

# INNOVATION

THE LATEST INNOVATIONS, COLLABORATIONS  
AND TECHNOLOGY TRANSFER

FROM THE UNIVERSITY OF OXFORD

# insights

ISSUE 4 SEPTEMBER 2016

## SMART ENERGY MANAGEMENT

Manage energy consumption accurately with Pilio ▶



Improving security  
protocols ▶



Ultra-clean  
Bio-fuel ▶



Fluid biomarker for  
diagnosis of joint injuries ▶



Targeting dysfunction of  
energy metabolism disorders ▶



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# INNOVATION insights

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## Supporting Innovation

Innovative discoveries, ideas and thinking are the currency of any academic institution. We're helping to nurture and develop the best from Oxford for the benefit of society.

In this edition we include new technologies from researchers in the sciences, public engagement activities from the humanities, and a feature on the progress of our first incubator startup, Pilio, which had its origins in the Environmental Change Institute, part of the Social Sciences Division.

The breadth of support that we offer is illustrated in other articles, including a report on our latest Technology Showcase, and a milestone in a major innovation consultancy project from Isis Enterprise. Blake Morgan, one of our Oxford Innovation Society members, outline the legal issues that may arise from Brexit.

Our intention, in this publication, is to provide an overview of the services that we provide to the University of Oxford and all our clients. We hope that you enjoy reading it, and welcome your feedback.

Linda Naylor, Managing Director



## News



### **OxSight develops smart glasses for the legally blind**

University spinout OxSight, have created 'SmartSpecs' which help sight impaired and blind people to make sense of their surroundings by using an augmented reality display system.

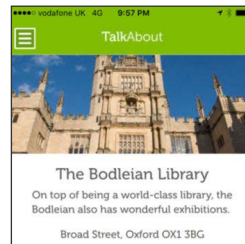
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### **From Oxbridge research to city investors**

Oxford and Cambridge researchers showcase the latest technologies to investors at an event held at the Royal Society of Chemistry.

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### **TalkAbout launches a new smartphone app**

An app developed by TalkAbout Guides allows users to engage with The Bodleian Library's new exhibition space in Oxford.

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### **University collaboration offers fast diagnostic tests**

Oxford spinout, OID (Oxford Impedance Diagnostics), has developed a range of biomarkers for a range of diseases.

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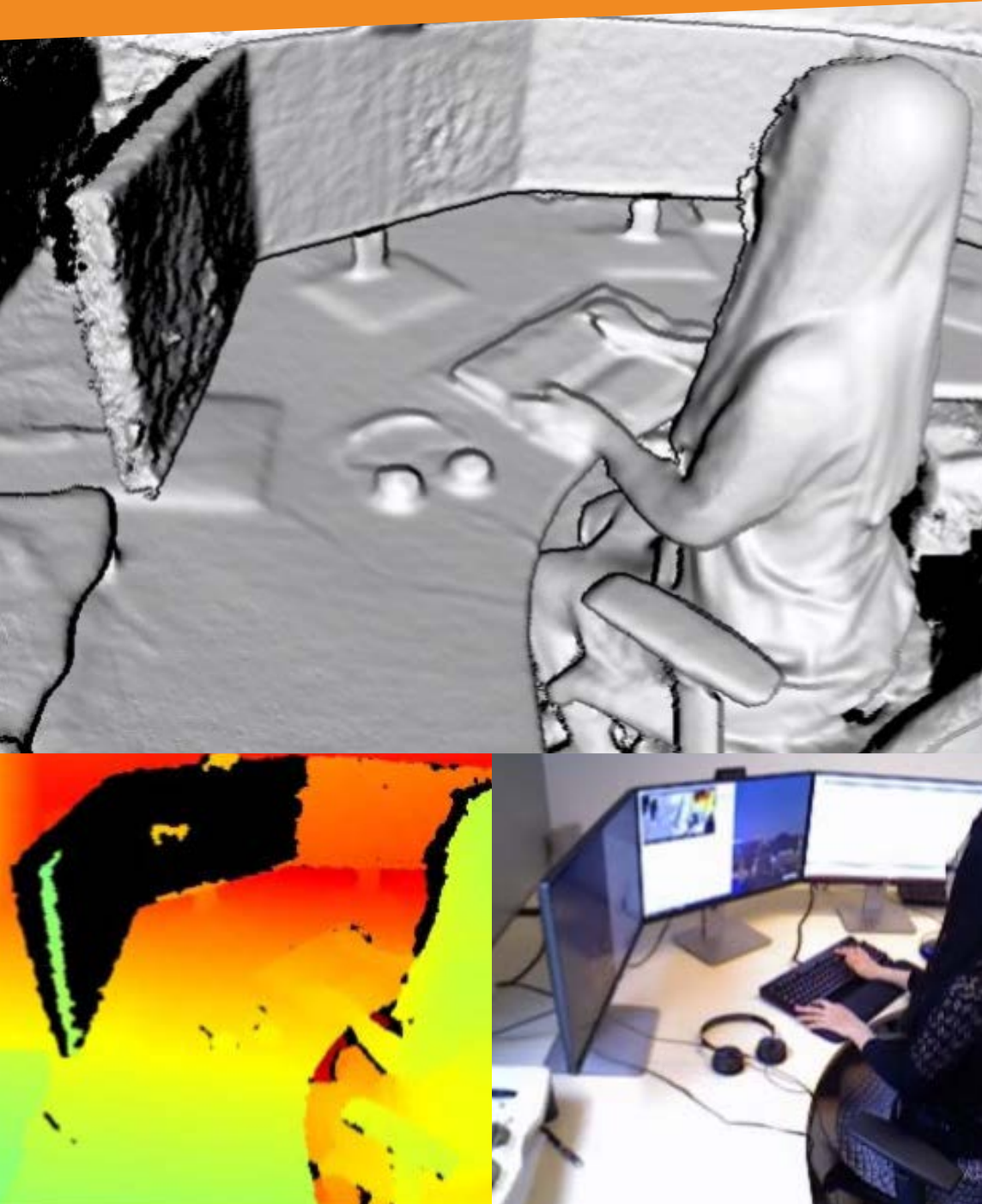


### **Measuring recovering quality of life in mental health**

A new mental health Patient Reported Outcome Measure, developed at The University of Sheffield, is exclusively available from Clinical Outcomes at Oxford University Innovation.

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## 3D modelling of complex environments

The ability to track a handheld camera whilst simultaneously performing detailed mapping of the scene is crucial for augmented and mixed reality applications.

Volumetric methods provide dense and photorealistic 3D reconstructions, allowing multiple-depth images to be integrated into a 3D model. Whilst high quality, large scale 3D models can be obtained for desktop and workstation applications, this is difficult to achieve in real-time on mobile devices with limited computational resources. Oxford researchers have developed InfiniTAM; a software implementation that is an order of magnitude faster than the current state-of-the-art. The significant optimisations provide a method for performing real-time 3D dense reconstruction and tracking of large spaces using a single mobile device.

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## Engaging with the Humanities

Oxford University Innovation has a growing portfolio of projects with the Humanities Division, from consultancy, start-ups and new ventures and licensing.

We have just published a brochure on some of the work we are doing which can be found on our updated website. [VISIT SITE](#) ►

To encourage entrepreneurial activity we are also sponsoring the Humanities Innovation Challenge Competition. We are doing this together with The Oxford Research Centre in the Humanities (TORCH). We are keen to encourage researchers, graduate students and staff to develop entrepreneurial ideas which can potentially enrich their own work, communicate to a wider audience, and develop new perspectives. You can read more about the competition at: [VISIT SITE](#) ►



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## Improving security protocols

In 2013, Edward Snowden, former Central Intelligence agency employee, revealed classified government information without prior authorisation. This led to much greater public interest in the issues surrounding encryption and securing our emails and messages. Subsequently, there has been increased focus on so-called end-to-end encryption: essentially any means of ensuring that third parties are not required for the encryption process so only the people communicating can read the messages. One practical means for providing end-to-end encryption is through the use of human-interactive security protocols.

An end-to-end encryption attack happens when an intruder impersonates one or more of the message recipients during the process of establishing secure communications. This is known as a man-in-the-middle attack.

Oxford researchers have developed improvements to human-interactive security protocols which allow users to distinguish between an innocent communication failure and an attacker attempting to mount a man-in-the-middle attack.

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## Big challenges need big ideas

This year's Oxford Technology Showcase highlighted the high quality and diversity of innovation in healthcare that has arisen from Oxford University, the Oxford University Hospital Trust and the region in the field of chronic disease. The audience was a mix of researchers, clinicians, investors, entrepreneurs, healthcare companies and others from the local innovation "ecosystem" and beyond.

Oxford University Innovation worked in partnership with the Oxford AHSN and, for the first time, with the NIHR Oxford Biomedical Research Centre. We also received industrial sponsorship from Triteq Ltd.

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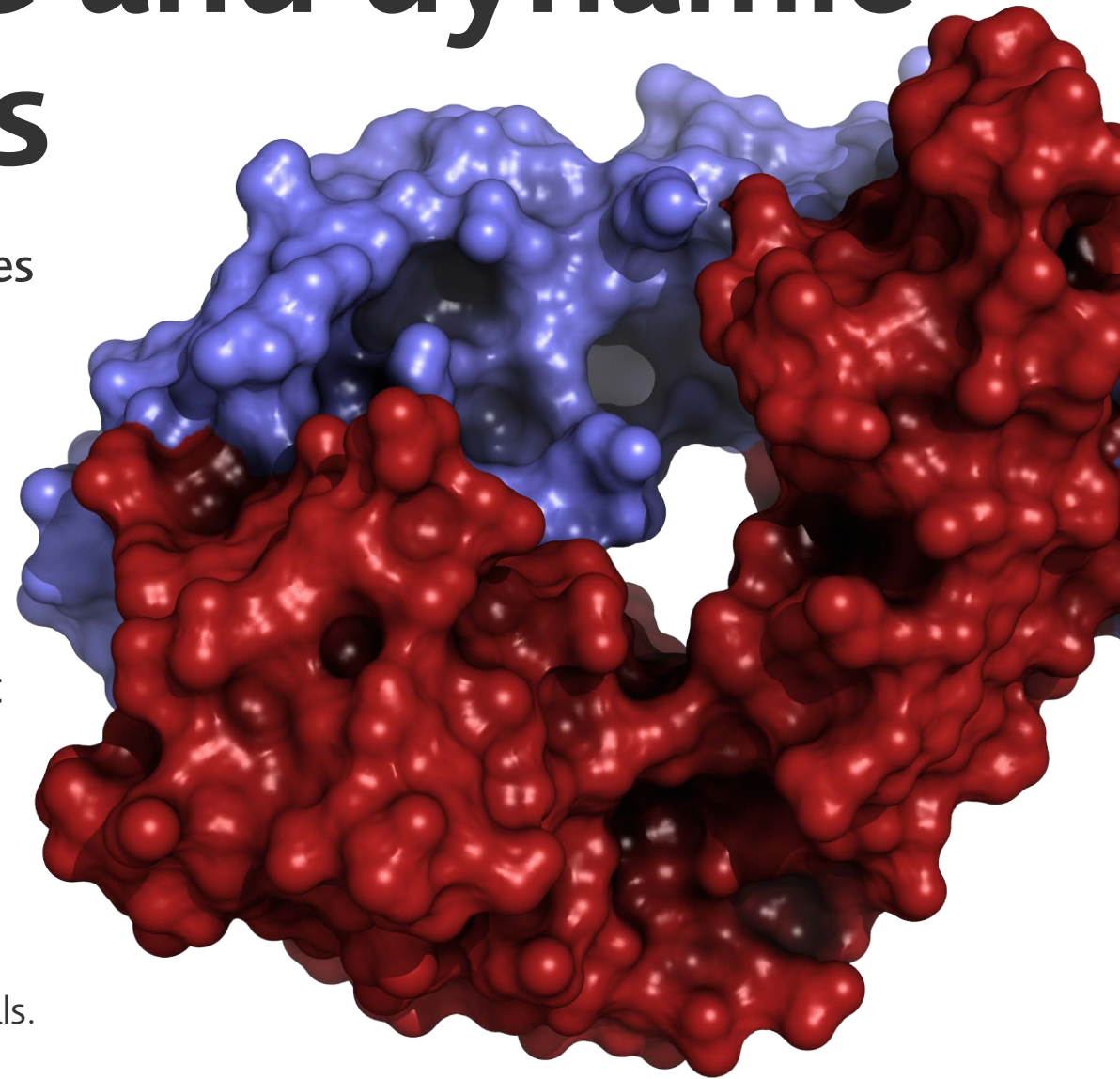


## Probing the structure and dynamic behaviour of proteins

Whilst “traditional” Nuclear Magnetic Resonance (NMR) techniques are able to provide a wealth of information about the structure of small proteins (up to 40 kDa) and their behaviour in solution, more advanced techniques are required for the analysis of larger macromolecules. As 70-80% of eukaryotic proteins assemble into larger structures, the ability to analyse very large proteins is of critical importance in drug discovery. The widespread use of modern techniques, such as methyl TROSY, is inhibited by current data analysis methods that are often time consuming, error prone and expensive.

Oxford researchers have developed a method for the robust assignment of methyl TROSY spectra. This innovative technology will allow a powerful but under-utilised technique to find mainstream use for structural biology, drug discovery and agrichemicals.

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## Higher education in Oman

Muscat University, Oman's newest higher education institution will open its doors to its first students in Pathway Programmes (Foundation and Pre-Master's) in October 2016. From 2017, the University will provide undergraduate and postgraduate degree programmes through its three Faculties of Business and Management, Engineering and Technology, and Transport and Logistics.

Muscat University has now been granted a licence to operate as a university by the Education Council, the supreme education body of the Omani government. The university has announced formal affiliation agreements with three international academic partners, including two of the UK's leading universities, Cranfield University and Aston University.

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## Ultra-clean bio-fuel

It is well documented that the increasing consumption of fossil fuels globally has contributed to severe environmental pollution and climate change. Even partial replacement of the fossil fuel with bio-oil would help to alleviate global warming and reduce air pollution. However, the use of bio-oil derived from corn or bio-diesel has caused significant problems in food production in certain regions. Pyrolysis oil from biomass or organic waste would help to alleviate this crisis whilst simultaneously increasing income for farmers. However, blending pyrolysis oil into gasoline and diesel remains a persistent challenge.



Oxford researchers have developed a new process and catalyst system that enables the production of ultra-clean gasoline fuel from a co-feed of FCC gasoline and pyrolysis oil. The simple process produces gasoline that is high in oxygenates and low in undesirable sulphur-containing components and unsaturated organics, with no reduction in octane number.

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## Can virtual reality help paranoia?

Increased confidence, reduced anxiety and improved performance could soon be achieved by stepping into the virtual world. Oxford VR is a University of Oxford spinout that fuses the best psychological science with cutting edge immersive virtual reality (VR) technology to deliver improved mental health and wellbeing.

Immersive VR allows individuals to experience, react and learn in a safe environment with benefits that endure and transfer into the real world. As cheaper headsets and VR-capable smartphones become increasingly widespread, Oxford VR will be at the forefront of this technological revolution with clinically validated products that are founded in world leading academic research. Oxford VR is looking to secure funding to help it build the go-to platform for delivering improved psychological health across clinical, corporate and consumer markets.

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## Synovial fluid biomarker of joint injuries

Degeneration of the knee joints leads to secretion of inflammatory proteins by the synovium, cartilage, and bone into the synovial fluid. Oxford scientists have identified unique combinations of these proteins that form a “fingerprint” for the diagnosis of either end-stage knee osteoarthritis, early knee injury, or inflammatory arthritis of the knee. This has led to the invention of the first method that uses synovial fluid biomarkers as a diagnostic tool for knee joint injuries or osteoarthritis. The method is based on a statistical analysis of multiple markers expressed by different cohorts of patients.

The generated data can assign patients to each of the cohorts with >96% accuracy, reliability, and specificity. Work is ongoing to develop the panel for use in earlier diagnosis, prognosis / personalised healthcare, or for early read-out of intervention efficacy.

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## Brexit and technology transfer: the legal issues



Oxford Innovation Society member, Blake Morgan, explains that Brexit will have a significant impact on technology transfer agreements and relationships. This goes beyond any funding and collaboration issues – the current legal landscape underpinning the protection and licensing of intellectual property (IP) is heavily driven by EU law.

This is because effective and consistent IP protection underpins the single market. Some areas will be impacted less than others but those involved in technology transfer will need to keep a close watch on legal developments as they unfold. In the meantime it is business as usual, especially for patents as European patents operate separately from the EU Treaty. More problematic will be what happens to the UK's participation in EU wide "unitary" IP rights such as trade marks, designs and the long awaited European Unitary patent – here there is considerable uncertainty. Copyright and trade secrets will be less affected, at least initially.

For further information, please contact Simon Stokes at Blake Morgan ►

[Oxford Innovation Society details](#) ►

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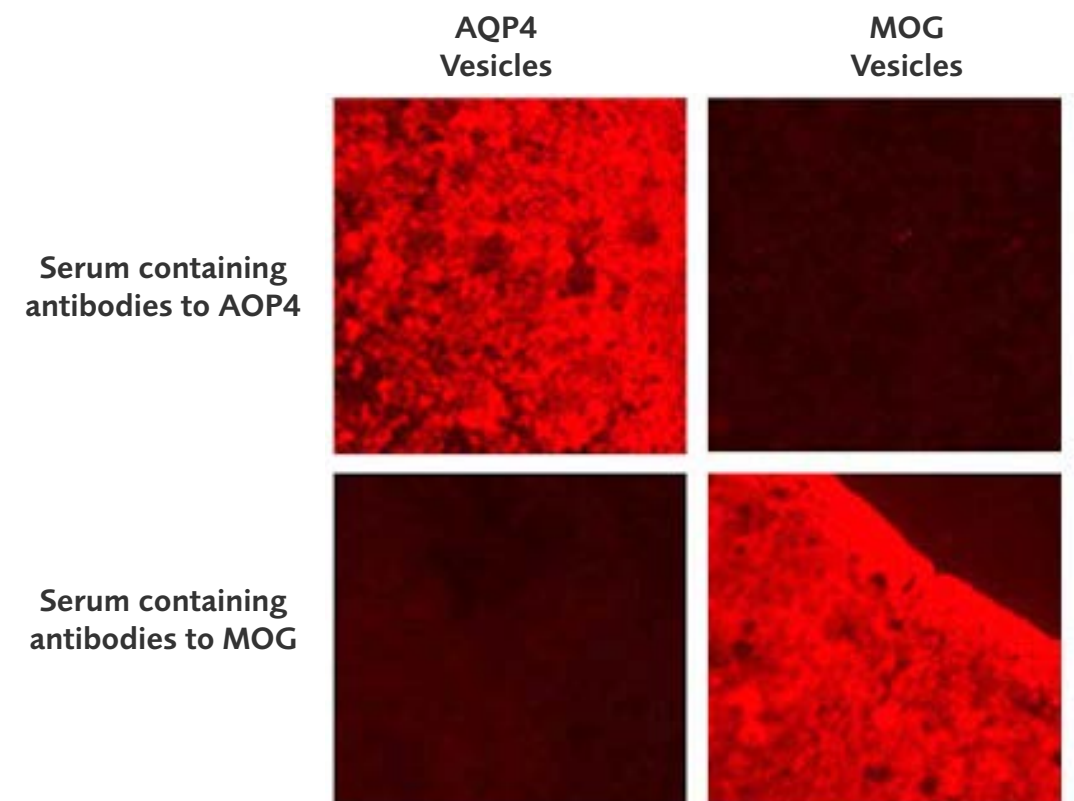




## High sensitivity identification of autoantibodies

A new method of using membrane vesicles for highly sensitive, specific detection of autoantibodies has been developed by researchers at the University of Oxford. This new method does not use live cells, thereby overcoming the need for fixing during transport and ensuring the sensitivity is not compromised.

The method of spotting membrane vesicles onto a slide is easy to apply in a non-specialist laboratory, which would enable quick diagnosis and treatment of patients with autoimmune diseases and specific cancers with associated biomarkers. This approach could be used for many different protein antigens, and could be developed into a micro-array diagnostic to test patients' samples for a broad range of antigens.



Example shows antibodies from two patients who both have neurological syndromes that include optic nerve and spinal cord inflammation binding to membrane vesicles expressing either AQP4 or MOG. Binding of the patient's auto-antibodies is detected by a secondary antibody to human IgG labelled with a red fluorophore. Patient 1 (Top row) - antibody-binding detected to AQP4 but not to MOG. Patient 2 (bottom row) - antibody-binding detected to MOG but not to AQP4.

Having either AQP4 or MOG auto-antibodies has different implications for disease diagnosis and screening. The use of these antigens together in a membrane vesicle-based screen could provide assays that discriminate between these two conditions, enabling quicker diagnosis and different approaches to treatment with prognostic implications.

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## Advanced electron spin resonance

New developments in the Centre for Advanced Electron Spin Resonance (CAESR), in the Department of Chemistry, are creating exciting opportunities for collaboration with industry to tackle crucial questions in (bio) chemistry, medicine, materials science and physics.

Electron Spin Resonance (ESR) is often used in the characterisation of stable paramagnetic centres and radicals generated in biological and polymer media under chemical redox reactions, such as oxidative stress, or via photolysis. Advanced ESR techniques are available for molecular structure and function characterisation and can determine interspin distances of up to 100Å and characterise short-lived, photogenerated states (such as in solar cell and OLED materials).

Consulting Services, a group within Oxford University Innovation, has established service contracts with industrial clients on behalf of CAESR. In addition to providing



spectroscopy facilities, the team engages with clients throughout the service period, providing expertise in experiment planning, optimisation of sample and data acquisition parameters, and interpretation of results.

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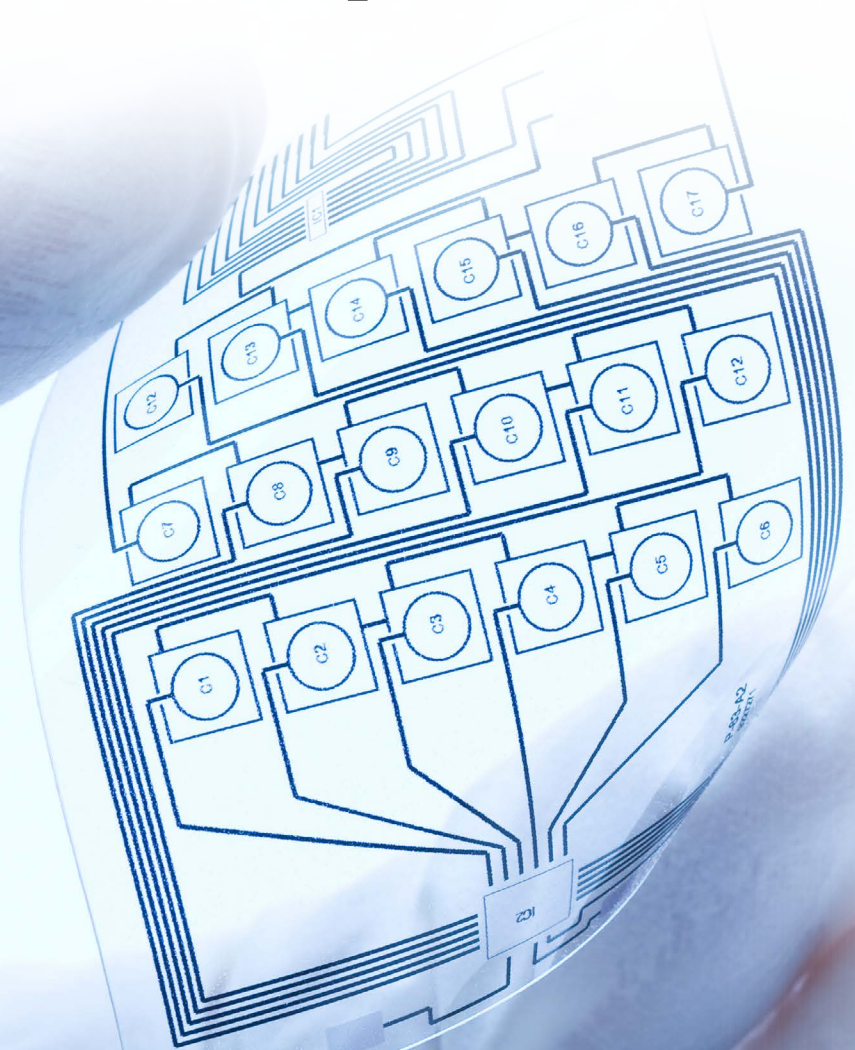
## Electrical properties in transparent conductor thin films

Transparent conducting oxides offer highly tuneable electronic properties in addition to being transparent to visible light. Thin films formed from such materials are, therefore, desirable as components for a wide range of applications in functional electronic devices.

Certain applications require transparent thin films that exhibit high charge carrier mobility values, which are difficult to produce using standard solution-based deposition techniques. Manufacturers must resort to depositing the powdered material onto a high temperature substrate to form films with the desired properties, preventing the use of temperature sensitive substrates such as flexible plastics. Alternatively, films can be modified post-formation, which results in short-lived improvements.

Oxford researchers have developed a method to prepare transparent thin films with long-lasting enhanced electronic properties in situ, offering persistent increases in charge carrier mobility, with a significant reduction in processing temperature.

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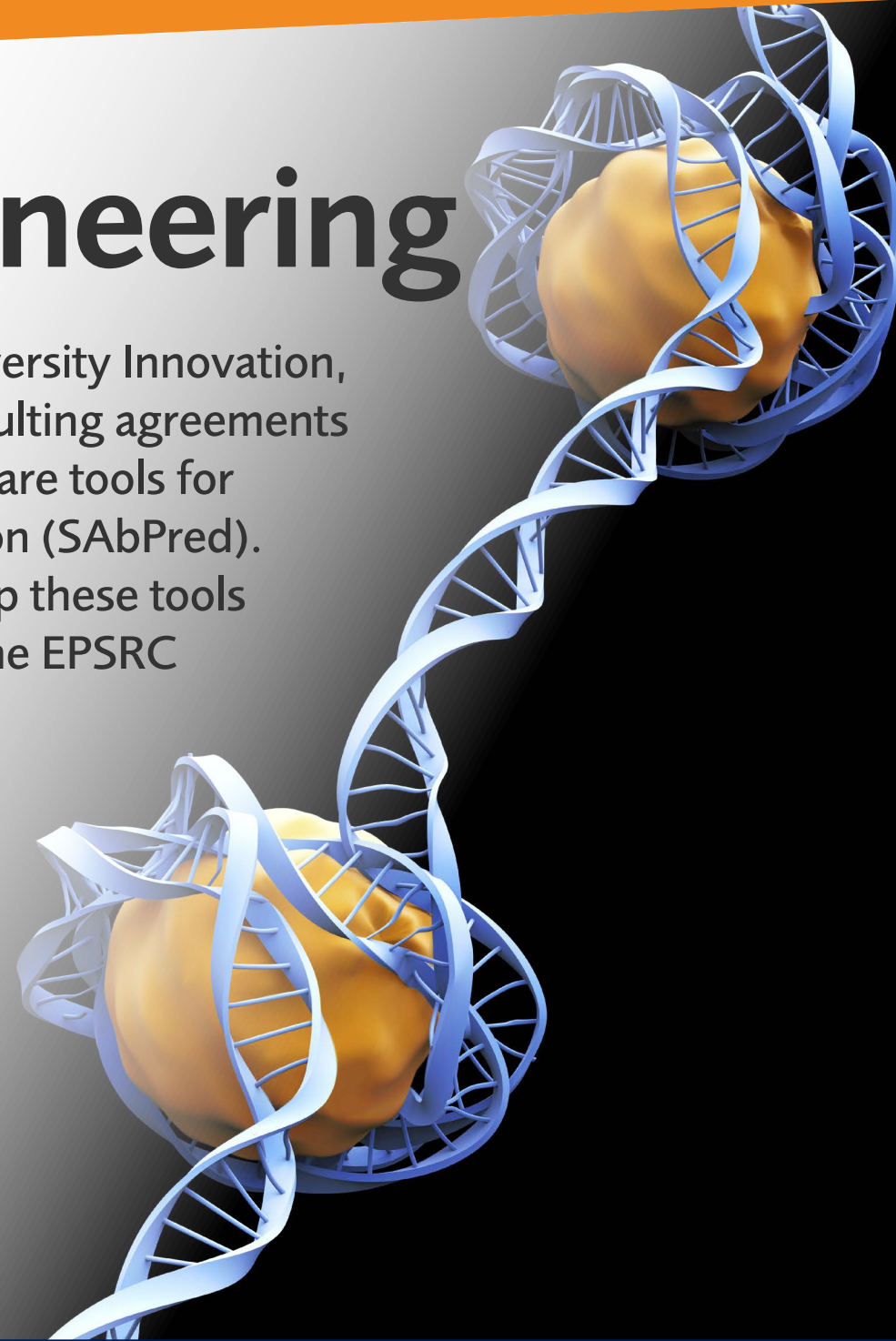
## Structural antibody engineering

Over the last few months Consulting Services, a group within Oxford University Innovation, has been working closely with the Department of Statistics to secure consulting agreements with a number of Pharma organisations for installing and supporting software tools for Structural Antibody Database (SAbDab) and Structural Antibody Prediction (SAbPred). Developed in Oxford by Prof Charlotte Deane's (James Dunbar et al) group these tools have been implemented into customer sites by Konrad Krawczyk who is the EPSRC supported Impact Software Engineer (ISE).

The SAbDab resource collects the antibody structural data from the Protein Data Bank and annotates them with antibody-specific information. As such, it is currently the most reliable structural antibody resource currently. The SAbPred platform integrates prediction tools facilitating rational design of antibodies; most notably the rapid antibody modeling tool ABodyBuilder (Leem et al.)

Oxford University Innovation has worked closely with the Department of Statistics to successfully sign five consulting agreements with a total value in the order of £76,000 across a range of Pharma companies.

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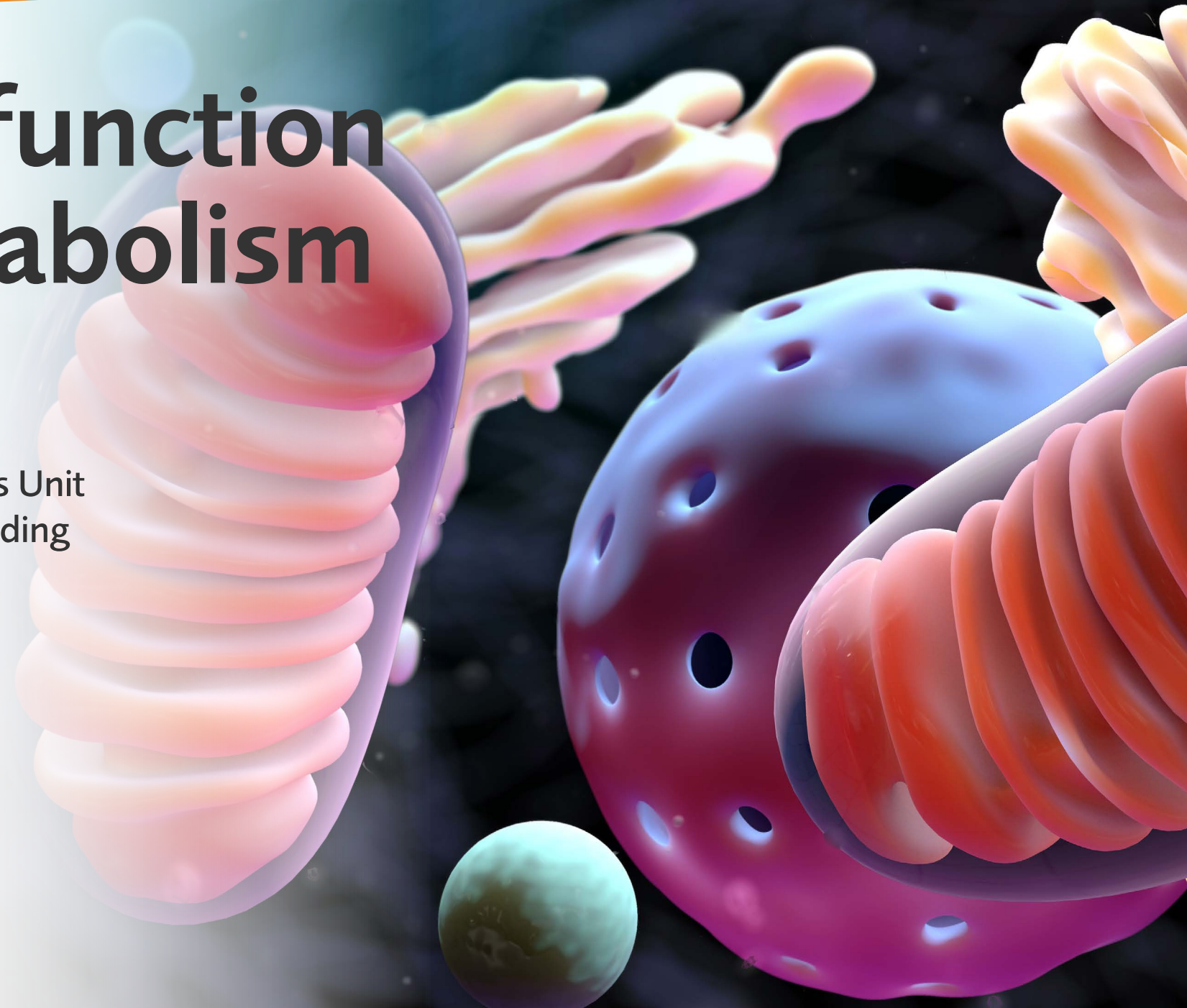


## Targeting dysfunction of energy metabolism disorders

Researchers at the MRC Functional Genomics Unit in Oxford have identified the first long noncoding RNA (lncRNA) to be involved in regulating oxidative metabolism within mitochondria.

Dysfunction of oxidative phosphorylation (OXPHOS) in mitochondria feature in a number of diseases including Parkinson's disease and type II diabetes. Cerox1 has been identified as a lncRNA regulating mitochondrial OXPHOS, leading to increased mitochondrial function of an individual.

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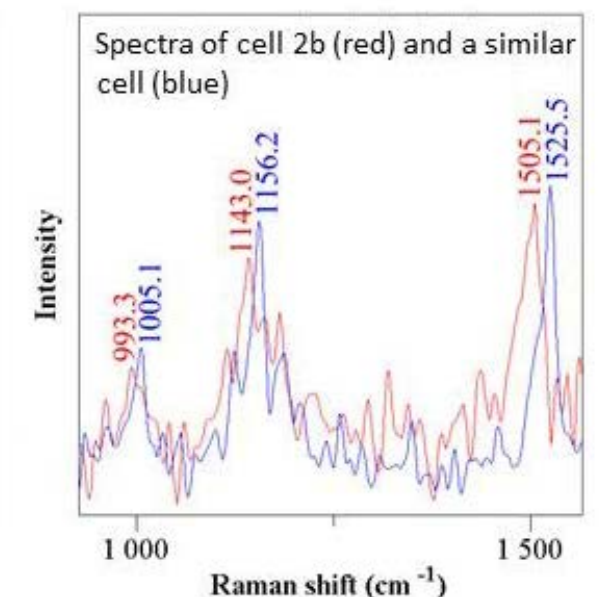
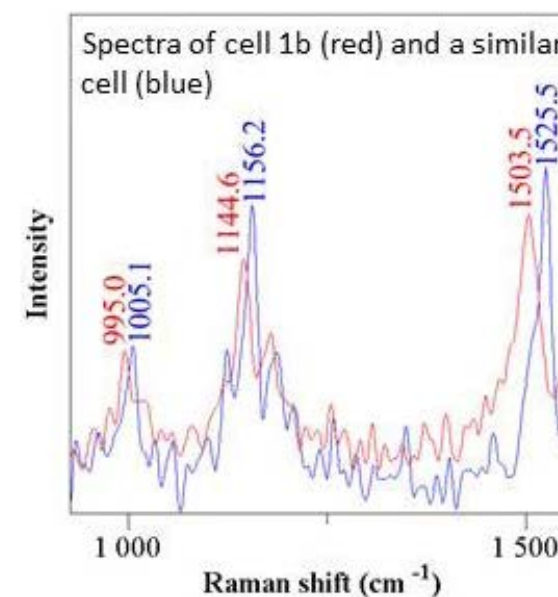
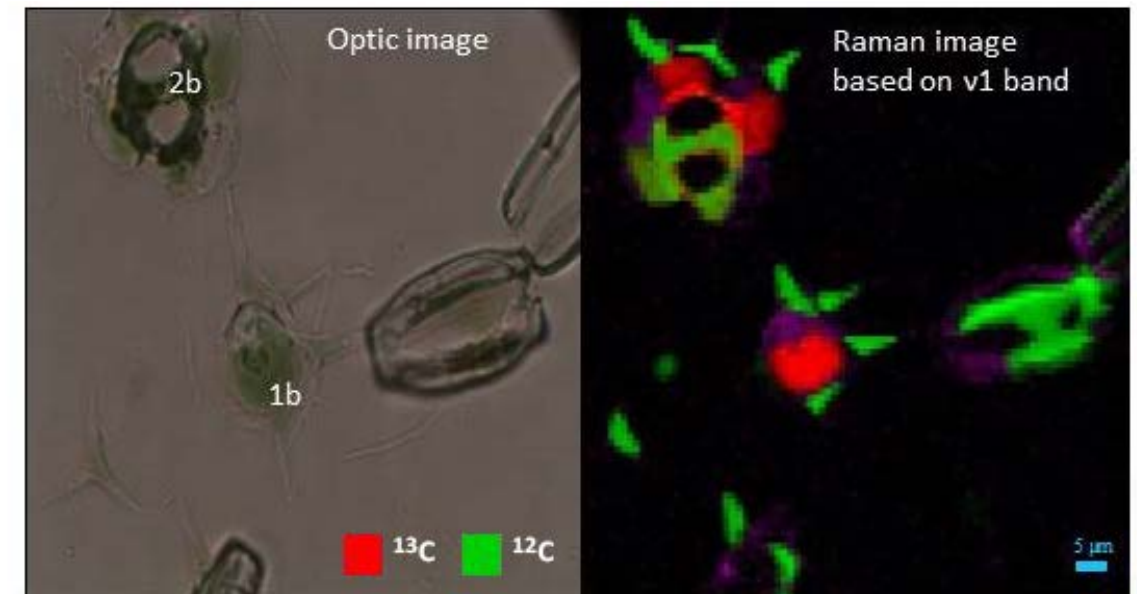


## Raman activated cell ejection

The ability to analyse single cells is of vital importance to the development of biotechnology. Current methods for single cell isolation and analysis require the cells to be labelled, potentially altering the natural state of each cell. Techniques that support the identification and isolation of single cells of interest in their natural state represent a valuable tool for a range of applications.

Oxford researchers have developed a method that ensures single cells of interest can be identified from a natural medium using non-invasive Raman Spectroscopy. Cells of interest can therefore be identified and isolated for further study using a single instrument under sterile conditions.

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## Increasing the performance of electrical machines

The development of electrical machines with increased current and torque densities is in demand. This is crucial for a number of applications, including electric and hybrid-electric vehicles, replacement of hydraulics in aerospace, and renewable energy generation. However, progress in this field has been limited due to inherent difficulties in temperature management. Increasing the current density in the coil windings results in an increase in temperature, which is detrimental to machine performance and lifetime.

Oxford researchers have developed two complementary solutions to enable more effective temperature management at increased current and torque densities. The first is an innovative construction for pole pieces with concentrated windings, enabling efficient heat transfer. The second uses a novel winding construction, allowing higher current densities to be achieved without a significant increase in temperature. The Oxford inventions will facilitate the manufacture of smaller, lighter, and cheaper electrical machines with increased machine performance and lifetime.

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## A microfluidic sonication device for microbubbles

The Oxford Team has developed a platform technology that could be used in a clinical setting to produce microbubbles employed as contrast agents in ultrasound imaging or as drug delivery vehicles. The technology also has other applications including foods, paints, biofuels and cosmetic products.

The use of microbubbles as contrast agents has been widely researched but it is well known that microbubbles manufactured using existing techniques suffer from poor stability, production rate and device lifetime. The Oxford technology combines the use of an ultrasonic device with a microfluidic channel to overcome the issues faced in producing bubbles with conventional emulsification techniques and standard microfluidics. Using this technology, microbubbles can be produced with very narrow size distributions and also with very high stability and high throughput.

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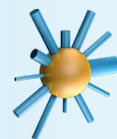
## Manage and control your company's estate energy accurately with Pilio

As we approach the 5th anniversary of Pilio Ltd, the first startup company created with the input of Oxford University Innovation, we take a look at the milestones in Pilio's successful history.



### WHO ARE PILIO LTD?

Pilio, founded by Catherine Bottrill and Dr Russell Layberry, empower companies to make smarter energy management decisions and lasting financial, energy and carbon savings across their business. Pilio has developed a 'software-as-a-service' model to provide businesses with building energy insight reports, assessing their energy consumption patterns, trends and anomalies. The software evaluates the opportunities, identifies waste and evaluates the effectiveness of energy saving measures. Alongside the software Pilio conducts on-site energy audits and staff training.



#### STEP 1: DATA CONNECT

Acquires, organises, cleans and imports your energy data from any source



#### STEP 2: ENERGY ENGINE

Pairs your data with weather, emission and benchmark data to assess efficiency



#### STEP 3: RESULTS

Promotes visibility of your energy saving priorities using configurable reporting



#### STEP 4: INTERPRETATION

Cutting-edge building energy expertise

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FEATURED ARTICLE



## WHERE ARE THEY NOW?

Pilio now boasts a diverse client portfolio ranging from Whitbread Plc to the Royal Albert Hall. Whitbread, with around 1,000 hotels and restaurants around the UK, make use of Pilio's advanced software to monitor their range of premises.

**"Pilio's advanced weather-energy analytics enables us to compare hotels, wherever they are in the UK, on a level playing field"** says David Dunbar, Whitbread's Energy Manager. The Royal Albert Hall is one of over 100 cultural buildings Pilio is supporting in their drive to increase energy efficiency. Chris Cotton, Chief Executive of the Royal Albert Hall describes Pilio's software as **"Simple to access and an extremely effective tool in getting a snapshot of energy consumption to then take appropriate action to improve efficiency."**

Catherine, one of twelve people selected for the Women in Tech Angel Academe supported by the City of London, is keen to initiate further innovation in the area. She said **"Pilio is active in sharing and connecting with students, researchers and companies to fast-track innovation."** Catherine goes on to acknowledge not only the key role that the Oxford Innovation community played in the creation of Pilio, but also the continued contribution of Oxford University to climate change in general explaining **"Oxford's contribution to climate change will most successfully be exercised through the active collaboration and engagement across the Departments, Estate and Colleges but also building partners with companies needing rapid innovation."**

## A BRIEF HISTORY:

**2010** – Founders Catherine Bottrill and Dr Russell Layberry are the first researchers into Oxford's Isis Software Incubator.

**2011** – Pilio Ltd is incorporated, representing the first spin-out from the Oxford University Environmental Change Institute (ECI).

**2012** – Delivered a prototype of the software to be tested in California by PG&E customers. Enters Climate KIC accelerator with other inventor peers

**2013** – UK finalists in the Climate-KIC competition, awarded by Europe's primary climate change innovation initiative.

**2014** – 100 theatres implemented the software developed by Pilio. The company was also given the Virtual Company of the Year award by Imperial College London.

**2015** – Pilio launched its subscription service for householders and provided predictive energy use algorithms to Scottish Power for integration with their connect device for remote heating control. Test real-time android based energy monitoring with commercial clients.

**2016** – Pilio launches annual building energy deck reports and Russell qualifies as Certified Energy Manager, ESOS assessor co-ordinator (UKAEE) and qualified electrician

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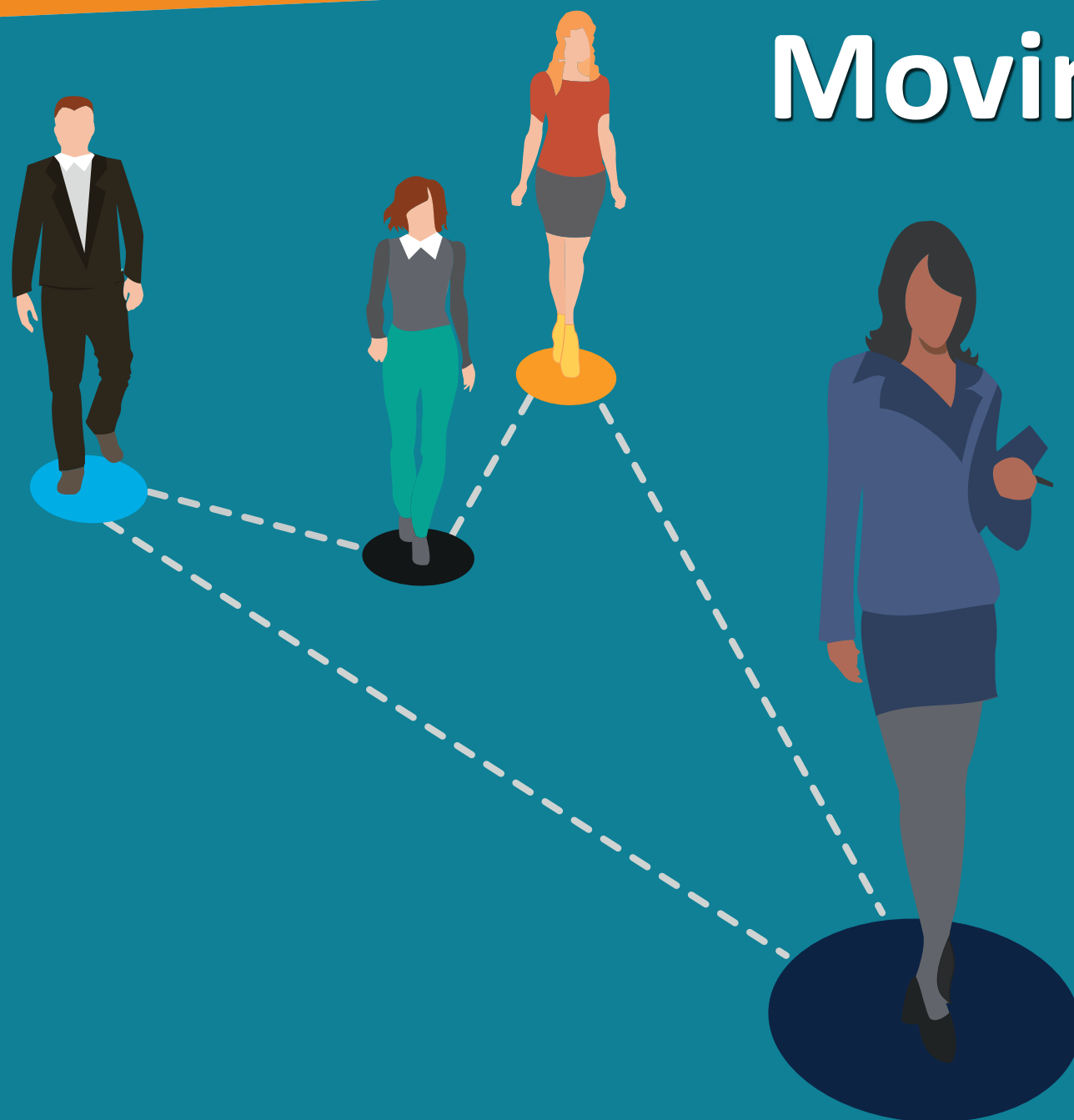




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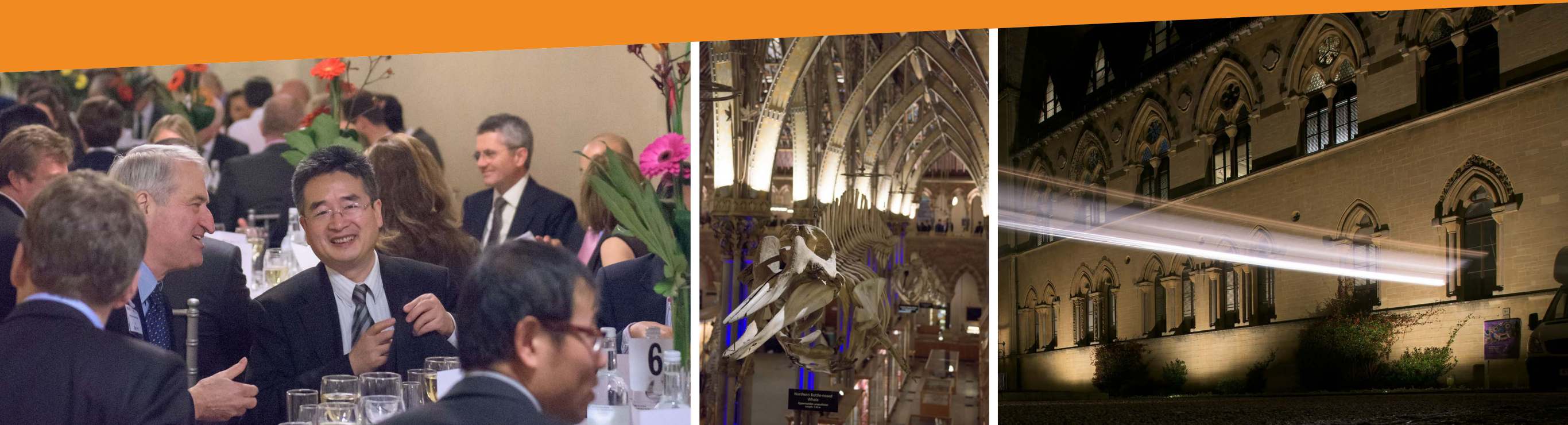


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## OXFORD INNOVATION SOCIETY 2016/17

The Oxford Innovation Society (OIS) is an open innovation network for industry, academia, and investors. Upcoming meetings will be held on:

- Thursday 15 September
- Thursday 23 March

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner.

Details on [www.innovation.ox.ac.uk/ois](http://www.innovation.ox.ac.uk/ois)



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