

Landwards ^{@IAgrE}

The professional journal for the Institution of Agricultural Engineers

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- New hydrogen engine development
- Natural ways with water
- Membership matters
- Future fuels conference



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Dr Emma Wilcox

Chief Executive Officer of the
Society for the Environment

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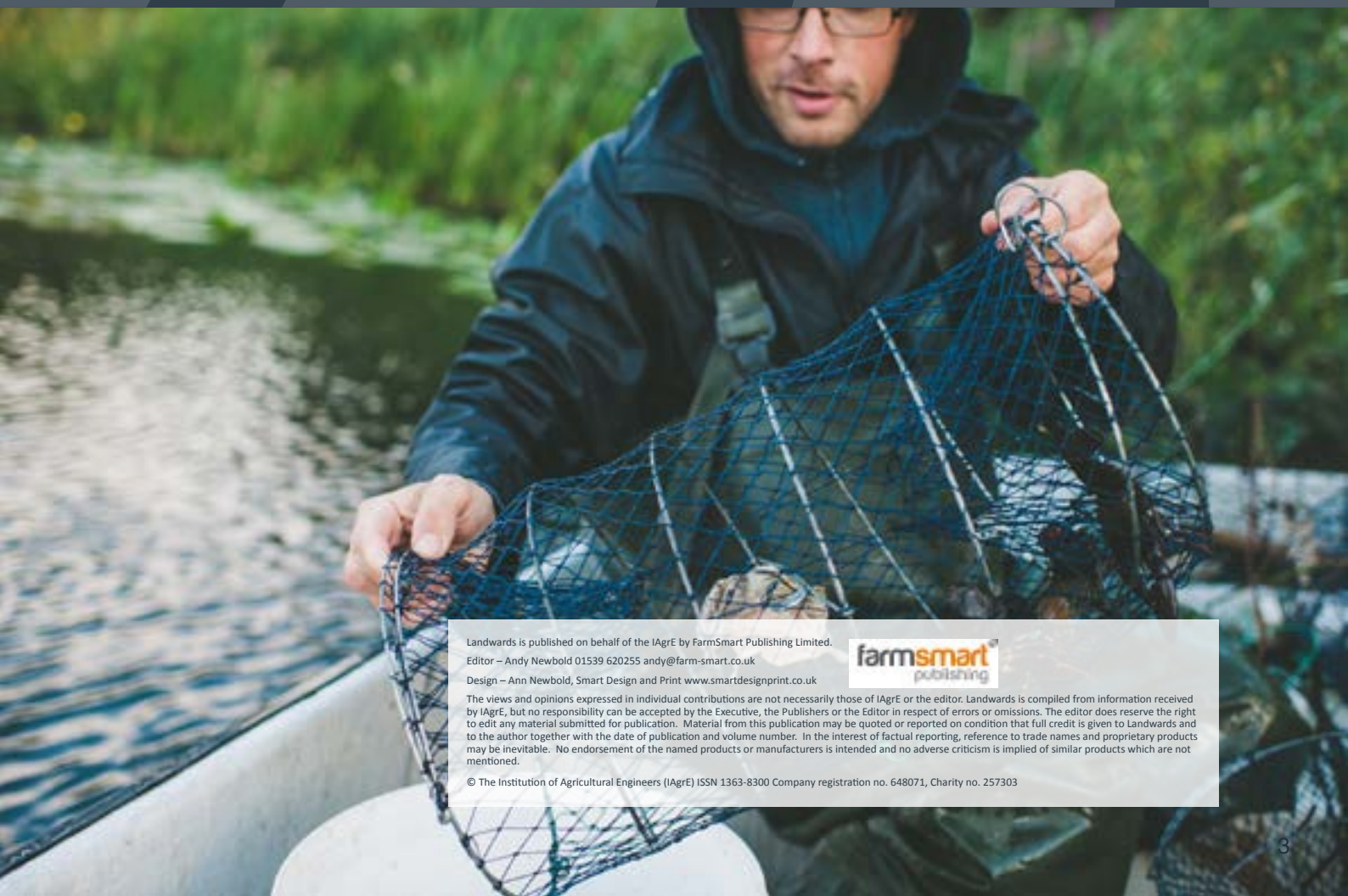
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Editors Welcome



It doesn't seem that long ago when your humble correspondent was pondering the 'big challenges' of society in general and agricultural engineering in particular. Let's say 25 years ago, for instance.

In the mid '90's we were all about production, yield maximising, precision farming (anyone remember the MF yield mapping trailer at Silsoe?) and getting bang per buck

from technology. Now whilst these themes still run big through much of farming and surrounding industries, there is a much more subtle mood music nowadays.

As government support pivots from production towards environmental benefits, and the emphasis shifts to measuring the industry's impact and reducing its carbon footprint. Now seems like a good time to be considering this emerging thinking.

A recent lunchtime lecture from Severn Trent Water's Alex Cooke gave a fascinating insight into how that organisation cleans water and works with landowners and farmers to use technology to prevent pollution(p20).

This year's IAgRE Landwards conference on Future Fuels (see preview p18) is as good a starting point as any to consider how carbon-based fuels will be replaced within agriculture. I would urge you to book your ticket now.

Likewise, JCB has been quick off the blocks with a work-ready hydrogen engine, which Paul Hemingway had the

chance to see recently (Practice p34).

Whilst Landwards does seem to spend a lot of time carping on about the internal combustion engine, it's a fundamental tool for the land-based industries, alternatives have to be considered. If all this historical hydrocarbon-based talk is just too much, turn to Practice (p38) and spend some time in Scotland seeing how peat bogs 'breathe'.

I wish you well for the coming months and hope you find something which piques your agricultural engineering interest in this edition.

Andy Newbold

Andy Newbold

Editor

andy@farm-smart.co.uk

Training on offer from the Institution of Mechanical Engineers

**Institution of
MECHANICAL
ENGINEERS**

Develop your leadership style, improve your mental wellbeing and enhance your technical abilities. The IMechE has very kindly agreed to share its training with IAgRE Members.

There is a good resource of free

content available on the Learning Management System.

The IMechE Online Learning Portal details the free and paid-for resources on offer.

IAgRE Members can access these

paid-for resources at the special IMechE Member rates by submitting the following IMechE Member ID:

23776552

<https://bit.ly/3naffbU>

John Deere acquires Bear Flag Robotics to accelerate autonomous technology on the farm



Deere & Company has signed a definitive agreement to acquire Bear Flag Robotics for \$250 million USD. Founded in 2017, the Silicon Valley-based start-up develops autonomous driving technology compatible with existing machines. The deal accelerates the development and delivery of automation and autonomy on the farm. It supports John Deere's long-term strategy to create smarter machines with advanced technology to support individual customer needs.

"Deere views autonomy as an important step forward in enabling farmers to leverage their resources strategically to feed the world and create more sustainable and profitable operations," said Jahmy Hindman, chief technology officer at John Deere. "Bear Flag's team of talented agriculture professionals, engineers and technologists have a proven ability to deliver advanced technology solutions to market. Joining that expertise and experience with Deere's expertise in autonomy, along with our world-class dealer channel, will accelerate the delivery of solutions to farmers that address the immense challenge of feeding a growing world."

Deere first started working with Bear Flag in 2019 as part of the company's Startup Collaborator program, an initiative focused on enhancing work with start-up companies whose technology could add value for Deere customers. Since then, Bear Flag has successfully deployed its autonomous solution on a limited number of farms in the U.S.

"One of the biggest challenges farmers face today is the availability of skilled labour to execute time-sensitive operations. Autonomy offers a safe and productive alternative," said Igino Cafiero, co-founder and CEO of Bear Flag Robotics. "Bear Flag's mission to increase global food production and reduce the cost of growing food through machine automation is aligned with Deere's. We're excited to join the Deere team to bring autonomy to more farms."

"Deere and Bear Flag are highly complementary from both a technology and mission perspective," said Dan Leibfried, director – automation & autonomy at Deere. "We look forward to working even closer together with the ultimate goal of helping farmers achieve the best possible outcomes through advanced technology."

Cyber Security Resources

Assured Service Provider



in association with
National Cyber
Security Centre

IAgrE has been approached by the National Cyber Security Centre (NCSC) and asked to share its information and training with you.

The **NCSC** has lots of useful resources for members including training eg **Cyber Security for Small Businesses**, an online course to teach you all you need to know to keep your organisation safe and the **Cyber Aware Campaign**, which has lots of information for home and business. Cyber essentials is a government-backed scheme to help guard against common threats and certification is often a necessity for the tendering process.

Find out all you need to know here.

<https://bit.ly/3ngJGgB>

This information has been added to the CPD Resources and Training Opportunities page in the Members area of the website.

Novel vertical farm to accelerate skills, research, and innovation

SRUC will be the first higher education institute in Scotland to open a vertical farm for research and education.

It will build the half million-pound facility at its King's Buildings campus in Edinburgh next year.

The project, which has received a £200,000 grant from the Scottish Government, will be used in key research into plant and crop science and will also be used by students.

The facility will grow nutrient-dense fruit and vegetables that have specific human health qualities. It will also analyse crop yield and growth rates with all resource inputs to compare their carbon footprint to other production systems.

It will operate on renewable energy sources from the national grid, supported by battery technology to manage peaks in energy demand.

With only a handful of commercial vertical farms in Scotland, the facility will be important for demonstration and knowledge exchange with farmers, growers and small businesses, giving vital support and promoting innovation.

Mairi Gougeon, Cabinet Secretary for Rural Affairs and Islands, said: "As we look to produce more fruits and vegetables locally, vertical farming could provide us with a way to make better use of our land. It's an exciting and innovative field that could bring us real benefits and it is important that we have the skills in Scotland to take advantage of this technology.

"By supporting the industry at an early stage, we can assess these benefits and help to focus our long-term strategy. We will also be reaching out to the wider industry to explore in further detail the opportunities which low-carbon

vertical farming offers. We will work together to establish the future of vertical farming in Scotland."

Professor Wayne Powell, Principal and Chief Executive of SRUC, said: "One of the most critical challenges we face is how to feed a growing global population. We have been teaching farmers for generations but, as the population increases, it is important that we look at growing different, more nutritious crops to support healthy diets and local access to food.

"Not only will this vertical farming unit be a valuable asset to our students, but it will also provide us with important data to help optimise and promote innovation into this expanding industry."

The project will be going out to tender shortly.



A new vertical farm at SRUC will be used for education and research

Agri-Tech Hackathon aims to kick-start safety innovations for autonomous agricultural vehicles



- This September, Agri-EPI Centre, in partnership with the Hands Free Farm, are running a virtual Hackathon event to address the safety and security challenges of autonomous vehicles and drones in agriculture.

While the advancement of autonomous farm vehicles offers new economic and environmental benefits, future growth presents the new challenge of ensuring unmanned machines pose no risk to farmers or the public.

Hands Free Farm's 35 hectare plot uses automated machines to grow, tend and harvest crops autonomously without operators in the driving seats or agronomists on the ground.

To ensure the rate of adoption can keep pace with the rate of innovation, the safety, security and reliability of new technologies must be guaranteed.

Clive Blacker, head of arable produce at Map of Ag, DBT trustee and Hands-Free farm lead partner, Precision Decisions, (part of the Map of Ag group) supports the route mapping element of the machine operations on the farm. He explains: "Safety is paramount to any solution and cannot be taken for granted. The diverse nature of agriculture and robotics operating in off-road and on-road environments poses many challenges, not just dealing with the structured rules of the road but also unconventional, unstructured field work which poses unpredictable challenges to the safety of robotics.

"The aim of our challenge is to bring great ideas from any background to agriculture that could support robotic safety in agriculture with the opportunity to test the ideas in a real robotic farm."

Enhancing the safety and security of autonomous agricultural vehicles is the core focus of this year's Agri-EPI Centre Hackathon. This spans a range of technological hazards

such as collision avoidance, human supervision and detecting both humans and animals traversing operational fields.

High-tech, high-value equipment and machinery must also be secure against the threat of theft and tampering, while the GPS systems and other software is at risk of cyber attack and data breaches.

Kit Franklin, senior agricultural engineer, Harper Adams University and principle investigator says: "It's about making really safe, secure systems that farmerS, the public, legislators and insurers are all comfortable with."

The winning Hackathon teams will be offered a unique opportunity to implement their technology on the Hands Free Farm, connecting them with expertise and experience to further develop their solution.

From the CEO's desk



I do hope everyone has managed to enjoy some form of summer break with the various restrictions and travel challenges being faced. I've certainly no desire to travel abroad at present and happily decided to stay within our own shores. As I write this, the need for isolation following contact with a positive coronavirus case has been lifted for those that are double jabbed, which will certainly start to ease us all back to normality. With our increasingly allowed freedom, we've had some great weather to enjoy; the fields are busy with harvest activity and various outdoor events have started to materialise, that at last do not just involve a computer screen!

Autonomous vehicles

Autonomous vehicles, automation and robotics are an area I have a real interest in, and I'm certainly keen to see how it continues to unfold for our industry over the next few years. Following on from Tom Beach's excellent presentation on AgrolIntelli's Robotti project for our Lunchtime Lectures, I took advantage of a Fram Farmers event local to me to speak with Tom and see Robotti in action. I can see great potential in the concept with its Gantry tractor configuration and familiar PTO and 3-point linkage for attaching implements. For labour hungry row crop work, such as

precision drilling, mechanical weeding, etc. and providing the payback works, it's a really viable prospect. I mentioned a Claas 'autonomous technology' acquisition in the last edition of Landwards, now it's John Deere's turn. Another big name in the news with the acquisition of Bear Flag Robotics. Bear Flag specialise in converting existing machinery to allow autonomous operation, without the need to invest in completely new concepts, utilising equipment they already have. I've certainly got my own views and opinions on the different types of concepts that are emerging, formed by many years designing, developing, and servicing machinery, and



Its certainly an interesting time for engineers in agriculture

ultimately striving for reliable products that are fit for purpose. It's certainly an interesting time for engineers in agriculture, this decade will see a multitude of new technologies appearing in and around the sector.

Annual conference

Hopefully you will have seen that we have set a date and launched the build-up to our annual conference, and I hope you will be attending, albeit virtually. We certainly felt it was still a little too early to be organising a face-to-face conference, so we've decided to run the event on line again, but this time the presentations will be live. We have a great line up of presenters

representing the diversity of the industry, so when we talk about fuel, it's not just as a costly input, but also the potential to capture it from agricultural processes as an output. Please do check out our website and social media for the event details and share it to your various networks. There will be everything from engine-input to cow-output being discussed, with all the technologies in between!

Registration and membership

On an operational level, we continue to be very busy with professional registration and membership admissions, which is really pleasing to see. Close contact with education/training providers and

students remains of great importance, along with the potential to accredit more courses so that they are recognised by the Engineering Council for professional registration. Thanks to all of you that have paid your 2021 subscription, but as we are marching through the year now, we really need those who have not paid to please do so.

New commercial members

Finally, I'd like to welcome Claas, Merlo and Knight Farm Machinery as commercial members to our institution, as well as thanking our existing commercial and academic members for their ongoing support. IAgRE is of course a professional membership organisation for individuals, but it is important to have the support of both education and industry in what we do to benefit the sector long term.

Food Engineering

Our Food Engineering Special Interest Group goes from strength to strength, thanks to the hard work of Daniel Hefft and the IAgRE team. We've had some great events recently covering honey, milk, and powder handling. Another interesting event coming up in September will focus on Food Extrusion with two expert speakers from Australia, who are leading consultants in the industry. Please check out the events section on our website for more details.

Presidents Musings

Paul Hemingway



I was interested to read of the acquisition of the British Agricultural and Garden Machinery Association (BAGMA) by the Agricultural Engineers Association (AEA).

Both are long established bodies with, in recent times, a very good working relationship although I am old enough to remember times when this was not always the case. Ultimately, members of both bodies have a common interest – to maximise the supply and service of equipment to farmers in the UK and in the case of the AEA, overseas as

well. Looking at the broader industry the motor trade through the Society of Motor Manufacturers and Traders (SMMT) has fulfilled just such a role on behalf of the car industry and so there is a great model for the new 'combined' organisation in our industry to emulate. I wish the new organisation well as it moves forward.

The internal combustion engine

I read with interest Alastair Tulloch's article on the future for the internal combustion engine in the summer edition of Landwards. I was invited by JCB to view the development programme running an adapted form of the JCB Dieselmax engine on pure hydrogen. The visit was



The President trying his hand at fuelling the new JCB hydrogen engined backhoe loader

fascinating and the seriousness of the JCB contention that here was a way forward for low emission output power of high-performance heavy duty, off-highway equipment was clear to see. In about 10 months a conventional, albeit modern design of, diesel engine has been modified to run as a spark ignition engine fuelled by high pressure hydrogen gas and then installed in a JCB machine. That this has happened against a backdrop of the Covid pandemic and the pressures that this has brought is remarkable. Also interesting in a post Brexit world is that technical assistance has been rendered to the project by the University of Aachen in Germany. Quite aside from the technical

challenges of engineering the product it will be necessary for other manufacturers to follow suit in order that supplies of hydrogen can be cost effectively distributed across the territories using these machines. It will be interesting to see how enthusiasm for this technology develops.

It is great to see that some agricultural shows and other events are starting to return to their pre-Covid formats. The Cereals event was one of the first out of the box and seems to have been well attended. It gave people chance to see 'in the flesh' machines launched in the virtual space during the lockdowns and to have some real

face to face communication. Let's hope that we will be able to keep meeting this way going forward.

Public perception

And finally, I have been amused by the very positive reaction of several of my farming friends to Jeremy Clarkson's farming series. Whilst some content is obviously hammed up for effect it does portray modern farming in a pretty accurate light subjected as it is to the vagaries of the weather, and constraints of so many sorts from the legislators. Any programme that educates the non-farming population on the efforts our farmers and growers make to put quality food on our tables must be good.

Biosystems Engineering

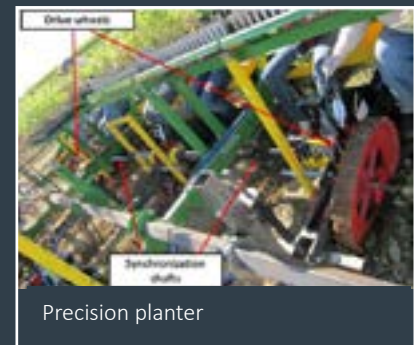
Biosystems Engineering, owned by the IAgRE, and the official scientific journal of EurAgEng, is published monthly with occasional special issues.

Head to <https://www.sciencedirect.com/journal/biosystems-engineering> to view the full article list of the latest edition and to find out more about depth and breadth of articles accepted for publication.

Reduced subscriptions are available to IAgRE members. Go to <https://iagre.org/biosystemsinformation> for details of the preferential rates for both paper and electronic versions.

The managing editor of Biosystems Engineering, Dr Steve Parkin, has kindly summarised a selection of papers published in the last three issues, which will be of interest to IAgRE members.





Biosystems Engineering
Volume 204, April 2021, Pages 358-376

Cost analysis of autonomous battery electric field tractors in agriculture

Oscar Lagnelöv, Shweta Dhillon, Gunnar Larsson,

Daniel Nilsson, Anders Larssolle, Per-Anders Hansson

Swedish University of Agricultural Sciences, Sweden

Uppsala University, P.O Box 538, SE-75237, Sweden

Interest in autonomous vehicles. Individual technologies have been well-explored, but not their combined use and the effects on agricultural fieldwork. In this study, cost analysis was conducted based on a simulated vehicle system with 50kW self-driving battery-electric drive (BED) tractors. Costs obtained were compared with those of contemporary manned diesel-based systems. BED systems had equal or lower annual costs compared to conventional manned diesel-based systems; this was due to lower costs for fuel and maintenance, while providing adequate capacity and lower energy usage. Sensitivity analysis showed that operating costs were of greater significance than investment costs. The generally more expensive investment costs of BED systems were outweighed by the reduced operating costs for several different BED system systems. Battery degradation costs and timeliness were influential, but not sufficient to make the system uncompetitive. The synergistic effect of vehicular autonomy and BED outweighed several of the drawbacks of BED systems, such as frequent recharging, increased transport and reduced consecutive work time.

Biosystems Engineering
Volume 205, May 2021, Pages 164-173

Factors affecting evaporation of water from cattle bedding materials

Lorenzo Leso, Patrícia F.P. Ferraz, Gabriel A.S. Ferraz, Giuseppe Rossi, Matteo Barbari

University of Florence, Florence, Italy

In livestock farming, maintaining dry bedding is considered to be important for maximising animal performance and welfare. A better understanding of the mechanisms that regulate drying has the potential to improve bedding management and reduce production costs. A custom laboratory-scale method was developed to explore the effects of environmental conditions and bedding characteristics on drying rate (DR). The effects of the type of material, bedding moisture content, bedding temperature, air temperature, air relative humidity (RH) and air velocity were evaluated in a full factorial experimental design. Bedding moisture content, air velocity and air RH had considerably larger effects than the other variables, together accounting for more than 70% of the variance in DR. The DR from bedding samples increased with bedding moisture content and air velocity but decreased with increasing air RH. To increase the DR and keep bedding dry, producers should focus primarily on providing adequate barn ventilation, whereas maintaining a high pack temperature may yield poorer-than-expected results.

Biosystems Engineering
Volume 206, June 2021, Pages 67-78

Development of a precision 3-row synchronised transplanter

Manuel Pérez-Ruiz, David C. Slaughter

Universidad de Sevilla, Spain

University of California, Davis, USA

Commercial vegetable crop transplanters currently use several unsynchronised planting units mounted to a common transport frame. The objective was to assess the performance of a new transplanting technology to improve the plant placement accuracy and spatiotemporal planting synchronization across adjacent rows, thus producing a grid-like planting pattern using adjacent vegetable crop transplanters. The feasibility of synchronisation of adjacent transplanting units for vegetable crops was demonstrated using tomato as the target crop. A colour, digital, high-speed computer vision analysis of the motion and dynamics of the plant trajectories of transplanted tomatoes was conducted. The high-speed video analysis led to the design and testing of an improved plant support mechanism to enhance the control and precision of the transplanting of vegetable crops. The absolute deviation values of the final location in the soil were reduced by approximately 25% for both the right planter and left planter compared to those in previous years.

The Landwards podcast

A series of podcasts have been commissioned with a monthly news podcast and a monthly interview with an agricultural engineer or influential person in the land based sector. The Landwards podcast is on iTunes, Spotify or click on <https://www.buzzsprout.com/1067353/episodes> for the latest one.



The Engineering Horizon



Green-on-green innovation for grassland weeds

An innovative precision farming platform is employing artificial intelligence (AI) in the battle against weeds in grassland.

Green-on-green, ie targeting green weeds in a green crop, has long been a challenge for those hoping to use precision farming technology to guide spray applications.

Now SoilEssentials, based in Angus, Scotland, has harnessed expertise from the space industry along with agronomists and leading academics, to develop AI to address this

green-on-green challenge. SKAi (The SoilEssentials KORE Artificial Intelligence platform, pronounced sky) has developed AI components which can be trained to recognise broad-leaved weeds growing in grass crops and then take control of a crop sprayer to implement targeted control as the machine progresses through the crop.

Dr Gregor Welsh from SoilEssentials, states: “Green-on-green species recognition is probably the biggest challenge we must overcome if farmers are to benefit from the efficiencies of automated targeted weed control in future.”

“I am delighted by the progress our SKAi project has made towards overcoming the challenge. We are



Targeting green weeds in a green crop has long been a challenge

now able to train SKAi to target weeds in grass fields and automate the sprayer control via our machine-mounted hardware.”

“The new SKAi technology operates in real-time, meaning there is no need to pre-map the field. The on-board AI is set-up to constantly scan the vegetation, identify and selectively treat weeds as the sprayer boom passes over.”

“Trials of the system are showing high levels of success in spraying docks in grass fields. We are confident that our partnership will be able to progress SKAi until

it can recognise and differentiate a wide range of weed and cash crop species.”

Wider benefits

Graham Ralston, Hardware Director at SoilEssentials commented on the potential roll-out of the new SKAi technology to the wider farming industry:

“Targeted weed control, resulting in reduced input costs and reduced environmental impact, is a win-win for farmers seeking more sustainable use of agrochemicals.”

Project partners

SoilEssentials is partnered in the InnovateUK-funded project by Deimos Space UK, University of the West of England and Scottish Agronomy Ltd.

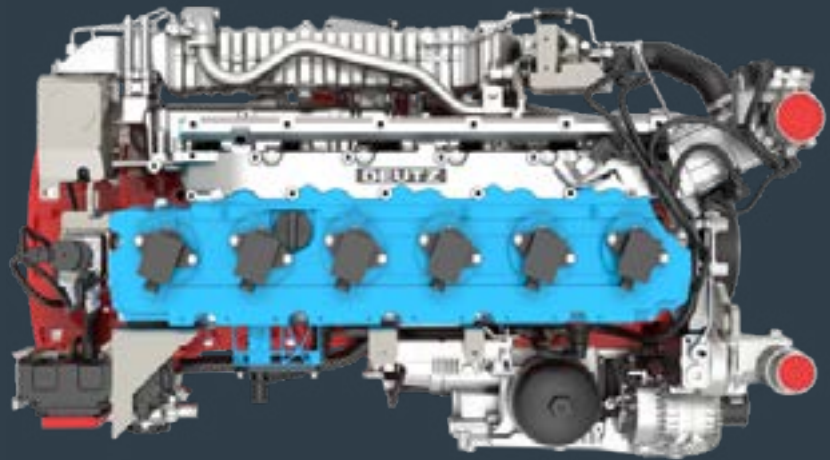
University of the West of England Centre for Machine Visions, Prof. Mark Hansen said:

“For UWE Bristol, being a part of the SKAi team gives us the opportunity to transfer academic knowledge into the real world in a cutting-edge project that will bring huge environmental benefits.”

“There are many situations where blanket herbicide application across a whole field is undesirable – I’m thinking of broad-leaved weed control in swards containing clover, for example. Ultimately, our challenge is to refine the technology until targeted control can be achieved even in what would appear to be difficult scenarios, eg blackgrass in wheat crops. And, of course, we must also make sure that the system makes affordable economic sense versus existing spray application methods.”

The Engineering Horizon

Deutz hydrogen engine heading to the market



Big autonomous questions being asked

Autonomous technologies allow machines to move and operate freely. Although full automation is still in the development stage, there has been considerable progress. German arable manufacturer Horsch is working on developments from task automation to autonomous driving systems. Horsch's Roboter is a development platform to explore autonomous technologies.



Deutz launches the TCG 7.8 H2, the company's first hydrogen engine. The drive, which meets all the eligibility criteria set by the EU for zero CO2 emission engines, is a further addition to the company's portfolio of low-emission and zero-emission drive systems.

"Deutz are pioneers of carbon-neutral drive systems for off-highway applications. We already manufacture clean and highly efficient engines. Now we are taking the next step: Our hydrogen engine is ready for the market. This represents an important

milestone that will help us to make our contribution toward the Paris climate goals," says Dr. Frank Hiller, CEO of Deutz AG.

The hydrogen-powered engine has performed on the test bench with flying colours and is scheduled to go into full production in 2024. Dr. Markus Müller, Chief Technology Officer of Deutz AG, explains: "The six-cylinder TCG 7.8 H2 is based on an existing engine design. Generating a power output of 200 kW it runs carbon-neutral and very quietly. In principle, the engine is suitable for all current Deutz

applications, but due to the available infrastructure it is likely to be used first in stationary equipment, generators, and rail transport."

First pilot project with customers in the pipeline

The hydrogen engine's first pilot application will be in stationary equipment for power generation in partnership with a regional utility company. The pilot is scheduled to commence at the beginning of 2022 with the aim of demonstrating the engine's suitability for everyday use.

Michael and Philipp Horsch have focused on automation and autonomous driving systems since the early 2000s, when they bought the first AutoFarm GPS steering system. It was the first RTK system which allowed for driving within the range of a centimetre. "We immediately thought 'If something like this works, we should also be able to drive completely autonomously.' When we bought our test farm AgroVation in the Czech Republic, we had the chance to focus on CTF and track planning. We originally started with an agronomic point of view, but we soon realised that CTF first and foremost is about planning. This was another step towards autonomous driving systems," says Michael Horsch.

Autonomous or automation?

There are many things associated with the term autonomous that Philipp Horsch would rather call automation. "Take the example of a tractor that drives with GPS and can reverse on its own. This only is an automation step, there is still somebody sitting on the machine who controls it. Autonomous means there is no driver and we are talking about different vehicles, vehicles without a cabin. What is extremely important: automation comes before autonomous driving. It is definitely the first step. Automation has been an important topic for years and we have been making good progress. However, there still are quite a few hurdles to clear until we reach complete autonomy," he explains. To be able to work in a partially

autonomous way today, there are three special requirements: the track planning system, geofencing (a digital fence) and the safety issue. "Today, we solve it by placing a 'driver' with a remote control in the field to monitor everything and to intervene in case of emergency. The remote control is effective for a 500m range. These aspects ensure that we can work in the field in a partially autonomous way and be safe," Philipp Horsch says.

"The next step will be the sensor system so that the machine can be monitored, for example, clogging detection. From a technical point of view, we are working on different concepts. We know we have to take different concepts into the field, learn and develop further."

Preview: Future Fuels in Agriculture



**How can engineers and technologists
address the challenges of alternative fuels?**

Date: Wednesday 3 November 2021 – 10am-2.30pm

Location: Online via Zoom

Cost: FREE to IAgRE Members – £30 for non-Members

Booking: <https://bit.ly/3mT40EB>

Background

In an age where the media is full of stories about climate change, sustainability and carbon reduction, when would be a better time to talk about how engineers and technologists are achieving this in our industry? The creation of food from agriculture does not only consume fuel to power tractors, cool potatoes and heat glass houses for example, but also has the added advantage of being able to generate it from growing energy crops and composting waste. In this year's conference we are going to explore a range of activities from capturing methane from dairy waste to powering machinery with hydrogen. The diversity of our sector is clearly demonstrated by

the diversity of the subjects that surround it when we talk about "Future Fuels in Agriculture" at our Landwards 2021 annual conference.






Mindful of the pandemic, we plan to run our conference online again this year, but this time as live session presentation via Zoom to ensure interaction.

Our experienced presenters will take us through a range of interesting and diverse topics and developments in agriculture and horticulture. We will see what some of the major OEMs are doing to enable alternative fuels and energy sources to power their products, ranging from battery electric propulsion, gas internal combustion and hydrogen. We also explore and understand the potential

on-farm energy production, delving into technology that can generate fuel and power, such as liquified biomethane production and alternative ways to heat glasshouses.

The presentations will interest people working within agriculture and its associated industries, equipment and component manufacturers, dealers and service outlets, education, research and agri-tech organisations, and will give a taste of the technologies being explored whether adoption is imminent or several years away. As members of IAgRE, we do hope you will join us and attend, we also hope that you will inform your wider industry colleagues and connections.

The Programme

9.55am	Arrival
10.00am	Introductory Remarks - Paul Hemingway – President IAgRE
10.10am 	Farmers - Fuelling the energy we need to succeed Caroline Drummond – Chief Executive LEAF <i>We often forget the long history of renewable energy and how the convenience of fossil fuel derived energy has created many of the problems we face around climate change. Now is the time to accelerate the role of renewable energy on farm, building on the past, maximising the opportunities of the present and embracing the innovations and technologies of the future. What will a fossil fuel free farm look like in 2030?</i>
10.45am 	Powered by Nature Alistair Walshaw – CNH Industrial Open Innovation <i>Alistair will give an insight into the New Holland T6 Methane powered tractor and explain how it supports the road to a carbon neutral farming cycle.</i>
11.20 - 11.30am	Short Break
11.30am 	Waste to Power – Upcycled Biomethane Energy Systems Nick Royal – Commercial Manager R&D – Ricardo UK Ltd <i>Nick's talk will cover the following: Harvesting agricultural waste resources to meet farm and community energy requirements whilst addressing the environmental impact of potent greenhouse gases. Producing a valuable energy resource through efficiently refining and liquefying biomethane fuel from biogas mixes at small scale. Supporting grid infrastructure and providing renewable energy backup / storage through a distributed and democratised biomethane energy system. Disrupting the economics of farming.</i>
12.05pm 	Electricity & Hydrogen - potential future energy sources for Agricultural machines Jarno Ratia – Global Engine Product Management Director AGCO Power <i>Jarno's talk will cover Emission legislation - now and in the future and Future fuels - their benefits and pitfalls.</i>
12.40pm 	The challenges and practicalities of decarbonisation in Horticulture Jon Swain – Technical Consultant NFU Energy <i>Jon will explore the challenges of achieving Net Zero by 2040 and discuss how to develop a Net Zero energy strategy.</i>
1.15 - 1.45pm	Break for Lunch
1.45pm	Q&A and Speaker Panel Discussion hosted by Andy Newbold, FarmSmart.
2.30pm	Close and thanks Charles Nicklin CEO IAgRE

Profession: Natural ways with water



Dr Alexandra Cooke



Natural ways with water

Farmers in the Severn Trent Water (STW) area are being encouraged to play an active role in improving drinking water quality by implementing a range of environmental schemes on their land.

STW is also conducting trials to see if similar techniques could help handle waste water as well, Dr Alex Cooke, Principal Catchment Scientist for STW told IAgRE members in a recent lunchtime lecture.

The features being promoted include planting woodlands, buffer strips, hedges, grassland, wildflower areas

and riparian margins, as well as creating wetland areas.

STW is keen for farmers to consider features that provide benefits to the community as well as to water quality, and to combine several helpful features.

Pesticides

These are referred to as 'stackable benefits', Dr Cooke says. The main concern for STW drinking water sources is from pesticides:

"They are difficult and expensive to treat, and that cost is passed back to customers."



Severn Trent Water is keen for farmers to consider features that provide benefits to the community as well as to water quality

STW's approach is to minimise and manage risks as well as tailoring solutions offered to farmers to specific risks in individual river catchments.

Wildlife engagement

Working with environmental schemes is the ideal entrée: "Farmers are better engaged by wildlife and habitat rather than by water quality." "But by implementing biodiversity innovations that benefit wildlife we get the water quality benefits too."

To help achieve that STW offers a 'toolbox' of different ideas to farmers in its region.

New habitat creation

Using the schemes has enabled it to talk to 10,000 farmers on the issues, and led to 2,180 hectares of new habitats being established.

And a 'chemicals amnesty' run alongside them has led to 20 tonnes of unwanted products being removed from farmsteads. 'Farm to Tap' offers incentives to

farmers for actions that help improve water quality, such as reducing herbicide use or substituting chemicals known to cause water quality problems with alternatives that pose less risk:

"Before they were withdrawn from outdoor use, we encouraged farmers to replace metaldehyde slug pellets with alternatives such as ferric phosphate:

"We are not prescriptive; we pay farmers for outcomes and let them find their own solutions."

Profession: Natural Ways with water

Grant scheme

The Farm To Tap scheme has been well supported, with 46,000 hectares signed up – as well as 2,180 hectares of new habitat created – and

2,300 grants awarded in the first six years. They have been used for a wide variety of ideas:

“We have helped fund the building of dedicated pesticide and spray washdown areas on farmsteads; establishment of low-input grassland areas; constructed wetlands to help manage phosphorous losses and installing features like bio filters for pesticides.

“Other applications have included rainwater harvesting, which can help make a farm more resilient to drought.

“We have also funded sediment retention ponds, which help slow water flow off the farm so sediment deposits in ponds and the water flowing out is clearer.”

And it even funded a boat for a farmer who wanted to do invasive species control and trap signal crayfish:

“Not all of these are nature-based solutions, but they all have environmental benefits, and all help us to reduce water treatment costs.”



Environmental protection

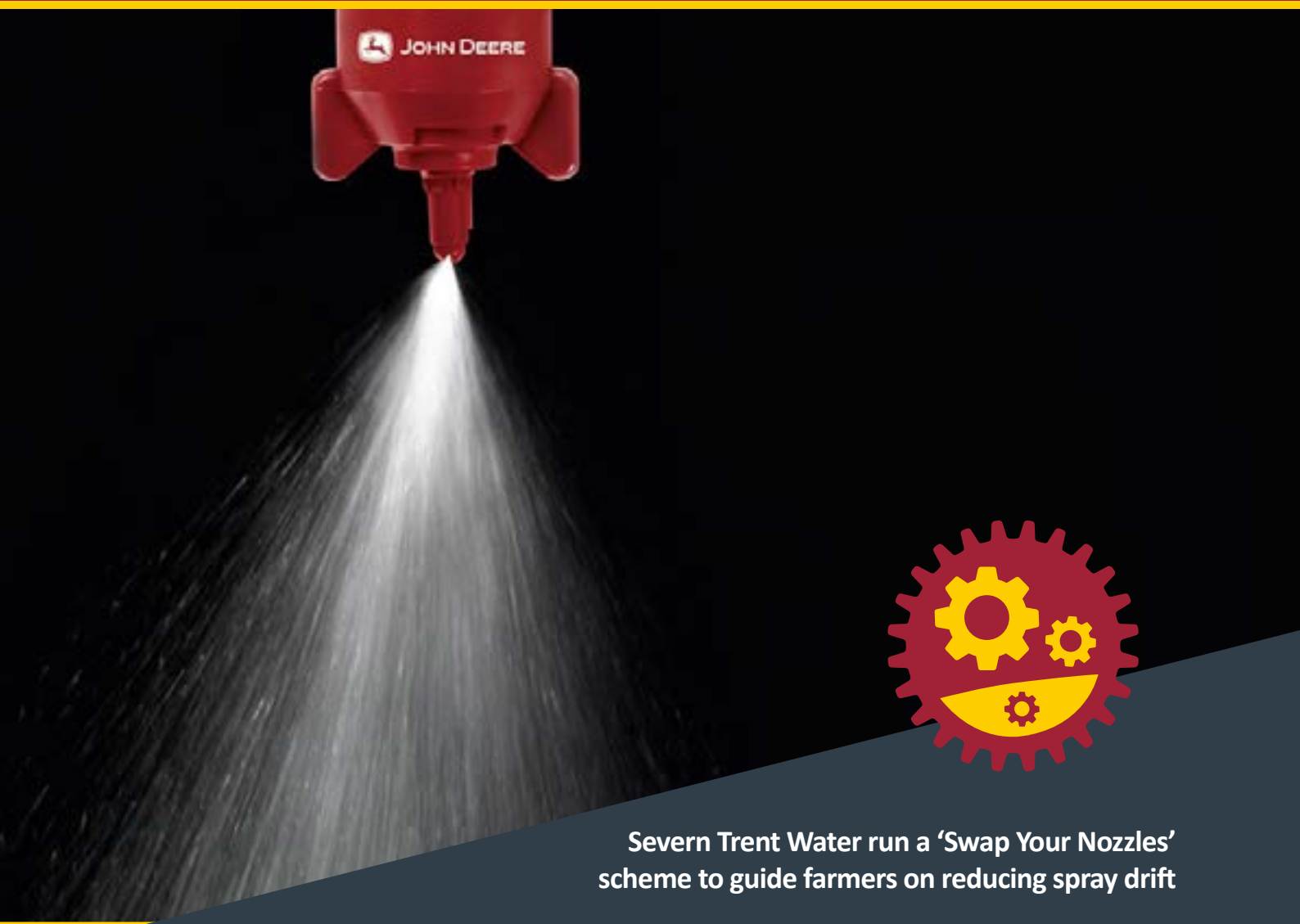
STW also offers grants under its Severn Trent Environmental Protection Scheme (STEPS) for practical works that help protect and improve water quality:

“These are for capital infrastructure or land-management based solutions.”

The company can also reward farmers for steps that enhance biodiversity and facilitate recreational use and access for the local community, like features located by public footpaths.

It also runs a ‘Swap Your Nozzles’ initiative which offers education and training events to guide farmers on reducing spray drift.

As the name suggests, it helps fund them to make the switch. As a result, some 33,000 hectares of land is now sprayed with low drift nozzles.



Severn Trent Water run a 'Swap Your Nozzles' scheme to guide farmers on reducing spray drift



The Specialist On Farm Advice (SOFA) service offers advice to optimise efficiency

Profession: Natural Ways with water

Access to specialist advice

Further advice is available via its Specialist On Farm Advice (SOFA) service, which offers advice to optimise farm efficiency and design capital projects that help achieve its aims.

This can include practical steps of value to the farmer, such as soil and manure sampling.

With many farmers now considering cover crops, it also offers to help fund their use in groundwater catchments, as they are particularly effective at reducing nitrate leaching to boreholes.

Under this campaign farmers can access training on soil health issues and managing cover crops to achieve optimum environmental benefits.

One complicating factor at present is uncertainty on how these schemes and payments will be treated under the ELMs scheme.

Small grant - huge benefits

Just £10,000 in grant aid to a Nottinghamshire outdoor pig farm has achieved benefits that may have saved Severn Trent Water millions of pounds.

The farm moved pigs from vulnerable fields around a drinking water borehole and installed a range of environmental features after consulting with STW.

Consequently, the company didn't need to install new treatment facilities that could have cost £2.45 million to build and over £100,000 a year to run.

The farm - near Rufford, Nottinghamshire - has benefitted from the investment:



"This borehole had high and rising nutrient concentrations connected to outdoor pig production," said Dr Cooke.

The two parties agreed to move the pigs from fields adjacent to the borehole and nearby watercourses and install buffer strips and introduce field corner management.

They also completed arable reversion and sowed grass to help prevent run-off, this work attracted £10,000 in grants over a decade:

"Moving the pigs to a lower risk site had multiple benefits," she says.

"We have gained water quality

benefits at the borehole; flooding relief benefits due to cover on the fields; biodiversity benefits from nectar and wildflower mixes plus aesthetic benefits. The whole area looks better."

And STW's customers benefit in several ways, including a reduction in peak nitrate levels in water and reduced cryptosporidium risks.

"Ultimately we didn't need to upgrade or install new water treatment facilities."

Wastewater next?

STW is looking at using similar nature-based methods to treat



Nectar and wildflower mixes have brought environmental and aesthetic benefits

wastewater that would normally be handled at sewage treatment works.

While the research is still at an early stage, initial observations look promising. The work is examining ways of reducing phosphorous losses by installing nature-based solutions such as in-catchment field interventions wetlands and reedbeds.

“We have reedbeds with different base mediums that can remove phosphorous from water, and already three different products are showing promise,” Said Dr Cooke.

Watch again

Don't forget that the Lunchtime Lectures are available to watch on the IAgRE's youtube channel:

<https://bit.ly/3kpKVF8>



Profession: Autonomous agri system



Tom Beach



Robot practical

Robots could provide the solution to a range of the fresh produce industry's most pressing problems, the audience at a recent IAgRE lunchtime lecture heard.

The sector faces major challenges in recruiting workers and the withdrawal of plant protection products, said Tom Beach.

He believes the Robotti machines which he and colleague Jack Wyatt import via Autonomous Agri Solutions could help address those problems.

The perfect employee?

The machine's ability to work very accurately, 24 hours a day is ideally suited to sector's needs, he said.



The ability to work 24 hours a day makes the robot ideal for the fresh produce sector

The only machine working in the UK thus far is at Home Farm, Nacton in Suffolk, where it is working with a range of organic crops (see panel). Tom expects interest to grow rapidly, initially from fresh produce growers, but spreading to 'broad acre' farming in the future.

Spot spraying potential

He sees potential to use techniques like spot spraying to

help the industry address the social and legislative pressure to reduce chemical usage, while the labour-substitution potential is of particular significance to the UK. There are already some 30 Robotti machines working across Europe. They are attracting interest from universities and research organisations because the ability to repeat activities with total accuracy is well suited to trial work. And they are already moving

into more general farming with contractors in Czechia using them to drill forage maize. The tractors work 24 hours a day and only stop to replenish seed and fuel tanks.

Nuts and bolts

The machine is powered by two diesel motors, which deliver 150hp. The unit weighs 3.1 tonnes – much lower than a conventional tractor of the same power. It uses a

Profession: Autonomous agri system



conventional three-point linkage and external hydraulics.

These enable it to mount, and lift implements, set them in work and adjust their working depth, as well as enabling the machine to manage its working speed and headland turns.

Gantry again

It is effectively a one-bed gantry system, said Tom, but without some of the limitations of conventional, wider gantries that stifled their usefulness and adoption in the UK. Removing the driver and mounting the working element in the middle has helped reduce its weight and ensure that it is evenly distributed. "The design means we are not hanging implements off the back of a tractor that we then need to compensate with weights on the front."

Bed widths

In normal format it has 72inch/183cm wheel centres, so it can span a single, conventional bed, but the wheels can be turned 90 degrees to produce a 78¾inch/200cm span to suit another bed width. In Europe it is being used with a variety of other row crops like sugar beet and maize, with models up to 3.65 metres wide able to straddle two adjacent beds.

Twin engine

The machine has two engines – one in each end box. The first powers the key operations like the hydraulics for the four-wheel drive, steering and link arms.

The second unit powers the hydraulic pressure for the PTO and external hydraulic spool valves needed for operations like sowing and spraying. These can be turned off if those features are not needed.

Now the machine is powered by diesel because its developers feel the alternative sources – electricity, hydrogen or solar power – are not developed enough at the moment.

"Electrical technology is not yet at a point where we can use it as efficiently or effectively as diesel," Tom said.

Decent output

Current experience at Nacton has shown that the machine can hoe two hectares an hour in suitable fields, consuming anything from four to six litres of diesel per hour.

Its ability to effectively turn by spinning around in its own footprint offers the potential to use much smaller headlands, which could

maximise the cropped area on high value soils.

Safety layers

The machine has multiple levels of safety features. Once it has been programmed with its task and limits of the field in which it will work, it will come to a halt if it gets to 0.5 metre from the specified boundary.

It can also avoid moving obstructions like animals or humans, and – if it meets a solid obstruction that it had not been informed of – will come to a halt, alert the operator and await further orders.

Straightforward technology

From a farmer's point of view Tom said the machine is relatively simple: "Mechanically it is relatively old technology with which farmers will be familiar. They will be able to repair and service without needing specialist tools."

And the cost? Currently it is around £150,000 depending on the specification chosen, which he said is comparable with a conventional tractor of the same power rating.

Nacton's 'here and now' need



Andrew Williams, Home Farm, Nacton's manager.

Home Farm, Nacton had an immediate need for a tool like Robotti, said Andrew Williams, the farm manager.

The farm is 1,900 hectares, of which some 10% is fully organic, on the Felixstowe Peninsula in Suffolk:

"We had been open to the idea of this kind of technology and were just waiting for somebody to come up with the right product. We could see that Robotti would fit into our system very well."

The machine is currently used for repetitive but regular jobs like weeding bed-grown crops.

Tom How, who operates it, says the task is best done regularly when the weeds are small:

"We are just going through with a comb – a set of thin tines – to pull out all the small weeds before they get established and become more of a nuisance.

"It's a 'little and often' job so we keep going over it. The advantage of Robotti is we can just leave it to do it and we don't have to worry about it."

It may also be used to hoe other crops like cauliflower, broccoli and leeks.

As well as reducing costs, he said crops are looking cleaner this year than previously.

Mr Williams expects the benefits and performance to increase as farm staff learn more about the system.

Watch again

Don't forget that the Lunchtime Lectures are available to watch on the IAgRE's youtube channel:

<https://bit.ly/3kpKVF8>



People:

Harry Henderson



Harry Henderson



Travel, talk and turn the world around

Budding agricultural engineers should be prepared to travel the world and talk to anyone, suggests Harry Henderson, IAgrE member and the AHDB's Knowledge Exchange Manager, who specializes in farm mechanization.

In the IAgrE's Landwards podcast he suggests they might also approach designing new machines from the point of view of the farmer rather than the inventor.

Harry was born into a North Wales

livestock farming family and has worked in Western Australia, Zimbabwe and the USA – all experiences that helped his career. After some time with John Deere – with whom he worked across Europe - he realised he

missed the agronomic work he had previously done and joined the AHDB as a regional manager in 2013.

He trained in agricultural management with mechanization at



Farm meetings can be a valuable sounding board, not for the technology, but the challenges technology should be able to solve.

Llysfasi College. Later he gained a HND in agricultural management from Oaklands College, Hertfordshire.

While he has qualifications in engineering, he doesn't consider himself to be an engineer. He sees himself as someone who straddles the boundaries between practical farming, agronomy, soil management and the farm machinery industry.

A problem solving perspective

And he believes engineers and innovators need a fresh perspective

on designing new machines. He feels too many develop a solution and then find a problem for it to solve.

"I think you have to talk to people who understand the issue and then develop a solution around that," he says.

Inventors need to ensure their innovations offer farmers real practical benefits if they are to be widely adopted:

"There is a lot of technology that can help the farmer. For example, as autosteer has seen a huge reduction

in fatigue along with an increase in output and productivity."

A Henry Ford moment

But other technologies remain unproven, leaving some farmers sceptical about them:

"We need a Henry Ford moment in precision technology where somebody produces a widget somewhere which has a real positive effect and is cheap to employ on the farm."

People: Harry Henderson

As well as aiding the farmer, he says the technology could also be advantageous for the environment, which would be important as environmental issues move centre stage.

Those making innovations need to explain the benefits more clearly to farmers:

“We have lots of people hanging a multi-spectral camera from a drone and telling farmers it is going to be transformational in their farming.”

“But the farmer wonders what they are going to do with the map. What are they going to do differently on receipt of the information, and how is it going to help their decision making?”

Engineers need to concentrate on ideas that would trigger genuine change and advantages, such as improved yields; improved environmental protection and/or reduced costs.

Talk to anyone (and listen)

Being prepared to talk with absolutely anyone is key: “Be open-minded and listen to people. Digest what they are telling you. If you have any ideas talk to farmers and ask whether they think they will work.”

The likelihood is that some people will show interest and others will not. So the key is to figure out who is worth listening to and continue liaising with them.

Some of the best advice might come from what appears – at first – to be unlikely sources:

“The thoughts of an 85-year-old are sometimes better than those of a

45-year-old. The 85-year-old didn’t have a 400hp tractor to throw at a problem and had to think outside the box.

“Listen to everybody – even the guy with holes in his jumper whose trousers are held up with string. You will never understand who you are meeting until you get talking with them, and there are some really interesting people out there.”

Travel informs decisions

Harry highlights how his travels informed his career and provided insights that have enriched his experience:

In Western Australia he discussed soil moisture retention with the owner of the 19,000 hectare farm on which he was working – a subject not exactly at the top of the agenda in his native North Wales!

In New Zealand he talked about the challenges of farming without subsidies.

In North Dakota, USA he was advised to grease the combine in the evening when it was still warm after work, because it would be so cold in the morning that the grease would not flow through his gun or the machine.

He also saw the heart-breaking effects of hail damage with hundreds of acres of wheat pounded into the ground in minutes.

While working with John Deere he discussed harvest with a Spanish farmer whose wheat was at 10% moisture, but was waiting for it to fall to 9% before starting work.

Harry pointed out that Scottish farmers start harvesting at 24% moisture, and Deere regards that country as one of the best places to test new combines.

The future

He believes there is a great future for agricultural engineers, but that the profession – like farming – will inevitably change. He believes the industry will become increasingly holistic.



In his role at AHDB he encourages farmers to become more sustainable so they can stay in business, something that is especially important with the Basic Payment Scheme ending:

“Commonly farmers assume that means buying a cheaper tractor, but it is more complex than that. All your machinery needs to be earning money for the farm. You shouldn’t need to be farming to pay for the machinery.”

Farmers will be under greater pressure to ensure investments earn their keep: “You can have the tractor of your heart’s desire providing you make money from it.”



Harry's passion is restoring vintage farm machines and this 1917 Titan 10-20 is his next project!

"There is no hard and fast rule regarding the number of hours it should do or its workload; there is a human element in all this."

Out of hours

For someone whose job is advising farmers on trends like the current move towards non-inversion tillage and direct drilling, he has an unusual hobby – judging ploughing matches.

But ploughing still has its place and benefits

"I am not a match ploughman, but from the agronomist's point of view I know what I need to see. I do want to see weed control; I

want to see uniformity and I want to see a proper finish."

He has become respected in the role – to the extent that his Saturdays are regularly booked up from September right through to

the end of November.

Harry says ploughing still has its place: "It has been around for a very long time, so it isn't going anywhere quick. It will not disappear in the next 10 years, that's for sure."

The Landwards podcast

This article is based on Harry's podcast. You can listen to the whole interview and many others at <https://bit.ly/3DnU0Jv>



Practice:

Dieselmax
hydrogen engine



Home-grown Hydrogen engine

The challenges of achieving zero emissions are very real for those involved in engine manufacture. The current 'noise' in the press is that the days of the Internal Combustion (IC) engine running on fossil fuels are numbered. JCB has chosen to turn that logic around to say that the fossil fuels may have to go but that IC engines may remain if a suitable fuel such as hydrogen are used to dramatically reduce, or eliminate, harmful emissions.

Paul Hemingway was invited to JCB for a look.



JCB have developed a hydrogen engine working in an excavator

Hydrogen as a fuel source in IC engines is attractive because:

1. The technology of IC engines, both spark and compression ignition, is well known by manufacturers and dealers alike. This gives the possibility of a swift and low-cost solution which is easy to service.
2. The 'engine package' employs very similar space to a diesel engine and similarly the hydrogen tanks can simply replace the space taken by the diesel tank. This offers

both ease of installation into the machine and even the possibility that if a machine for whatever reason needed a new engine, it could go from having had a diesel engine to having a new hydrogen engine fitted.

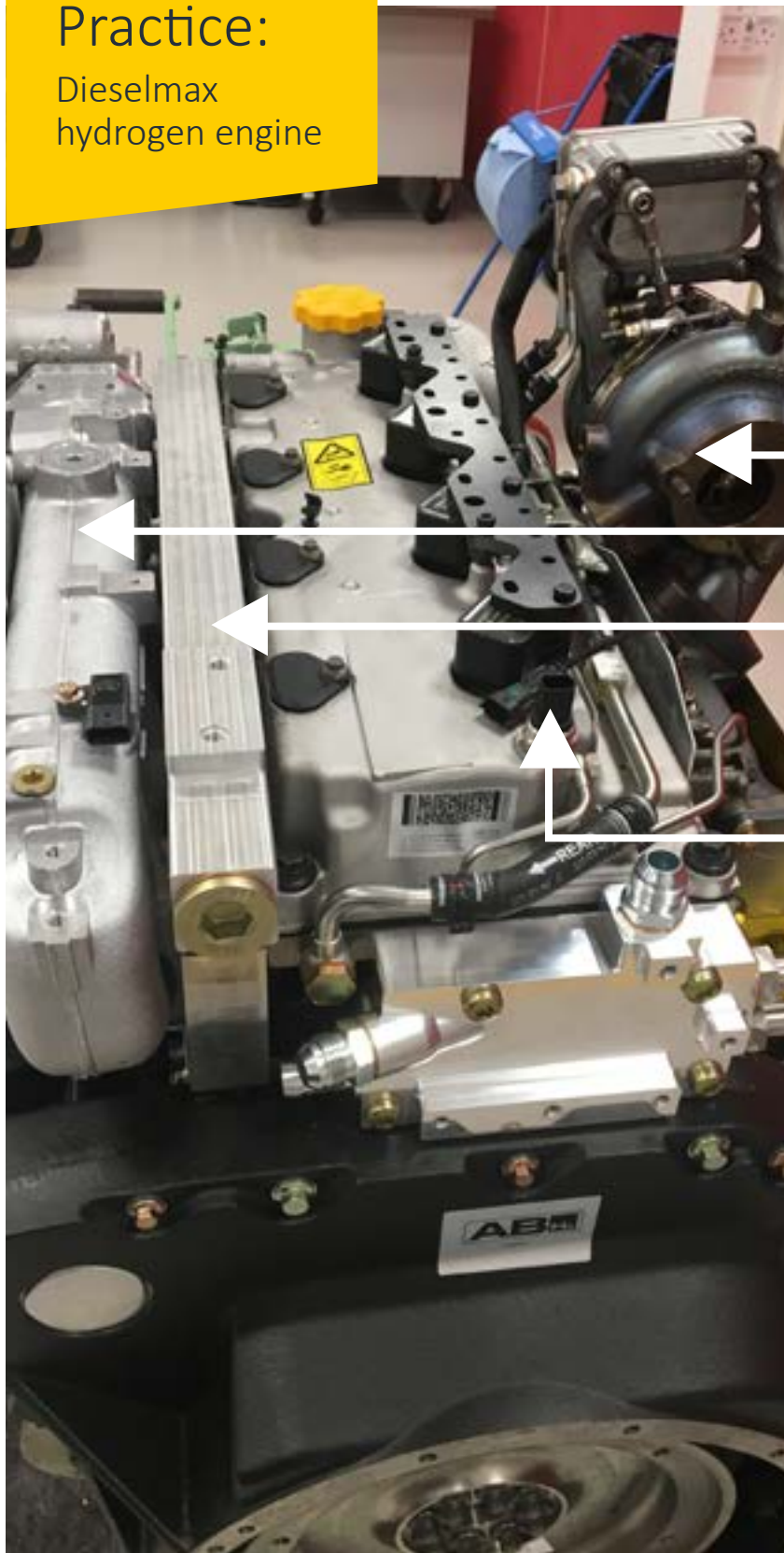
3. Given the right equipment the engine is quick, easy and clean to re-fuel.
4. The unit cost of a hydrogen-powered engine would be very similar to that of a diesel one.

The project

A standard JCB 448 engine (4 cylinder, 4.8l capacity) has been adapted to run on hydrogen. From the cylinder head gasket down the engine is basically standard. A revised cylinder head has been designed to optimise gas flow into the engine and accommodate electric coil powered spark plugs. Piston crowns have been modified to facilitate thorough mixing of hydrogen and air.

Practice:

Dieselmex
hydrogen engine



Head layout

TURBOCHARGER

INLET MANIFOLD

**HYDROGEN
MANIFOLD**

**ELECTRIC COIL
SPARK PLUGS**

To minimise NO_x emissions a very lean mixture is run (Lambda 3) of approximately 100 parts air: 1 part H₂ by mass. To achieve this mix requires a larger than normal turbocharger which was evident when the engine was heard running. Whilst it had a softer detonation

sound than its diesel counterpart, the turbo noise is more audible.

As well as running engines on a test bed, a development engine has been installed in a backhoe loader and from a distance (and probably from the driver's seat) you would be hard

pressed to tell this machine from its conventional parent were it not for the striking paint job! No structural changes have had to be made to accommodate the new engine and the cooling pack is also the same.



Fuelling is clean and easy

Fuelling

The diesel tank has been replaced by a cassette of three gas tanks each capable of holding 1kg of gas at 320bar. A fourth tank is located at the rear of the machine. Refuelling of the machine is clean and easy given access to a suitable supply of gas at a pressure greater than 320bar.

Access to green Hydrogen

Hydrogen is commercially available, although at current levels of use the transport and storage costs involved make it expensive. It will take widespread adoption of this technology and hence demand for hydrogen for this to change.

The more fundamental issue is how the hydrogen is generated in the first place. Much of that in the market today (Grey Hydrogen) has been generated using fossil fuels and so environmentally moves the pollution from one place to another rather than eliminating it.

The end game must be to harvest the hydrogen using renewable power sources to produce Green Hydrogen. Hydrogen seems to be rising to the fore as a fuel of the future because of its energy density and ability to be used as a replacement for fossil fuels. At the same time the UK Government is actively looking at the potential for high pressure hydrogen to be fed nationwide to fuel domestic and factory heating boilers. Ultimately

there must be a finite potential for production of hydrogen and there will be a real challenge for government to prioritise its use.

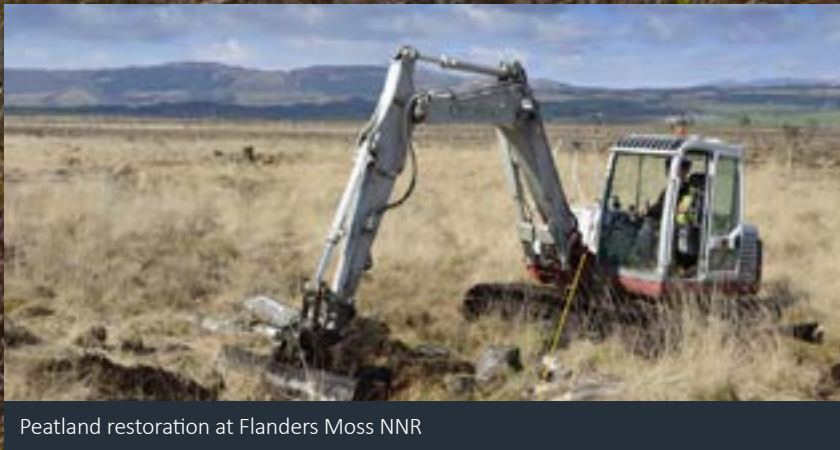
Summary

The JCB exercise has proven that an existing IC diesel engine can be modified to run on hydrogen at very low emissions. JCB estimate that its engine could be market ready by late 2022. Whether the market is ready to accept and adopt the technology so soon is less certain. If the heavy-duty machinery industry wants to secure its share of the available hydrogen going forward it needs to start moving quickly.

Acknowledgement

The author would like to thank JCB Excavators Ltd for their kind invitation to view the project and to hear their vision for the future.

Practice: Satellite peatland restoration



Peatland restoration at Flanders Moss NNR

Using satellite technology to look at how bogs ‘breathe’

New research, published on International Bog Day (July 25th), demonstrates the potential for measuring ‘bog breathing’ - or peatland surface motion – to monitor restoration sites in future.



Bogs can move due to precipitation, water level, vegetation composition and land management

A collaboration between NatureScot, University of the Highlands and Islands, University of Nottingham, and Forestry and Land Scotland, the research uses Satellite Interferometric Synthetic

Aperture Radar (InSAR), which can map the movement of the ground's surface – a technique developed with University of Nottingham spinout company Terra Motion Ltd.

The way that bogs move, or breathe, can be influenced by many factors, including precipitation, water level, vegetation composition, micro-topography and land management.

Practice: Satellite peatland restoration



This technique could provide a better understanding of peatlands in Scotland and has the potential to be used on a large scale.

Time path dependent

By measuring the motion over time, the technique is able to assess the condition of peatland and the effectiveness of different restoration techniques on a large-scale.

If developed on a national scale, the method could provide a better estimate of the amount, distribution, condition and associated carbon inventories of peatlands in Scotland,

and a means of assessing the impact of investment in peatland restoration.

It could also help to identify areas at high-risk of peat instability, fire and erosion, and highlight where urgent restoration action might be needed.

Long term potential

May Shirkhorshidi, NatureScot's Peatland ACTION report manager, said: "Peatland restoration

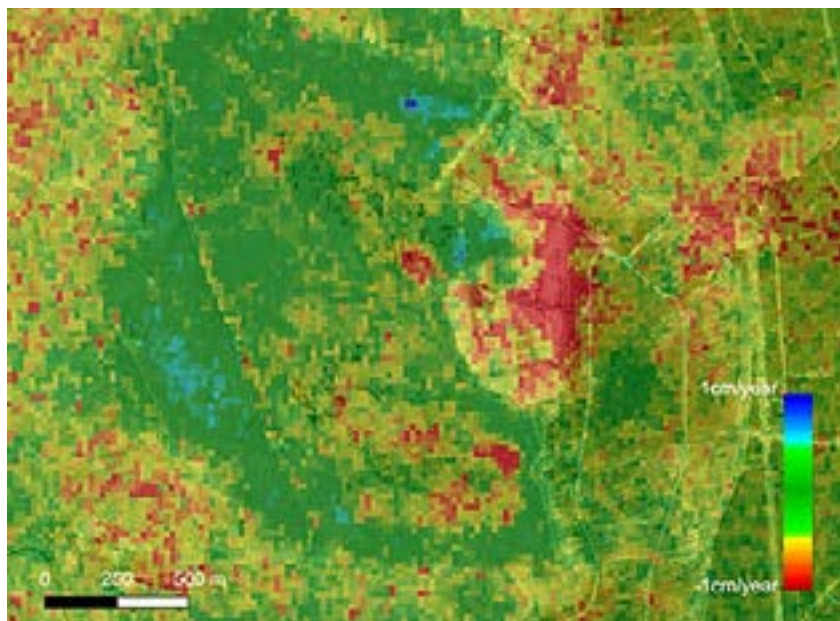
is a crucial nature-based solution to the twin crises of climate change and biodiversity loss, a key priority as we look towards the COP26 in Glasgow later this year.

"While in the early stages of development, we are excited about the long-term potential of this research. It could help Peatland ACTION target priority areas for restoration and offer a scientifically-proven way of



**better estimate of the condition of
potential to be applied elsewhere**

monitoring changes in peatland condition after restoration. "This is a really interesting development for all the Peatland ACTION partners as it could help us evaluate the success of different restoration techniques - putting us in a better position to share this knowledge. Crucially it could allow us to do this more quickly and on a far larger scale across Scotland. We look forward to working with partners over the coming years to develop the concept."



Developments in imagery and processing techniques enable peatland monitoring at a scale unimaginable a decade ago.

Lead author Chris Marshall conducted the research while at Nottingham and subsequently with the Environmental Research Institute at North Highland College UHI, part of the University of the Highlands and Islands, where he is now a peatland scientist.

He said: "Bog breathing or peat surface motion gives a unique insight into the inner workings of the peatland including its landscape, hydrology and ecology. However, the high frequency of ESA sentinel-1 imagery and developments in InSAR processing techniques allows us to monitor peatland condition at a scale unimaginable a decade ago. It allows peatland restoration progress to be measured in real time.

"The techniques developed during this work are now being applied as part of a Leverhulme award to determine how resilient Scotland's peatlands are to extreme climate events such as wildfire, drought and extreme precipitation events. This will help guide management of these valuable ecosystems during this period of climatic change."

New method

David Large, co-author and peatland specialist at the University of Nottingham, said: "This new tool allows us to see the landscape

swell and contract in response to different environmental conditions. A healthy peatland is wet with lots of soft and spongy sphagnum mosses that swell and retain water. In contrast, drier peatlands are stiffer and unresponsive to the addition of water. The former moves like a beating heart, whereas a degraded peatland could be described as flatlining!"

"This technique is really exciting because it enhances our understanding of peatlands, allowing us to see what we would not ordinarily be able to with the naked eye, making our peatlands more accessible and ensuring restoration takes place in the right place. In the future, it has the potential to be used to monitor carbon emissions."

**Read the full
research report**

<https://bit.ly/3h4KMbA>

Obituary

Dr David Llewellyn Owen Smith



If you wanted something done you would go to David. If you wanted to know something you would ask David. If you wanted a sympathetic ear, David would listen. David was an academic but not the dry crusty sort, he was an engineer with a wide breadth of skills, he was a teacher who could make most things understandable, he was a traveller and an adventurer, he was a businessman, he was a loving family man. However, he was essentially just a nice man to spend time with.

After completing his A levels at St Albans school David moved on to the National College of Agricultural Engineering in Silsoe, Bedfordshire. There in his third year David spent two months in Kenya on the college's overseas aid programme teaching the management of water resources. He loved Africa, it always remained a favourite place. In his free time there he went exploring - hitchhiking where he could. On one occasion he climbed a good way up Mt. Kenya. Seizing opportunities and exploring his surrounding where he could was to remain with him for the rest of his life. Whilst there he found time to visit the local railway station, met the local station master and made a beeline for the signal box, he was always interested in signalling. On the wall was a sign saying 'Remember Abermule' (referring to a dreadful signalling accident in 1921) little knowing that he would live so close to Abermule forty-five years later.

He was student president in his final year. Having gained his BSc(Hons) he won a scholarship to Iowa State University to study for a Masters degree in Agricultural Engineering. He was invited to stay on and work for a PhD in Civil and Geotechnical Engineering. To fund this he took on a teaching role at the university for nine months of the year allowing him to travel for the remaining three months. He went trekking in the Grand Canyon, white water rafting, exploring Alaska and visiting many of the national parks - preferably camping to really appreciate the sights.

After a few years in America, armed with his PhD, and by then an Associate Professor in the Civil Engineering Department, he returned home and found a position at the Scottish Institute of Agricultural Engineering. He enjoyed three years at Penicuik, often walking in the Pentland hills. Then in 1986 he moved south to the National College of Agricultural Engineering in Silsoe, Bedfordshire. He was a lecturer teaching and motivating students, in such subjects as land surveying, water management and soil mechanics.

In from the cold

At one point David had a Russian soil scientist studying soil compaction with him. David was approached by MI6 to keep an eye on him. The Russian spent many hours photocopying every book he could find about soil compaction. David had to give weekly reports back to MI6. There was great puzzlement as to why he was so interested in soil compaction because from a military point of view that would be inevitable when any tanks rolled over a border. When he returned from a short break in Russia, he came bearing gifts of Samovars for David and the Head of Department, assuming they were bugged it caused great amusement as to what it might relay to the Russian embassy.

On to Wrest Park

Within a few years he moved over the road in Silsoe to Wrest Park, the leading agricultural research centre of its time. There he made an impression with his fine engineering skills, his people skills and his general knowledge.

A former director recently sent this tribute:

'David was just the best member of staff anyone could wish for, he always had a big smile, was always coming up with a new idea or new angle on an old problem, and was amazingly versatile in tackling any situation he was faced with.'

Other interests

David took up horse riding in the early 1990s, but it had to fit in with all his other long-standing interests:

*model engineering
horology
industrial archaeology
ships
canals
sailing
steam locomotives
vintage tractors
walking.*

Only someone with his orderly mind could have done it. If he took something up, he wanted to do it the best he could. He was persuaded to enter a couple of his engineering models at the prestigious International London Engineering Exhibition at the Alexandra Palace. His models both won a Gold Medal. Modest as ever David would point out all the faults in his exhibit and why perhaps the Silver or Bronze models were more impressive.

David had three careers: a university lecturer, a research engineer and an internet marketeer. But he was an engineer through and through. He was a clever but modest man, exceptionally talented but always encouraging to those less so. He was massively skilful and knowledgeable but not remote or daunting to others. He was always kind and polite, seeing the best in people, almost to a fault. He was compassionate, generous and helpful.

He was happy to move to Wales in 2015, being of Welsh ancestry he soon settled in. He and Liz his wife had a delightful property inside and out. He really liked getting to know new friends nearby, who have made him feel very welcome. It gave him great pleasure in his final weeks and days knowing that Liz would always have good friends to turn to.

He always had a big smile on his face and put a big one on so many other people's faces. That is how he would like to be remembered.

Membership Change

1/05/21 to 31/07/21

Admissions

Fellow

Professor Nikolaos Katsoulas (Greece)

Member

Mr James Lesser (East Midlands)
Mr David Henshaw (West Midlands)
Mr Michael Egan (Ireland)

Associate Member

Associate

Affiliate

Dr Sandra Landahl (S E Midlands)

Technician

Mr Jeremy Delvarr (S.Eastern)
Mr Simon Mudd (East Midlands)

Student

CAFRE

Mr Ben Adams
Mr Dara Bradley
Mr Mark Cassidy
Mr Luan Crozier
Mr Dominic Duffin
Mr Shane Hanna
Mr Kyle Holmes
Mr Caleb Kane
Mr Aaron Linton
Mr Cathal McEntee
Mr Ben McNally
Mr Nathan Morris
Mr Allistair Truesdale

UNIVERSITY OF LINCOLN

Ms Stephanie (Tepher) Ward

UNIVERSITY OF CAMBRIDGE

Miss Bethan Moncur

UNIVERSITY OF BIRMINGHAM

Mr Jeff Balemoge

WILLIAM DE FERRERS

Mr Kieran Day

MYERSCOUGH COLLEGE

Mr Marley Rees-Boydell
Mr Matthew Brown

CRAVEN COLLEGE

Mr David Atkinson
Mr Oliver Lee

REASEHEATH COLLEGE

Mr Oliver Goodgrove
Mr Jamie O'Brien
Mr Quin Palombella-Ankers
Mr Archie Wedd

UNIVERSITY OF NOTTINGHAM

Mr Nelson Baganha
Miss Maria Malliaroundaki

HARPER ADAMS UNIVERSITY

Mr Alex Anderson
Mr Duncan Leach

CRANFIELD UNIVERSITY

Ms Sophia Bahddou
Mr Robert Colston
Mr Gaurav Shelar
Miss Chloe Turba

MUNSTER TECHNOLOGICAL UNIVERSITY

Mr Declan Forkan
Mr Darren McGillicuddy
Mr Stephen Moran
Mr Jack Murphy
Mr David O'Connor
Mr Paul O'Flaherty
Mr Edward Quigley
Miss Melany Rorke

Readmission

Mr Symon Bradney (S E Midlands)

Deaths

We have recently learned of the death of the following members and we send our condolences to their family and friends:

Dr David L O Smith CEng MIAgrE. Dr Smith joined the Institution in 1987 and gained Chartered Engineer registration in the same year.

Dr Geoffrey Davies FIAgrE. Dr Davies joined the Institution as member in 2010, and upgraded to Fellow in 2013.

Mr Anthony N Curry MIAgrE. Mr Curry had been a member of the Institution since 1967, joining as a student member, then becoming a full member in 1971. He had been a member for over 50 years.

Mr Michael J Hadley MIAgrE. Mr Hadley joined the Institution in 1959 as an Associate, and upgraded to Member in 1969. He had been a member for over 60 years.

Transfers

Fellow

Mr Charles Nicklin (Wrekin)
Mr James Middleton (Uganda)
Mr Robert Jones (East Midlands)

Member

Mr Kit Franklin (Wrekin)
Mr Chris Nendick (France)
Mr (Alex) David Shorten (S.Western)
Mr Linden Dixon (Yorkshire)

Associate Member

Affiliate

Engineering Council

Registrations

CEng

IEng

EngTech

Mr Andy Tabberer-Catt (W.Midlands)
Mr James Lesser (East Midlands)

Society for the Environment

CEnv

Academic Members

Berkshire College of Agriculture

Hall Place, Burchetts Green,
Maidenhead, Berks, SL6 6QR

Bishop Burton College

York Road, Bishop Burton, Beverley,
HU17 8QG

Brooksby Melton College

Asfordby Road, Melton Mowbray,
Leics, LE13 0HJ

Coleg Sir Gar

Gelli Aur Campus, Llandeilo,
Carmarthenshire, SA32 8NJ

Cranfield University

Cranfield, Bedfordshire, MK43 0AL

Duchy College

Stoke Climsland, Callington,
Cornwall, PL17 8PB

Easton & Otley College

Easton, Norwich, Norfolk, NR9 5DX

Greenmount College

CAFRE, 22 Greenmount Road,
Antrim, Northern Ireland, BT41 4PU

Harper Adams University

Newport, Shropshire, TF10 8NB

Hartpury College and University

Gloucester, GL19 3BE

Institute of Technology

Tralee Clash, Tralee, Co Kerry, Ireland

Lincoln Institute of Agri-Food

Technology, Lincoln University,
Lincoln, LN6 7TS

Manchester University

School of Electrical and Electronic
Engineering, C39, Sackville
Street Building, Sackville Street,
Manchester, M1 3WE

Myerscough College

Bilsbarrow, Preston, Lancashire, PR3
0RY

Newcastle University

King's Gate, Newcastle Upon Tyne,
NE1 7RU

Pallaskenry Agricultural College

Co Limerick, Ireland

Plumpton College

Ditchling Road, Lewes, East Sussex,
BN7 3AE

Reaseheath College

Reaseheath, Nantwich, Cheshire,
CW5 6DF

Royal Agricultural University

Cirencester, Gloucester, GL7 6JS

Sparsholt College

Sparsholt, Winchester, SO21 2NF

SRUC – Auchincruive

Auchincruive Estate, Ayr, KA6 5HW

University of Manitoba

Winnipeg, Canada, MB R3T 2N2

Warwickshire College Group

Warwick New Road, Leamington Spa,
CV32 5JE

Wiltshire College Lackham

Lacock, Chippenham, Wiltshire,
SN15 2NY

Commercial Members

Ace Aquatec Ltd

16B City Quay, Camperdown Street,
Dundee, DD1 3JA

Agri-EPI Centre

1-4 Bush House Cottages, Edinburgh,
Technopole, EH26 0BA

Agricultural Engineers Association (AEA)

Samuelson House, 62 Forder Way,
Hampton, Peterborough, PE7 8JB

AGCO Ltd

Stoneleigh, Abbey Park, Kenilworth,
Warwickshire, CV8 2TQ

Alvan Blanch Development Co

Chelworth, Malmesbury,
Wiltshire, SN16 9SG

Autoguide Equipment Ltd

Stockley Road, Hedington, Calne,
Wiltshire, SN11 0PS

BAGMA

225 Bristol Road, Birmingham,
B5 7UB

Briggs Irrigation

Boyle Road, Corby, Northants,
NN17 5XU

City and Guilds

1 Giltspur Street, London, EC1A 9DD

City Farm Systems Ltd

25 Hepplewhite Close, High
Wycombe, Bucks, HP13 6BZ

David Ritchie (Implements) Ltd

Carseview Road, Suttieside, Forfar,
Angus, DD8 3EE

Douglas Bomford Trust

The Bullock Building, University Way,
Cranfield, Bedford, MK34 0GH

DSL Systems

Adbolton Hall, Adbolton Lane, West
Bridgford, Nottingham, NG2 5AS

NFU Energy Services

Stoneleigh Park, Kenilworth,
Warwickshire, CV8 2LS

Fullwood

Grange Road, Ellesmere, Cheshire,
SY12 9DF

Househam Sprayers

Roughton Moor, Woodhall Spa, Lincs,
LN10 6YQ

HSS Hire

25 Willow Lane, Mitcham, London,
CR4 4TS

JCB

Rochester, Staffs, ST14 5JR

John Deere Ltd

Harby Road, Langar,
Nottinghamshire, NG13 9HT

Marks & Clerk LLP

90 Long Acre, London, WC2E 9RA

Mastenbroek Ltd

83 Swineshead Road, Boston, Lincs,
PE21 7JG

National Fluid Power Centre

Carlton Road, Worksop, Notts,
S81 7HP

Orby Engineering

Craigmore Road, Newry, BT35 6JR

Reesink Turfcare UK

1-3 Station Road, St Neots,
Huntingdon, PE19 1QH

PlantTech Research Institute

Bay of Plenty, New Zealand

Shelbourne Reynolds

Shepherds Grove Ind Estate, Stanton,
Bury St Edmunds, Suffolk, IP31 2AR

SSAB Swedish Steel Ltd

Narrowboat Way, Hurst Business
Park, Brierley Hill, West Midlands,
DY5 1UF

Teagle Ltd

Blackwater, Truro, Cornwall, TR4 8HQ

TeeJet London Ltd

Headley House, Headley Road,
Hindhead, Surrey, GU26 6UK

Witham Oil and Paint Ltd

Outer Circle Road, Lincoln, LN10 6YQ

Forthcoming Events

IAgrE engineering for food seminar - “food extrusion: engineering not witchcraft”

16 September 2021 Virtual seminar 10am-12noon.



The speakers, Dennis Forte and Gordon Young are food engineering consultants from Australia, and are highly experienced in extrusion processing. They have been presenting industry training courses in extrusion and related areas for more than 25 years, with annual courses in Norway, Switzerland, Chile, and Thailand.

Gordon Young will present an overview of extrusion in the food industry, showing the range of products produced by extrusion, and how the process is changed to produce such a wide variety of product characteristics. He will also discuss ingredients used and how they are transformed during the process.

Dennis Forte will present an overview of alternative Extruder Configurations, the role of Rheology and will also discuss some of the key considerations for Extrusion Process Scale-up.

Biographical Details:

Dennis Forte:

A chemical engineering graduate of the RMIT, Dennis Forte spent ten years with the MARS Corporation. During this time, he was involved in both process and product development roles within the areas of confectionery, canned pet food and dry pet food extrusion technologies. He then spent five years with The Uncle Toby's Company (a business involved in the manufacture of breakfast cereals, snacks and pasta), as the process engineering manager. His key areas of expertise include extrusion processing, mixing technology (for fluids and solids), process modelling, process optimization and drying technology. He has been practising as an Independent engineering consultant since 2000.

Gordon Young:

Gordon graduated in Agricultural Engineering in 1980, later undertaking a Master of Engineering Science (by research), and a Graduate Diploma in Business. He started his professional career in research related to mechanical harvesting of fruit. He moved into the area of food processing when

he became the first engineer at what was then the 'Queensland Food Research Laboratory' - a state government institution in Australia. After spending some time managing the Agricultural Engineering Section in the state government, he moved on to lecturing in food technology/engineering at the University of Queensland. It was during that time that he was introduced to extrusion technology. For the past 20 years he has worked as a private consultant in food engineering, specialising in areas of thermal processing (retorting/canning), drying, and extrusion.

West Midlands

Branch technical talk - experience of working at Massey Ferguson

22/09/2021 - 7.30pm

Stoneleigh Village Hall, Hall Close, Stoneleigh, Coventry CV8 3DG

Talk by Chris Clack who is a known authority on Massey Ferguson and has written a number of articles on the subject for various tractor and machinery magazines.

Please contact William Waddilove

westmids@iagre.biz

for more information

Current Vacancies

Graduate Specialist - Inspector Grade III - CAFRE/DAERA



An Inspector In Agricultural Engineering is sought. Predominantly based at one of the three CAFRE campuses with some posts based at DAERA locations across Northern Ireland, including Ballykelly House.

Closing date for applications is

12 noon Friday 24 September 2021.

<https://bit.ly/3tmcc88>

Industrial Product Specialist - Spaldings Ltd

The Industrial Product Specialist reports directly to the Managing Director, working alongside the existing product team. The responsibilities include the identification, development, introduction, sales/ marketing data collation and monitoring of products for the groundcare, central spares and industrial divisions.

For the full details and to apply please follow this link:

<https://bit.ly/3nksFID>

Graduate Engineer for an engineering intensive farm -

J F Temple & Son Ltd

We are a mixed farm in Norfolk of about 550 acres, with arable, a dairy herd, anaerobic digestion and cheesemaking. The business is tightly integrated, with the byproducts from one section supplying the inputs to others with the aim of minimising waste. Reduction of greenhouse gas and other emissions is a major objective of the business, through generation and utilisation of energy as well as regenerative agriculture.

Contact: Stephen Temple FIAgrE for more information

e: sjt@jftemple.co.uk

t: 07789 750553

Graduate Manufacturing Engineer - Knight Farm Machinery



The manufacturing engineer will be responsible for the integration of design engineering and production. The successful applicant will work in the small engineering team to deliver new designs from conception through manufacture and to continuously improve current products and processes.

For the full details and to apply please follow this link:

<https://bit.ly/3jZ5g7d>

River Idle Catchment Agricultural Advisor - Severn Trent



Severn Trent Water and the Nottinghamshire Wildlife Trust are working in the River Idle Catchment to tackle pollution in watercourses. An important part of this programme is to work with farmers to reduce diffuse agricultural pollution into watercourses and to tackle water quality in Severn Trent's drinking water boreholes in the area, as well as helping to develop and deliver innovative habitat projects that will benefit our wetland wildlife.

<https://bit.ly/3DPZ89j>

Production Supervisor/Manager - Knight Farm Machinery



Reporting directly to the Engineering Director the Production supervisor/ manager will be responsible for managing and scheduling the manufacture and assembly of all new machines produced by Knight Farm Machinery. As required this will also involve refurbishment of 2nd hand/ trade in machines. The successful applicant will work as part of a small management team to delivery quality machines on time and to budget.

For the full details and to apply please follow this link:

<https://bit.ly/3k1Xh9H>



Professional:
Douglas Bomford
Trust

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Talent, awards, and the future

The Douglas Bomford Trust's secretary Alan Plom reports on recent meetings and looks forward to future activities supporting the agricultural engineering sector:

Cranfield's '**Talent Forum and Industry Insights**' event in May brought together industry professionals, academics, alumni and students from Cranfield's Water, Environment and Agrifood, Energy and Design theme courses with representatives of the Trust.

Back to Cranfield (virtually) a month later to 'present' the Trust's Annual Prizes to their students who 'best demonstrated the application of engineering and technology for sustainable agriculture' on Environmental and Agriculture Theme courses. The former was awarded to **Luke Waterman** (thesis entitled 'A mixed methods

investigation into barriers for sharing geospatial and resilience flood data across key stakeholders in the UK') and the latter to **Grace Jepkosgei** (MSc in Future Food Sustainability, for her thesis on 'Modelling avocado water use and productivity in relation to climate and drought risks in South Africa').

Into the Dragons Den

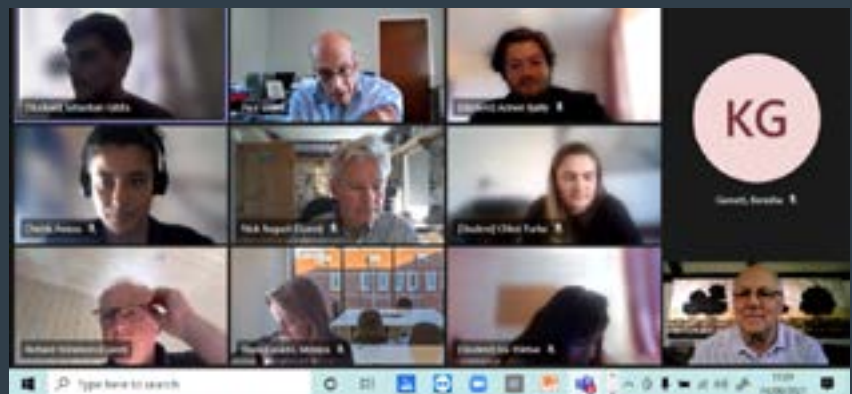
Also in June, the second group of (multi-national/multi-discipline) Cranfield MSc students presented their 'Strategic review of support for Agricultural and Environmental Engineering Research and Development' to Trustees.

Focused on food traceability, greenhouse gas emissions and energy efficiency, they produced alternative socio-economic scenarios in relation to innovation and development, based on a detailed literature search and a limited survey of 'experts' to identify likely drivers of change in UK agriculture over the next 5, 10 and 15 years as well as potential areas for collaboration between agricultural and environmental engineering.

The team aimed to help 'understand our world in constant transition and evolution toward sustainability and environmental-focused policies' and contribute to the fulfilment of the Trust's stated objective.



activities in the agricultural engineering
supported by the Douglas Bomford Trust



“to advance knowledge, understanding, practice, and competence in the application of engineering and technology to achieve sustainable agricultural, food and biological systems for the benefit of the environment and mankind.”

The Douglas Bomford Trust

Professional: Douglas Bomford Trust

Student successes

We are pleased to report that a number of PhD's are about to be completed or have recently been awarded to DBT-funded students, some at universities not traditionally associated with 'agricultural engineering'. Novel applications are challenging our broad mission statement, and many do not realise that they are 'ag engineers', but reflect the sector's diverse nature eg:

- desalination (Birmingham), soil erosion (Worcester), flood protection (Reading),
- machine vision to detect disease and plant stress (Imperial),
- computer vision to identify and manage cattle (Nottingham)
- 'Virtual sheep fencing' (Liverpool John Moore's).

Looking to the future

The Trustees will be discussing the latest project proposals face to face for the first time in two years, at our combined AGM and Board meeting in mid-November. Funds are limited so hard choices have to be made to meet the core objectives.

We have also continued to explore potential collaboration with Agri-EPI Centres, to provide evaluation and analytical support for research projects supported by the Trust.

Focus on Students - The Future of the Profession

To encourage students with an interest in agricultural engineering or technology to enhance their studies and personal development and to enable them to go on to successful careers in the industry, we provide:

IAgrE Student membership -

Funded by the Trust for decades, we are exploring how we can increase the number of students staying as members of IAgrE on completing their studies. We would welcome comments from students on what information and assistance they wish to receive.

e: enquiries@dbt.org.uk

or comment via

@BomfordTrust



Student Prizes –

The Trust has traditionally awarded prizes recognising excellent performance at Harper Adams University and the Royal Agricultural University, as well as Cranfield. Others may be considered.

(Please write to the Trust Secretary).

Studentships -

Student Members of IAgrE (ie registered on a relevant course of study in UK or Ireland) may apply for awards (typically up to £1,500) for purchase of materials, equipment, computer hardware/software, or

other (ideally costed) proposals. They are awarded to those who best demonstrate how their sponsorship will be used to enhance their studies and personal development.

The Trust's Secretary must receive applications by;

31st October 2021

All are assessed and those 'short-listed' will be interviewed by a panel, during November. - See:

<https://bit.ly/3h4nfaw>

Travel Scholarships –

For groups to attend technical events, study tours, etc within the UK and beyond, for personal and professional development. Full details including what will be achieved in terms of personal and professional development must be provided in ample time for it to be considered.

Apply any time, via email.

e: enquiries@dbt.org.uk

'Major' Awards (ie applications exceeding £5000) -

Typically for postgraduate research, around 10 major projects being co-sponsored with other charities, industry, etc each year.

Trustees consider applications in mid-April and mid-November, and must be received by the Secretary by

1st March and 1st October.

Additional details and justification is obviously required - follow the briefing notes and use the form at:

www.dbt.org.uk/over-1500

Trustee Mentors monitor progress and work with project teams to help achieve agreed outcomes. The Trust again expects recognition of our support, eg. in reports, presentations and conference papers.

THE DOUGLAS BOMFORD TRUST



The Trust provides a range of student awards to support relevant projects

'Minor' Awards (less than £5000) -

Includes individual travel, attendance at conferences, project work, etc. Although requests obviously tailed off during the pandemic, that hasn't stopped us supporting participants participate in online Conferences 'worldwide'. For example, two HAU Graduates (both former DBT Scholars) **Amy Boothby** and **Will Hook** presented their degree projects to the EurAgEng AgrEng2000 Conference:

'New Challenges for Agricultural Engineering towards a Digital World'

4-8 July 2021, see:

<https://ageng2020.com/>

Unfortunately this was held online instead of in Portugal, but was still an interesting and character-building experience.

Golden Anniversary 2022

The Trust celebrates its 50th Anniversary in 2022 and we are planning a special celebration event in September. Over the years, hundreds of students have been sponsored, supporting research at PhD and Masters level, travel to events and conferences, study tours, and other educational activities. We would like to compile examples illustrating how the Trust has helped individuals, so please send your 'testimonials' to the email below. This event will not just be retrospective – we will also be looking to the future.

For further information, contact the Trust

e: enquiries@dbt.org.uk

t: 07951 527051

@BomfordTrust

Landwards
Conference
2021

FUTURE FUELS IN AGRICULTURE



We are delighted to announce that the IAgrE will host an annual conference this year. The topic will be the alternatives to existing carbon-based fuels, with expert speakers looking at the options currently available and on the horizon.

Wednesday 3rd November 2021 - 10am - 2.30pm.

Mindful of the pandemic, the conference will run online again this year, but this time as a live session presentation via Zoom to ensure interaction.

Further details will be shared as plans progress.

• www.iagre.org • secretary@iagre.org • 01234 750876

