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In Advances Wales, we celebrate the dynamic, diverse, and determined spirit of Welsh innovation.

In issue 105, we continue to highlight projects that align with the Welsh Government's Innovation Strategy Missions – education, economy, health, and wellbeing – showcasing breakthroughs that are reshaping science, healthcare, technology, and learning.

Our lead article explores cutting-edge sports research, featuring an AI model developed to predict and prevent rugby injuries. Researchers in Swansea, collaborating with international partners, have uncovered a new anticancer T-cell type, offering promising new directions in cancer treatment. We also look at discoveries into marine animal behaviours, the development of a coral-inspired bone graft that dissolves naturally after healing, and an indoor air quality monitor powered by clean energy.

Healthcare innovation is a major theme in this issue, with digital technologies transforming patient care, advances in endoscopy equipment designed to ease hospital workloads, and progress in DNA testing that is making diagnostics faster and more accessible. Groundbreaking work is also underway to develop rapid testing methods for prostate cancer detection.

Environmental research also features prominently. New AI tools are being developed to predict natural climate patterns, while a river monitoring project is introducing innovative methods to protect and restore vital water systems.

Advances in technology are helping make home computing more efficient, and new immersive learning platforms are enriching children's access to the Welsh language.

Across all these fields, Wales continues to drive forward transformative innovation, advancing health, technology, the environment, and culture for a brighter, more sustainable future.

Gwyn Tudor
Editor

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Advances Wales is a quarterly technology journal produced by Welsh Government to showcase new developments in science, engineering and technology from Wales. Advances raises the profile of the technologies and expertise available from Wales in order to facilitate collaborative relationships between organisations and individuals interested in new technologies and innovation.

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Have you created a new technology or carried out research in Wales?
If so, we'd love to hear from you...
email: advances@teamworksdesign.com

Developer launches interactive platform to inspire young readers

BAFTA Award-winning developer Osian Evans, known for his work on BBC innovations including Walking with Beasts and Wimbledon Interactive, has launched a new venture aimed at transforming how children engage with reading.

His company, Goiawn, has introduced Y Fideo Diogelwch (The Security Video), the first in the Nüwa 2174 series — an interactive, comic-style, sci-fi adventure designed to capture the imagination of young Welsh speakers.

Set on Mars in 2174, the story follows twins Gruff and Gwen as they race to uncover a security video that could clear their parents' name, while facing off against a ruthless corporation — and hunting for long-lost biscuits hidden under Gruff's bed.

The programme is already in use across schools participating in the ARFOR scheme, which supports entrepreneurship, economic growth and the future of the Welsh language.

Photograph by HUW JOHN

"Goiawn is about sparking curiosity and creativity in young minds. We've created a shared classroom experience that encourages collaboration and communication through storytelling and multiplayer games, helping pupils apply their knowledge and skills. Our pilot is already showing strong results, and we're looking forward to expanding across Wales in 2025."

Craig Mayberry Thomas
Goiawn

www.goiawn.co

Students set course for Silverstone glory

Cardiff University Autonomous Racing, a team of dedicated students is aiming to make their mark at this prestigious venue.

In July 2025, university teams from around the world will converge on Silverstone, the legendary home of the British Grand Prix, to compete in the Formula Student Artificial Intelligence (FS AI) competition. The event, organised by the Institution of Mechanical Engineers (IMechE), challenges students from around the world to develop autonomous driving systems capable of navigating a high-speed race circuit without human intervention.

Formula Student AI is more than just a race, it's also a testbed for the future of autonomous vehicle technology. The competition includes both dynamic track events and static challenges, where teams must demonstrate their engineering expertise, software development skills, and understanding of real-world autonomous transport applications.

The Cardiff University team was revived this year by a group of students from the School of Computer Science and Informatics.

Morgan, a second year Applied Software Engineering (BSc) student and Team Principal said: "I'm a massive motorsport fan, so I jumped at the chance to join Cardiff Racing - the University's Formula Student combustion team. I started by researching the event and reaching out to graduates from the original team. They were incredibly helpful and excited about my plans to revive it. From there, I began building a core group of passionate students."

In just a few months, Cardiff University Autonomous Racing has gone from a handful of ambitious students to a fully-fledged team with industry sponsorship and local support. The team has grown significantly, now boasting over 30 members dedicated to preparing for this competition.

Marketing Team Lead Romilly Nash, reflected on their rapid progress: **"Over the past couple of months, we've built up a great core team and had a hugely successful recruitment drive, our success in securing sponsors is a testament to how hard the team is working."**

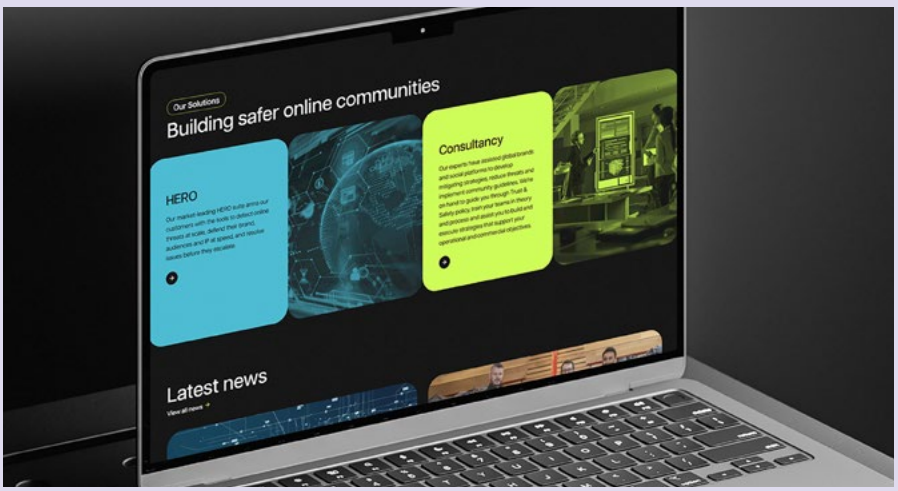
For the students at Cardiff University Autonomous Racing, this is an opportunity to not only showcase their skills on an international stage but also contribute to the advancement of autonomous vehicle technology, a field that is rapidly shaping the future of mobility.

www.cardiff.ac.uk

Welsh AI start-up sets new standard for online safety

Cardiff-based artificial intelligence start-up, Nisien.AI, is rapidly emerging as a leader in Wales's burgeoning tech sector. Founded in 2023 as a Cardiff University spin-out, the company uses advanced AI to tackle one of the digital age's most pressing challenges: ensuring online safety.

Specialising in real-time threat detection and risk mitigation, Nisien.AI has developed the Harms Evaluation & Response Observatory (HERO)—a platform employing innovative AI algorithms to identify and assess online harms across multiple platforms. Unlike traditional moderation tools, HERO interprets linguistic context and intent, enabling more accurate detection and significantly reducing false positives.



Building upon this technology, the company has launched HERO Detect, a tool that delivers live monitoring and classification of online threats. Providing organisations with real-time insights through dashboards and detailed reports this addition has already been adopted by several social media platforms and global brands.

Beyond harm detection, Nisien.AI is also developing a suite of AI tools aimed at fostering healthier digital communities. These tools promote constructive debate and reduce online conflict without resorting to censorship, enhancing user experience and engagement while respecting freedom of expression—an increasingly critical balance in today's polarised online landscape.

As the implementation of the Online Safety Act approaches, the company's solutions are timely and have the potential for creating safer online environments.

www.nisien.ai

IN BRIEF

Award-winning app for social workers

A social worker from Blaenau Gwent, in south Wales, has developed an award-winning app that could transform the way social services operate across Wales and beyond. Matthew Davies, at Merthyr Tydfil Children's Service, has designed the Social Work Way app, a purpose-built platform created to ease the challenges faced by social and support workers as they deliver essential services. The app offers a range of features, including referral forms, a feedback system, real-time updates on legislative changes, and professional development tools such as training modules and progress tracking, all designed to support workers, children, and local authorities.

Landmarkguide on exercise and insulin technology

Swansea University academic, Professor Richard Bracken, has contributed to a new guide for people with type 1 diabetes to help with the use of Automated Insulin Delivery (AID) systems during physical activity and supporting them to lead safer and more active lives. Launched by two leading UK diabetes associations, the resource offers practical, evidence-based recommendations on managing exercise and glucose levels with AID technology. It provides tailored advice alongside strategies to maintain blood glucose within target ranges during both planned and unplanned activity. The guidance also addresses common barriers to exercise, such as fear of hypoglycaemia and issues surrounding access to appropriate support and technology. Professor Bracken of Swansea University said: "While AID systems are increasingly prescribed for glucose management, there has, until now, been a lack of clear, practical advice on how to incorporate these devices into an active lifestyle. This guidance aims to close that gap."

Welsh water tech company secures project in Ecuador

A Wales-based water technology company has secured a contract to support an environmental project in Quito, the capital of Ecuador. The city faces significant challenges from polluted wastewater generated by its main landfill site. Hydro Industries, headquartered in Carmarthenshire, has been commissioned to treat 192,000 tonnes of leachate – a heavily contaminated liquid containing toxic metals such as lead, zinc, arsenic and cadmium. The treatment plant will be located almost 9,000 feet above sea level, making it one of the highest facilities of its kind in the world. The company's technology will play a key role in preventing this wastewater from entering the city's river systems, which flow through areas of Quito recognised as UNESCO World Heritage Sites. The plant will treat more than 800 tonnes of water per day, ensuring it meets strict environmental discharge standards.

Spinout develops new imaging technology

Fovo Technology, a spinout company from Cardiff Metropolitan University, is developing an innovative form of imaging technology that could transform the way images are viewed and created. Known as "Dynamic Projection," the system is based on research by artists and scientists into how human vision works and enables technology to produce images that more closely reflect the way people naturally see the world. The company has already secured 15 international patents to protect its novel process, with several more pending. Potential applications for the technology span a wide range of industries, including computer gaming, smartphone cameras, cinematography, medical imaging, security, defence, and communications. Dr Robert Pepperell, co-founder of Fovo Technology said: "It has taken many years to solve the problem of making wide-angle images appear natural in imaging media. We believe it won't be long before Dynamic Projection features in computer game titles and other consumer technologies."

UK's first commercial scale sushi-grade prawn farm

The UK relies entirely on prawn imports, with 78,000 tonnes brought in annually from overseas. 99.9% of these imports are frozen, compromising taste, texture and nutritional value and often mislabelled as 'fresh'. Swansea based Three-Sixty Aquaculture has pioneered the UK's only indoor fish farm producing fresh prawns, using the Recirculating Aquaculture System (RAS) farming method to providing an alternative to imported prawns. Having developed its proprietary, technology in its R&D facility, Three-Sixty Aquaculture are now increasing capacity in a new facility in Neath, south Wales, to scale up its prawn farming.

Study trials music and VR treatment for anxiety

A new collaborative study is exploring the use of music and virtual reality (VR) as a treatment for anxiety and other mental health conditions. The innovative trial is a partnership between Cardiff-based Rescape (featured in Advances Wales, issue 100), Universal Music Group, ethical AI company Bria and Cardiff University.

The treatment, called 'VR-Melody,' integrates personalised music, immersive scenic environments, and active listening exercises to address anxiety and promote mental well-being. The trial involves up to 50 participants, who will have access to the VR module for a period of 10-14 days. During this time, the participants will provide feedback which will be used to assess the effectiveness of the treatment.

The need for innovative treatments is evident, anxiety affects around 60% of the UK population. There has also been a concerning increase in the number of young people being prescribed antidepressants. For example, one in three teenagers report taking this medication, with the figure rising to 43% among 19-21-year-olds.

The idea that music can have therapeutic effects is well-documented, and this new project is building on existing research. The technology firm behind the VR component has already provided its VR solutions to over 60 hospitals across the UK, where it has supported patients in various settings, from paediatric wards to intensive care units.

Universal Music has been at the forefront of incorporating music into health and well-being. They have licensed their music to more than 40 companies, working in areas such as fitness, mental well-being, and relaxation. Their previous projects have seen music used as a complementary treatment for a range of serious medical conditions, including stroke recovery, dementia, and Parkinson's disease.

By combining the power of music with the immersive potential of virtual reality, VR-Melody aims to offer a single, scalable solution that could make a significant impact on mental health treatment.

www.rescape.health

Welsh innovation targets carbon reduction in farming

An agricultural contractor is pioneering the use of carbon capture technology in farming, offering a new way to reduce emissions while improving soil health and crop yields. Phil Hughes, founder of J&H Spreading and Agri Engineering, has combined engineering expertise with hands-on farming knowledge to expand the use of basalt dust, a natural material with the potential to lock atmospheric carbon safely into the soil. The technology is based on enhanced rock weathering, where basalt dust reacts with carbon dioxide in the air and stores it in the earth as stable minerals. Alongside its environmental potential, basalt also enriches soil quality, supporting healthier crops and higher yields. As the agricultural sector continues to search for ways to meet net zero targets, the adoption of this approach offers both economic and ecological value. Following successful trials, which delivered noticeable improvements in grass growth, Phil has refined the process into a scalable service.

Targeting hearing loss risks from antibiotics

A Swansea University researcher has secured funding from the Academy of Medical Sciences to investigate ways to prevent hearing loss caused by certain life-saving antibiotics. Some antibiotics, while essential for treating severe bacterial infections, can cause permanent hearing loss by damaging the delicate hair cells within the cochlea. These cells are vital for hearing and cannot regenerate once harmed. The work will focus on understanding how antibiotics enter and affect the hair cells, and how adjusting specific cellular processes might improve cell survival. The study will also explore whether known protective compounds influence these same processes, with the aim of identifying potential ways to safeguard hearing during antibiotic treatment.

Powering world's first online card-present transaction

Cardiff-based start-up Burbank has completed the first online card-present transaction. Card-Present over Internet (CPoI) brings the tap-and-PIN method from the high street into the world of e-commerce. CPoI allows consumers to tap their payment card against their mobile device and enter their PIN, offering the same level of security as an in-store payment. Online retailers face more than £32 billion in fraud losses each year. By requiring both a physical card and a PIN, CPoI ensures that only genuine cardholders can complete a transaction. In addition to tackling fraud, CPoI also addresses so called "false positives." Current fraud detection systems mistakenly decline billions of legitimate transactions, costing merchants an estimated £354 billion per year. Burbank's platform has been further strengthened through a strategic partnership with global payment technology provider Transactility, known as the creator of jPOS, a platform that underpins billions of secure transactions for banks worldwide.

Advancing emotional intelligence in FinTech

Cardiff-based company Cavefish AI has created EchoDepthAI, an emotional intelligence platform designed to help financial institutions better understand and respond to customer sentiment. The platform analyses 52 distinct emotional states from text, voice, and facial expressions in real time, offering new ways to strengthen customer engagement, refine risk assessment, and support regulatory compliance. EchoDepthAI enables financial businesses to make more informed decisions by providing deeper insight into client emotions. By identifying emotional signals, the platform enhances both customer experience and risk awareness. Designed for integration with digital banking systems, EchoDepthAI delivers a clearer understanding of the complex emotional factors that influence financial choices. The platform offers financial institutions a new level of awareness to manage relationships, meet regulatory standards, and improve service delivery.

Edible soap highlights hygiene poverty

Welsh luxury skincare brand The Goodwash Company has teamed up with charity The Hygiene Bank to create an unusual product with a serious message - an edible soap. Designed to highlight the difficult choices faced by millions living in hygiene poverty, the soap draws attention to the reality that many people are forced to choose between eating and washing. More than 4.2 million people in the UK are estimated to struggle with access to basic hygiene products, and The Hygiene Bank hopes the soap will help spark conversation, raise donations, and support calls to remove VAT from essential toiletries. The team explored a range of potential flavours from chicken tikka masala to apple crumble before settling on a taste that would be recognisable to many - beans on toast. Since its launch, it has not only raised funds for The Hygiene Bank but has also attracted attention from chefs and broadcasters alike, even making its way onto the menus of Michelin-starred restaurants in London.

AI predicts rugby injuries before they happen

Researchers led by Bangor University have developed an AI model that predicts the risk of non-contact lower limb injuries in rugby players.

Rugby union is a high-intensity sport where injuries, particularly non-contact lower limb injuries, are a common concern. These injuries, which account for nearly 50% of player absences, often disrupt both player performance and team dynamics. Recent research led by Bangor University has taken a significant step toward addressing this issue by developing an AI model that predicts the risk of non-contact lower limb injuries in rugby players. This innovation may not only improve injury prevention in rugby but also have broader applications for other sports.

The AI model is the result of data collected over two seasons from 36 semi-professional rugby players. The research team focused on a range of variables, including training load, performance testing, musculoskeletal screenings, subjective measures like fatigue, and prior injuries. The outcome is a system that uses complex pattern recognition to predict injury risks based on combinations of these factors.

Unlike traditional injury risk assessments, which often rely on linear relationships, the AI model accounts for the nuanced interplay between various elements. Traditional models tend to assume that a single factor, like muscle weakness, directly correlates to a specific injury. However, the new model adjusts risk predictions based on other variables, such as a player's age, body mass, and recent training load.

This AI model offers a more refined way of anticipating injuries, with the potential for up to 75% accuracy in predicting non-contact lower limb injuries. One particularly surprising finding was that forwards were at a higher risk of severe injuries compared to backs, especially if they had slower sprint times and weaker lower limb muscles. Other factors, such as a player's history of concussion, were also found to increase injury risk. However, the researchers caution that these results may not apply universally across all players and styles of play.

What sets this approach apart is the AI's ability to analyse a multitude of factors simultaneously, predicting injury risks with greater precision. By monitoring a combination of indicators, such as hamstring and groin strength, joint flexibility, muscle soreness, and changes in training intensity, the model can provide early warnings of potential injuries. In one example, the AI predicted severe non-contact leg injuries with an 82% accuracy rate. While the model wasn't as effective in predicting some injuries, like hamstring strains, it still provides valuable insights for coaches, helping them tailor training regimens to reduce risk.

As this research demonstrates, AI's potential in injury prevention is just beginning to be realised. While the technology is still in its early stages, its application in rugby could soon revolutionise how coaches and medical staff monitor and protect athletes. By incorporating personalised training plans and injury prevention strategies, this AI-driven approach could help athletes stay healthier and perform at their peak.

> **"The outputs from this model are based on those 36 players, so you would need a much larger dataset for the findings to be more widely applicable. This means that the model is very specific in assessing the risk for a particular group of players and the specific type of training and play they are involved in."**
>
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BANGOR

DNA testing innovation set to transform pathogen detection

A biotechnology start-up is bringing a new approach to DNA testing, aiming to make advanced pathogen detection as accessible as using a smartphone.

With a focus on ease of use and efficiency, Amped PCR has developed a system designed to enable industries such as food production, environmental monitoring, and veterinary diagnostics to carry out on-site testing without the need for specialist laboratories.

At the core of this innovation is PurifAI, a modular diagnostic system that leverages Polymerase Chain Reaction (PCR) technology to rapidly detect harmful pathogens. PCR is a technique that amplifies small DNA samples into millions or even billions of copies, making it easier to identify microbial threats with precision. Traditional pathogen testing methods often depend on laboratory-based culture techniques, which can take days to yield results. In contrast, PCR provides highly accurate detection within hours, allowing users to identify and address potential risks swiftly, minimising delays and reducing the impact of contamination.

By refining and automating the PCR process, PurifAI allows DNA testing to move out of a specialist laboratory setting and into the real world where rapid results are essential. This advancement is particularly relevant in industries where delays in identifying pathogens such as salmonella, listeria, and campylobacter can lead to costly product recalls, regulatory action, and public health risks.

By integrating AI and machine learning, the company has also enhanced data analysis, offering insights into pathogen risks and trends. This feature supports a predictive approach to food safety and environmental monitoring, helping users to anticipate potential issues before they escalate.

A key goal for the development team has been to ensure that PurifAI is intuitive for users without specialist scientific training. The vision is for DNA testing to be as straightforward as using a smartphone—powerful technology working seamlessly in the background while delivering easy-to-interpret results.

With regulatory compliance being a crucial step, the company is working towards securing ISO 13485 certification, CE marking, and FDA clearance for the new technology. Achieving these standards will validate the reliability and safety of the system, paving the way for broader adoption across different sectors.

One of the major benefits of this technology is its ability to streamline testing processes, reducing dependency on external laboratories. This not only speeds up decision-making but also lowers operational costs by allowing companies to conduct in-house testing with minimal training.

This focus on user experience extends beyond the hardware itself. The AI-driven data analytics platform enables real-time monitoring of food safety risks, while predictive modelling helps organisations mitigate potential contamination threats before they occur.

PurifAI has also been designed with scalability in mind, making it suitable for operations ranging from small farms to large-scale food production facilities. Its modular nature allows businesses to deploy the system in different locations, ensuring rapid and effective pathogen surveillance wherever needed.

By working with industry partners, the company now seeks to drive greater adoption of advanced DNA testing across multiple sectors, improving global public health standards and strengthening food safety measures. The ability to detect and respond to microbial threats in real time represents a significant step forward in safeguarding supply chains and reducing the risks associated with contamination.

By removing the barriers traditionally associated with DNA testing, this technology could play a crucial role in enhancing food safety, improving veterinary diagnostics, and supporting global bio surveillance efforts.

Contact

Amped PCR

www.ampedpcr.co.uk

ABERYSTWYTH

Developing a rapid diagnostic test for prostate cancer

A Welsh diagnostics company, Valley Diagnostics, is developing an innovative test that could significantly improve the speed and accuracy of prostate cancer detection.

A new lateral flow test, currently in development, aims to provide results within minutes using a simple urine sample, potentially allowing men to test for prostate cancer at home or in a GP surgery. If successfully rolled out, the test could form the basis of a nationwide screening programme, potentially saving thousands of lives and reducing the financial burden on the NHS.

Prostate cancer is the most common cancer in men in the UK, with more than 52,000 new cases diagnosed each year. Alarmingly, around one in four of these diagnoses occurs at a later stage, when treatment options are more invasive, costly, and less effective. The annual cost of treating advanced prostate cancer is estimated at £650 million for the NHS.

The development of this test builds on findings from a research collaboration between Aberystwyth University and Betsi Cadwaladr University Health Board. The study has analysed thousands of urine samples from men with prostate cancer across 12 hospitals in England and Wales. Researchers have identified specific biomarkers (substances that can be measured to indicate the presence of a disease or infection) in urine, which provide significantly higher diagnostic accuracy compared to the prostate-specific antigen (PSA) blood test currently used by the NHS.

The company behind the test is working closely with scientists at Aberystwyth University to commercialise the biomarker research. By using lateral flow technology, similar to that used in COVID-19 rapid tests, the goal is to create a portable, easy-to-use diagnostic tool that can be widely deployed.

More traditional PSA testing, while widely used, has known limitations in accuracy, which can lead to false positives and unnecessary medical procedures. The new urine-based test could help eliminate these issues, providing a more reliable and accessible alternative for early detection. A more efficient and accessible screening method could reduce late-stage diagnoses, allowing doctors to treat the disease earlier and more effectively. The proposed lateral flow test is designed to be user-friendly and cost-effective, providing immediate results that could improve patient triage and reduce unnecessary referrals to specialists.

In addition, the company is exploring the introduction of artificial intelligence (AI) and data analytics to further enhance the test's accuracy by identifying patterns in biomarker levels, making it easier to detect early signs of prostate cancer. If successful, this technology could set a new standard for cancer diagnostics, paving the way for faster, more accurate screening methods.

A reliable, non-invasive screening method could revolutionise prostate cancer detection, ensuring more men receive a timely diagnosis and access to life-saving treatment. By bringing diagnostics closer to patients, this innovation could not only improve outcomes but also ease pressure on NHS resources. If clinical trials are successful, this Welsh-led development could reshape the future of prostate cancer screening, offering a faster, more accessible solution for early detection and treatment.

Professor Luis Mur, lead researcher of the OSCAR study at Aberystwyth University explained that although awareness of prostate cancer risks has increased, current testing methods are not suitable for widespread screening. He believes that the new biomarkers discovered in urine will enable the development of a test that can be used in non-specialist settings, reducing the need for laboratory testing and improving early detection rates. "We expect this will lead to a paradigm shift in prostate cancer detection, potentially saving lives and preventing unnecessary treatments," he said. "The improved accuracy of this test could also result in significant cost savings for the NHS."

Dr Darren Leaning, Consultant Clinical Oncologist at the James Cook Cancer Institute, has also stressed the urgent need for better screening tools. He regularly meets patients who only receive a diagnosis once the disease has progressed to an incurable stage.

> **"It doesn't have to be this way, Prostate cancer is highly treatable when caught early, often before symptoms appear. The current PSA test is not reliable enough for screening, so we need a more accurate and convenient method. A urine-based test that can be done at home or in a GP surgery would completely transform how we screen for prostate cancer. This test has the potential to save thousands of lives each year, not just in the UK but globally."**
>
> **Dr Darren Leaning**
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Pioneering digital health solutions in Wales

In the rapidly evolving field of healthcare technology, Virtual Ward Technologies, a Welsh company, has been making strides in improving patient care.

Over the past year, the company has formed successful partnerships with two Welsh health boards, to address major healthcare challenges such as childhood obesity and post-surgery cancer care.

The AFAL Connection-Cysylltiad project, a collaboration with Cardiff and Vale University Health Board, has transformed how childhood obesity is managed. It combines a 'virtual ward' platform with wearable fitness devices, allowing real-time health tracking and goal setting for children and their families. This system has boosted patient follow-ups by over 500%, leading to quicker and more targeted support. Kids involved in the program increased their daily steps by an average of 6,000, improved their sleep, and saw positive changes in their overall health, including weight loss. The project also saw a huge drop in missed appointments, with the "Did Not Attend" rate falling from 30% to zero. This not only reduced disruptions to education but also decreased the need for in-person clinic visits. As a result, the time spent in the program dropped from 12 months to just 3 months. The next phase of the project will aim to offer a fully contactless service for the 3,000 children on the waiting list each year, with the goal of achieving even better results with a more streamlined approach.

The companies work with Swansea Bay University Health Board has focused on enhancing care for patients undergoing major cancer surgery. The V-Cancer Care project leverages similar wearable technology to monitor patients throughout their treatment journey. The results have been striking, particularly in terms of physical activity levels, with pre-surgery patients experiencing a fourfold increase in activity—a crucial factor in improving recovery. The system has also improved communication between patients and healthcare professionals, allowing for remote monitoring that eliminates the need for in-person visits and the associated travel. One of the most significant successes of this project has been the early detection of complications. By continuously tracking patient data, the system has facilitated the early identification of potential post-operative infections and mental health crises, enabling swift interventions that may have saved lives and reduced hospital readmission rates.

The success of these pilot projects has demonstrated the transformative potential of digital health solutions in improving patient outcomes and reducing healthcare costs. VWT is now seeking to secure additional NHS funding to expand these initiatives across Wales. The company is confident that its digital health solutions can lead the way in modernising healthcare delivery, helping NHS Wales create a more sustainable system capable of meeting future healthcare challenges.

Embracing digital health solutions has the potential to deliver far-reaching benefits both delivering improved healthcare for patients and cost efficiency for the NHS. As these innovations continue to evolve, they offer a glimpse of a more connected, efficient, and patient-centric healthcare system for the future.

The economic impact of these two projects is considerable. The childhood obesity initiative is estimated to save £124 million over a lifetime for every 1,000 children treated. Meanwhile, for cancer care, the reduction in hospital stays and in-person follow-ups translates into cost savings of £4.3 million per 1,000 patients for the NHS. In addition to these savings, both projects alleviate pressure on NHS resources by enabling earlier discharge of patients and by reducing the need for physical appointments, which in turn allows for more efficient use of NHS staff and facilities.

Contact

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LLANDEILO

Coral-inspired material to revolutionise bone repair

A team of researchers led by Swansea University have developed a pioneering bone graft substitute inspired by coral, which accelerates healing and then dissolves naturally after the repair process is complete.

Bone defects, resulting from fractures, tumours, or non-healing injuries, are among the most challenging conditions to treat. Currently, clinicians rely on autografts, where bone is harvested from a patient's own body, or allografts, using donor bone. However, these approaches come with drawbacks. Autografts require additional surgery, increasing recovery time and the risk of complications, while allografts may lead to rejection, infection, or ethical concerns over sourcing.

To address these limitations, the team has developed a synthetic material using advanced 3D-printing technology. The new 'biomimetic graft' mimics the structure and composition of coral, which has a porous architecture similar to natural bone. This design allows the material to integrate seamlessly with human bone, facilitating faster healing and eventual biodegradation once its function is complete. Unlike traditional grafting materials, this innovation does not require multiple procedures or long-term monitoring, making it a practical solution for patients and healthcare providers alike.

One of the standout features of this new material is its ability to promote rapid bone regeneration. Preclinical in vivo studies have demonstrated that new bone starts forming within just 2–4 weeks, with full integration occurring in 3–6 months. The material not only encourages bone cell growth but also stimulates the production of a strong, healthy cortical bone layer, which is essential for long-term structural integrity.

Another critical advantage is the material's biodegradability. Unlike many synthetic grafts, which either degrade too slowly or leave behind harmful residues, this new material completely dissolves within 6–12 months, leaving behind only natural bone. This process eliminates the need for follow-up surgeries to remove the graft, reducing both patient discomfort and healthcare costs.

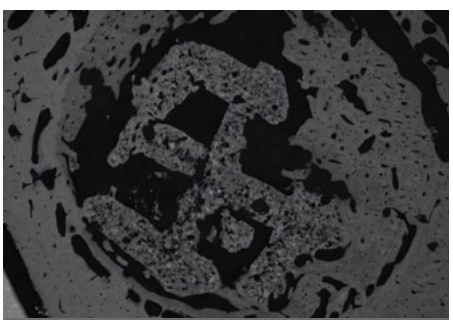
While natural coral has been used in bone repair before, its availability has been limited, and harvesting it raises environmental concerns. By creating a synthetic version

using 3D printing, the material can be produced in large quantities, cost-effectively, and without depleting marine ecosystems. This approach makes the technology more accessible, particularly in regions where traditional bone grafting options are scarce or expensive.

Many synthetic bone graft substitutes currently available struggle to match the performance of natural bone. Some take years to break down, potentially causing chronic inflammation, while others fail to integrate properly, leading to weak or incomplete healing. The new material addresses these shortcomings by closely replicating both the mechanical properties and biological behaviour of human bone.

Beyond individual patient benefits, this innovation delivers benefits for the wider healthcare sector. With an ageing population and an increasing number of bone-related conditions, the demand for effective grafting solutions is increasing. This new material could reduce the strain on healthcare systems by minimising surgical interventions and post-operative complications.

In the long term, this research could pave the way for further advancements in regenerative medicine. The principles behind this material—biocompatibility, biodegradability, and structural mimicry—could be applied to other areas, such as cartilage or organ regeneration. If successfully commercialised, it may revolutionise not just orthopaedic surgery but broader fields of medical science. The Swansea University team is now actively seeking partnerships with medical companies and healthcare organisations to bring the technology to market.



An image of a 3D-printed material implanted in vivo for 4 weeks. The photo was taken using a scanning electron microscope. Credit: Dr Zhidao Xia.

Dr Xia, Swansea University, emphasised the transformative potential of this research: "Our invention bridges the gap between synthetic substitutes and donor bone. We've shown that it's possible to create a material that is safe, effective, and scalable to meet global demand. This could end reliance on donor bone and address the ethical and supply challenges in bone grafting."

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SWANSEA

New anticancer T-Cell type discovered

A newly discovered subtype of T-cells could pave the way for groundbreaking cancer treatments, offering hope that our own immune system might be trained to fight cancer more effectively.

T-cells are a type of white blood cell that plays a crucial role in the immune system. They help defend the body by identifying and destroying infected or abnormal cells. While some T-cells are trained to attack viruses or bacteria, others specialise in recognising and eliminating cancerous cells.

Researchers from Cardiff University have found that all individuals have the capacity to produce a particular type of anticancer T-cell that can detect and attack cancer cells through a molecule called MR1 (MHC Class I-related Molecule 1).

Unlike other immune responses that depend on recognising specific surface markers unique to each type of cancer, this new T-cell appears to detect metabolic changes that occur when a cell becomes cancerous. This suggests the potential for a universal cancer-targeting mechanism—one that could work across different types of cancer.

MR1 is a protein involved in the immune system's ability to identify harmful cells. In infections, MR1 helps flag infected cells by displaying metabolites (small molecules produced by microbes) on the cell surface, signalling T-cells to destroy them.

In this new study, scientists investigated whether T-cells could also recognise cancer cells via MR1—without harming normal, healthy cells. To do this, they analysed blood samples from ten healthy donors and a patient with acute myeloid leukaemia. Remarkably, they found that in all samples, T-cells could be stimulated to kill cancer cells via MR1.

Further analysis revealed that these anticancer T-cells share a distinct molecular signature, suggesting they all recognise the same MR1-presented marker on cancerous cells. Importantly, this marker is either absent or significantly reduced in normal, healthy cells, meaning the immune response remains targeted at cancer alone.

Dr Garry Dolton, Research Fellow at Cardiff University, commented: "We do not yet understand why these T-cells become activated in only a small number of cancer patients or whether their presence is linked to improved outcomes. The fact that everybody has these T-cells—and that they likely recognise the same molecular marker on cancer cells—offers interesting avenues to explore. Could we use a vaccine to stimulate them to attack cancer?"

This discovery opens up exciting possibilities for cancer immunotherapy—treatments that harness the power of the immune system to fight cancer. If scientists can determine how to activate and direct these T-cells in more patients, it could lead to new types of treatments, including vaccines or cell therapies that train the immune system to attack cancer more effectively.

While much work remains to be done, this breakthrough offers a glimpse into a future where the immune system itself could become one of the most powerful weapons in the fight against cancer.

> **"Our experiments suggest that these newly identified T-cells recognise metabolic changes in cancer cells in a way similar to how T-cells detect bacterial infections via MR1. However, we still do not fully understand the nature of the metabolic compound involved. Further research will be crucial to confirm these findings and identify the molecule that allows MR1 to present cancer cells to these T-cells for destruction."**
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CARDIFF

Single-use technology meets the endoscopy challenge

Welsh company IQ Endoscopes has introduced a forward-thinking approach to overcoming challenges in internal diagnostics with its range of single-use endoscopes.

An endoscope is a flexible tube with a light and a camera at the end, allowing doctors to visually inspect areas such as the digestive tract, lungs, or joints. It can be used for diagnostic purposes, such as identifying diseases or abnormalities, and for therapeutic procedures, such as removing tissue or taking biopsies. Endoscopy plays a critical role in modern healthcare, enabling clinicians to diagnose a variety of conditions internally. However, traditional endoscopic procedures can often be hampered by logistical challenges such as cleaning, maintenance, and the risk of cross-infection.

The introduction of these products is part of a broader initiative aimed at tackling the strain on diagnostic endoscopy services. The company is working on a collaborative project launched by Cardiff and Vale University Health Board, The Endoscopy Challenge, addressing the sharp rise in patient demand for diagnostic endoscopies. Over the past few years, waiting lists for these vital procedures have grown significantly, putting increasing pressure on healthcare providers.

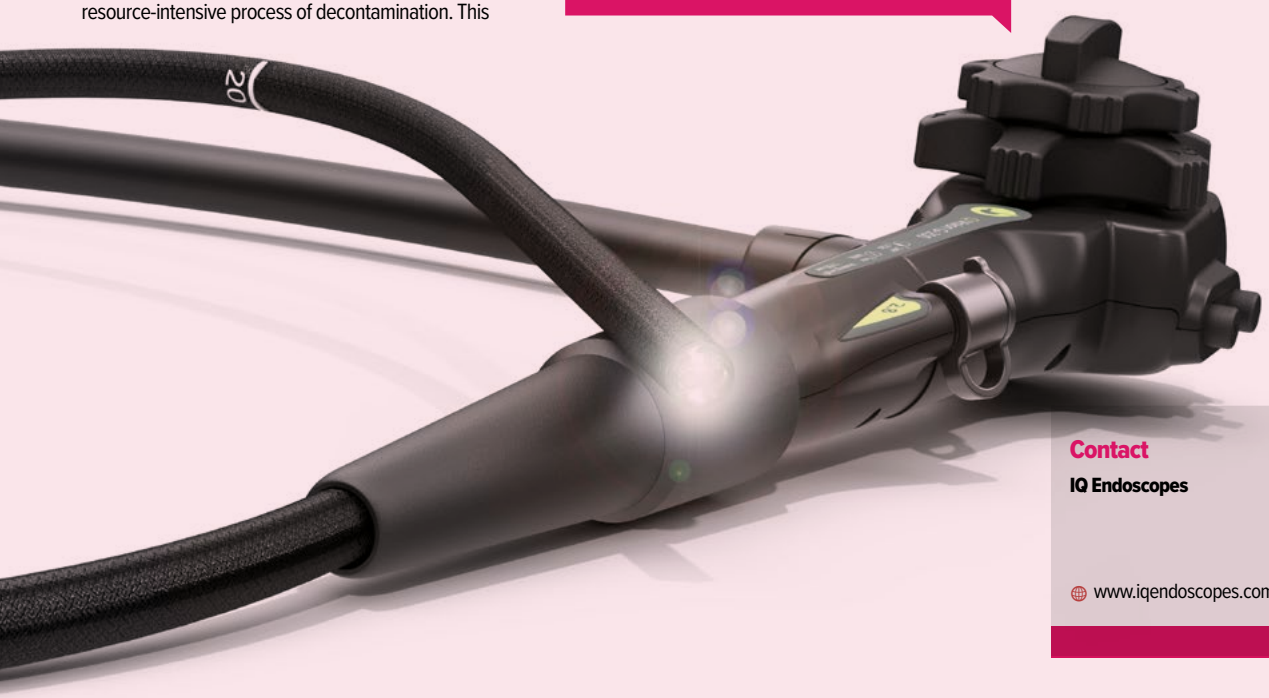
IQ Endoscopes has developed a range of single-use devices designed to enhance patient safety by reducing the risk of cross-contamination. Single-use devices eliminate the need for the time-consuming and resource-intensive process of decontamination. This speeds up the diagnostic process and so alleviates pressure on healthcare systems by increasing capacity, allowing more procedures to be carried out in a shorter time. Additionally, single use devices offer a cost-effective alternative to traditional flexible endoscopes by removing the costs associated with cleaning and maintaining reusable scopes.

Another advantage of the single-use model is the reduction in operational risk. By eliminating concerns about the reliability of traditional scopes, which can be prone to malfunction, leading to cancelled procedures, clinicians can focus more on patient care and less on equipment maintenance.

The new products can be used in both hospital and non-hospital settings, creating new opportunities for endoscopic procedures to be carried out outside of specialised endoscopy suites, including intensive care units, outpatient departments, wards, and even in community health settings. This flexibility extends the reach of endoscopy services, addressing the growing demand for diagnostic procedures in a wide variety of healthcare environments.

Alongside improving healthcare efficiency, the company is committed to reducing the environmental impact of its products. Single-use devices can have a lower environmental impact on endoscopy procedures, primarily by reducing water consumption and eliminating the need for hazardous cleaning chemicals. The single-use option avoids the disposal of washing brushes and other disposable cleaning tools, while also mitigating the risk of chemical contamination in wastewater. By removing the need for complex reprocessing procedures, a single-use approach helps healthcare providers reduce the need for waste incineration and the pollution associated with chemical disposal.

Early evaluations of the system's use have shown promising results, with single-use gastroscopes (SUGs) contributing to faster diagnostic pathways. Unlike reusable gastroscopes (RUGs), which require lengthy cleaning and sterilisation processes, SUGs are designed to be used once and then discarded, offering a quicker turnaround. The single-use devices have been found to be particularly suited to handling non-routine and urgent procedures.



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IQ Endoscopes

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CHEPSTOW

Water quality monitoring with groundbreaking technology

The Teifi Nutrient Monitoring project, led by Ceredigion County Council in partnership with the Nutrient Management Board, is setting new benchmarks for water quality monitoring across Wales.

This innovative initiative combines cutting-edge technology with community engagement to address pressing water quality challenges and safeguard the Teifi River system for generations to come.

At the heart of the project is the deployment of High-Frequency Monitoring (HFM) sensors and Multisondes, advanced water quality probes that integrate several sensors into one device, at key points along the Teifi and its tributaries. These sophisticated tools act as high-tech "eyes and ears," capturing data up to four times a day to monitor pollution levels and pinpoint their sources. In tandem with this technology, Citizen Scientists contribute valuable data through handheld monitoring methods, offering crucial insights and bolstering the overall impact of the project.

By combining the power of technology with local volunteer efforts, the project aims to fill vital evidence gaps, enhance understanding of pollution patterns, and inform the development of effective mitigation strategies. The data collected will provide a foundation for long-term improvements in water quality, benefiting both the ecosystem and the communities that depend on the river system.

Phase One of the project concentrates on the main Teifi River, while Phase Two expands monitoring to over 20 tributaries. This expansion addresses previously under-monitored areas, providing a more comprehensive view of pollution across the entire catchment. The high-frequency sensors have already collected hundreds of data readings, delivering invaluable insights into pollution sources and trends. The information gathered is key to identifying the causes of pollution and determining the most effective solutions.

The findings from the monitoring efforts will feed into the Nutrient Management Plan for the Teifi, river which is designated as Special Areas of Conservation (SAC). The plan outlines practical steps for reducing pollution and improving water quality. By identifying excess nutrients and understanding their patterns, the project is setting the stage for evidence-based strategies that can have a lasting positive impact on water quality.

Beyond its immediate benefits, the project's methodologies are serving as a model for the Tywi and Cleddau rivers in west Wales as the technology and pollution reduction efforts are expanded to these rivers as well. This wider applicability highlights the significance of the project as a key initiative in protecting and restoring river systems across the region.

What distinguishes the Teifi Nutrient Monitoring project is the integration of technology and community participation. Collaboration between Citizen Scientists, local authorities, environmental agencies, and organisations like Natural Resources Wales fosters a coordinated, community-driven approach to environmental management. This holistic method encourages local ownership and responsibility, providing a strong foundation for sustainable environmental practices.

The Nutrient Management Boards in west Wales play an important role in addressing nutrient-related challenges across the Teifi, Tywi, and Cleddau river catchments. The boards have brought together local authorities, environmental agencies, and community groups, to restore Special Areas of Conservation (SACs) and support sustainable development for future generations in the region.

Looking ahead, the success of the project is expected to serve as a blueprint for other regions grappling with similar environmental challenges. The methodologies and technologies developed will ensure that water quality monitoring across Wales becomes more efficient, precise, and community-driven, ultimately supporting the long-term health of the country's river systems.

"By monitoring water quality and addressing pollution in the Teifi River, this initiative will benefit the community, businesses, and residents by helping to create healthier rivers and ecosystems. Preventing future environmental damage promotes a sustainable environment for all."

Gail Pearce-Taylor
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ABERYSTWYTH

Marine animals save energy by swimming in a depth 'sweet spot'

Like many air-breathing marine megafauna, green turtles optimise their swim depth during migration to minimise the "cost of transport", in order to avoid creating waves whilst maximising horizontal distance travelled.

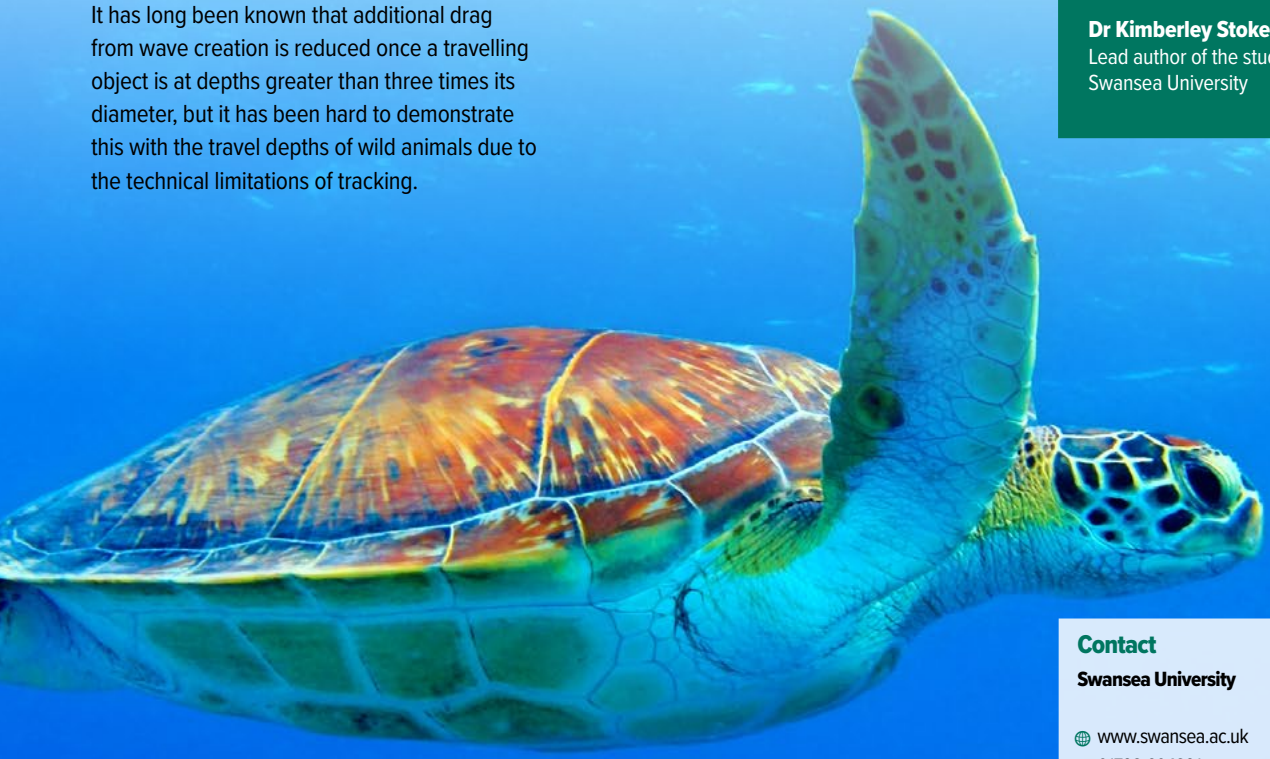
A team from Swansea University have led research across six institutes in five countries comparing the swim depths of several sea turtle, penguin and whale species. All of which travel at around three body depths from the surface in order to swim in the 'sweet spot' that minimises wave formation at the surface and vertical distance travelled.

Some semi-aquatic animals, such as mink, swim at the surface where the creation of waves can be less energy efficient. However marine birds, mammals and reptiles who travel long distances over their lifetimes, adapt, by swimming below the surface, to minimise the energy cost of transport, particularly on long journeys.

It has long been known that additional drag from wave creation is reduced once a travelling object is at depths greater than three times its diameter, but it has been hard to demonstrate this with the travel depths of wild animals due to the technical limitations of tracking.

In this new study near surface swim depths were recorded to within 1.5 centimetres in little penguin and loggerhead turtles, along with motion data and video footage from animal borne cameras. This was compared with satellite tracking data for long-distance migrations in green turtles and data from other studies on penguins and whales. It was found that these animal swim at optimal predicted depths when either 'commuting' to a foraging patch in the wild or migrating over longer distances while not feeding. This adaptation helps to reduce the cost of transport in travelling animals and has implications for conservation management through efforts to reduce boat strike fatalities and fishery bycatch.

> **"There are of course examples where animal swim depth is driven by other factors, such as searching for prey, but it was exciting to find that all published examples of non-foraging air-breathing marine animals followed the predicted pattern. This has rarely been recorded because of the difficulty in retrieving depth data from animals that migrate over large distances, so it was great to find enough examples to show a common relationship between swim depth and body size from animals across the size spectrum from 30 cm to about 20 m in length."**
>
> **Dr Kimberley Stokes**
> Lead author of the study
> Swansea University



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Predicting Earth's natural climate changes

Scientists may now be able to predict the onset of the next ice age, thanks to a new interpretation of the subtle changes in Earth's orbit around the Sun. These small shifts, which occur over thousands of years, are responsible for triggering major climate changes, such as the transition between ice ages and warmer interglacial periods.

The breakthrough was made by an international team of researchers, led by Cardiff University. Their work builds on a century-old theory that suggests Earth's orbit influences the fluctuations between glacial (ice age) and interglacial (warmer) periods.

For decades, scientists have struggled to identify which specific elements of Earth's orbit are most important in marking the start and end of ice ages. The difficulty in dating climate changes that occurred so far in the past added to the challenge. However, the team, which includes experts from University College London, the University of California, Santa Barbara, and the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, has overcome this problem by studying the shape of the climate record through time. This approach has allowed them to identify how different aspects of Earth's orbit work together to produce the climate changes we observe today.

By examining these patterns, the researchers were able to make accurate predictions about past climate cycles. They could identify when each interglacial period occurred over the last million years and how long each lasted. Now, they are able to offer predictions about future climate cycles based on Earth's natural orbital parameters.

Currently, we are in an interglacial period known as the Holocene, and the research allows the team to predict when Earth's climate might return to a glacial state. However, they note that this transition is highly unlikely to occur within the next 10,000 years, primarily due to human-caused climate change. The increase in carbon dioxide levels in the atmosphere has already shifted the planet's natural climate course, and these changes are expected to have long-term effects far into the future.

Looking ahead, the team plans to build on their findings by creating a clearer picture of Earth's natural climate over the next 10,000 to 20,000 years. They aim to calibrate past climate changes and use climate model simulations to understand how human-induced climate change may affect the planet's future.

This research is an important step in understanding Earth's natural climate cycles, offering valuable insight into how human activities are impacting the planet's future.

> **"The pattern we found is so reproducible that we were able to make an accurate prediction of when each interglacial period of the past million years or so would occur and how long each would last. Now that we know climate is largely predictable over these long timescales, we can use past changes to give us an idea of what could have happened in a future without human influence."**
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CARDIFF

Innovative air quality monitor will protect public from CO_2 dangers

Technology company Reef-IOT, a spin-out from Swansea University, has developed a new air quality monitor that could play a key role in safeguarding public health while also promoting sustainability.

The device, which operates wirelessly and is powered by solar energy, even from indoor light, measures carbon dioxide (CO_2) levels in real time. This technology offers a practical solution for organisations seeking to enhance indoor air quality while reducing their energy consumption.

Air pollution and indoor air quality have become growing global concerns, particularly in the wake of the COVID-19 pandemic. Poor ventilation in enclosed spaces can lead to elevated CO_2 levels, which can negatively impact cognitive function, cause health issues, and, at extreme concentrations, pose serious health risks. This new device, known as the AIR-sense-IQ, provides live readings of CO_2 levels and issues alerts when concentrations exceed safe limits.

CO_2 is naturally present in the atmosphere at low levels, but excessive accumulation indoors can cause fatigue, dizziness, headaches, and, in severe cases, life-threatening conditions. In workplaces and public spaces, monitoring CO_2 is essential for maintaining a healthy environment. When levels become too high, action should be taken, such as improving ventilation or adjusting occupancy rates to ensure safe air circulation.

The monitor is powered by state-of-the-art printed solar cells, which are flexible, highly efficient, and capable of operating even in low-light conditions. These solar cells enable the device to function independently, eliminating the need for disposable batteries, frequent maintenance, or cumbersome wiring. Advances in photovoltaic technology have made self-powering electronic devices increasingly viable, and this innovation is a prime example of how such solutions can be integrated into everyday life.

Wireless electronic devices that harvest energy from ambient indoor light are becoming a reality thanks to improvements in energy efficiency. On one hand, modern electronic sensors consume significantly less power, allowing them to function with minimal energy. On the other, advances in solar cell technology now enable devices to capture and utilise light more effectively. This combination is paving the way for a new generation of self-sustaining devices, with applications extending beyond air quality monitoring. In the near future, everyday items such as computer keyboards could be powered entirely by indoor light, eliminating the need for cables or battery replacements.

The development of the AIR-sense-IQ is part of a broader effort to integrate next-generation photovoltaic technologies into

practical applications. Research funding for the project has been provided through a multi-million-pound programme focused on advancing scalable, low-cost solar energy solutions. This initiative involves collaboration between multiple academic institutions and industry partners, aiming to drive innovation in areas such as sustainable building materials, agricultural technology, and smart devices.

A key aspect of this research is the integration of solar-powered technology into the "internet of things" (IoT). IoT devices operate autonomously with minimal environmental impact, monitoring and adjusting energy consumption in real time to prevent unnecessary waste. Their ability to function independently with minimal human intervention improves efficiency while also lowering maintenance requirements.

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SWANSEA

Using energy twice to decarbonise domestic heating

Repurposing heat from cloud computing to warm homes, cutting emissions from both data centres and domestic heating while offering an efficient, low-cost alternative to traditional energy sources.

On the path to net zero, decarbonising domestic heating is one of the UK's most complex challenges, accounting for around 17% of national greenhouse gas emissions. Most homes are still heated using natural gas, and much of the UK's housing stock is poorly insulated and energy inefficient. Overcoming these issues is essential to meeting climate targets

South Wales-based company Thermify is offering a novel solution by combining cloud computing and domestic heating into a single integrated system.

Central to this new approach is a network of compact computer modules installed in homes. These devices carry out secure data processing for clients in sectors such as finance, healthcare and media – industries that rely heavily on computational power. Unlike traditional data centres, where waste heat is simply expelled, this system captures the heat generated during processing and uses it to provide hot water and space heating for households.

This integrated model presents a more sustainable alternative to conventional approaches in both computing and domestic energy. It reduces the demand for centralised, high-energy data centres while also lowering household reliance on fossil-fuelled or electric heating systems. By addressing the energy needs of both sectors simultaneously, the system supports progress on two key fronts: reducing the carbon footprint of the digital economy and cutting emissions from home heating.

The solution also introduces new business models by linking commercial data processing with domestic energy use. This could make low-carbon heating more affordable and accessible, particularly in areas lacking infrastructure for heat pumps or heat networks.

The principle is simple: use electricity twice – first to power computing, then to heat the home. Unlike conventional data centres, which vent waste heat, this unique combination captures and repurposes it. The company's HeatHub units are already operating at around 80% efficiency, with ongoing improvements planned.

In addition to the environmental benefits, this model also offers a cost advantage over other electric heating options. By reusing energy already consumed for cloud computing, households can reduce heating costs. This makes the approach especially valuable for social initiatives aimed at supporting low-income households with affordable, or even free, heat.

The system's environmental credentials are reinforced by independent assessments showing its distributed data network emits around 75% less carbon than traditional data centres. The company also follows a green supply chain policy, with an emphasis on local sourcing to minimise transport-related emissions.

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BRIDGEND