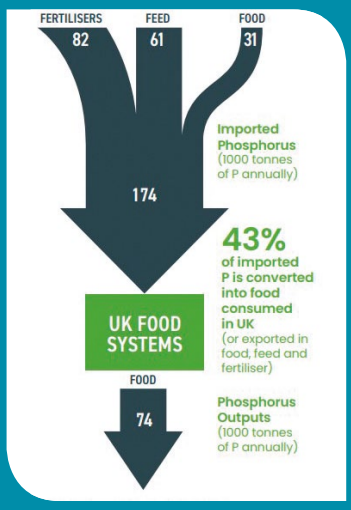
A final consideration is the production of nitrogen fertiliser consumes ~2% of the world's energy output and produces between 1.4-5% of global GHGs – to convert atmospheric nitrogen into reactive nitrogen of which 50% returns to the atmosphere or waterways. It is an unsustainable cycle that must be broken, to curb all the emissions associated with production of mineral fertilisers.

The Phosphorous Cycle

As with the nitrogen cycle, the hallmarks of the phosphorous cycle are waste and water pollution (it does not volatise into gaseous form as nitrogen does). The UK imports 174,000 tonnes of phosphorous rock each year, of which more than half is wasted (see *Phosphorous Flows*). The cost in environmental damage caused by phosphorous leakage from land to water is valued at £39.5 billion – the asset value assigned to the UK's fresh water ecosystem (UK

PHOSPHOROUS CYCLE

Less than half of the 174,000 tonnes of phosphorus imported into the UK each year is productively used, that is, converted into 74,000 tonnes of phosphorus in food consumed domestically and exported in food and commodities.



The RePhoKUs project's phosphorus flow analysis identified three hotspot areas of phosphorus inefficiency and loss in the UK food system:

- phosphorus accumulation in agricultural soils (90 kt P yr) (this surplus contributes to legacy phosphorus)
- phosphorus loss to water bodies (26 kt P yr)
- phosphorus sent to landfill and construction (22 kt P yr)

Natural Capital Freshwater Ecosystem Assets and Services Accounts - Office for National Statistics http://tiny.cc/6tx0yz).

The figures come from the RePhoKUs (The Role of Phosphorus in the Resilience and Sustainability of the UK Food System) project. The collective of eight leading institutions has been funded under the UK's Global Food Security research programme to better understand the critical role phosphorus plays in the UK food system.

Last year the project released "The UK Phosphorous Transformation Strategy; towards a circular UK food system". It warned that we were sleepwalking into a food and water security crisis because of the mismanagement of phosphorous.

Nothing grows without phosphorous – in layman's terms it is the foundation that allows all other macronutrients and biological molecules to function (including nitrogen). The UK is reliant on imports, which the report says leaves us vulnerable to supply disruption and price spikes – as was seen at the start of Russia's invasion of Ukraine.

Five countries control 85 per cent of the world's phosphate rock reserves: Morocco (70%), China (5%), Egypt (4%) Algeria (3%), and Syria (3%). In terms of the annual supply of phosphate rock, just four countries were responsible for 72 per cent of global production in 2021: China (39%), Morocco (17%), the US (10%), and Russia (6%).

But the report asks, do we need to import any phosphorous? In considering regional imbalances in phosphorous availability between livestock and arable intensive areas it says, "there is more phosphorus in livestock manures than the UK imports in fertilisers" (see *map*).

So, finding innovative and cost-effective ways to extract or relocate the phosphorus in manure from livestock intensive areas like Northern Ireland and Northwest England to arable cropping areas [in the east on England], will be key to addressing regional imbalances.

Continued>>

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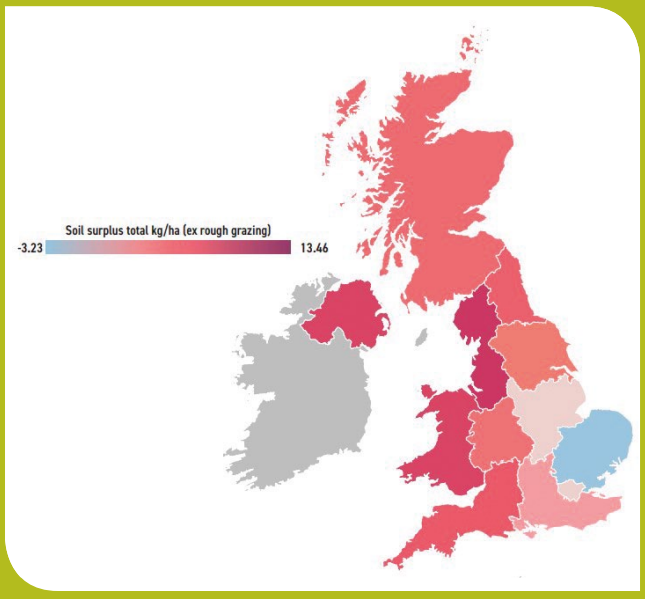
PHOSPHOROUS IMBALANCE



Within individual regions, estimates of the availability of secondary phosphorus sources (manures, biosolids and recycled food waste) that theoretically could replace demand for imported fertilisers suggest that the North West has nearly twice as much secondary phosphorus available than is required by its pastures and crops (184%). In contrast, the Eastern region could meet only 45% of its agricultural phosphorus demand from secondary sources. A similar regional imbalance occurs in Scotland.
http://tiny.cc/6y42yz

Managing N&P with digestate

Both the WWF and RePhoKUs reports recognise anaerobic digestion (AD) as a key manure processing measure that can reduce emissions associated with N and P.

At its most basic AD serves to degas manures, capturing the methane and other greenhouse gases that would otherwise be released to the atmosphere. The digestate produced as a byproduct of AD retains most of the nutrients from the original manure but does so in a more stable form, minimising the risk of volatisation and nutrient runoff and leaching into water bodies.

The WWF report states, "For waste management, anaerobic digestion of cattle manure has the greatest GHG abatement potential and a medium to large magnitude effect on reducing NH_3, NO_3, N_2O and total N losses, [and] no direct impact on biodiversity."

Of the 91 Mt of manure that is produced annually in the UK and goes untreated most is cattle manure. Cattle manure comprises 67 Mt (80%) of the total 83 Mt of UK annual livestock manure production during the housing period. (ref http://tiny.cc/qtx0yz) The remainder is predominantly poultry litter.

If the digestate is mechanically separated into liquid and solid fractions the benefits are magnified. Mechanical separation allows for the concentration of nutrients, particularly phosphorus and nitrogen, in the solid fraction of the digestate. The liquid fraction, correspondingly, has a lower nutrient concentration and can be more easily applied to crops without the risk of over-fertilisation.

N&P FLOWS

Food waste

When food is wasted, nitrogen and phosphorous are lost from the system. Food waste occurs across the supply chain from farm to fork. Both reports are clear, that where food wastes cannot first be reduced or redistributed, they should be recycled through AD, minimising the requirement to introduce additional N and P to the system.

Sewage

Wastewater contains N and P from human waste, food and certain soaps and detergents. While wastewater companies have made great strides in the recycling of macronutrients from wastewater – through advances in ammonia stripping and struvite recovery – that counts for nothing if, as is currently the case, sewage does not reach the wastewater treatment works.

Sewage spills into England's rivers and seas by water companies more than doubled in 2023. According to the Environment Agency, there were 3.6 million hours of spills, compared to 1.75 million hours in 2022.

It is inescapable however that the increased intensification of farming has resulted in regional concentrations of nutrients that will likely exceed the requirements of the local landbank. Over 50% of the UK is considered a nitrogen vulnerable zone.

The RePhoKUs report says to address this issue support needs to be given to encourage, "finding innovative and cost-effective ways to extract or relocate phosphorus in manure from livestock intensive areas like Northern Ireland and North West England to arable cropping areas, will be key to addressing regional imbalances."

Mechanical separation is the first step towards achieving this, making the solid fraction of digestate more economical to export.

River Wye Action plan

The government has recognised that treating manures and exporting nutrients is required to 'better protect and preserve' our rivers. Earlier this year River Action sought a Judicial Review of the Environment Agency (EA), alleging it has acted unlawfully in allowing destructive levels of nutrients from chicken manure to enter the River Wye.

It basically accused the EA of not doing its job, having not made one prosecution under Farming Rules for Water in the six years since the legislation was introduced. The legislation is designed to prevent nutrients being applied to land in excess to crop need.

Pre-empting the outcome of the review, the government announced an action plan to rescue the River Wye on April 12. The action plan includes, "requiring large poultry farms to export manure away from areas where they would otherwise cause excess pollution".

It also says it will provide up to £35m in grant support for on-farm poultry manure combustors (PMCs) – subject to planning permission – "in the Wye Special Area of Conservation catchment to facilitate the export of poultry litter to where it is needed".

Continued>>

POOLE HARBOUR – POLLUTER PAYS

In 2015, Fish Legal, Angling Trust and WWF launched a judicial review challenge against Defra and the Environment Agency, alleging they were failing to meet their obligations under the Water Framework Directive, determining not to use crucial measures such as the creation of "Water Protection Zones" (WPZs) to prevent agricultural pollution in protected sites.

The campaigners won. As a result, the Government was instructed to evaluate the use of mandatory WPZs, alongside voluntary steps by farmers. A WPZ was drafted, drawing an angry backlash from farmers. It went so far as to suggest arable land be reduced by 40% and livestock numbers by 50%, to bring nutrient run off under control. Think that sounds ludicrous? It is happening in the Netherlands, grappling with similar levels of nutrient pollution.

However, there was an appetite for an alternative, as to impose the WPZ would have required costly primary legislation and ongoing enforcement (and perhaps political capital in Dorset and wider farming regions) and taken time to implement. The upshot was the development of the Poole Harbour Nutrient Management Scheme.

In the aftermath of the Judicial Review the EA developed a nitrogen leaching tool, mining data from the 1980s when Poole Harbour was last in good condition. On the basis of that analysis, the EA said the catchment needs to reduce nitrogen leaching to 18.7 kg per hectare.

This is the target being pursued by members of the scheme, who farm over 80% of land in the Poole Harbour catchment area. The members are all committed to a flight path to achieve the 18.1kg leaching by 2030. Currently the rate stands at ~26.5kg. Those who are not members of the scheme must achieve 18.1kg immediately.

All farmers in the catchment area have to monitor and report their nutrient management activity, building an increasingly sophisticated database, sensitive to impacts of different winter cover crops and types of fertilisers and identifying legacy nutrient issues. Next year a trading element – farmer to farmer – will start, with N credits per hectare issued, meaning those who use most fertiliser purchasing credits from those who use least; a variation of polluter pays.

PMC is a form of energy from waste (incineration) where chicken litter is viewed as biomass. The government press release states, "Combusting poultry manure provides a source of renewable energy and converts manure to a nutrient rich ash, which is a valuable fertiliser that is easier to transport and use on farms - reducing risk to the environment."

It does, but it does not optimise resource recovery and recycling in the way treatment through AD would. PMC will destroy ~30% of mineral content, the antithesis to the recycling called for in the RePhoKUs analysis. The report calls on the government to back phosphorous recovery and recycling and assist in stimulating an export market.

The action plan does however also include a commitment to, "Proving the concept of a circular economy in manure nutrients with the potential added benefit of boosting rural renewable energy, through a carefully supported Pilot Farm Trial of Micro Anaerobic Digesters (AD)."

These are clearly steps in the right direction. Previously, following an earlier Judicial Review, a cull was mooted (see *Poole Harbour – polluter pays*).

Joined Up Thinking

Farmers have been placed in the front line of meeting the triple challenge of delivering food security, tackling the climate crisis and reversing nature loss. As both the RePhoKUs and WWF reports make clear – anaerobic digestion is the gateway technology that allows for the management of nitrogen and phosphorous. Simply by degassing manures and slurries, the technology has a profound impact. Mechanical separation further enhances the benefits and creates the potential for fertilisers to be exported to where they are needed.

Yet this is just the tip of the iceberg of what is possible. R&D across the sector is advancing the natural fertiliser frontier at pace – across all scales.

Project Nomad is piloting a mobile digester to allow small farms to access the advantages of digestate. Meanwhile a host of modular systems, from the likes of FreEnergy and BioFactory, increasingly offer affordable ways for farmers to access scalable AD systems.

Nijhuis Industries has developed a process to isolate phosphorous from wastewater treatment biosolids and ammonia (NH_3) from food waste and on-farm digestate; N_2 Applied a way to fix nitrogen in digestate to prevent 80% of ammonia emissions; CCm Technologies a means to utilise the CO_2 from biomethane production to turn biosolids into pelletised fertiliser that looks and acts like mineral fertiliser. These all represent pathways to either replace mineral fertilisers or create macronutrient feedstocks for mineral fertiliser production.

Yara, one of the world's largest mineral fertiliser producers, has committed to recovering and recycling nutrients in preference to using the Haber Bosch process. CNHi has developed a biomethane tractor to run on AD derived transport fuel, to further help decarbonise the agriculture sector.

What is evident is that deploying AD to tackle the nutrient crisis represents an opportunity to maximise synergies across policy goals for climate, food and energy security while feeding into the agendas to level up and create skilled 'green jobs'. Post-Brexit we have the opportunity to incentivise the use of digestate, develop solutions to one of the greatest threats the planet faces and create a market for recycled nutrients.

Nitrogen and phosphorous are globally traded commodities in the food supply chain and this is a nascent market that needs nurturing, to grow the sector and foster innovation and entrepreneurship. The UK could gain first mover advantage in framing the future of nutrient management, a much-needed local imperative with global application.

MINIMISING RISK

Here we launch the first in a series of quizzes focused on health and safety. In this edition we consider behavioural safety and risk assessment fundamentals. ADBA Technical Support Manager **Flavio Ascenco** is your quizmaster.

Health and safety on biogas plants are paramount due to the nature of the operations involved. The operation of these plants involves several risks that can be effectively contained with the right structures in place. Effective safety measures protect workers, the environment, and ensure compliance with legal standards, ultimately leading to a safer and more efficient biogas production process. All answers p30.

Behavioural Safety

Statistics show that unsafe acts are the most common cause of workplace accidents. The reason for this is that unsafe acts involve the Human Factor, that is, they occur as a result of people's attitudes and behaviours. Behavioural Safety offers a way to reduce the incidence of unsafe acts. Are you up to speed on the basics of behaviour safety? Test yourself and colleagues here.

1. Which of these would not be classified as an unsafe act?
a) Not following safe work procedures
b) Inappropriate use of equipment
c) Slippery floors
d) Failure to wear personal protective equipment

2. What factor makes unsafe acts more difficult to control than unsafe conditions?
a) The human factor
b) The equipment factor
c) The X factor
d) The accident factor

3. Which of these is not a common cause of unsafe acts?
a) Acts of indifference
b) Positive reinforcement
c) Lack of knowledge
d) Lack of concentration 17

4. What theory is Behavioural Safety based on?
a) The theory of Evolution
b) The theory of Observation
c) The theory of Behaviour Modification
d) The theory of Cause and Effect

5. Positive reinforcement uses _____ and _____ to establish positive consequences for improved behaviour?
a) Feedback and discussion
b) Rules and discipline
c) Obedience and punishment
d) Plant and equipment

6. A person is more likely to choose ____ if there are positive consequences?
a) Unsafe behaviour
b) Manual handling
c) Life
d) Safe behaviour

7. What is the first component of a Behavioural Safety program?
a) Lack of concentration
b) Identification of behaviours that could contribute to accidents
c) Lifting and carrying
d) Using personal protective equipment

8. What is the purpose of observations in Behavioural Safety?
a) To teach people how to handle hazardous substances
b) To record people's names
c) To eliminate unsafe conditions
d) To determine what is being done safely and what is 'at risk' behaviour

9. Feedback uses information from the observations to…
a) Assign blame for accidents
b) Determine appropriate punishments for unsafe acts
c) Bring about change in people's behaviour
d) Improve manual handling 18

10. A Behavioural Safety programme will only succeed if …
a) The workplace is situated outdoors
b) The workplace has already established safe work procedures and practices
c) Employees work as fast as possible
d) The company is profitable

Risk Assessment Fundamentals

In simple terms a risk assessment requires the identification of workplace hazards and an evaluation of the risks they present. The purpose of an overall workplace risk assessment is to establish whether the level of risk arising from workplace activities is acceptable, or whether additional measures need to be taken to control workplace hazards to further reduce or remove unacceptable risks. These questions will test your knowledge of the fundamental considerations.

1. A ____ is anything that has the potential to cause an accident, injury, illness or disease.
a) Hazard
b) Risk
c) Policy
d) Accident

2. A ____ is the likelihood that a specific hazard will actually result in an accident, injury, illness or disease occurring?
a) Hazard
b) Fine
c) Risk
d) Audit

Continued>>

3. What is the first step of a successful Risk Assessment?
a) Evaluate all the risks
b) Decide the possible consequences of hazards present
c) Identify all the hazards
d) Write a report

4. Which of these are examples of obvious hazards?
a) Untidy work areas
b) Blind corners
c) Slippery floors
d) All of these answers

5. The identification of hazards can be aided by reference to Safety Data _____
a) Cones
b) Sheets
c) Machines
d) Bases

6. Risk Assessment evaluations can be based on _____
a) Industry standards
b) Regulations
c) Established safe work procedures
d) All of these answers

7. The ultimate control measure is _____
a) Elimination
b) PPE
c) Substitution
d) Administrative Controls.

8. Which of these is an example of the elimination control measure?
a) Putting more money into workplace safety
b) Replacing a manual handling task by using a mechanical lifting device
c) Wearing PPE
d) All of the above

9. Which of these is not an example of an administrative control?
a) Monitoring of contaminant levels
b) The placement of warning signs and symbols
c) Establishing procedures for the maintenance of plant and equipment
d) Plumbing

10. In evaluating any hazard, we must first ask: is the risk _____, and do we need to control it?
a) Acceptable
b) Risky
c) Objective
d) Airborne

POSITIONING FOR THE ELECTION A MIXED BAG FOR NET ZERO

February was dominated by the news that Labour has officially dropped their £28 billion green investment pledge. Blaming worsening public finances under a Conservative government, Labour's most ambitious (and expensive) policy was unceremoniously dropped despite senior figures stressing Starmer's continued commitment to making the UK a clean energy superpower.

The general consensus seems to be that the switch was a result of a miscalculation of public mood surrounding climate change – following the Uxbridge by-election loss which was fought over expansion of the ultra-low emission zone. To me, this most recent backpedalling appears more like the 'pragmatic' actions of a party preparing itself for government, taking a business-friendly approach to net zero and cutting its cloth accordingly.

Starmer and his team are betting that the Conservatives will lose the election, rather than Labour themselves winning – it's this perception that is informing their current strategy. I, for one, think it's a precarious position to take. On the other hand, the government's announcement that it is to back the building of new gas power plants should be taken as an admission of failure to invest adequately in renewables such as biogas and biomethane that can meet energy demands when the sun doesn't shine and the wind doesn't blow.

Report after report shows that renewables are more cost-efficient, secure, and cheaper for the consumer, as well as being environmentally prudent. Doug Parr, Chief Scientist at Greenpeace UK, lamented that the new plants would "make Britain more dependent on the very fossil fuel that sent our bills rocketing and our planet's temperature soaring". I couldn't have put it better.

In other news, DEFRA's recent report of a downward trend in household recycling rates strikes a particularly worrying chord. According to the department's recently published 'Local Authority collected waste management – annual results 2022/23', the total amount of waste recycled diminished from 10.2 million tonnes in 2021 to 9.3 million tonnes in 2022. Looking more closely at the figures, we can see that separately collected food waste sent for recycling decreased by 2.6% within the same time frame.

The government's Simpler Recycling proposals won't be enough to buck the trend. Indeed, increasing black binbag collections and allowing mixed garden and food waste collections is widely expected to reduce recycling further. One wonders if this policy announcement was more driven by culture wars than common sense.

While it's clear that the system needs to be simpler to promote uptake, I think that the public needs to feel a tangible benefit within their communities as a result of more positive recycling behaviour. Biomethane, as a useful product of recycled food waste, could provide a solution here. If local council vehicles or buses were advertised as powered by local food waste (e.g., biomethane) communities would feel far more engaged with the entire process and therefore more likely to take advantage of the recycling infrastructure available to them.

For more information please contact contact External Affairs Lead Giulia Ceccarelli at giulia.ceccarelli@adbioresources.org

CLIMATE CHANGE RISK & ADAPTATION ASSESSMENTS

To strengthen operational resilience in the face of increasing natural hazards, AD operators are now required to have a climate change action plan. **Alice Tidswell**, Lead Consultant, SLR, outlines expectations within the new regulations.

The environmental regulators for England and Wales, the Environment Agency (EA) and National Resources Wales (NRW) respectively, now require environmental permit holders to include a climate change risk assessment and adaptation plan within their environmental management system.[1]

This requirement applies to both existing permit holders and to those applying for new environmental permits. If your permit was issued before April 2023, you should complete a climate change adaptation risk assessment by 1 April 2024, and be prepared to complete a supporting adaptation plan to manage your risks shortly after. Most existing or planned AD plants will need to comply with this regulation.

Climate Impacts for the Biogas Industry

Like all UK industries, the biogas industry is impacted by natural hazards, with weather-related impacts such as flooding and lightning strikes resulting in damage to sites and a risk to the health and safety of on-site personnel and nearby receptors.

The latest Intergovernmental Panel on Climate Change (IPCC) AR6 Synthesis report[2], published in 2023, states that global surface temperatures have reached "1.1°C above 1850–1900 levels in 2011–2020". Under stated policies as of 2020, it is anticipated to rise to around 3.2°C by 2100.

At a regional level, the 2021 UK Climate Change Risk Assessment (CCRA3)[3] highlights the following:

- All UK energy-related infrastructure is at risk from the impacts of climate change, especially due to the changing frequency and intensity of surface water and coastal flooding[4].
- Both high and low temperatures, snow, ice, high winds, and lightning can all cause disruption to the energy network. The future risks from wind and lightning are more uncertain than for other climate hazards.
- The potential for reduced water availability in the future could reduce the output of thermal power generators and potentially biomass and gas power output.
- Agricultural productivity could be at impacted under future climate scenarios. This could be as a direct result of more extreme weather, or indirectly due to a greater number of pests, pathogens and invasive non-native species (INNS)[5].

Climate change impacts affecting the biogas industry may vary considerably geographically and between sites. Therefore, it is important for site managers to understand the climate change impacts specific to each site, and how climate will impact the sites' activities on nearby receptors during its' operational lifetime. In doing so, site managers can adequately respond to, and manage or mitigate against the impact of identified climate change risks through the development of a climate change adaptation plan.

Continued>>

[1] EA 'A changing climate' guidance update, April 2023 www.gov.uk/guidance/develop-a-management-system-environmental-permits
[2] IPCC AR6 Synthesis Report 2023 www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf
[3] 2021 UK CCRA3 Report www.ukclimaterisk.org/publications/technical-report-ccra3-ia/
[4] CCRA3 Energy Sector Briefing www.ukclimaterisk.org/publications/energy-sector-briefing/#section-1-about-this-document
[5] CCRA3 Agriculture and Food Sector Briefing www.ukclimaterisk.org/publications/agriculture-and-food-sector-briefing/#section-2-key-messages

Conducting a Climate Change Risk Assessment

The steps outlined below describe the process for conducting a climate change risk assessment.

Step 1: Identify Potential Risks

To start, site managers should scope out potential risks that could impact their site, and potential risks that the site could create for nearby receptors, due to changes in the climate. Site managers should consider a broad range of climate variables in their risk identification exercise. When considering potential risks, sites should consider risks that could impact the site both today and at future time horizons, e.g., 2050, up to the operational lifespan of the asset. Sites should also consider which nearby receptors could be impacted e.g., local watercourses, residential areas, designated sites and transportation networks.

Table 1 sets out different climate variables and the potential impacts that they could have on the site and nearby receptors.

Step 2: Climate Change Risk Assessment

Once potential climate impacts have been identified, site managers should conduct a climate change risk assessment. A best practice climate change risk assessment will consider the impacts associated with multiple forward-looking climate change scenarios, as recommended by the ISO 14090 standard. For compliance purposes, the environmental regulators only require organisations to consider a scenario that assumes a 4°C rise by 2100 and a 2°C rise by 2050, equivalent to an RCP8.5 or SSP5-8.5 scenario (see Table 2).

When considering which climate scenarios to use, site managers should opt for the latest available data, where possible, to future-proof their risk

TABLE 1 CLIMATE CHANGE VARIABLES AND ASSOCIATED IMPACTS

Climate Change Variable	Example Impact to Site	Example Impact a Site Could Create
Summer Daily Maximum Temperature	Increased water usage. Issues with cooling biogas for condensate removal.	Increased odour generation from site.
Winter Daily Minimum Temperature	Freezing of condensate in biogas lines or chiller – potential restrictions leading to the use of flare or pressure relief valves	
Winter Daily Maximum Temperature	Lower demand for gas in the network. Potential for lower manure supply – cattle grazing in fields for more of the year.	
Daily Extreme Rainfall	Flooding in bunds and potential damage to equipment. Need to process water through digesters, reducing feeding capacity.	Increased risk of contamination from surface water discharge.
Average Winter Rainfall	Potential for increased site surface water flooding leading to access issues for operators. Need to process water through digesters reducing feeding capacity.	Increased risk of contamination from surface water.
Drier Summers	Potential limit to abstraction from boreholes for dilution. Less rainwater for feedstock dilution – more digestate recycling needed.	Increased risk of contamination from surface water discharge.
River Flow	Insufficient river flow for abstraction for site use.	River flows unable to accept discharge flow due to low dilution.
Sea Level Rise	Potential risk of flooding at coastal sites.	Increased risk of contamination from surface water discharge.
Storms (incl. lightning strikes & high winds)	Increased risk of lightning strikes. High winds causing damage to membrane roof.	

assessments. Currently, the latest climate data available is the Coupled Model Intercomparison Project Phase 6 (CMIP6) dataset; a multi-model set of globally simulated climate data. Sites may alternatively opt for the earlier Phase 5 dataset, CMIP5, which has informed the widely available UK specific, UK Climate Projections 2018 (UKCP18) dataset.

To align with best practice, site managers should choose downscaled climate change projections from these datasets i.e., recalibrated projections for regional or local use. If a more detailed assessment or scenario analysis is required, site managers are recommended to seek external support from climate change experts who will be able to support with processing and interpreting climate data.

Table 2 outlines both the CMIP5 and CMIP6 datasets, the scenarios available within CMIP5 (and UKCP18) and the comparable scenarios in CMIP6 that result in a similar amount of warming by 2100. Note that scenarios in bold are those recommended to provide a high, medium, low view of future climate conditions.

Preparing A Climate Change Adaptation Plan

Once potentially material risks to the site or nearby receptors have been identified under different climate change scenarios and time horizons, it is then the responsibility of the site manager to ensure that these risks are managed to limit the impact of them to the site and nearby receptors. The detail in the final plan should be commensurate with the level of climate risk identified in the risk assessment.

Under EA and NRW requirements, site managers are responsible for identifying and establishing risk management controls, along with monitoring procedures. These should be put into place at the site and incorporated into the management system tied to the applicable environmental permit. The identified actions therefore must be specific to the individual site and the identified risks.

Continued>>

TABLE 2 CMIP5 AND CMIP6 CLIMATE SCENARIOS

CMIP5	CMIP6	Approximate Associated Warming °C in 2100 (based on CMIP6[6])	Future Warming Scenario Use Case
RCP*2.6	SSP**1-2.6	1.3 – 2.4	Low
RCP4.5	SSP2-4.5	2.1 – 3.5	Medium
RCP6.0	SSP3-7.0 (OR SSP4-6.0***)	2.8 – 4.6	
RCP8.5	SSP5-8.5	3.3 – 5.7	High

Dataset providers:
CMIP5: UKCP18 User Interface https://ukclimateprojections-ui.metoffice.gov.uk/products, CEDA Archive https://archive.ceda.ac.uk
CMIP6: WCRP CMIP6 Archive https://esgf-index1.ceda.ac.uk/search/cmip6-ceda

Additional notes:

***RCP = Representative Concentration Pathway**, the number of each scenario denotes the associated radiative forcing potential of each scenario at 2100.

****SSP = Shared Socioeconomic Pathway**, the first number of each scenario denotes the socioeconomic pathway, i.e. plausible policy, economic growth, technological development pathways . There are five SSP scenarios in total. The second number refers to the associated radiative forcing that aligns with the RCP scenarios.[7]

*****SSP4-6.0 is known as "tier 2" scenario** which an additional scenario of interest and is not commonly used. It is therefore recommended that the SSP3-7.0 is used instead if a further high emissions scenario is required.[8]

[6] PCC AR6 Report – Summary for Policymakers www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf
[7] O'Neill, B.C., Kriegler, E., Riahi, K. et al. A new scenario framework for climate change research: the concept of shared socioeconomic pathways. Climatic Change 122, 387–400 (2014). https://doi.org/10.1007/s10584-013-0905-2
[8] Government of Canada CMIP6 and Shared Socio-economic Pathways overview https://climate-scenarios.canada.ca/?page=cmip6-overview-notes

To prepare a climate change adaptation plan site managers should consider the following, in line with the ISO 14090 standard:

Identify Risk Controls

For each material risk or risk category, site managers should consider the options available for minimising the impact of each risk, or minimising exposure to the risk. Multiple options may be available for each risk at this stage, and site managers should understand the economic, environmental and social costs or benefits associated with each of the proposed measures, in addition to the timeline over which they are effective. As part of this exercise, it may be necessary to seek input from other stakeholders both on and off site.

Prioritise Actions

From the controls identified, site managers should evaluate and select the preferred measures noting any assumptions that have informed the prioritisation. Where possible, low- or no-regret actions, such as nature-based solutions, should be prioritised over hard engineering solutions or non-reversible actions to avoid lock-in. For example, actions delivering multiple benefits that address several climate impacts or offer longer-term resilience may be prioritised over actions that are costly, or only help to manage one climate impact.

The EA and NRW recommend adopting a dynamic planning approach to allow for flexibility in the implementation of adaptation actions. In a dynamic planning approach, different future adaptation scenarios are modelled with pre-determined decision and trigger points for implementing each control measure in a phased manner according to their prioritisation. Such an approach limits the need for upfront capital expenditure and facilitates a more measured approach to climate change adaptation and investment. To facilitate a dynamic planning approach, site managers should have a robust monitoring programme in place (see Monitor and Review below.) with Key Risk Indicators (KRIs) to inform decision and trigger points.

Develop a Plan

In developing the Climate Change Risk and Adaptation Action Plan, the site manager should set out clear objectives for the plan. Each adaptation action or climate risk control within the plan should have a clear owner, timescale for implementation and justification for inclusion. Where possible, the plan should align with existing business continuity, or site safety plans employed by the company and/or site. In some cases, existing plans may be adjusted to incorporate specific climate risks and their management actions. However, best practice guidance says adaptation plans should be site specific.

Monitor and Review

An adaptation plan is a working document that should be reviewed regularly and updated accordingly. Monitoring the effectiveness of the implemented adaptation actions is key to understanding whether the plan has achieved its objectives. As part of this, all climate related incidents or near misses at or from the site should be recorded. If following a dynamic planning approach, monitoring plays a vital role in the implementation of the adaptation plan itself.

The site manager or risk owner is responsible for conducting regular reviews of the plan. The timing of these reviews is best determined by the site manager; however, best practice guidance recommends the plan is reviewed at least annually, with a full reassessment at least every 4 years. More frequent reviews may be necessary if multiple incidents or near-misses occur, or if new climate information becomes available.

For further information on conducting a climate change risk and adaptation assessment, please refer to ISO14090 or the following guidance:

EA Guidance for Climate Change: risk assessment and adaptation planning in your management system http://tiny.cc/25w2yz

Biowaste: examples for your adapting to climate change risk assessment http://tiny.cc/v5w2yz

ADCS: addresses climate adaptation under Module 7, covering Environmental Management Schemes www.adcertificationscheme.co.uk

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SLR Consulting is a global leader in sustainability solutions, with 100 offices across six continents, providing clients with strategic advice and on the ground support, partnering with them in Making Sustainability Happen.

FM BIOENERGY BOOSTS BIOGAS POTENTIAL FOR VALE GREEN FOLLOWING SILAGE ADDITIVE TRIAL

Results show spoilage avoided and energy loss minimised while preserving the biogas potential of the silage

At this year's World Biogas Expo (stand H9, 10-11 July 2024, NEC Birmingham), FM BioEnergy will share the results of a seven-month trial of their new grass silage additive, Silasil Energy SG. Developed specifically for use on UK grass, the product has doubled levels of beneficial acids at Vale Green Energy's 1.5 MW Spring Hill AD plant, maximising biogas potential for the Evesham-based operator.

After nine days, both lactic and acetic acids – essential for good silage production – had significantly increased, while pH had been rapidly lowered to optimal levels. When the silage was analysed again, seven months after the initial treatment, beneficial acid levels were equally high while pH was still within the optimal range. The use of Silasil Energy SG has therefore avoided spoilage and minimised energy losses in the clamp long term, while preserving the biogas potential of the silage.

Vale Green Energy operates this 1.5 MW AD plant at Spring Hill, which produces 500 kW of electricity and exports up to 7,800m³ of methane to the gas grid each day

"Silasil Energy SG is very easy to apply and convenient to use and is flexible enough to work on wet or normal grass," says Nick Reynolds, Feedstock Manager, Vale Green Energy. The face of the clamp does not heat up when we expose it, meaning that the energy is staying where we want it to be – in the silage – rather than being lost to the atmosphere."

Silasil Energy SG contains four bacterial strains instead of the usual two, helping to preserve the biogas potential of grass in the clamp, regardless of whether the season has been wet or dry

The importance of good silage

Good silage production is essential to reduce energy losses in the clamp and preserve the biogas potential of AD feedstock. Lactic acid rapidly lowers the pH of silage, while acetic acid suppresses the growth of yeasts and moulds. Boosting the production of both lactic and acetic acids therefore enables silage to stabilise more quickly, reducing energy losses, improving storability and maximising biogas potential.

Nick Reynolds is responsible for producing feedstock for Vale Green Energy's AD plants. With 12,000 tonnes of grass silage harvested from three cuts in 2023, he was keen to trial Silasil Energy SG, exclusively developed by FM BioEnergy's German partner Schaumann BioEnergy in response to demand from UK AD operators.

Nick applied Silasil Energy SG to all Vale Green Energy's 2023 grass crop and has been impressed with the results. "Not only is it easy to apply, but it works on both wet and dry grass, keeping the clamp face cool and ensuring the energy stays in the silage," he states.

Analysing the benefits

Vale Green Energy worked with FM BioEnergy to quantify the benefits of the additive in a seven-month laboratory trial. Samples of their treated and untreated grass were taken by FM BioEnergy's National Silage Specialist Andy Lee at the point of harvest in July 2023. The crop's fermentation process was halted at three, six- and nine-days post-harvest by freezing the samples, which were then analysed at Schaumann's laboratories in Germany. Further samples were taken from the clamp face in January 2024, approximately seven months after harvesting.

Continued>>

In 2023, Vale Green harvested 12,000t of grass silage, all of which was treated with Silasil Energy SG

Untreated and treated samples were taken and sent to Schaumann BioEnergy's laboratory for analysis

"The analysis showed that levels of lactic acid and acetic acid in the samples that had been treated with Silasil Energy SG had doubled after just three days compared to the untreated silage," says Andy. "Nine days after harvesting, the lactic acid levels were more than double those of the untreated samples (2.95 compared to 1.35), while the pH was around 0.5 lower (3.94 compared to 4.41). Seven months later, acid levels were equally high and the pH remained stable. These figures show that, combined with good silage practice, Silasil Energy SG helps grass silage to stabilise more quickly, preserving its energy potential and improving storability."

Effective on wet or dry grass

The variability of UK weather often results in large differences in crop dry matter from one season to the next. Previously, selecting the right silage additive was a challenge, with growers often stocking up on multiple additives to cover all eventualities.

The introduction of Silasil Energy SG means that this is no longer necessary: it works just as efficiently on wet and dry grass thanks to the presence of four bacterial strains, instead of the usual two. A combination of *L. plantarum, L. buchneri, L. coryniformis and E. faecium* preserve the biogas potential of grass in the clamp, regardless of whether the season has been wet, dry, mild or warm.

For Nick Reynolds, the trial has delivered the data to back up what he already knew from seeing the treated silage in his clamp – that by boosting lactic and acetic acids and rapidly lowering the pH, Silasil Energy SG is providing long-term protection to Vale Green Energy's grass silage. "Our silage is free from moulds and yeasts, doesn't heat up at the clamp face or during feed-out, and the energy is preserved for biogas production."

L-R: Andy Lee, National Biogas Silage Specialist at FM BioEnergy, and Nick Reynolds, Feedstock Manager at Vale Green Energy

To find out more about FM BioEnergy's range of digester care services – including silage additives, biological consultancy, gas leakage detection surveys and their new one-a-day, easy-dose trace element tab BC.MICROcon5 – visit stand H9 at World Biogas Expo, 10-11 July 2024, NEC Birmingham.

BIOCHAR, AD AND DIGESTATE

Biochar has the potential to boost AD production, sequester carbon, improve soil health and increase crop yield. **Lidia Krzynowek** and **David Vaughan** introduce this ancient yet modern material.

The use of biochar can be traced back to ancient civilisations such as the Amazonians, who practiced slash-and-char agriculture. Today it is enjoying a renaissance and being hailed across a raft of applications.

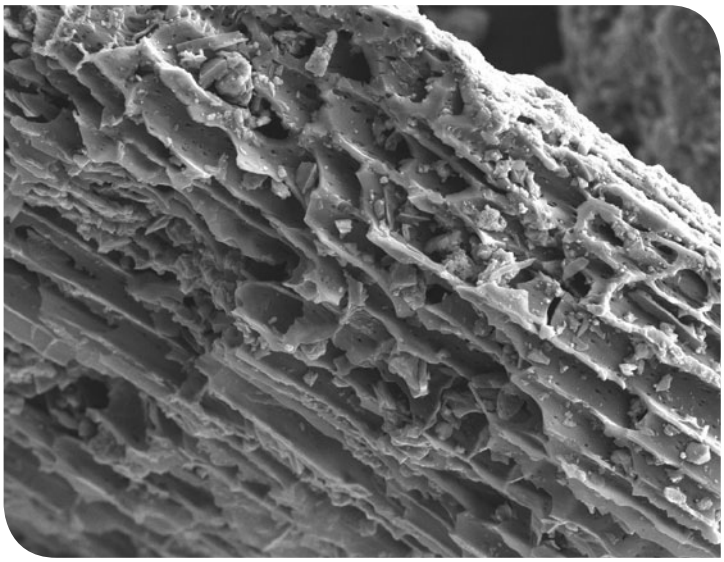
Biochar is a special kind of charcoal made from organic materials like wood chips, agricultural waste and secondary biomass products. It is made through a process called pyrolysis, which involves heating the organic material in a zero-oxygen environment to produce biochar and renewable energy.

The physiochemical properties of biochars can vary dependent upon different parameters e.g. feedstock and production temperatures. This means not all biochars carry the same characteristics and can, therefore, be produced to be optimal for a given application. Quality and customisation are paramount in harnessing the full potential of biochar, to meet the distinct requirements of various applications and ensure consistent quality.

Biochar is perhaps best known for its ability to improve soil health and fertility. Among the key physicochemical properties of biochar are its porous structure and high surface area. Typically, biochar boasts a surface area of 100-500m^2/g. As such, a single gramme of char has roughly the same surface area as a tennis court.

When added to soil, it helps retain moisture, nutrients, and beneficial microbes, which can enhance plant growth. It also helps reduce greenhouse gas emissions by sequestering carbon in the soil, which can contribute to combating climate change.

The carbon in biochar is highly stable and can endure in soils for thousands of years without being degraded by microorganisms. When produced to meet quality standard i.e. European Biochar Certification (EBC standard) biochar represents a long-term CO_2 sink that can sequester carbon in the soil virtually indefinitely. This makes biochar a promising Carbon Dioxide Removal (CDR) technology that can contribute to the mitigation of climate change and help work towards net zero goals.



Biochar, after organic material has been treated in a patented drying and pyrolysis oven known as PyroDry

At the time of writing, one tonne of biochar-based carbon fetched between €100 and €500 on the voluntary carbon trading platform Puro.Earth. The additional income from carbon credits can enable biochar makers to offer their product at a lower price, thereby contributing to the economic viability of the biochar industry.

Biochar and AD

As AD is often likened to tending an animal, it is perhaps telling that biochar is already in use as a feed additive for a range of farm animals including cows, pigs and poultry, where it can prevent or treat digestive problems. This leads to improved feed conversion and hence to faster weight gain and better meat quality.

Continued>>

BOOSTING MICROBIAL COMMUNITIES IN AD

There is lots of ongoing research around how biochar mediates several bio-electrochemical interactions, including in the AD process, especially by mediating and even accelerating (bio)-electrochemical interactions such as Direct Interspecies Electron Transfer (DIET).

DIET is a microbial interaction mechanism in which different species of microorganisms exchange electrons directly between each other as part of their metabolic processes. In microbial communities, DIET enables the transfer of electrons from one microorganism to another without the need for intermediary molecules such as hydrogen or formate.

In DIET, certain microorganisms possess the ability to form conductive structures, such as pili or nanowires, which facilitate the transfer of electrons between cells. These conductive structures act as conduits, allowing electrons to move from the electron donor microorganism to the electron acceptor microorganism.

DIET is particularly significant in anaerobic environments, such as those found in sediments, wastewater treatment systems, and the gastrointestinal tracts of animals, where microbial communities play crucial roles in biogeochemical cycling and organic matter degradation.

By facilitating direct electron transfer between different microbial species, DIET enables more efficient energy metabolism and enhances the overall metabolic capabilities of microbial communities. This mechanism has implications for various biotechnological applications, including bioenergy production, bioremediation, and wastewater treatment.

Understanding and harnessing DIET could lead to the development of novel strategies for sustainable energy production and environmental management.

Dr Anjali Jayakumar *Lecturer in Chemical Engineering, Fellow of the Higher Education Academy, Deputy Degree Program Director MSc Sustainable Chemical Engineering, Newcastle University*

Similarly, biochar of high quality and designed to meet key specifications can enhance the performance of anaerobic digestion (AD) plants in several ways:

Improving Digestion Efficiency: Adding biochar to the AD process can increase the surface area available for microbial colonization. This provides a habitat for beneficial microorganisms that help break down organic matter more efficiently, thus enhancing digestion rates and overall biogas production.

Buffering pH Levels: Biochar has a neutral to slightly alkaline pH, which can help stabilize pH levels within the AD system. This buffering capacity can mitigate fluctuations in pH that may occur during digestion, maintaining optimal conditions for microbial activity and biogas production.

Reducing Inhibitory Compounds: Biochar has been shown to adsorb or immobilize certain inhibitory compounds present in the feedstock or produced during digestion, such as ammonia and fatty acids. By reducing the concentration of these inhibitory substances, biochar can improve the stability and performance of the AD process.

Enhancing Methane Yield: Studies have indicated that the addition of biochar to anaerobic digesters can increase methane yield per unit of feedstock input. This improvement in methane production efficiency can result in higher biogas yields and greater energy generation from AD plants.

Finally, **Enhancing Nutrient Recycling:** Biochar acts as a carrier for nutrients and helps retain essential elements like nitrogen, phosphorus, and potassium during the digestion process. This nutrient retention capability of biochar can improve the quality of the digestate produced, making it a more effective fertilizer for agricultural use. It could also have the potential to reduce leaching of nutrients when digestate is added to soils, but this will require additional biochar incorporation after the digestion process. The production parameters may not need to be as specific as for the AD process-enhancing char.

Overall, incorporating biochar into anaerobic digestion systems has the potential to optimize process efficiency, increase biogas production, and improve the quality of digestate, thereby contributing to the sustainability and effectiveness of AD operations (see Boosting Microbial Communities in AD).

Future options

Biochar is an old material, but a relatively young market, with extensive research being conducted into its possible uses. Due to its diverse attributes, biochar has found itself connected to a lot of potential markets.

One line of research being carried out is on circular economy approaches such as the Sequential Biochar Systems, where several thermochemical and biological pathways are efficiently integrated to valorise waste biomass. These include the use of biochar in water or air purification followed by its use in AD. Ultimately, at the end-of-life, the spent biochar finds application in soils, ensuring that the biochar from each step is tailored for the next. This not only generates more revenue strands, but also reduces the carbon footprints of each application.

In a recent EB Network webinar on biochar, hosted by the Biochars for Pollution Prevention Working Group, Distinguished Professor Andy Ball from RMIT University (Royal Melbourne Institute of Technology) outlined a study which showed that the addition of biochar generally enhanced the removal of petroleum hydrocarbons from contaminated soils, but that the biochar pyrolysis temperature, biochar application dose and fertiliser dose affected the hydrocarbon removal efficacy. The study has been demonstrated at pilot scale in Singapore.

ECOCHAR FROM DIGESTATE

At the time of going to press, Carbogenics announced it had won Innovate UK funding to undertake research into a new product derived from the pyrolysis of digestate, EcoChar (Emission Control Organic-Char). The project seeks to validate the potential for EcoChar to be used as a low-cost, efficient and eco-friendly alternative to traditional Anaerobic Digestion (AD) lagoon cover materials.

The Clean Air Strategy aims to tackle emissions from open slurry and digestate stores, mandating the use of emission abatement measures, particularly for lagoons currently exposed to the elements.

While new constructions will require fixed covers, existing infrastructure can utilise various options, including organic layers of lightweight aggregates. Biochar is one, which can not only suppress emissions but can also serve as a fertiliser and soil conditioner, contributing to carbon sequestration.

Professor Fred Coulon of Cranfield University explored the bioremediation concept further by describing work they are doing using biochar from sewage sludge pellets and wheat straw pellets which had been dosed ("bioaugmented") with microbes, including *Bacillus sonorensis* and *Pseudomonas aeruginosa*. These were applied to remediate soil contaminated with crude oil. They found that the bioaugmented biochars degraded the total petroleum hydrocarbons (TPH) more effectively than the plain biochar.

As with any new product, some of these applications will need to overcome legislative hurdles and it remains to be seen under which scheme that biochars will be certified in the UK. Biochar is a growth industry and is set to play a large role in tackling climate change, the race to net zero and carbon sequestration.

Lidia Krzynowek is COO-Cofounder and David Vaughan R&D Director at Carbogenics.

INTERESTED IN BIOCHAR?

Join the Environmental Biotechnology Network Biochars for Pollution Prevention Working Group, led by Dr Meredith Rose Barr, Lecturer, Division of Chemical and Energy Engineering, London South Bank University. Read more about the working group here https://ebnet.ac.uk/wg-details/wg-biochar, where you can also view research papers and view our webinars and upcoming events.

INTERESTED IN FINDING OUT MORE ABOUT USING BIOCHAR IN YOUR DIGESTER?

Contact Lidia Krzynowek, Lidia lidia.krzynowek@carbogenics.com or visit www.carbogenics.com

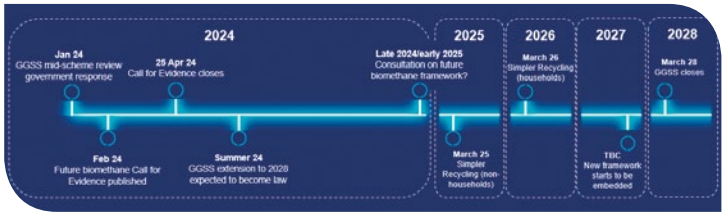
POSITIVE SIGNS FOR UK AD SECTOR AT ADBA SPRING MEETING – KEY TAKEAWAYS

ADBA's Spring Members Meeting at Cranfield University in April brought together nearly 100 stakeholders from across the UK anaerobic digestion industry. The packed agenda provided crucial updates from government officials, market insights and technical guidance. Several key takeaways emerged:

Policy Progress

There were encouraging signs that the government is taking a more positive line towards the AD sector. Ludo Tolu, the Director for Heat Networks and Biomethane Policy from DESNZ, outlined plans for a "holistic future policy framework" to maximise the potential for biomethane production beyond 2028 when current subsidies end. Informed by the responses to the recently closed call for evidence on the Future Framework for Biomethane Production, DESNZ aims to design policies that overcome barriers, enable revenue stacking, introduce sustainability criteria, and set a clear long-term vision for the multifaceted role of biomethane to 2050.

DESNZ also provided a high-level timeline for the ongoing work in developing this Future Framework:



ADBA welcomes the ongoing and positive engagement from the department.

Markets and Growth

ADBA market update highlighted the UK AD sector's significant growth in 2023, with green gas capacity expanding by an impressive 16.7%. This sharp rise aligns with projections from the International Energy Agency and brings the UK closer to the rapid growth seen in Europe and the US as countries seek secure renewable energy solutions in response to gas supply disruptions caused by Russia's invasion of Ukraine.

As ADBA Chair Chris Huhne pointed out, this trajectory puts the sector on track to achieve its ambitious target of 1,000 new AD plants by 2030, potentially overtaking nuclear power's contribution during 2031. Policymakers increasingly view biogas as a "no-regrets" renewable option, providing homegrown, dispatchable energy to reduce reliance on imported fossil fuels for heating and transport.

While new large-scale plants drive capacity growth, volatile gas prices, Renewable Transport Fuel Certificate prices, and lack of long-term policy support among other reasons continue to create market uncertainty. The meeting also highlighted the immense opportunity for small-scale on-farm AD to decarbonise agriculture, but high costs, skills gaps, and connection challenges remain barriers.

Operational Excellence

With the AD sector receiving more scrutiny due to last year's lightning strike at the Cassington AD plant, the meeting drove home the importance of operational best practices and regulatory compliance. Presentations covered

critical issues like climate change risk assessments, lightning protection, fugitive methane emissions monitoring, and safety requirements under environmental permitting and COMAH regulations. The Environment Agency highlighted plans to require biogas capture from slurry stores and tank emissions monitoring using techniques like Infra-Red camera inspections.

ADBA's Technical Support Manager, Flavio Ascenco, in his presentation, further reinforced ADBA's role in developing guidance to support environmental and safety management. As the sector scales up, robust management of operational risks and minimising emissions will be essential to demonstrate AD's sustainability credentials and maintain public trust. The industry benchmark, the AD Certification Scheme (ADCS) is the mark of assurance of such operational best practice. www.adcertificationscheme.co.uk

In summary, ADBA's Spring Meeting signalled improving policy engagement from DESNZ, recognising the potential for biomethane and AD to contribute to the UK's net zero goals. However, unlocking that potential will require overcoming commercial hurdles through coherent long-term policy frameworks, expanding feedstock availability responsibly, investing in operational excellence, and proactively addressing environmental impacts. https://tinyurl.com/47mbvhj5

11-POINT ROADMAP TO SCALE UP GREEN GAS

ADBA has developed a Green Gas Roadmap with 11 points for the road to a biogas fuelled 2030. We are asking political parties and relevant stakeholders to include the Roadmap's points and arguments in their manifestoes for the general election. To protect consumers from sky-high energy bills, quickly tackle potent greenhouse gases, and ensure a sustainable home-grown energy supply for British homes and businesses, green gas must be scaled up.

The anaerobic digestion (AD) of organic wastes produces biogas – also known as green gas. It is a key part of creating a sustainable, circular economy in a net zero world. It also provides quick wins, as the sector can build quicker and faster than any other turn-on, turn-off energy source providing baseload or back-up power. It is projected to grow faster than wind power, has attracted billions of pounds in investment from BP, Shell and TotalEnergies, and is set to be bigger than the UK nuclear sector in 2031.

ADBA MEMBER WINS LARGEST EVER CONTRACT

Matt Hale, Head of International Sales, HRS Heat Exchangers

ADBA member **HRS Heat Exchangers**, a leading global provider of efficient heat transfer solutions, has won its largest ever component order, valued at $3.8 million. The heat exchangers, for a North American client, will form part of a major environmental project and are due for delivery in late 2024. The order includes 348 6m and 10m long heat exchanger modules, using almost 10 km of HRS' corrugated tube technology. Together the exchangers have 2,268 flanges and more than 18,000 nuts and bolts. Once complete the 126 tonnes of equipment will be transported in 18 shipping containers. The system includes various modules to perform a range of heating, cooling and heat recovery operations as part of a renewable energy project.
www.hrs-heatexchangers.com

BIRCH SOLUTIONS DOUBLES AD PARTS CAPACITY

Anaerobic digestion specialist **Birch Solutions** is doubling the size of its warehouse to support the growth of its parts business, after securing a swathe of new strategic deals with international manufacturers.
The Lincolnshire-based business will now stock more than £500k of parts for the anaerobic digestion industry at any one time and is looking to further invest. Birch Solutions have agreed a number of preferred supplier deals with renowned brands such as 2G, Himmel, Steverding, Paulmichl, PTM and Pronova and have secured preferential rates with other brands like Suma, Vogelsang, Borger, Wangen, Vega and Landia. The business can also supply chemicals for AD plants along with testing services to help ensure operators can extract maximum efficiency from their AD plant.
www.singletonbirch.co.uk/ad-equipment/

BIO CAPITAL ADDS TRANSFER STATION TO SCOTTISH PORTFOLIO

Bio Capital's General Manager George O'Malley

Bio Capital Group has added a fourth asset to its portfolio in Scotland. The newly acquired Linwood food waste transfer station will significantly improve Bio Capital's ability to process feedstock for its regional Anaerobic Digestion (AD) facilities.

The Linwood transfer station in Paisely has the capability to divert 13,200 tonnes of food waste from landfill, equating to a CO_2 saving of 11,554 tonnes, equivalent of taking over 6,800 cars off the roads for a year. Linwood is strategically located 8 miles from Barkip and 27 miles from Energen, making low mileage transfers possible, reducing the cost and emissions of transportation and further improving the efficiency of the AD process. All of Bio Capital's AD plants are certified under the Anaerobic Digestion Certification Scheme, the industry's best practice kitemark.

Both sites produce and supply renewable electricity and gas all year round, providing a consistent and reliable local energy source supplied directly to the national grid. The UK produces around 9.5M tonnes of food waste each year, equivalent to 25M tonnes of greenhouse gas emissions. Bio Capital's General Manager George O'Malley said, "This transfer station is an important acquisition to the Bio Capital group, securing local feedstock, and gives us an opportunity to expand our tonnage portfolio. Bio Capital continues to acquire strategic sites and develop working partnerships with key stakeholders, this is yet another exciting move, both for the company, as well as for Scotland and the UK's net zero ambitions".
https://bio-capital.co.uk/

To keep up to date with ADBA, member and industry news subscribe to our newsletter at https://adbioresources.org/newsroom

HEALTH AND SAFETY QUIZ ANSWERS

BEHAVIOURAL SAFETY

1: c) Slippery floors. Unsafe acts result from people's behaviour, where workers fail to follow safe work procedures or practices, as opposed to unsafe conditions, which relate to the state of the workplace itself.
2: a) The human factor. Unlike unsafe conditions, unsafe acts occur as a result of people's behaviours and attitudes, making them more difficult to control.
3: b) Positive reinforcement. Acts of indifference are the most common causes of unsafe acts, with lack of knowledge, usually from inexperience or inadequate job training, another common cause. Other factors contributing to unsafe acts include lack of concentration as well as things like physical limitations, fatigue or haste.
4: c) The theory of Behaviour Modification. The theory of Behaviour Modification states that a person's behaviours and attitudes can be modified using positive reinforcement, the technique that uses feedback and discussion to establish positive consequences for improved behaviour.
5: a) Feedback and discussion. In Behavioural Safety, feedback and discussion should establish good reasons to perform job tasks differently to ensure safety.
6: d) Safe behaviour. Whether a person chooses to behave in a particular way or not depends on the consequences of that behaviour. If the consequences are positive then the behaviour is more likely to be repeated. If the consequences are negative, the behaviour is more likely to be avoided.
7: b) Identification of behaviours that could contribute to accidents. This is the first step in a Behavioural Safety program. A list of behaviours critical to safety should be drawn up, and it should be ensured everyone agrees on what behaviours are to be observed. 20
8: d) To determine what is being done safely and what is 'at risk' behaviour. Observations should be conducted regularly and address all the behaviours that have been identified as potential causes of accidents.
9: c) Bring about change in people's behaviour. Observations followed by appropriate feedback and discussion, when carried out regularly, emphasise the importance of safe behaviour and the safe performance of job tasks.
10: b) A workplace with already-established safe work procedures and practices. Behavioural Safety is not a quick fix, or a substitute for other safety measures. There must also be a clear and separate process to deal with the unsafe conditions identified by the Behavioural Safety programme.

RISK ASSESSMENT FUNDAMENTALS

1. A) Hazard
2. C) Risk
3. C) Identify all the hazards
4. D) All of these answers
5. B) Sheets
6. D) All of these answers
7. A) Elimination
8. B) Replacing a manual handling task by using a mechanical lifting device
9. D) Plumbing
10. A) Acceptable

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