



# research\*eu

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## Turning waste into a resource

The most defining difference between nature and human society is probably the way each deals with waste. With the former, everything is used as a resource for generating new life: dead plants and animals become natural fertilisers or food for a new generation of organisms, which will eventually go through the same process.

Society, on the other hand, has often indulged in careless consumption and disposal — although it is now progressively moving away from this, in light of the dramatic consequences for human health and the environment. Nature has become a source of inspiration, and sustainability concepts such as ‘life-cycle assessment’ (LCA) now stress the importance when developing new products of having a clear idea of how they will be recycled. This is vital for economies, such as ours, which rely on a limited supply of steadily depleting resources.

EU-funded science is playing an essential role in turning waste into a key resource for tomorrow, which is why this issue of *research\*eu results magazine* is putting some of the most ground-breaking waste-related projects under the spotlight. This issue includes an exclusive interview with Dr Sonia Heaven of the University of Southampton — who coordinates an ambitious project aiming to make the recovery of energy from food-waste processes more efficient — as well as with Dr Mario Malinconico from IUPAC, who sheds light on the SUSRAC project, which is making a key contribution to the long-term sustainability of increasingly successful composite materials. Other articles related to this special feature topic are spread throughout the ‘energy and transport’, ‘environment’ and ‘industrial technologies’ sections of the magazine.

But other major EU science issues have not been left out. The ‘biology and medicine’ section begins with ‘Fractures fixed in a fraction of time’ on page 6, followed by the ‘social sciences and humanities’ section which starts with ‘Learning workplace skills through gaming’ on page 13.

Immediately after the ‘environment’ section, which begins with a special article entitled ‘Assessing the sustainability of aquaculture production’ on page 25, the ‘IT and telecommunications’ section looks into solutions for ‘Breaking through the fault-testing bottleneck in chip production’, on page 31. Finally, the ‘space’ section features the story ‘Keeping an eye on Europe's biodiversity... from space’ on page 41.

The issue ends, as usual, with a list of events and upcoming conferences.

We look forward to receiving your feedback on this issue and on the *research\*eu* publications in general. Send questions or suggestions to: [cordis-helpdesk@publications.europa.eu](mailto:cordis-helpdesk@publications.europa.eu)

*The editorial team*



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#### Special topic

Each issue of the *research\*eu results magazine* sheds light on a specific science topic. To find out more about the latest results and findings, look out for this icon next to article headlines.



#### Videos

Want to see EU research projects in motion? Some of the projects presented in this issue have a dedicated video available on the internet. To view a video, just open the digital version of the magazine (available at <http://cordis.europa.eu/research-eu>) and click on this icon.

### See you next month!

Coming up in issue 27 of *research\*eu results magazine* — a special dossier called ‘Spotlight on international cooperation’.

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## BIOLOGY AND MEDICINE



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# Fractures fixed in a fraction of time

*Regenerative medicine is a new scientific field that focuses on helping patients heal faster. It can help a body repair broken bones in a fraction of the time it would normally take. An EU-funded research project is using gene therapy and stem cells to help damaged bones regenerate faster and open up new market opportunities for tissue-repair technology in the European medical sector.*

Regenerative medicine aims to regenerate damaged tissues by developing functional cell, tissue, and organ substitutes to repair, replace or enhance biological function in the affected area.

The technologies involved are based on the successful interaction between three components. These include the scaffold that holds the cells together to create the tissue's physical form and the cells that create the tissue. Biological signalling mechanisms (such as bioreactors or devices which stimulate cells) that direct the cells to express the desired tissue phenotype (an organism's observable characteristics or traits) make up the third component.

Through his COLLREGEN<sup>1</sup> research project, funded by the European Research Council (ERC), Professor Fergal O'Brien of the Royal College of Surgeons in Ireland is pursuing

specific projects in all three areas. His goal is to develop bone-graft substitutes from bio-materials and laboratory-engineered bone tissue for implantation in damaged areas.

By creating innovative bioengineered alternatives to bone grafts and transplants, Prof. O'Brien aims to revolutionise the healing of fractures and breaks and reduce treatment and recovery times for patients. The objective is to ultimately pave the way for innovative treatments for sufferers of other conditions involving tissue damage.

'We are trying to encourage the body to repair itself in instances where it normally might not do so,' explains Prof. O'Brien, who received an ERC Starting Grant for the project in 2009.

COLLREGEN is basing its research on creating collagen-based biomaterials, which are combined with gene therapy, growth factors

and stem cell technology to promote tissue repair.

### Bridging broken bones

One of the main focuses of the project has been the development of new scaffold materials that can be used to encourage the flow of oxygenated blood to damaged bone. Many defects fail to heal because of poor infiltration of blood vessels and the new tissue struggles to survive without a supply of oxygen and nutrients. The scaffold provides signals for the recruitment of, and support for new blood vessels to grow into.

With his team, Prof. O'Brien has developed an innovative scaffold material made from collagen and nano-sized particles of hydroxyapatite (a calcium phosphate ceramic) which acts as a platform to attract the body's own stem cells to repair bone in the damaged area using gene therapy.

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The cells are programmed to overproduce proteins which encourage the regrowth of healthy bone tissue.

The significance of this work is that it provides a way for new bone tissue to be generated where it has been damaged, or destroyed by disease, and avoids the need for surgical bone grafts. Bone grafts, either from another part of the person's body, or from a donor, carry the risk of infection.

There is also the risk that the grafted bone will not properly 'take' at the site where it is required.

'By stimulating the body to repair itself, using non-viral gene therapeutics, these negative side effects can be avoided and bone tissue growth is promoted efficiently and safely,' says Prof. O'Brien.

### Potential for further regeneration

He explains that there is a large potential market for bone-graft substitute materials, such as the innovative scaffolds being developed by the COLLREGEN team, and that a future objective is to develop a commercially viable, functionalised platform for use in the medical sector.

Prof. O'Brien and his team are also investigating how this process can be used not only to engineer bone tissue but to deliver genes that promote the formation of blood vessels in the regeneration of tissues in other parts of the body.

'This technique of using scaffolds combined with therapeutic genes to repair damaged tissue could be applied in the future to repair damaged heart or even brain tissue,' explains Prof. O'Brien. 'We're hoping the research we're

undertaking will lead to successful regenerative therapeutics for other damaged or diseased tissues in addition to bone.'

The project is coordinated by the Royal College of Surgeons in Ireland.

1 'Collagen scaffolds for bone regeneration: applied biomaterials, bioreactor and stem cell technology'.

Funded under the FP7 specific programme 'Ideas' (European Research Council).  
<http://ec.europa.eu/research/infocentre> > search > 30713

## Antibiotic resistance revisited: the role of biocides

*Antibiotic resistance is a serious medical issue affecting health-care efficacy and sometimes causing life-threatening infections or sepsis. An EU-funded project aimed to investigate the extent to which the antibiotic resistance phenomenon could be caused or exacerbated by improper use of biocides.*

Biocide refers to a family of compounds that have the ability to control or deter the harmful effects of various pathogens. Despite biocide usage for hundreds of years in antiseptics, disinfection and preservation, they remain effective against most bacterial and fungal species.

An increasing number of reports note the co- and cross-resistance between antibiotics and biocides, raising speculation on the

potential hazard of biocide use. The EU-funded BIOHYPO<sup>1</sup> project was initiated to investigate this issue.

The key issue raised by BIOHYPO concerned assessing the impact of biocides' use in the food chain on the emergence of antibiotic-resistant human pathogens. The work focused on four biocides: triclosan, benzalkonium chloride, chlorhexidine and sodium hypochlorite.

Partners performed phenotypic screening of over 4000 strains of the species *Staphylococcus aureus*, *Salmonella Enteritidis*, *Escherichia coli* and *Enterococcus faecalis*. Their aim was to determine the 'minimal inhibitory concentration' (MIC) and 'minimal bactericidal concentration' (MBC) of biocide susceptibility. These values are publicly available online and would help determine the required effective doses for each case.

A reduced susceptibility to triclosan was observed in some strains of *S. aureus* to be due to the aberrant expression of a 'Fatty-acid biosynthesis' (FabI) gene. This was caused either by the acquisition of an additional allele — one of the alternative forms of the gene — from *S. hemolyticus* or by an insertion upstream of the endogenous FabI sequence.

BIOHYPO partners studied the reduced susceptibility to biocides in relation to antibiotic resistance and found no correlation overall. However, they believed

this might change as they could detect plasmids in *S. aureus* carrying both the 'cation' resistance gene QacA and the sh-fabI gene.

Information generated by the BIOHYPO consortium will help shape intervention strategies for limiting the impact of biocide use on antibiotic resistance. Dissemination of BIOHYPO data and results to the European Committee for Standardization (CEN) will also aid the legislative efforts of public authorities in this arena.

The project was coordinated by the University of Siena in Italy.



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1 'Confronting the clinical relevance of biocide-induced antibiotic resistance'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
[http://cordis.europa.eu/result/brief/rcn9974\\_en.html](http://cordis.europa.eu/result/brief/rcn9974_en.html)  
Project website:  
<https://kdbio.inesc-id.pt/biohyppo/>

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# The 'ABC' of prescribing medication

*Medicine is an important component of health care, but can be a bitter pill to swallow for patients. Since as many as half of European patients do not take medication as prescribed, a European project has identified ways to improve compliance.*

Medication is at the heart of modern medicine. It not only saves lives, but also improves the quality of life and health of patients. For medicines to be effective they must be taken as prescribed. However, up to half of European patients reportedly do not adhere to their doctors' orders, resulting in non-response to therapy, the progression of diseases, and a greater economic burden on patients, their families and society.

ABC<sup>1</sup> was an EU-financed project set up to provide empirical evidence on how to enhance patient adherence and improve the use of medication in Europe. Targeting different clinical sectors, health-care settings and population groups, the project identified the determinants of non-compliance and investigated current adherence management practices.

The project team also assessed the effectiveness of various

interventions and produced policy recommendations for health-care professionals, policy-makers, patients, industry and the research community.

Of the 771 non-compliance factors identified by ABC, the majority were related to implementation, with only 47 linked to persistence with medication. This means that measures to improve implementation could have an enormous impact.

Therefore, the project concluded that patients need to be empowered and supported with information and education when medication is first prescribed. Health-care professionals also need more education and training on patient-centred care, identifying and addressing non-adherence, and choosing the right intervention.

To achieve this, ABC recommends the two parties should discuss the patient's treatment beliefs



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and preferences, forge a partnership to make decisions on treatment, and build up mutual trust.

Moreover, where possible, industry should simplify medication regimens, while health-care providers should prioritise adherence support. In addition, governments should raise public awareness, promote effective interventions and support further research in the field.

The project's integrated set of recommendations could make patients' adherence to their prescribed medication as simple as 'ABC', with huge benefits for

patients, their loved ones and society.

The project was coordinated by the Medical University of Łódź in Poland.

- 1 'Ascertaining barriers for compliance: policies for safe, effective and cost-effective use of medicines in Europe'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcn/11555\\_en.html](http://cordis.europa.eu/result/brief/rcn/11555_en.html)  
 Project website:  
<http://abcproject.eu/index.php>

## Sponge enzymes: nature's little bio-builders

*Sponges seem an unlikely source for innovation, yet they may hold the key to new nanotechnologies, innovative optical devices and new ways of regrowing human bone and preventing bone disease. Difficult to believe? Not for Werner E.G. Müller. In the BIOSILICA<sup>1</sup> project, he and his team are developing ways to adapt the complex processes that natural glassy sponges use to build their wondrous biosilica structures for use in biodegradable implants that would facilitate bone healing after surgery or fractures.*

Biomineralisation is the formation of composite structures containing inorganic materials by living organisms — for example, an eggshell or a tooth. Biosilica is an important biomineral — produced on the scale of gigatonnes through biosilicification, mainly by marine organisms, such as siliceous sponges.

The length of the delicate, intricate biosilica structures found in siliceous sponges ranges

from nanometres to millimetres. These beautiful open frameworks of rod- and star-shaped biosilica spicules have amazed scientists since they were first observed. But to the more application-oriented eye, they have other interesting features: nanometre-scale silica structures form vital components in micro- and nanoelectronics, such as insulators and optical wave guides. In addition, biosilica holds the promise of

biocompatibility — a vital property for medical implants.

At the University Medical Center of Johannes Gutenberg University Mainz in Germany, Professor Werner E. G. Müller and his co-workers in the Institute for Physiological Chemistry are using an ERC Advanced Grant to uncover the fundamental mechanism of biomineralisation, in particular biosilicification, and to harness

its processes for a range of exciting new technologies.

'The beauty of nature is that it finds strategies to make things happen. In chemistry, change is constrained by the activation energy needed for a chemical reaction — you must put in a lot of energy in order to get things going,' says Werner Müller. 'In contrast, biochemical reactions get round this by using natural catalysts to reduce the activation

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energy required. In biosilicification, it is enzymes that play this catalytic role.'

Indeed, he points out, fabricating silica nanostructures and optical components at present involves extreme conditions: temperatures of around 1000 °C for silica optical fibres. Yet sponges achieve similar



© W.E.G. Müller – Mainz

results at ambient temperatures and with much less energy expenditure by using enzymes that expedite chemical processes simply by binding transiently to the materials involved.

### Building on a new paradigm

'The discovery of the enzyme catalyst silicatein in the last decade, and its role in the formation of inorganic biosilica, produced a paradigm change for researchers. We now know that only a few enzymes can control reactions, but our research shows that it is not limited to biosilica — other biomaterials containing metals can also be produced using specific enzymes,' explains Professor Müller. His team is taking biosilicification research further by bringing in cutting-edge techniques from structural biology, biochemistry, bioengineering and material sciences. Already this research has borne fruit in the parallel SI-BONE-POC<sup>2</sup> project awarded by the ERC.

'Sponge structures are extremely diverse and it's the same for animal bones; each species has its own specific body plan. Even though we don't know how this is determined in humans, we have discovered that bone growth is controlled by enzymes as well, which led us to produce prosthetic implants using biosilica made *in vitro*. These implants have proved highly biocompatible in animal experiments — they are not rejected by the host organism.

'We are also discovering that they offer other benefits: they are biodegradable over time, thus removing the need for surgery to remove them, as is done for metal pins used to repair fractures. Even better, this slow biodegradation allows for a controlled regrowth of new bone. Indeed, the biosilica also seems to promote new bone growth. This is not so surprising since human bodies contain biosilica and glassy sponges were among the first organisms to evolve on earth. They are thought

to be the ancestors of vertebrates — so a strong biocompatibility reflects this.

In SI-BONE-POC, we are taking this research forward. In particular, we are looking at the role which the silicatein enzyme might play in preventing and even curing osteoporosis, an age-related bone disease that brings huge costs and great misery to sufferers, and which is on the rise as we live longer.'

The project is coordinated by the University Medical Center of Johannes Gutenberg University Mainz in Germany.

- 1 'From gene to biomineral: Biosynthesis and application of sponge biosilica'.
- 2 'Silica-based nanobiomedical approaches for treatment of bone diseases: Proof-of-Concept'.

Funded under the FP7 specific programme 'Ideas' (European Research Council).  
<http://erc.europa.eu> > Projects and Results  
 > ERC Stories

## Understanding the health benefits of flavanols

*It is no secret that eating the right foods can help people feel better and live longer. The nutrition in our daily diet is a major lifestyle factor in influencing human health and disease. For example, medical evidence has long shown that diets rich in plant-based foods can decrease the risk of cardiovascular diseases.*

One particular class of compounds, called flavanols, has been investigated in recent years. Found in certain teas, fruits, and cocoa products, these substances have shown a potential to deliver various health benefits, including better vascular function, lower blood pressure and improved immune responses.

The EU-funded project FLAVIOLA<sup>1</sup> aimed to advance our knowledge of the delivery, function and health benefits of dietary flavanols.

FLAVIOLA researchers say their research has provided a much clearer understanding of the cardiovascular and circulatory health benefits of flavanols — a benefit for public health.

Recent innovations in analytics, chemistry, food-processing technology, and non-invasive cardiovascular function assessments have helped researchers study flavanols more comprehensively, providing advances that support the development of future applications, including potential dietary recommendations.

Multi-disciplinary research carried out under the project has shed new light on the types and amounts of flavanols in cocoa, as well as the effects of food processing and manufacturing on the flavanol content of certain food products.

These novel findings have also advanced our understanding of what happens to flavanols in the human body following



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consumption, and provided insights into the action mechanisms that underlie the biological effects of this plant-derived nutrient.

FLAVIOLA researchers have also compiled a comprehensive database of the amounts and types of flavanols consumed in 14 countries across the European Union. This will enable better interpretation of dietary intervention studies and clearer associations between flavanol consumption and health.

The project, which was completed early in 2013, received around EUR 3 million in EU funding. It included researchers from Belgium,

Germany, France, the Netherlands, Sweden, Switzerland and the United Kingdom.

The project was coordinated by the University of Düsseldorf in Germany.

- 1 'Targeted delivery of dietary flavanols for optimal human cell function: Effect on cardiovascular health'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
<http://cordis.europa.eu/news> > search > 35973  
 Project website: <http://www.flaviola.org/>

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# Work on cell memory mechanism could help identify disease-causing mutations

*When a 'mother' cell divides into 'daughter' cells — as often as once every 24 hours — the latter inherit the identity and functions of the former. A team at Sweden's Karolinska Institutet has recently unveiled the mechanisms behind this memory transmission, with help from various institutions and EU-funded projects.*

The way our cells continuously divide to form two identical copies is key to our own existence. Without cell division we would not be able to grow or heal from injuries. In fact, most of the species populating our planet, including humans, simply would not exist.

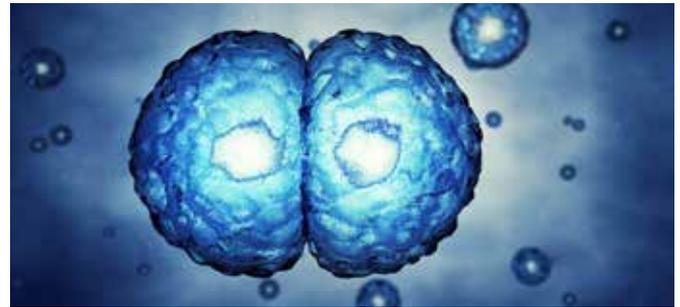
Despite its importance, some of the underlying mechanisms behind cell division are still unknown. This was the case of 'cell memory' transmission, a process which allows daughter cells to inherit their functions — insulin production, for instance — from mother cells. Despite many years of intense research, no general mechanism had been discovered which could explain how this works.

Admittedly, the process is mind-boggling: transcription factors — proteins which are bound to specific DNA sequences, control the flow of genetic information and thereby determine a cell's identity and function — are erased each time a cell divides. Surprisingly enough, these binding patterns are eventually restored in both mother and daughter cells. A mystery? Not anymore, according to Jussi Taipale, Professor at the Department of

Biosciences and Nutrition (BioNut) at Karolinska Institutet and head of the research team behind the discovery.

'The problem is that there is so much DNA in a cell that it would be impossible for the transcription factors to find their way back within a reasonable time frame. But now we have found a possible mechanism for how this cellular memory works, and how it helps the cell remember the order that existed before the cell divided, helping the transcription factors find their correct places,' explains Prof. Taipale.

Having produced the most complete map yet of transcription factors in a cell, the group found that a large protein complex called cohesin is positioned as a ring around the two DNA strands that are formed when a cell divides, marking virtually all the places on the DNA where transcription factors were bound. Cohesin encircles the DNA strand, and the protein complexes that replicate DNA can pass through the ring without displacing it. Since the two new DNA strands are caught in the ring, only one cohesin is needed to mark the two, thereby helping the transcription factors to find



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their original binding region on both DNA strands.

'More research is needed before we can be sure, but so far all experiments support our model,' Martin Enge, assistant professor at BioNut, Karolinska Institutet, says.

Transcription factors play a pivotal role in many illnesses, including cancer and many hereditary diseases. In future, the team's discovery may therefore have direct consequences for patients with cancer or hereditary diseases, with cohesin functioning as an indicator of which DNA sequences might contain disease-causing mutations.

'Currently, we analyse DNA sequences that are directly located in genes, which constitute about 3 % of the genome. However, most mutations that have been shown to cause cancer are located outside of genes. We cannot analyse these in a reliable manner — the genome is simply too large. By only analysing DNA sequences that bind to cohesin, roughly 1 % of the genome, it would allow us to analyse an

individual's mutations and make it much easier to conduct studies to identify novel harmful mutations,' Enge concludes.

The research was supported by the Center for Biosciences at Karolinska Institutet, the Knut and Alice Wallenberg Foundation, the Swedish Research Council, Science for Life Laboratory, the Swedish Cancer Foundation, the ERC Advanced Grant GROWTHCONTROL<sup>1</sup>, and the EU FP7 Health project SYSCOL<sup>2</sup>.

The project is coordinated by the Karolinska Institutet in Sweden.

- 1 'Dissecting the transcriptional mechanisms controlling growth during normal development and cancer', funded under the FP7 specific programme 'Ideas' (European Research Council).
- 2 'Systems biology of colorectal cancer', funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.

<http://cordis.europa.eu/news > search > 35997>  
Project website: <http://syscol-project.eu/>

## Novel drugs against trypanosomal diseases

*Experts in parasite biology and medicinal chemistry teamed up to identify compounds with potent activity against protozoa of the Trypanosomatidae family. They investigated strategies that intervene with the basic metabolism and DNA in these protozoa.*

Protozoa of the genera *Leishmania* and *Trypanosoma* are responsible

for Leishmaniasis, African trypanosomiasis and Chagas disease.

Leishmaniasis alone gives rise to over 2 million clinical cases annually, while nearly 18 million people are infected with *Trypanosoma cruzi* (Chagas disease). Overall, these infected diseases have been relatively neglected in research but are the cause of substantial

morbidity and mortality in endemic regions, found mainly in tropical and sub-tropical areas.

As a result, new tools and drug targets are required for combating pathogenic protozoa. Antimetabolites against purine

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and pyrimidine (components of DNA helix nucleobases) have been used with great success in the treatment of a wide range of diseases, including cancer and AIDS.

The EU-funded TRYPOBASE<sup>1</sup> project explored the anti-parasite potential of novel nucleobase derivatives. Among the project's objectives were to screen

drug-like compounds *in vitro* and *in vivo*, as well as to synthesise novel ones. To this end, a library of nearly 7000 nucleoside and nucleobase derivatives was screened and several compounds exhibited anti-parasite activity, especially against *T. cruzi*.

An alternative strategy was explored by the TRYPOBASE consortium. This entailed the

targeting of the 'Deoxyuridine triphosphate nucleotidohydrolyase' (dUTPase) enzyme implicated in nucleotide metabolism. Using RNA interference, the consortium unveiled the importance of dUTPase for parasite growth and proliferation. Parasites with reduced enzyme levels exhibited either absence of or an enlarged nucleus, and presented defects in cell cycle progression.

To prepare inhibitors for the dUTPase enzyme, scientists screened a chemical library of over 62 000 compounds. Three-dimensional (3D) analysis of the enzyme for the identification of potential targets revealed a polar active site requiring significant further structural optimisation of the selected compounds.

Although the nucleotide antimetabolite work of the TRYPOBASE

project exhibited higher anti-parasite potential, information generated on the dUTPase enzyme in particular is expected to drive future research on this target. Following optimisation, the identified compounds have the potential to progress down the development pathway rapidly toward clinical candidates.

The project was coordinated by the Spanish National Research Council in Spain.

1 'Nucleobase derivatives as drugs against trypanosomal diseases'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcv/11551\\_en.html](http://cordis.europa.eu/result/brief/rcv/11551_en.html)  
 Project website:  
<http://www.ipb.csic.es/trypobase.html>

## New mycotoxin detection device goes from prototype to production

*Mycotoxins are naturally occurring fungi which typically grow on wheat-based foodstuffs, including cereals and bread, under humid conditions. They can cause a variety of adverse health effects in humans, such as damaging kidneys or compromising immune systems. In an effort to safeguard the food chain, a series of EU-funded research teams have developed a low-cost device able to detect traces of mycotoxins in feed, food and beverages.*

Traditional methods of detecting toxins in food products are often unreliable and prove costly and time-consuming for SMEs. Against this background, the University of Rome and the Research Institute INESC MN, Portugal launched the OTASENS<sup>1</sup> project.

The researchers developed a novel device able to perform rapid detection and quantification of ochratoxin A or OTA — a highly toxic strain of mycotoxin — in wine, beer and feed through a linear array of amorphous silicon (a-Si:H) photosensors deposited on a glass substrate.

The device is able to detect highly toxic varieties of mycotoxins. It was integrated with surfaces treated in different ways in order to gauge their sensitivity to mycotoxins in several food and feed products. Spearheaded by two SMEs, OTASENS experimented

with different extraction methodologies by analysing food that was naturally contaminated and fortified with OTA.

Mycotoxins are often resistant to decomposition and as such can remain in the food chain, posing a threat to important sources of human nutrition — particularly meat and dairy products. To tackle this, the new device will be able to perform a reliable analysis in various settings, including canteens, breweries and farms, with the aim of satisfying food quality control requirements.

Now that a compact portable device has been developed, the next step is to make the transition from prototype to commercial device. The recently launched DEMOTOX<sup>2</sup> project aims to do just



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that, preparing a pre-series of devices ready to be introduced into the commercial market within the next two years.

SMEs, which are very interested in a low-cost and efficient method of identifying contamination in food, will be working together with researchers from OTASENS. A small team will prepare around 20 demonstrative devices which will be distributed to end-users in various sectors to

pilot the device's commercial potential.

Combining expertise in product development, management and risk mitigation, members of OTASENS and DEMOTOX have set out to take the device to market with the assistance of competent external bodies. A kick-off meeting took place in late August to demonstrate the new device to stakeholders and interest groups. Through commercialisation, project

partners hope to make SMEs in the food industry more competitive while increasing safety across the food chain.

The DEMOTOX project is coordinated by Automation in Italy; OTASENS was coordinated by Giesinger Biermanufaktur & Spezialitäten Braugesellschaft in Germany.

- 1 'Novel photosensor-based device for rapid and quantitative ochratoxin A determination in wine, beer and feed'.
- 2 'A new device to detect quickly and friendly ochratoxin A and other mycotoxins in feed, food and beverage'.

Both projects are funded under the FP7 specific programme 'Capacities' under the theme 'Research for the benefit of SMEs'.  
<http://cordis.europa.eu/news/search/35989>  
 Project websites:  
<http://www.otasens.it/>  
<http://www.demotox.it/>

## Anxious for a cure

*New research has revealed some of the underlying environmental, behavioural and biological factors behind anxiety. The condition affects countless individuals and has even become an economic burden due to the amount of sick leave sufferers take from work.*

Scientists have known for a long time that two brain hormones, 'gamma-aminobutyric acid' (GABA) and serotonin, play a role in anxiety. It has recently come to light that environmental risk factors may affect serotonin-related genes, and that GABA receptors play an important role in mediating the anxiety-counteracting effects of GABA. It is also now known that these two hormonal systems

interact, although deeper insights are needed if targeted therapies are to be developed.

Specialists in development, neuronal plasticity, neurobehaviour, neuropharmacology and mouse genetics came together under the EU-funded DEVANX<sup>1</sup> project to gain further related insights. They focused on how GABA and serotonin systems interact in the

developmental programming of anxiety.

Project researchers fully characterised various mouse models, including some that were deficient in serotonin or certain GABA receptor activities. They were able to determine the role of two GABA receptors, GABAb1A and GABAb1B, as well as the implication of specific hippocampal

circuits involved in remembering anxiety-causing stimuli.

The team also validated new genetic methods to examine serotonin circuits. They found that pharmacogenetic approaches worked well to tease apart anxiety-related circuits.

A number of scientific publications have been published relating to this research, pointing to the massive contribution the DEVANX project has made to the field. A better understanding of the mechanisms driving anxiety could lead to novel therapeutic approaches.

The project was coordinated by INSERM in France.

- 1 'Serotonin and GABA-B receptors in anxiety: From developmental risk factors to treatment'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcn/7393\\_en.html](http://cordis.europa.eu/result/brief/rcn/7393_en.html)  
 Project website: <http://devanx.vitamib.com/>





## Learning workplace skills through gaming

*In the current economic environment, highly skilled, productive and efficient workers are among a company's best assets. But keeping employees at peak performance and teaching them new skills requires effective lifelong learning. A technology-enhanced approach to learning, combining elements from serious games and learning theories, is now being developed.*

Training programmes, seminars and workplace learning courses are widely used today by organisations of all sizes looking to develop employee skill sets and build competence in performing different tasks. Many focus on reducing so-called 'Time to competence' (TTC), the period it takes for an employee to be proficient in a certain role. The main route to shorten TTC is a bespoke face-to-face or blended course, which tends to be resource-intensive — courses cost money and time to set up and run, and workers often need to miss work to attend them. In addition, it is widely recognised that

a classroom approach to learning is less effective and engaging than practice-oriented, interactive methods.

'Ideally, if you're trying to train someone to be a project manager you want them to experience being a project manager and learn the skills on the job, so to speak. However, it is risky and potentially very costly for a company to put someone without the right training in such a position — they could make mistakes or be ineffective,' says Dr Hans Torvatn, a senior research scientist at the Institute of Technology and Society (SINTEF) in Norway.

But what if they could take on the role of a project manager, experience the challenges of the position, make mistakes, learn from them, and try again?

That is the thinking behind a project managed by Dr Torvatn to develop a game-based approach to training using virtual reality (VR) environments and simulations to quickly and cost-effectively teach knowledge workers — such as engineers, doctors, civil servants or project managers — new skills. Called TARGET<sup>1</sup>, the project is focused on methods and tools for cost-effective



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dynamic competence development, with flexible learning contexts of varying complexity and longevity. TARGET has a budget of EUR 9.4 million, with funding of EUR 6.8 million from the European Commission. The consortium involves 15 partners from 11 European countries.

Although games, VR and simulations are already well-established training tools, they have mostly been used to date to teach people specific technical skills or enhance existing ones through practice.

‘For example, there are training simulators for doctors who perform surgery to improve their dexterity or for resource managers to practice planning, but in TARGET we are focusing on what could be described as “soft skills” or higher cognitive skills — things like negotiation, trust-building, leadership and communication,’ the project manager explains.

‘TARGET is built on modern approaches to pedagogy and learning, especially ideas on personalised learning and learning plans, where Threshold Concepts play a key role. One may perceive a Threshold Concept as a gateway in a particular knowledge domain, which once mastered, leads to emergent new knowledge as the individual’s understanding is expanded and they are transformed into thinking like a practitioner.’

### Unique approach

The approach addresses several key learning challenges, including taking into account that each learner is a unique individual, with different cognitive abilities, emotional intelligence, personality, knowledge and experience. Therefore, Dr Torvatn says, it is not feasible to develop a single solution tailored to all learners, but rather it is necessary to support mass individualisation. The problems are exacerbated by the need to retain the capacity to handle unpredicted events, meaning that at least some of the learners and managers in an organisation need to attain novel ways of understanding and the ability to think with different perspectives.

For the trainee, learning begins by logging into the TARGET platform and undergoing an analysis to determine their learning goals and build a personalised learning plan. They are then offered a range of different stories or scenarios to choose from, in each of which they take on a specific role that they play out as an avatar in a virtual reality environment. The project team has so far designed three scenarios — ‘stakeholder management’ (SM), ‘sustainable global manufacturing’ (SGM) and ‘social architect’ (SA) — under which the

system was evaluated with engineering, project management and business school students.

### What would you like to learn today?

If a worker needs to develop interpersonal skills for conducting business in highly dynamic, complex and demanding social environments, for example, they might be guided to play the role of an energy company manager negotiating with a town mayor, a farmer and an environmental campaigner about the installation of a wind farm.

If they need to develop leadership abilities and build experience in managing multicultural business relationships, they might take on the role of a manager charged with putting together a team for a new project.

Or if they need to develop long-term critical and strategic thinking skills, they might act as a sustainability manager attempting to draw up a sustainable global manufacturing strategy for a medium-sized company, where the CEO supports the strategy but the rest of the key stakeholders do not.

‘As part of the total evaluation efforts, the three scenarios have been evaluated in trials by different project partners involving more than 60 participants across Europe. However, evidently many different scenarios are possible depending on the needs of the employer and the employee,’ Dr Torvatn says. ‘The training they receive is interactive, engaging and highly personalised to their requirements, depending on the skills they need to develop for the job they plan to perform.’

### Game plan

Within each game, the roles and attitudes of different ‘Non-player characters’ (NPCs), along with other factors, can change dynamically to meet specific requirements — such as becoming more confrontational or delaying tasks within a project. A ‘Competence performance analyser’ (CPA) looks at each player’s performance during the game and scores them on different skills. When the session is finished, the CPA gives them visual feedback in the form of video playback of what they did, correlated with their scores on a timeline, therefore supporting the necessary reflection for learning. Players are also able to interact with other participants and share experiences in a VR social space called the ‘Lounge’.

‘Players can play the games as many times as they like. They can try different strategies, make mistakes, reflect on them and learn from them. In that way they learn from experience — it’s a case of practice makes perfect,’ Dr Torvatn says.

The main problem the TARGET team had to overcome was to transform theories of learning into models that software developers could use to develop the various components, and then integrate them into a total system. There were also other technological challenges, such as enabling dialogue between players and NPCs and the personalisation of stories tailored to the individual’s learning needs.

‘The system is a prototype and some features undoubtedly require more work,’ Dr Torvatn acknowledges. ‘However, there is a lot of interest in the platform, and especially in this approach to reducing time-to-competence for knowledge workers, particularly as using VR and games in this way is considerably less expensive and time-consuming than devising personalised real-world training programmes.’

Several of the project partners plan to continue work on the platform now the project has ended, and the team is interested in using the technology commercially to design game scenarios for companies to train workers to meet their specific business requirements.

‘In the future, this approach to training and skills development is likely to become more widespread. If you look at the younger generation of workers and those now entering the workforce, they are very accustomed to playing games and to this style of learning. They won’t just need this sort of interactive, personalised training, they will in fact demand it,’ the TARGET project manager says.

The project was coordinated by SINTEF in Norway.

1 ‘Transformative, adaptive, responsive and engaging environment’.

**SOCIAL SCIENCES AND HUMANITIES**

## Gender equality in science

*Although gender equality policies are in place, women are still under-represented in scientific and technological research (STR). An EU-funded initiative worked towards improving the capacity of STR organisations to manage, monitor and increase gender diversity.*

The WHIST<sup>1</sup> project fostered a joint learning process between institutions in Denmark, Germany and France: the University of Aarhus, the Fraunhofer-Institut für Arbeitswirtschaft und Organisation (IAO), and the European Space Agency (ESA), respectively. The idea was to gain insights into gender-equality actions that really work to promote diversity.

Such actions include the University of Aarhus' mentoring programme and an incentive scheme aimed at hiring

20 women professors. ESA, on the other hand, implemented actions aimed at encouraging a corporate culture that understands and values cultural and gender diversity. And, amongst other actions, the Fraunhofer-IAO created a re-entry support service aimed at employees on parental leave.

These experimental actions have ignited real change at the institutions, ensuring that women are able to participate at all levels of research. Other institutions have already started to adopt some



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these practices and the WHIST project has produced guidelines for more to follow suite. Fundamentally, the project has contributed to a positive change in attitude regarding gender equality.

The project was coordinated by the Dipartimento per i Diritti e le Pari Opportunità in Italy.

1 'Women's careers hitting the target: Gender management in scientific and technological research'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Science in Society' (SIS).  
[http://cordis.europa.eu/result/brief/rcn/6595\\_en.html](http://cordis.europa.eu/result/brief/rcn/6595_en.html)

## Journalism students get to grips with research

*Communication of research science to the general public can be ineffective or inaccurate due to a lack of understanding on the part of journalists. To address this, final-year journalism students were given the opportunity to spend some time in research labs and write about their experiences.*

The EU has identified that science communication to the general public is lacking in several aspects. This includes insufficient engagement and debate between researchers and the public, as well as a perceived distrust of

journalists in communicating scientific results.

RELATE<sup>1</sup> was an EU-funded project that placed 78 journalism students in 30 research laboratories. The students spent a week in the laboratory

learning about the daily lives of scientists, and then wrote about their experiences.

RELATE was established as a pilot project to get research labs on-board, with the aim of creating a permanent programme. The project also aimed to bridge the divide between researchers and journalists.

Students wrote daily blogs of their experiences in order to monitor the effectiveness of the programme. At the end of their week-long stay, they wrote feature articles, approximately 25 % of which were published in various print and online media.

This project has improved science journalism in Europe by bringing together researchers and journalists in a new way,

and by extending interdisciplinary communication and understanding. In addition, hands-on scientific experience for journalists will translate into more accessible science communication for the public. The articles published by the students are available on the project website.

The project was coordinated by Minerva Consulting and Communication in Belgium.

1 'Research labs for teaching journalists'.

Funded under the FP7 specific programme 'Capacities' under the research theme 'Science in Society'.  
[http://cordis.europa.eu/result/brief/rcn/11480\\_en.html](http://cordis.europa.eu/result/brief/rcn/11480_en.html)  
 Project website: <http://relateproject.eu>



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## SOCIAL SCIENCES AND HUMANITIES

### Why Europeans are having less children

*Several factors influence changes in birth rates. An EU-funded project used an integrated macro-micro approach to investigate these reasons for the purpose of informing family-oriented policies.*

Most European countries have low fertility rates because various obstacles prevent people from having their desired number of children. The REPRO<sup>1</sup> project was established to gain insights into these obstacles. It involved researchers from 12 countries who maintained close contact with the Organisation for Economic Co-operation and Development (OECD) and the European Commission.

The researchers identified economic uncertainty as one of the main factors associated with variable fertility rates. Unemployment among

men and job insecurity among women were associated with lower fertility rates.

Other findings were that increased fertility rates could be achieved through creating opportunities for women to combine family life and employment, or by providing affordable, quality childcare. Paid and employment-protected leave and financial transfers, on the other hand, were found to be less influential on fertility rates. On a more personal level, individuals' beliefs about positive outcomes, level of education and age did seem to influence birth rates.



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These insights have led to a better understanding of why fertility is low in the EU. The information is useful for those decision-makers developing family policies that encourage having more children.

The project was coordinated by the Vienna Institute of Demography in Austria.

- 1 'Reproductive decision-making in a macro-micro perspective'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Socio-economic sciences and humanities' (SSH).  
[http://cordis.europa.eu/result/brief/rcn/11278\\_en.html](http://cordis.europa.eu/result/brief/rcn/11278_en.html)  
 Project website:  
<http://vidrepro.oew.ac.at/>



### New social platform boosts research on families

*Today's social trends and developments are changing the way families function, prompting the need for more in-depth research and better-informed policies to enhance family well-being.*

Modern values, rapidly ageing populations and a shift in priorities are all changing our fundamental understanding of the European family. Current research on family well-being is necessary to redefine policies in this respect and secure a better future for European citizens. The aim of the EU-funded project FAMILYPLATFORM<sup>1</sup> was to identify the social challenges and explore their effect on the family unit.

By establishing a social platform in conjunction with various stakeholders and policy-makers, the project sought to reconcile the perspectives of different social groups to map key trends and challenges facing families. It identified knowledge gaps and research needs on the topic, providing important data on family life and family policies across Europe.

Through a series of workshops, the project team investigated the impact of key societal trends on family life, promoting valuable exchanges among stakeholders and researchers. Specific topics investigated included providing care for family members, management of everyday family life, migration, mobility, inequality and family life changes. FAMILYPLATFORM also looked at how new media and information technologies shape family life and behaviour, including risks and new opportunities linked to the development of communication.

Having updated family research data and generated key policy questions to upgrade policy-making, the project set out a research agenda for the future. Project outcomes included comprehensive field reports on several important



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family topics from social services to education. FAMILYPLATFORM also organised a congress, workshop and conferences with focus groups that investigated and reviewed the project's results, in addition to launching an online platform for discussion.

Overall, the project is expected to show how national disparities in family policies can be evaluated in the long run. It will help stakeholders in policy and research to understand the needs and desires of families, encouraging the implementation of family-relevant policies. From living environments and social welfare to state policies and social equality, European families

can look forward to better policies and an enhanced quality of life in the future.

The project was coordinated by the Technical University of Dortmund in Germany.

- 1 'Social platform on research for families and family policies'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Socio-economic sciences and humanities' (SSH).  
[http://cordis.europa.eu/result/brief/rcn/11277\\_en.html](http://cordis.europa.eu/result/brief/rcn/11277_en.html)



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## Digesting food waste to produce energy

*Scientists are putting food waste, growing energy needs and climate change — three of society's most important challenges — into an equation so that every bit adds up: generating energy from food waste could be the most workable, sustainable solution to tackle these issues simultaneously. Well aware of this potential, the VALORGAS<sup>1</sup> project set out to improve existing processes and technologies.*

Food waste arising from homes, restaurants, catering facilities, food markets and food-processing activities represents a large fraction of the municipal waste stream. According to the European Commission, some 90 million tonnes of food is wasted annually in Europe, and this figure is constantly growing. Not only is it unacceptable when close to 900 million people in the world are suffering from hunger, but food waste usually ends up in landfills where it generates enormous quantities of greenhouse gases (GHGs). Food waste is unsustainable, in every sense of the word.

While a zero-food-waste society would require a revolution in the way we consume and produce food, the emergence of a second generation of biofuels as a serious

political, scientific and commercial option could help us turn a dead loss into a significant gain. However, conventional combustion processes are not the best way to access the high energy potential of food waste, as its high moisture content tends to lower its heat value.

Anaerobic digestion of food waste could help overcome this issue. It allows for highly efficient recovery of second-generation biofuel gas with multiple applications for the end-user, captures nutrients present in the waste and allows these to be returned to agricultural use, reduces moisture content in the residual waste stream, and is compatible with advanced automated sorting technologies. The EU-funded project VALORGAS aims to tap into this potential, and project coordinator

Dr Sonia Heaven told *research\*eu results magazine* how it expects to do so.

### What are the main objectives of the project?

In the UK, for instance, food wastes that can be segregated account for around 24% of the total waste from household, industry and businesses. Reusing this waste to generate energy through anaerobic digestion is the main scientific and technical challenge facing VALORGAS — which we aim to take on by proceeding to a thorough analysis of the current methods before identifying necessary improvements.

VALORGAS is focusing on many aspects of biogas production: both the processes — such as improvement of



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waste-collection schemes, optimisation of pre-treatment, and determination of the energy and carbon footprint — and the food waste itself, by improving the current understanding of the chemical and microbiological factors affecting the potential energy gain.

The team also aims to improve current technologies in order to increase productivity and achieve a good mass and energy balance around two full-scale digesters treating food waste, one at 'mesophilic' and one at 'thermophilic' temperature. The next step will be developing low-cost small-scale biogas upgrading technologies and storage systems for application in transportation and local low-pressure distribution systems.

Finally, the project will evaluate the appropriateness of scale of digestion and end-use energy conversion technologies as well as their potential markets, with a focus on the potential of food waste digestion as a second-generation biofuel source across the EU in terms of energy yield, environmental benefit and end-user requirements.

### What is new or innovative about the project and the way it is addressing these issues?

Anaerobic digestion is not a new technology, but its application to energy recovery in the field of municipal waste treatment is quite recent in Europe. When this project began, the use of source-segregated food wastes as a feedstock was not widespread, in part because of the technical challenges linked with collection, handling, pre-treatment and digestion of this material.

The research includes a number of innovative components in terms of the underlying science and technological applications; but its main novelty lies in the holistic way by which it is addressing these issues. This is brought about by having a single common goal: to evaluate and, where possible, to improve the energy production process with respect to the overall net energy gain achieved within defined system boundaries that include collection, sorting, processing, and beneficial use of recovered material.

### What first drew you to research in this area?

The motivation was rather technical. Previous trials with the anaerobic digestion of source-segregated food waste in laboratories and in the field led to quite unusual conditions, including very high concentrations of ammonia and volatile fatty acids (which are normally considered to inhibit the process). The digesters could operate for quite long periods in these conditions, with good yields of biogas, but a small shock or change in conditions could produce instability and, in extreme cases, rapid and complete failure of the process.

We wanted to explain why this happened and find solutions which would allow us to make use of this energy- and nutrient-rich waste stream for renewable energy production. So we started by looking at some of the more fundamental scientific issues related to the factors affecting microbial populations and metabolic pathways: some of this work was co-funded by the UK government.

However, we soon realised that, in order to optimise renewable energy production, you need to consider the whole process from collection and pre-processing of the material, to anaerobic digestion, and then utilisation of the biogas and 'digestate'. This has to be assessed in a rational way, looking at the whole-life energy balance and comparing different options, to be sure that we understand the consequences of our choices and can select the best combination of solutions.

### What are some of the difficulties you have encountered and how did you solve them?

The biggest difficulties have probably been scientific ones — trying analytical techniques used in other applications only to find they do not give clear results in this case, or testing approaches that were not as promising as originally hoped. We have tried to overcome those by using alternative methods, and coming up with new ideas. But like all consortia we have had our share of other problems — misunderstandings between partners, problems with travel, and sadly even the loss of one partner due to bankruptcy. We have managed to deal with those issues by having tolerant and flexible partners, with everyone being willing to reallocate work between consortium members to ensure we do the best job and deliver the best results we can.

### What are the concrete results from the research so far?

Our big successes are that we have found a way to solve the problems of unstable operation of food waste digestion, through supplementation by trace elements. We also came up with a hypothesis about the reasons behind this instability, in terms of underlying microbiology and metabolic pathways, and have proved it is correct.

This approach only works in mesophilic temperatures, but we have also developed and tested a method of stripping ammonia from digesters to levels below the toxic threshold, which can be used in thermophilic conditions. The recovered ammonia can then be used to provide high-value agricultural fertiliser products with much lower fossil fuel inputs.

Other project outcomes include work on small-scale low-cost gas upgrading systems which has led to the development of new systems that will shortly be coming to the



© Dr. Sonia Heaven

Dr Sonia Heaven

market and will make a significant contribution to the efficient use of biogas in local transportation systems.

We have also designed a mechanistic model of waste-collection systems that allows you to compare the efficiency and resource demand in terms of fuel consumption, greenhouse gas (GHG) emissions, number of vehicles required and amount of staff time. This can be used to assess existing systems or look for optimum solutions, and is available in the form of a free software package.

And we have developed a methodology for a whole life assessment of schemes for renewable energy production from anaerobic digestion of organic municipal or industrial wastes. This consists of the collections software plus a modelling tool for determining the energy balance from anaerobic digestion through to utilisation of the end products. It is already available in spreadsheet form and will be released as a software package as soon as it has been fully beta tested.

### How and when do you expect the results of your work to impact food-waste-related policies and initiatives?

The results of the research have already begun to affect food-waste policy and practice. Addition of trace elements to food-waste digesters is becoming common practice, and thanks to this work we can now advise operators on the correct components and dosages. Correct operation enables a large increase in the amount of food-waste that can be treated: when we started the project, long-term stable operation of food-waste digesters could not be at loading rates above 2 kg of 'organic dry matter' (ODM) per cubic metre (m<sup>3</sup>) per day. In our laboratories we are now operating at 8 kg ODM/m<sup>3</sup>/day with no signs

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of instability or loss of performance. This means a four-fold increase in the amount of material that can be treated by a given digester — or in the case of a new digester, it could be one-quarter of the size. While few or no commercial plants are running at a loading of 8 kg ODM/m<sup>3</sup>/day on pure source-segregated domestic food waste, loading rates are creeping up and so the profitability and resource efficiency is increasing. The work has also given us a clear idea on the advantages and disadvantages of collecting source-segregated food waste from households, in terms of the overall energy balance and usability of the outputs: and this type of collection is now becoming more popular. But we expect some of the major impacts to occur in the 6-12 months following the project. In Italy, Finland, the UK and Portugal the partners are helping to shape the agenda on discussions of the optimum systems for use of organic wastes. The conclusions on stability use of digestate are already being considered

by national agencies and will go forward for consideration in the 'End-of-Waste criteria' of the EU's Waste Framework Directive.

### What are the next steps of the project, or next topics for your research?

The research outputs have raised some very interesting questions. On the scientific side, we would like to further extend our fundamental knowledge of these anaerobic systems so that we can understand their limitations and turn these to our advantage by applying them to biotechnology applications for bio-based production. In engineering terms, we see numerous opportunities to extend some of the systems we have been developing for source-segregated domestic food waste to other organic wastes — especially for dealing with problematic high-nitrogen materials like slaughterhouse wastes and animal and poultry manures. There is huge scope for further development of technical

solutions for ammonia removal, gas upgrading, digestate conditioning and even hydrogen production. We would also like to be part of the wider attempt to produce clear and rational methodologies for the assessment of energy balances, to allow effective and unbiased comparison between options.

The project was coordinated by the University of Southampton in the United Kingdom.

1 'Valorisation of food waste to biogas'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Energy'.  
Project website:  
<http://www.valorgas.soton.ac.uk/>



## Predicting when lightning will strike

*When something is unlikely to happen, people often say that there is a greater chance of being struck by lightning. The fact is however that lightning does strike, and is one of the leading weather-related causes of death and injury.*

Furthermore, important infrastructure, including airports, hospitals, sports stadiums and power lines, can often be affected by lightning. Electronic components are particularly vulnerable to lightning-induced transient voltages.

There is therefore a potentially huge market for accurate lightning data. National

Meteorological Services (MET) in a number of Member States already provide some data, in most cases because of the incidence of forest fires. Lightning is estimated to cause up to 16% of forest fires in the EU, costing EUR 70 million in mitigation efforts a year.

However, this data tends to be very expensive for end-users,

and is often not accurate enough to make a significant difference. The EU-funded LOLIGHT<sup>1</sup> project sought to address this by developing a low-cost system capable of detecting lightning to an accuracy of 100 metres.

In addition, the system can track and predict lightning events in real time, and map lightning patterns within an area of 200 kilometres.

This project has outstanding commercial potential. The accurate and quick location of strikes can help reduce costs associated with lightning, such as forest fires. Power distribution companies also stand to benefit from this service, since they can prepare for storm-caused power outages by proactive load-management plans before operations are impacted.

When power disturbances are not handled quickly, there is risk of cascading failure. When a power line goes down, the

electricity that once flowed down the damaged line is forced down other paths. If those other lines are already close to full capacity, the onslaught of electricity will cause them to overload as a result of congestion, creating a domino effect that is the leading cause of massive blackouts.

The project also offers cost savings for airports and the air traffic control sector. During lightning threats, aircrafts have to re-route around the hazardous area, using up fuel and man hours. By using precise, real-time monitoring, routes can be planned more accurately, benefiting both the industry and passengers.

The project was coordinated by MFKK in Hungary.

1 'Lightning Mapping and Supercell Tracking System'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Research for the benefit of SMEs'.  
<http://cordis.europa.eu/news/search/35993>  
Project website: <http://www.lolight.eu>



## ENERGY AND TRANSPORT

# Kick-starting Europe's electric vehicle industry

*Electric vehicles (e-vehicles, or EVs) are set to play a key role in the future of urban mobility, reducing pollution, decreasing dependence on fossil fuels and saving drivers money. Although e-vehicles make up only a tiny fraction of the European car fleet at present, sales are expected to grow exponentially over the coming years, thanks, in no small measure, to advances in e-vehicle technology being made by EU-funded researchers. Fully electric vehicle technologies that optimise safety, energy consumption and kinetic energy recovery are also major contributors to ongoing improvements in the performance of hybrid vehicles.*



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Across the European Union, transport accounts for more than 70% of total oil consumption, the vast majority of which is imported from abroad. With more than 1 million additional cars going on to Europe's roads every 50 days, fuel consumption, congestion and pollution will only continue to increase if the internal combustion engine remains the main source of automotive power. Hence, the EU, national governments and private companies are spending billions on supporting the development of e-vehicles.

'Rather than offering forms of mobility based on ever-increasing energy prices, the industry is now faced with satisfying a rational demand for mobility: clean, safe and low-energy-consumption vehicles, requiring less energy to be produced, and using recyclable and eventually self-disposable materials,' says Dr Pietro Perlo, the CEO of Interactive Fully Electrical Vehicles (IFEVS), an Italian SME dedicated to e-vehicle development.

Dr Perlo helped oversee the development of ground-breaking e-vehicle technology in the P-MOB<sup>1</sup> project, supported by almost EUR 2.8 million in funding from the European Commission. Involving researchers from six companies

(Siemens from Germany; Mazel from Spain; IFEVS, Polimodel and Fiat from Italy; and Magnomatics from the United Kingdom), as well as the University of Sheffield in the UK, the project resulted in the development of a novel prototype electric car with a range of up to 20 kilometres (km) powered by solar power alone.

Coordinated by the Fiat Research Centre in Turin, Italy, the team behind P-MOB sought to break the link between increasing transport capacity and rising road deaths, congestion and pollution by developing an e-vehicle prototype that is not only clean, but extremely safe and compact. To do so, the researchers took a novel approach to advanced systems integration focusing, among other things, on solar cells, e-motor and magnetic torque control, power-energy management, distributed accumulators and technologies to enable e-vehicles to put power back into the grid when not in use.

'The design has met the highest safety ranking, a low footprint and extremely low energy consumption, making the vehicle ideal for most people's needs in cities as well as suburban roads,' Dr Perlo notes.

The prototype is a small compact vehicle — weighing less than 600

kilogrammes (kg) before the installation of the battery pack, and with a top speed of over 100 km per hour (km/h) — which meets new regulations on 'micro' electric vehicles. It also complies with the classical regulations for vehicle categories such as M1 (a car with eight or less passenger seats).

### Aerodynamic, safe and solar powered

A parallel project called WIDE-MOB<sup>2</sup>, also involving the P-MOB partners, helped address the design and development of the basic building blocks of electric vehicles. The WIDE-MOB team worked on optimised aerodynamics to radically reduce the drag at any speed, lightweight and low-cost bodies designed for high safety in the event of a frontal or lateral crash, as well as a variety of technologies for distributed propulsion.

'Our vehicle is the first with a two-motor powertrain with one motor per axle. We have two doors on one side only ensuring a high degree of safety, better ergonomics and reduced complexity with extremely low aerodynamic drag: around 30% lower than other vehicles of the same dimensions,' Dr Perlo explains. 'All the technologies were developed during the course of the project by the partners. Only the battery cells were produced

outside Europe, though the design came from within the project.'

The project's integrated ICT-based control systems allow for the operation of two motors and two differentials — so the vehicle's front and rear axles are independent, providing effective four-wheel drive — as well as variation of the torque ratio, depending on driving conditions, which provides a variety of important benefits. It increases vehicle control on small radius curves, improves adherence on wet and icy roads, provides the impression of faster acceleration without drawing more power and allows for fail-safe operation: if one motor fails the other will always allow you to return home. Most significantly, this in turn ensures that a single motor failure will not cause loss of control of the vehicle, particularly at high speeds.

In addition, the use of two motors combined with ICT-based smart energy management enables higher efficiency, because the two motors can individually be operated at peak performance in all driving conditions, while maximising energy recovery during braking through distributed braking on two axles combined with virtual 'anti-lock braking system' (ABS) control.

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Meanwhile, smart photovoltaic panels with smart diodes and self-adapting electronics minimise loss of energy generation due to shadows or a single malfunctioning cell. Like most electric vehicles, the P-MOB prototype can be charged directly from the electricity grid. The addition of flexible high-efficiency mono-crystalline silicon solar-cell technology, however, means that it can also be powered by the sun alone and can even sell back power to the electricity grid once its batteries are full.

In trials at Fiat's testing track in Turin, the vehicle was able to travel 20 km powered solely by its solar cells — more than enough for the average European daily commuter, especially in sunnier southern Europe.

'The vehicle's performance met our expectations for the design: it showed very high stability on small radius curves and had an average energy consumption of around 80 Watt-hours per kilometre,' Dr Perlo says. 'We presented

it to the public at events in Turin, Athens and Brussels and received very positive feedback.'

The prototype was designed using the first variable design platform for micro electric vehicles, also created within the P-MOB and WIDE-MOB projects, and now set to continue its evolution within the EU-MOBY R&D platform, supported by the European Commission.

'The idea of having a vehicle that with minor additions could meet both the homologation of micro electric vehicles and the classical M1 world is new and is enabling novel business approaches. All these concepts have been patented,' Dr Perlo notes.

However, he points out that batteries are at the heart of electrical vehicles and Europe's lack of a strong battery industry remains a challenge to home-grown technology. 'No doubt a new level of pan-European industrial organisation is needed to specifically address the manufacture of batteries because

this will put the overall road transport industry in trouble in the next few years,' he says.

Nonetheless, electric vehicle sales in Europe are expected to increase apace, rising from 45 000 this year to 400 000 in 2015, representing around 3.5% of new passenger car registrations. As technology improves, prices will also drop, with a small to mid-sized electric passenger car with a range of 250 km on a single charge predicted to cost EUR 15 000 within four years, down from EUR 20 000 at present.

Another incentive to switch to electric is likely to come from EU plans to progressively reduce overall passenger car fleet CO<sub>2</sub> emissions over the coming years.

'This will likely induce a deep change in the personal mobility offer: the conventional passenger car price will increase due to the technology to achieve the CO<sub>2</sub> emission threshold while electric

vehicles will fall in cost thanks to the optimisation of the manufacturing process and increasing sales,' Dr Perlo predicts. 'There will be a new equilibrium in the market and there will be room for new vehicle concepts such as the one developed in P-MOB.'

The project is coordinated by the Fiat Research Centre in Italy.

- 1 'Integrated enabling technologies for efficient electrical personal mobility', funded under FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT).
- 2 'Building blocks concepts for efficient and safe multiuse urban electrical vehicles', funded under FP7 specific programme 'Cooperation' under the research theme 'Transport'.

[http://cordis.europa.eu/result/brief/rcn/11511\\_en.html](http://cordis.europa.eu/result/brief/rcn/11511_en.html)  
Project websites:  
P-MOB  
<http://eeeepro.shef.ac.uk/p-mob/>  
WIDE-MOB  
<http://eeeepro.shef.ac.uk/wide-mob/>



## Making good use of biodiesel waste

*EU-funded scientists are developing a win-win concept for biodiesel producers. They are recruiting microorganisms to convert a major biodiesel waste by-product into value-added liquid fuels in an advanced biorefinery concept.*

In the quest to reduce dependence on fossil fuels and the associated impact on global climate change and energy security, biodiesel production from vegetable oils for the transportation sector has gained tremendous ground. However, with increasing production of valuable biodiesel, there is now a large excess of one of its by-products, glycerol (also known as glycerine).

In order to make biodiesel production sustainable, the market requires new uses for glycerol in other advanced liquid fuels, bio-energy applications and green biochemicals. In addition, incorporating the production of such existing and novel substances in an advanced biorefinery concept will enhance the competitiveness of current biodiesel producers.

Scientists initiated the EU-funded project GLYFINERY<sup>1</sup> to create just such an integrated and sustainable production process. Research is focused on the development of novel biocatalysts that favour high yields of desired products from glycerol using the majority of the feedstock in the process.

Having identified the most promising biocatalytic microorganisms and the fermentation processes for biological conversion, the third and fourth project years have been devoted to optimising the bioprocess design and to developing and optimising the recovery processes. Five potential products were identified during the third year (1,3-Propanediol (PDO), butanol, ethanol, biodiesel and biomethane). Processes for all five

were optimised and scaled-up leading to initial pilot-scale tests. Fermentation products were fed into an anaerobic biodigester to recover biomethane. Production and recovery partners collaborated closely on a 'life-cycle assessment' (LCA) to develop methods both economically and environmentally sustainable for integration into an advanced biorefinery concept.

GLYFINERY has successfully demonstrated the technical, economic and environmental feasibility of converting glycerol to value-added products for sustainable biodiesel production and effective waste management. In the face of a glycerol glut as global biodiesel production continues to increase, the developed technology should have an important impact on the competitiveness of biodiesel production.

The project was coordinated by the Technical University of Denmark.



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- 1 'Sustainable and integrated production of liquid biofuels, bioenergy and green chemicals from glycerol in biorefineries'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.  
[http://cordis.europa.eu/result/brief/rcn/6202\\_en.html](http://cordis.europa.eu/result/brief/rcn/6202_en.html)  
Project website:  
<http://www.glyfinery.net/>

## ENERGY AND TRANSPORT



### Waste heat utility in electricity generation

*Industries utilise energy generating heat that goes to waste. An EU-funded initiative has been researching how to utilise waste heat for electricity generation.*



The LOVE<sup>1</sup> project members intend to identify low-temperature — less than 120 degrees Celsius (°C) — waste-heat sources and develop cost-effective technologies for their conversion into electricity. Methodologies have been developed for characterising waste-heat sources.

LOVE researchers developed models of 'low-temperature heat valorisation' (LTHV) cycles for integration into a district heating system case study. 'Organic Rankine Cycle' (ORC) prototypes were integrated into two pilot-study cement plants for waste-heat recovery and power generation. Components that include a radial-inflow turbine, finned-tube and packed-column heat exchanger were designed and sized for these pilot studies. Cost effectiveness and efficiency of the ORC prototypes were assessed at the cement plants. ORC efficiency optimisation was found to be constrained by its use on different waste-heat sources. Necessary modifications would be economically viable, but possibly only for large-scale production.

Two prototypes of polymeric gas-liquid heat exchangers were also developed by LOVE researchers to undergo laboratory-scale testing. Their aim is to reduce pressure drop on the gas side before pilot testing at a plant.

The LOVE consortium holds regular meetings and maintains an updated project website for internal communication and the dissemination of results. An industrial advisory committee meeting was also held to present project results to industrial representatives to increase application potential.

Successful LOVE project outcomes will result in the introduction of novel heat exchangers, cost-effective radial-inflow turbines and more to international markets. These novel technologies and methodologies could produce electricity from waste heat at industrial plants thereby significantly reducing global energy consumption.

The project is coordinated by the Swiss Federal Institute of Technology of Lausanne in Switzerland.

1 "Low-temperature heat valorisation towards electricity production".

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.  
[http://cordis.europa.eu/result/brief/rcn/11332\\_en.html](http://cordis.europa.eu/result/brief/rcn/11332_en.html)  
 Project website: <http://love.epfl.ch/>

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### New industrial wizardry for biodiesel from waste

*Demand for biodiesel is on the rise as the world starts to look beyond fossil fuels in the search for more sustainable alternatives. Researchers have developed new methods of production using a broad range of feedstock wastes to produce the fuel while reducing greenhouse gases (GHGs).*

Diesel use in Europe and Latin America is predicted to rise over the next 20 years, from both passenger cars and heavy vehicles. In order to meet the EU's mandate to increase the use of biodiesel in normal

diesel engines, more efficient methods of biodiesel production are needed.

The EU-funded DIBANET<sup>1</sup> project aimed to address this need by improving biodiesel

production from a range of common feedstock wastes in Europe and Latin America. It involved cooperation and knowledge-sharing between European and Latin American research institutions, with a

view to decreasing the reliance of these regions on imported diesel.

DIBANET has pioneered a novel way of testing new sources of biomass for biodiesel

## ENERGY AND TRANSPORT



production potential. Their approach will decrease costs and harmful environmental effects.

Another major accomplishment of the new DIBANET processing method was the highest reported yield yet of levulinic acid, a key biofuel precursor. This was achieved through optimisation efforts that involved the combination of novel catalysts and computer modelling.

By broadening the range of raw materials and improving the yield of the biodiesel production process, this project has made great strides in the field. The participating regions

are set to rely less on imported diesel and they should simultaneously improve the sustainability of their own biodiesel production.

The project was coordinated by the University of Limerick in Ireland.

- 1 'The production of sustainable diesel miscible biofuels from the residues and wastes of Europe and Latin America'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Energy'.  
[http://cordis.europa.eu/result/brief/rcn/11537\\_en.html](http://cordis.europa.eu/result/brief/rcn/11537_en.html)  
 Project website: <http://www.dibanet.org/>

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## Actinide recycling of radioactive waste

*When used nuclear fuel is discharged from nuclear reactors, it is still mainly made up of uranium (around 95%). But it also contains radioactive elements such as actinides (plutonium and the minor actinides) and other fission products, known as nuclear waste. EU-funded scientists are developing actinide separation technology in order to minimise this radioactive waste.*

Actinide recycling by 'partitioning and transmutation' (P&T) is considered an important method for reducing the global inventory of radioactive waste. The EU-funded project ACSEPT<sup>1</sup> optimised promising, technically mature aqueous (hydrometallurgical) partitioning (or separation) processes in addition to developing

state-of-the-art dry (pyrochemical) processes.

Aqueous separation processes are focused largely on the development of actinide separation processes based on the liquid-liquid extraction technology. A prerequisite is the design of new molecules extracting these actinides

selectively. An additional conversion step allows their transformation into metal oxides suitable for fuel re-fabrication. Approximately 150 new molecules were synthesised and tested for their extraction capability. Of these, five were selected for further studies. Four separation processes were successfully tested on

genuine spent fuel solutions at the lab-scale, including a hot-test demonstration of an innovative 'Group actinide extraction' (GANEX) process achieved thanks to the strong collaboration between the partners.

ACSEPT also enhanced two pyrochemical processes (high-temperature processes in non-organic media such as molten salts and liquid metals) while simultaneously investigating actinide recycling and waste management. Previous studies, such as the FP6 project, EUROPART<sup>2</sup>, have enabled the development of processes in which actinides are selectively recovered into aluminium. In ACSEPT, two process options have been developed to recover actinides from aluminium. In addition, partners successfully studied fission product release during head-end step spent fuel treatments at temperatures up to 2500 degrees Celsius (°C). Moreover, two materials have been characterised for their



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potential use as confinement matrices, one for salt waste and the other for metallic waste.

ACSEPT placed great emphasis on education and training, with funding also being allotted to 15 student exchanges and the hiring of a two postdoctoral fellows. In March 2010, an international workshop emphasised student contributions to the field, with ACSEPT students making 22 presentations

and chairing various sessions. In 2012, ACSEPT results were widely disseminated thanks to the organisation of a specific technical session of the International ATALANTE 2012 Conference gathering more than 400 people in the field.

ACSEPT thus made an important contribution to process separation for actinide recycling and transmutation, providing information to policy-makers and the public

regarding greater safety and the sustainability of the nuclear energy sector.

The project was coordinated by the Atomic Energy and Alternative Energies Commission in France.

- 1 'Actinide recycling by separation and transmutation'.
- 2 'European research program for the partitioning of minor actinides and some long-lived fission products from high active wastes issuing the reprocessing of spent nuclear fuels'.

Funded under the FP7 specific programmes of the European Atomic Energy Community (Euratom) under the research theme 'Nuclear fission and radiation protection'.  
[http://cordis.europa.eu/result/brief/rcn/11379\\_en.html](http://cordis.europa.eu/result/brief/rcn/11379_en.html)  
 Project website: <http://www.acsept.org/>



## Better enzymes for alternative energy sources

*EU-funded scientists are putting genomics to work to find novel enzymes that convert woody plant residues into bioethanol. Lowering costs and increasing efficiency should enhance market adoption of this renewable liquid fuel.*



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Cellulose is the main constituent of plant cell walls and is often referred to as dietary fibre. As such, the majority of fibre in the human diet comes from fruits and vegetables. A lack of appropriate enzymes to break down the cellulose is beneficial for people as the bulky fibre provides a good workout for the gastrointestinal system. However, in the renewable fuels industry, difficulty in finding efficient enzymes to break down cellulose and hemicellulose has been a thorn in the sides of engineers and scientists.

Woody plants and their residues are a great source of sugars that can be fermented to

produce bioethanol. However, the cellulose and hemicelluloses (complex sugars) that they contain must first be broken down into simple sugars. The cellulose and hemicellulose are tightly bound to another organic polymer, lignin, in a lignocellulose complex that is difficult to break down. Scientists launched the EU-funded project DISCO<sup>1</sup> to search for novel enzymes that break down cellulose and hemicellulose and increase the efficiency of the fermentation process for 'simultaneous saccharification and fermentation' (SSF).

Scientists developed and optimised the pretreatment

methods for selected biomass feedstock using chemical and microscopy analytical techniques developed within the project to characterise biomass structure. Investigators used classical genomic screening of about 950 strains of fungi mostly from new soil isolates that break down lignocelluloses, to identify novel promising enzymes. Together with modern functional screening of metagenomics libraries, the enzyme discovery process has been quite fruitful. The most promising candidates are being cloned and produced in bacteria for analysis of mechanisms of action. Results are already providing important insights

enabling the optimisation of processes for pretreatment and fermentation.

DISCO is delivering previously lacking knowledge on the detailed structure of pretreated lignocellulose and enzymatic hydrolysis mechanisms essential for suitable enzyme selection for specific targets. Numerous novel enzymes that enhance the efficiency of biomass conversion to bioethanol have been discovered. DISCO research outcomes are making a significant contribution to lowering the cost and increasing the efficiency of bioethanol production for major impact on market uptake.

The project was coordinated by the VTT Technical Research Centre of Finland.

- 1 'Targeted discovery of novel cellulases and hemicellulases and their reaction mechanisms for hydrolysis of lignocellulosic biomass'.

Funded under FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
[http://cordis.europa.eu/result/brief/rcn/11007\\_en.html](http://cordis.europa.eu/result/brief/rcn/11007_en.html)  
 Project website: <http://www.disco-project.eu/>



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## Assessing the sustainability of aquaculture production

*Global consumption of seafood has risen dramatically over the last decade, due to a growing population, increased affluence and changing eating habits — many now see seafood as a healthy alternative to meat. The EU is the largest single regional importer, with many of its imports coming from Asia.*

The EU-funded project SEAT<sup>1</sup> is building up an understanding of new Asian aquatic food chains — and looking into their sustainability. The international team's research covered the top four aquaculture products making their way into European shops and restaurants: tilapia, *pangasius* (catfish), shrimps and prawns.

The project brings together European and Asian researchers as well as small business stakeholders from Bangladesh, China, Thailand and Vietnam.

The team began by developing a comprehensive picture of the value chains for each

product through interviews and focus groups in all four countries. This helped to establish the history of production and processing at each site studied, along with local views on limits to increasing production. The work also allowed the team to identify important stakeholder groups.

The next step was a life-cycle assessment of all the processes involved in getting aquatic products to consumers, from the production of feed — which includes soybeans in Brazil and maize in the US — to the consumer's disposal of food waste. A life-cycle analysis helped detect the parts of the chain that are problematic.

The analysis has been translated into statistical data demonstrating clearly why some processes are more sustainable than others. The SEAT assessment is the first of its kind in terms of coverage and detail.

This data has also been fed into specially developed models able to predict the risk of other activities, such as agriculture, to existing aquaculture practice, as well as any environmental change resulting from aquaculture practices.

In South-East Asia, most fish farms use ponds. As farming has intensified and local populations remain reliant on the >

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same water bodies, aquaculture waste has the potential to pose health and environmental risks to nearby communities and land areas.

The models are tailored to each species and each country. By inputting data on production practices and water-management strategies at each farm, the researchers will be able to estimate nutrient levels and the potential for eutrophication — excessive growth of algae due to a high concentration of nutrients — and risk of chemical contamination in water systems.

The SEAT project also developed a system to help local fish farmers predict potential environmental impacts before they occur, by combining large-scale 'pollution' models with models which predict interactions within individual farms.

The team has investigated the social and ethical effects of aquaculture production in Bangladesh, China, Thailand and Vietnam. They found that stories of very poor conditions at farms and processing plants are not necessarily true, and emphasise the high levels of local employment created by the aquaculture industry — in Bangladesh, there are 250 000 farmers producing black tiger shrimps.

The SEAT project is due to finish in November 2013. The research should help ensure Asian aquaculture production is sustainable. It will also lead to stronger scientific, business, industry and policy links between Europe and Asia.

The research will feed into the development of an Ethical Aquaculture Food Index

(EAFI) — a decision-support tool that brings together all outputs of the project to ensure the continued supply of sustainable aquaculture products to the EU.

The project is coordinated by the University of Stirling in the United Kingdom.

1 'Sustainable trade in ethical aquaculture'.

Funded under the FP7 specific programme 'Cooperation under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
<http://cordis.europa.eu/news> > search > 35992  
 Project website: <http://seatglobal.eu/>

## Biodefence of the phytoplankton

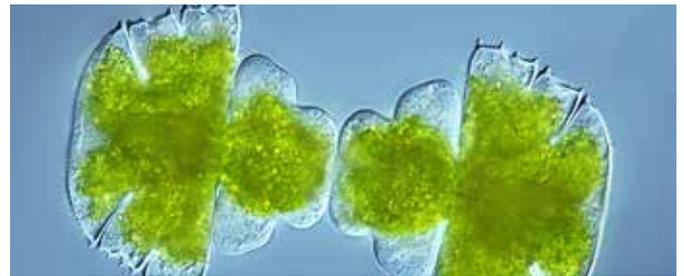
*Plankton behaviour and availability determine the survival of the entire marine ecosystem. The LIDPOP project identified dramatic changes in both the morphology and behaviour of phytoplankton in response to grazers.*

Plankton are aquatic organisms that cannot swim against the current. Phytoplankton is an algae that lives near the surface of the water where there is enough light to support photosynthesis. Zooplankton are a different class of plankton that feed on phytoplankton. The LIDPOP<sup>1</sup> project was set up with EU funding to study the defence mechanisms that allow phytoplankton to survive.

LIDPOP was a multidisciplinary project drawing on methods and expertise from small-scale hydrodynamics, analytical chemistry and ecological modelling. Project

researchers performed multiple experiments with cultures of both phytoplankton and zooplankton to identify small molecule mediators that could protect phytoplankton from grazer attacks. They found that some phytoplankton increase their production of toxic substances in response to chemical cues from zooplankton grazers.

Gathering information on the effect of grazer-induced toxin formation is very important for the development of computer models of the marine ecosystem. The LIDPOP team developed a MatLab algorithm to identify



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the algae-based toxin that was responsible for preventing interaction between the two types of plankton.

This method could be used to study plankton ecology and proliferation as it is sensitive enough to identify minute concentrations of the released chemicals. Outcomes of the study could lead to the recognition of plankton behaviour as a backbone of the entire marine ecosystem.

The project was coordinated by the Technical University of Denmark.

1 'Linking inducible chemical defences and phytoplankton population dynamics'.

Funded under the FP7 specific programme 'People' (Marie-Curie actions).  
[http://cordis.europa.eu/result/brief/rcn/11273\\_en.html](http://cordis.europa.eu/result/brief/rcn/11273_en.html)



## Better waste management

*Regions from across Europe have come together to promote innovation in the waste industry.*

Handling waste is a huge challenge for societies — it is costly to deal with and can cause serious environmental problems. However, if dealt with in a smart manner, the negative impacts

can be minimal and waste can create lucrative business opportunities.

Approaches to waste management vary widely. An EU-funded

research project, WASTEKIT<sup>1</sup> created a network across Europe so that authorities and businesses in the waste sector could learn from each other. With each sharing their specific areas of

expertise, the team comprised 19 project partners from four regions — in Bulgaria, Italy, the Netherlands and the United Kingdom.

WASTEKIT identified strengths and weaknesses in the respective waste-management systems,

## ENVIRONMENT AND SOCIETY



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looking at five key areas: waste to energy technologies, options for plastics, knowledge transfer, funding models, and public communications. Results were shared at a number of events and collated in an online database, enabling other regions not directly involved to benefit as well.

Every citizen in Europe creates waste and is affected by how we deal with it. WASTEKIT will help to make future waste management more efficient and sustainable.

The project was coordinated by Amsterdam Innovation Motor in the Netherlands.

1 'Waste management focusing on knowledge and integration to create transnational economic development'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Regions of knowledge'.  
[http://cordis.europa.eu/result/brief/rcn/11398\\_en.html](http://cordis.europa.eu/result/brief/rcn/11398_en.html)  
 Project website:  
<http://www.wastekit.nl/>



## New concept for containing waste

*The European Union's (EU) approach to waste management is based on three principles: waste prevention, reuse and recycling, and improving final disposal and monitoring. In 2010, the total generation of waste from economic activities and households in the EU amounted to 2570 million tonnes, which equates to 5.1 tonnes of waste per person.*

As we come to realise our impact on the environment and the severity of our actions, more and more stringent environmental requirements, norms and laws are enforced. This means industry needs to come up with ever more innovative solutions in all sectors of their work, from transport to waste management, construction to IT solutions.

The EU-funded project BURBA<sup>1</sup> presents a new concept of waste service. It uses surveillance and feedback to create an optimised collection service, and a social game aspect to reward positive behaviour. The three-year study is

using cutting-edge low-cost 'radio-frequency identification' (RFID) and 'location-based service' (LBS) technologies for the separation and collection of waste at source. These are integrated into an 'intelligent waste container' (IWAC) with a capacity of 1100 litres for use in densely populated areas and eventually for industrial areas.

The IWAC will be able to identify a citizen or user through a personal RFID card, to control the receptacle's lid and, therefore, to give feedback about the correct disposal by the user. From this data, the waste management team can assess the disposal correctness of individuals,

groups, blocks and buildings by location and time of day. This data is sent to a control centre where all the information about all the IWACs is collected. The same information is also available to the citizens through their mobile phone and is providing support to appropriate sorting and disposal of waste. This gives a detailed profile of the collection services required by address and time. The use of waste disposal identification could also prevent illegal disposal of waste.

The integration among municipalities, citizens and the IWAC allows for incentive-based programmes to increase the recycling efficiency of those using the technology. The BURBA project allows for unique computing of waste sorting efforts and develops a system that can reward positive behaviour, such as discount rates on waste disposal and taxes.

BURBA involved nine partners from Italy, Spain, Poland, Portugal and China. The organisations included university research for prototyping state-of-the-art equipment, and small and medium-sized enterprises (SMEs) to analyse safety regulations and localisation technologies. 'We chose three different-sized cities (Camogli in Italy, Santander in Spain and Rzeszow

in Poland) with different habits in order to have a complete view of what the problem is all over Europe,' said Simona Bruna, coordinator of the project at D'Appolonia, the Italian company coordinating the project and representing one of the industrial components of the study.

Throughout the study, researchers have produced a 'life-cycle analysis' (LCA), the practical scope of which is to study not only the possible benefits of improving waste truck fleet collection paths but also to ensure savings are not outweighed by the production and utilisation costs of the system.

The BURBA team is on the point of finalising the first project prototypes and further testing them in the real environment. A network of IWAC facilities will be available in Italy, Poland and Spain. 'The technology developed seems to be quite promising and [the users of the service] are very interested in validating it,' concluded Bruna.

The project is coordinated by D'Appolonia in Italy.

1 'Bottom-up selection, collection and management of urban waste'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.  
<http://ec.europa.eu/research/headlines/search/30693>  
 Project website:  
<http://www.burbaproject.net/>



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## ENVIRONMENT AND SOCIETY



# Improved waste recycling will benefit environment and boost European industry

*Waste from electrical and electronic equipment is one of the fastest growing waste streams in the European Union (EU). The increasing prevalence of affordable electronics means landfill sites are filling up with the consequent waste from sources such as light bulbs, spent batteries, printed circuit boards, liquid crystal displays and cathode ray tubes. The quantity of such waste doubles every 12 to 15 years.*

In addition, this waste contains rare and precious metals. Emerging green technologies, such as solar cells and energy-efficient light bulbs, depend heavily on raw materials like gallium, indium and rare-earth elements. Improved electronic-waste recycling could thus not only reduce the environmental impact from new mining, but also boost European industry and provide resource security.

That is the aim of the EU-funded project HYDROWEEE DEMO<sup>1</sup>. Started in October 2012, the project brings together research organisations across four European countries with EUR 2.6 million in EU funding.

HYDROWEEE DEMO builds upon the earlier success of HYDROWEEE, an EU-funded project that concluded in February 2012. That project laid the groundwork for the design of a mobile plant using liquid solvents

to extract metals like yttrium, indium, lithium, cobalt, zinc, copper, gold, silver, nickel, lead and tin in a high purity from electronic waste.

The objective of HYDROWEEE DEMO is to build two demonstration plants — one stationary and one mobile — to test the performance of the techniques devised. The demo plants will also develop processes to recover additional metals from 'Waste electrical and electronic equipment' (WEEE), and expand beyond that waste stream to other sectors such as automotive waste.

The project, which runs until September 2016, will assess the technical outcomes of the plants, their health risks, and benefits to society and the environment.

It is particularly designed to cater to the needs of small and medium-sized enterprises (SMEs). Several SMEs can use the services

of a single mobile plant, limiting the necessary quantities of waste as well as equipment cost. In addition, the HYDROWEEE DEMO plants will produce pure enough metals for SMEs to use directly, thereby cutting down on their production costs and making them more competitive with large multinational companies.

The project is presently in the final round of offers to select the supplier of components for the stationary plant, due to become operational later during 2013. The mobile plant will be ready in spring or summer 2014.

'I always compare our HYDROWEEE plant with a kitchen. Depending on the different ingredients and recipes, or processes, you can get a different output,' explains Bernd Kopacek, the project coordinator. 'Therefore, we would like, on the one hand, to optimise our already developed "recipes" for



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powder from fluorescent lamps and cathode ray tubes, liquid crystal displays, printed circuit boards and lithium-ion batteries, and, on the other hand, to develop additional "recipes" for other input materials,' he concludes.

The project is coordinated by Kopacek in Austria.

<sup>1</sup> 'Innovative hydrometallurgical processes to recover metals from WEEE including lamps and batteries'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.  
<http://ec.europa.eu/research/infocentre/search/30873>  
 Project website:  
<http://www.4980.timewarp.at/sat/hydroWEEE/>



## EU-Mediterranean power against pollution

*Dynamic partnerships, enterprising projects, new databases and valuable research exchanges have helped to improve the management of solid waste and wastewater in the Mediterranean region.*



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The Mediterranean region is considered to be one of the most beautiful regions in the world. However, the Mediterranean Sea is threatened by the pollution and effluents of the thousands of towns, cities and industries that dot its coasts. Much of the pressure comes from solid waste and wastewater that end up in the sea or in the rivers and lakes that lead to it.

Against this backdrop, the EU-funded project SOWAEUMED<sup>1</sup>

sought to overcome this ominous development.

Project members built robust partnerships among scientists, policy-makers and industry experts on the topic across the EU with Associated States and Mediterranean countries. They reinforced treatment technologies related to water and waste control by linking with concerned institutions, conducting training and encouraging mobility of staff among all implicated nations.

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Part of this effort involved strengthening institutions to exploit not only conventional treatment approaches but also advanced solutions and nanoscience-based treatment technologies and applications.

To achieve its aims the project team reinforced research and development (R&D) infrastructure by acquiring new equipment for scientific and technological research centres. It outlined pivotal topics that should be researched, in addition to communicating these research priorities and delivering roadmaps to stakeholders.

These included researchers, inventors, decision-makers, funding agencies, innovators, industry investors and policy-makers.

SOWAEUMED made significant progress in researching water and sediment in different areas, as well as in studying methods of purification of polluted waters. It investigated pollution parameters and fostered researcher and expert exchanges among different countries in the region. Achievements also involved disseminating relevant information to concerned stakeholders,

holding regular meetings to map future priorities, and reinforcing businesses involved in waste and water treatment.

Overall, the project led to much more solid research relationships and partnerships, which is expected to yield joint EU-Mediterranean projects in environmental fields. It also improved databases that will help launch more projects, and linked with other EU initiatives in the field. The outcome is expected to be a cleaner Mediterranean and a better standard of living for numerous communities across the region.

The project was coordinated by the Autonomous University of Barcelona in Spain.

1 'Network in solid-waste and water treatment between Europe and Mediterranean countries'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Stimulating the realisation of the full research potential of the enlarged European Union Community' (Regional Potential).  
[http://cordis.europa.eu/result/brief/rcn/10535\\_en.html](http://cordis.europa.eu/result/brief/rcn/10535_en.html)  
 Project website:  
<http://grupsderecerca.uab.cat/sowaeumed/>



## Recycling Europe's 3 million tonnes of tyre waste

*Almost 1 billion tyres reach the end of their life around the world annually — some 350 million of these in the EU, and numbers are increasing every year.*

Waste tyres are potentially fully recyclable. The recovered materials can be put to other uses, in turn reducing the environmental impact of this priority waste stream. With this aim, the EU-funded project TYGRE<sup>1</sup> set out to find new uses for Europe's waste tyres — estimated to be 3.5 million tonnes a year.

Tyres contain steel, and a large amount of organic materials, which can be used instead of coal or biomass as a fuel source or as secondary raw materials for high added-value by-products.

The project team is investigating new ways to harness this

resource through a process able to produce a fuel gas or 'syngas' (mainly a mixture of hydrogen, carbon monoxide and dioxide, and methane), along with a ceramic material, silicon carbide.

Leading this project is the Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) in Portici, Italy. Sabrina Portofino, a researcher at ENEA, says such by-products are a 'must' in the recycling process.

'Basically, the main idea consists in redirecting the gasification process towards the material recycling,' she says. 'Therefore, to increase the added value of the gasification we decided to couple a second process, dedicated to the synthesis of ceramics, such as silicon carbide — the carbon reacts with silicon oxide at high temperature to form silicon carbide.'

Silicon carbide can be used in the manufacture of ceramic materials and for electronic applications.

The project received EUR 3.3 million in EU funding. The

research consortium involves researchers and companies representing the main value chain involved — tyre recycler, ceramic powders final user and pyro-carbons producer.

Significant achievements have been made since the start of the project in 2009. The new process has been developed and tested at laboratory scale. A prototype plant was installed at ENEA's facilities in Trisaia. The consortium aims to process 20 kilograms of tyre waste per hour. Operating the prototype will establish the sustainability of the TYGRE recycling scheme. The project team will then be able to assess the energy balance of the whole process.

The project was coordinated by the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) in Italy.

1 'High added-value materials from waste tyre gasification residues'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.  
<http://cordis.europa.eu/news/search/35926>  
 Project website: <http://www.tygre.eu>



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### Ocean acidification: past, present and future

*The main focus of research into the increase in carbon dioxide (CO<sub>2</sub>) levels globally centres on climate change. A European initiative has investigated other effects on the world's oceans.*

Man-made CO<sub>2</sub> is being absorbed by the world's oceans globally at a rate of 24 million tonnes per day. Effects of this are a lowering of pH — becoming more 'acid' — and carbonate ion concentration. Most research prior to the EPOCA<sup>1</sup> project has focused on creatures that make shells and skeletons with the carbonate ion converted into calcium carbonate.

EPOCA was the first international research effort on ocean acidification. The 27-member consortium put many other processes likely to be affected under the microscope. These include nutrient uptake, reproduction, acid-base regulation, nitrogen fixation and primary production. Changes in the dynamics of these biological processes are likely to affect marine flora and fauna profoundly.

The four-year long project produced results based on four themes. One of the major findings under the first, ocean chemistry, is that acidification measured in terms of pH drop

in the Arctic near Iceland is 50% faster than average rates in subtropical zones in the Pacific Ocean.

For biological and ecosystem responses, EPOCA researchers studied a broad range of marine life. There is now robust evidence that many calcifying organisms are adversely affected by ocean acidification although there is considerable difference in sensitivity, even between closely related species. Citing just one of the alarming effects of acidification that came to light, severe tissue damage in Atlantic cod larvae was recorded. Synergistic effects of multiple stressors, including warming, deoxygenation and eutrophication, were also investigated.

Project researchers coupled 'Earth system models' (ESMs), global and regional ocean models, and a sediment model to anticipate how acidification will alter ocean biogeochemistry. Climate change has little effect on acidification except in the Arctic, where freshening from



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ice melt exacerbates the situation. Regional model simulations highlighted the vulnerability of some near-shore regions as a result of river input and organic matter degradation as well as local upwelling systems.

The book *Ocean Acidification* contains a great deal of information from the EPOCA project, including advances from the modelling initiative and the majority of the synthesis chapter. Raising awareness of the gravity of ocean acidification has also been achieved through the EPOCA website, blog and collaboration with other groups of scientists. Working with school students in Plymouth, an animation — 'The other CO<sub>2</sub> problem' — was produced and a film 'Tipping Point' received three awards for best scientific movie at the Mediterranean film festival.

EPOCA results stand to have a wide-ranging impact and the

project has produced evidence of current damage caused by acidification as well as predictions using sophisticated modelling techniques. The implications for all ecosystems as well as effects of ocean acidification on the development of mass-spawning fish species of high commercial importance (e.g. Atlantic cod), have been elucidated. Perhaps most importantly, the risks and relevant thresholds — tipping points — have been identified and quantified.

The project was coordinated by CNRS in France.

1 'European project on ocean acidification'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.  
[http://cordis.europa.eu/result/brief/rcn/5717\\_en.html](http://cordis.europa.eu/result/brief/rcn/5717_en.html)  
 Project website:  
<http://www.epoca-project.eu/>



### European eels in troubled waters

*Researchers studied the reasons for declines in European eel populations in an effort to design a recovery plan.*

Eels play an important socio-economic and ecological role in many European countries, and as they migrate between oceans and freshwater rivers they can provide markers as to the health of different ecosystems.

Their stocks have dropped dramatically in recent decades and are now judged to be out of safe biological limits. The EU-funded research project EELIAD<sup>1</sup> looked into the reasons for this dip in population numbers. It focused on the marine phase of these species' lives — an aspect of their

development about which little was previously known.

A first step in the project was to develop effective ways to tag eels. Different tagging methods were tested and new designs made. The researchers tagged more than 500 eels and collected data on more than 3000 days of eel behaviour.

The project team, which included experts from marine research institutes in six European countries, collected and analysed eels from different European catchments. They developed models to simulate

the early life history of eels and linked this data to larval dispersal patterns and routes. Results will feed directly into conservation efforts and the development of a European eel management plan. The EELIAD team raised awareness of their findings by presenting their results at conferences and in a number of papers, and local and national media.

EELIAD has improved the knowledge base regarding a unique species of animal, while the data collected increases our understanding of complex ecological interactions.

The project was coordinated by the Department for Environment, Food



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and Rural Affairs (DEFRA) in the United Kingdom.

1 'European eels in the Atlantic: Assessment of their decline'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Environment'.  
[http://cordis.europa.eu/result/brief/rcn/11553\\_en.html](http://cordis.europa.eu/result/brief/rcn/11553_en.html)  
 Project website:  
<http://www.eeliad.com/>



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## Breaking through the fault-testing bottleneck in chip production

*A team of EU-funded researchers have developed ground-breaking technology to clear one of the biggest bottlenecks facing the development of ever more advanced computer chips: the costly and time-consuming process of fault testing and verification. Their holistic approach to detecting and solving errors in chips, or 'integrated circuits' (ICs), promises to accelerate chip production, save money and dramatically lower the cost of electronic equipment and devices.*

'A decade or two ago the complexity of silicon chips was considerably lower than now. Since then, the size in terms of the number of transistors has grown to billions. Such chips are difficult to design but even more difficult to test and verify. Testing and verification have clearly become the bottleneck of the development process,' explains Dr Jaan Raik, a professor of digital systems verification at the Department of Computer Engineering of Tallinn University of Technology in Estonia.

One EU-funded project, PROSYD<sup>1</sup>, carried out extensive research on chip-manufacturing processes and found that as much as 40% of the entire IC design cycle is spent locating and correcting errors caused by design mistakes.

In recent years, numerous test and verification approaches have emerged. But, while they are good at identifying the presence of faults, they

are usually unable to pinpoint the root cause of an error.

'It is not helpful for the designer to merely know that the chip is not working. It is necessary also to locate the fault and, ultimately, to correct it. Relatively little attention has been paid to the latter tasks,' explains Dr Raik.

Until now, that is. Over the course of three years a consortium of universities and technology companies teamed up in the DIAMOND<sup>2</sup> project to develop innovative models and technology to test, detect, verify and, most importantly, fix IC errors. Their approach, supported by almost EUR 2.9 million in funding from the European Commission, marks a major leap forward for the semiconductor industry — offering potentially enormous time and cost savings if implemented widely.

### A holistic approach with three-fold benefits

According to the project, a modern chip design project costs around EUR 60 million, but if the error detection and correction process could be accelerated by automation, these costs could be cut by EUR 15 million. Dr Raik, who coordinated DIAMOND, describes the project's contribution to solving the challenge of detecting and fixing IC errors as three-fold.

'First, a holistic model for different types of faults was developed. Based on this model, the same localisation engines can be applied to design errors, soft errors and defects. Second, more efficient automated localisation and correction methods were developed. Particular stress was put on system-level approaches where previous research work has been inadequate. And third, post-silicon *in-situ* debug approaches were developed. Such approaches extend the >

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lifetime of silicon chips by localising and isolating faulty regions in them,' Dr Raik says.

The team created an open-source system-level design-error localisation and correction system called 'Formal repair environment for simple C' (Forensic) — jointly developed by Graz University of Technology, the University of Bremen and Tallinn University of Technology, with a second version of the environment released last December.

To detect and fix errors at the register-transfer level, the DIAMOND researchers used a design elaboration system called zamiaCAD, a highly scalable open-source platform that can easily handle large commercial systems, such as those used by one of the project's industrial partners, IBM. On top of that platform, the team implemented new error localisation methods capable of pinpointing design errors in such large designs.

In addition, because so-called soft errors — such as those caused by the effects of radiation — are increasingly becoming an issue in new nanometre-scale technologies, IBM and the University of Bremen jointly developed efficient simulation and vulnerability check approaches for such faults. Meanwhile, a post-silicon fault-management system to extend the lifetime of future chips was designed by Ericsson, the University of Linköping and Estonian 'electronic design automation' (EDA) company Testonica.

'The key innovations of the DIAMOND project are the holistic handling of different kinds of faults, as well as new engines for system-level fault localisation and correction, for soft error analysis and for fault management,' Dr Raik summarises.

### An almost four-fold increase in efficiency

The upshot is major gains in the efficiency of the processes used to find and correct faults.

'At the system-level, Forensic was able to correct 60% of the benchmark designs compared to 16% with previous tools,' the project coordinator notes. 'At the register-transfer level, we performed a case study on a real processor design. We cooperated with a design team at TU Ilmenau who kindly provided us with documented bug cases. The DIAMOND methods were able to locate all the bugs in a couple of minutes, versus several hours needed for manual localisation.'

These new, more efficient fault correction methods mean huge savings. IBM estimates that EUR 15 million per chip project could be saved if fault diagnosis and correction efficiency can be doubled. For a consumer, ultimately, it means cheaper and safer electronic products.

IBM has so far filed two patents on technologies developed in DIAMOND and is continuing to exploit the results internally, including successfully applying the testing and verification tools in design projects. Ericsson, another project partner, is also exploiting the results internally and is applying the new fault-management technology in product developments.

EDA companies TransEDA and Testonica — the latter a spin-off of the research group at Tallinn University of Technology — have included the fault-diagnosis tools in their product portfolios. Testonica has filed one patent on technologies developed in DIAMOND.

Meanwhile, some of the results have been presented to chipmaker Intel and several SMEs have also expressed interest.

'The interest from outside has been quite strong,' Dr Raik notes. 'There is a clear trend towards multi-core designs due mainly to the need to keep the power dissipation of future chips under control. I therefore see that test, reliability and design will become more intertwined within multi-core systems. In fact, the regularity and modularity inherent to multi-core architectures provides new opportunities for test, verification and design.'

On the strength of these results, the project's work could be expected to help shorten the time for new chips to be designed, produced and come to market — accelerating innovation in electronic devices — as well as leading to lower prices for electronic equipment.

The project was coordinated by the Tallinn University of Technology in Estonia.

- 1 'Property-based system design', funded under the FP6 specific programme 'Information Society Technologies' (IST).
- 2 'Diagnosis, error-modelling and correction for reliable systems design', funded under the FP7 specific programme 'Cooperation' under the research theme 'Information and communication technologies' (ICT).

<http://cordis.europa.eu/marketplace> > search > offers > 11512  
Project website:  
<http://www.fp7-diamond.eu/>



## European scientific research now on YouTube

*EU-funded media experts distributed short documentaries via the internet to raise awareness of European research.*

Broadview.TV (BTV), an international award-winning film and internet production company, and United Docs, one of the largest German TV distributors, became partners to communicate EU research to the public at large. With EU-funding of the project COMED<sup>1</sup>, they produced nine short videos and a trailer about EU-funded health-related research projects. The films show interviews with researchers and patients, and provide news about

the projects in non-scientific language to inform the public and enhance young people's perceptions of science.

The creation of a project logo was an important marketing tool to increase recognition and awareness and it is present on all information disseminated. Partners exploited the medium most used by youth today, the internet. Videos were distributed via video-sharing portals such

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as YouTube, social networking services such as Facebook, podcasts, blogs, online magazines and the project website. They also distributed the videos to television broadcasters. Of course, dissemination would not have been complete without presentations at scientific conferences to raise awareness on the

part of the research community and encourage more scientists to develop innovative ways of targeting the public.

COMED filled an important gap between science and society, using brief and snappy videos to generate excitement and enthusiasm about the potential of

scientific research — targeting the general public, and in particular, young people.

The project was coordinated by Broadview.TV in Germany.

- 1 'Communication of medical research through film production and wide distribution'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcn/6652\\_en.html](http://cordis.europa.eu/result/brief/rcn/6652_en.html)

## Balkan agriculture goes high-tech

*New remote-sensing technology for use in agriculture and environmental management has supported stakeholders in the industry, helping to build new partnerships between the Western Balkans and the EU.*

Agriculture can benefit greatly from new sensing technologies to monitor the environment and other important parameters. The EU-funded project AGROSENSE<sup>1</sup> explored new opportunities in this area.

Working to upgrade agriculture methods and forestry protection in the Western Balkan Countries (WBCs), the project took the region of Vojvodina in Serbia as a test case. It then acquired the necessary equipment and hired EU experts in the field, developing a system that employs unmanned aerial vehicles, sophisticated sensors and thermal cameras.

Sensing and monitoring systems were distributed in fields to monitor soil conditions, crop growth and other parameters, representing a new system of precision agriculture. Results of the live demonstration, which involved measuring a range of bio-parameters, were unveiled on the project's website.

In parallel, the experts trained WBC actors in areas such as environmental monitoring applications, simulation tools, integration of wireless technologies and coordination of research projects. This raised awareness of the project's potential among those interested in the technology for agriculture, forestry and environmental protection.

Most importantly, the project's progress led to the launch of the BioSense Centre in conjunction



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with the University of Novi Sad. The centre has already become an important regional actor in European research. Related networking activities and new partnerships brought stakeholders from Serbia and other WBCs together with actors from Italy and Slovenia.

As dissemination of the project's results spread, it helped influence government institutions to adopt precision agriculture, promoting the approach to the agricultural industry, farmers and students involved. This was achieved through several conferences,

agricultural fairs and publications. A key achievement with respect to dissemination was the BioSense09 workshop in Novi Sad on sensing technology in agriculture, forestry and environment.

Noteworthy as well, in addition to stakeholders related to agriculture, academic staff from related fields such as ecology and water management showed great interest in the AGROSENSE project. All these efforts have helped to build stronger science and technology (S&T) cooperation opportunities among WBCs and with the rest of Europe.

The project was coordinated by the University of Novi Sad's Faculty of Technical Sciences in Serbia.

- 1 'Wireless sensor networks and remote sensing — foundation of a modern agricultural infrastructure in the region'.

Funded under the FP7 specific programme 'Capacities' under the theme 'Stimulating the realisation of the full research potential of the enlarged European Union community' (REGPOT).  
[http://cordis.europa.eu/result/brief/rcn/6284\\_en.html](http://cordis.europa.eu/result/brief/rcn/6284_en.html)

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### Aviation safety training strengthened

*New simulation systems and training modules will help pilots avoid catastrophic events in the air and save lives in the process.*

Loss of control in flight, often attributed to a lack of crew awareness and experience in recovering from extreme flight conditions, is the most common cause of fatal accidents in aviation. These extreme conditions include aviation 'upsets' such as a high roll-angle of more than 45°, where the pilot inadvertently allows the situation to become critical. With plans to make training for upset-recovery mandatory, the EU is looking at new, effective ways to train pilots in overcoming these potentially fatal events.

The EU-funded SUPRA<sup>1</sup> project worked on improving flight simulations of upset conditions. As current simulation technology is not capable of such modelling, the project team furthered the state of the

art in flight-dynamics modelling and motion cueing to address shortcomings in ground-based simulators.

SUPRA based its work on previous modelling efforts, which use wind-tunnel techniques and novel computational fluid dynamics to predict the behaviour of fighter aircraft in flight. It also developed motion cueing improvements and investigated numerous flight regimes not typically encountered during the normal flight operations of commercial aeroplanes. Another important achievement involved the correct replication of physical strain on the human body during an upset using centrifugation as a simulator solution.

In effect, SUPRA successfully developed a generic model to capture the



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key aerodynamic behaviour of transport-category aircraft in high-incidence flight. It brought in expert test pilots to evaluate the concept and validate its viability. The research was disseminated to stakeholders through the project website and a symposium that attracted aeroplane manufacturers and operators as well as aviation authorities.

Once the technology is exploited to improve pilot flight-handling skills, it will help pilots re-establish stable control of the aircraft after upsets. As these incidents count for 10–20% of fatal accidents in public

air transport, this simulation technology should help save lives, not only in Europe but hopefully across the globe as well.

The project was coordinated by TNO in the Netherlands.

- 1 'Simulation of upset recovery in aviation'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Transport'.  
[http://cordis.europa.eu/result/brief/rcn/10561\\_en.html](http://cordis.europa.eu/result/brief/rcn/10561_en.html)  
 Project website: [www.supra.aero](http://www.supra.aero)

## Non-invasive optical imaging to monitor brain function

*A European consortium worked towards the development of advanced non-invasive imaging methodologies for in vivo diagnosis, monitoring and prognosis of major neurological diseases. This integrated approach could revolutionise the diagnosis and monitoring of conditions including stroke and severe brain trauma.*

'Computed tomography' (CT), 'magnetic resonance imaging' (MRI) and 'positron emission tomography' (PET) are imaging techniques that provide vital anatomical and physiological data for guiding medical diagnosis and therapy. However, these methods cannot assess systemic parameters such as heart rate or blood pressure, and they cannot be applied at the bedside. Electroencephalography (EEG), on the other hand, is a well-established technique that can continuously and non-invasively monitor the brain.

The EU-funded NEUROPT<sup>1</sup> consortium was motivated to generate a clinical tool for continuous monitoring of the haemodynamic parameters of cerebral oxygenation

and perfusion. This tool should also complement MRI/CT/PET methods and at the same time be compatible with existing neuro-monitoring techniques (EEG, Doppler ultrasound).

To achieve this, partners had to improve spatial resolution of current imaging techniques, remove 'artefacts' — elements of the image that result from the processing techniques rather than the subject being monitored — and enable the absolute quantification of physiological parameters. To this end, they employed time-resolved techniques that offer greater sensitivity than most optical methods and distinguish between surface tissues (e.g. skin and skull) and brain tissue.

Novel photonic devices were constructed, as well as device prototypes for use in the clinical setting, including a specialised helmet for attaching the optical fibres to the head. Through software development, researchers could also analyse the time-resolved measurements on the head and calculate the oxy- and deoxyhaemoglobin concentrations. Additionally, NEUROPT researchers worked on realistic modelling and computation, especially with a view to improving light propagation in the human head.

The feasibility of this combinatorial approach was tested in separate visual and motor studies in healthy individuals. It was further successfully applied to performing measurements in patients with acute neurological conditions, photosensitive epilepsy or stroke.

Given the non-invasive nature of the NEUROPT approach and its potential to be continuously applied at the bedside, it should facilitate



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the diagnosis of functional brain impairment and monitor its progress. As a result, it should improve the prognosis of patients with serious neurological conditions and could also be applied to imaging the brains of infants.

The project was coordinated by the Politecnico di Milano in Italy.

- 1 'Non-invasive imaging of brain function and disease by pulsed near infrared light'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcn/6016\\_en.html](http://cordis.europa.eu/result/brief/rcn/6016_en.html)  
 Project website: <http://www.neuropt.eu/project.html>

## Monitoring emerging diseases in wild animals

*Three-quarters of the new human diseases that have emerged in the last two decades have originated from wildlife species. The goal of the WILDTECH project is to design a surveillance system that will detect and monitor the potential spread of pathogenic infections in wildlife.*

The spread of wildlife diseases affecting both humans and domestic animals is believed to be caused by a rapid evolution of viral pathogens adjusting to changes in the human population, host-pathogen relationship and environmental pollution.

Previously, there had been no coordinated effort to monitor the spread of infection in the European Union. To address this problem, the WILDTECH<sup>1</sup> project established a platform for high-throughput wildlife-disease diagnosis.



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WILDTECH research members designed a prototype microarray chip to identify both known and novel pathogens in wildlife populations. They also developed high-throughput serological screening of wildlife populations for potential infectious agents. This technology allows for continuous monitoring of disease spread in wildlife and evaluation of potential risks to the human population.

Investigators established a pathogen database to store all the information about samples run in the project. Part of that data related to the pathogen characterisation was forwarded to the Wildpro<sup>®</sup> electronic encyclopaedia.

Project activities resulted in the construction of a multi-host disease model essential

for epidemiologists across the EU. In the long term, this work will prevent the proliferation of food-borne pathogens, which could significantly reduce mortality rate and improve welfare for both human and animal populations.

The project was coordinated by the University of Nottingham in the United Kingdom.

- 1 'Novel technologies for surveillance of emerging and re-emerging infections of wildlife'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
[http://cordis.europa.eu/result/brief/rcn/11325\\_en.html](http://cordis.europa.eu/result/brief/rcn/11325_en.html)  
 Project website:  
<http://www.wildtechproject.com>

## Making an online move for science

*Young Europeans are turning away from scientific studies and careers. This poses a problem, as humankind faces serious challenges that can only be addressed with renewed research efforts.*

The EU-funded POR<sup>1</sup> project was therefore developed with the aim of raising public interest in science, particularly among young people, by means of a computer game. The POR game consisted of two parts: a long-term strategy research game, and a short-term hospital game. Within the research game, players entered as scientists, selected a specific research topic and worked at a research institution.

Gamers shared responsibility in securing funding, skills and resources to perform their tasks, while managing their own energy and well-being. This gave players an inside look into the real world of scientific researchers. Completed research projects were published in virtual journals.

The second part of the game took part in a hospital. In the real-time, three-dimensional (3D) environment, players had the opportunity to assume the role of medical doctors. The challenge of the game was to manage a doctor's daily life, overseeing the treatment of several patients with different diseases within a tight time frame.

In both games, experience earned the players rewards, titles and new resources. A strong resource base was also provided for players, giving them up-to-date medical knowledge that could be used both online and in the real world. This included a virtual library, scientific picture gallery and a database of Nobel laureates.



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The game received more than 120 000 unique visitors on the site. Radio, press releases and various websites were all used to spread the word about POR, while users shared the game on their personal social media platforms.

POR managed to tackle the image problem of scientists as perceived by today's youth by allowing players to encounter all the positive and interesting characteristics of a scientific career.

The project was coordinated by Biolution in Austria.

- 1 'Disseminate the power of research through an on-line simulation of the scientific endeavour'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Health'.  
[http://cordis.europa.eu/result/brief/rcn/10449\\_en.html](http://cordis.europa.eu/result/brief/rcn/10449_en.html)

## INDUSTRIAL TECHNOLOGIES



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# Closing the loop for lightweight materials

*From next-generation planes to electric vehicles and their already heavy batteries, every extra kilogramme matters when trying to achieve more sustainable transportation. Lightweight, high-performance materials have never been so successful, but their end-of-life remains a key concern.*

Every time a scientist or engineer comes to grips with the brain-teasing issue of greenhouse gas emissions and reduced fossil-fuel consumption, the weight element is central. Much of materials science now revolves around discovering or enhancing lighter materials, with better — or at least equal — performance, which explains the tremendous success of composite materials such as carbon-fibre reinforced polymers.

However, there is another side to the coin. Composites still fall short of satisfactory second-life options, which is a real concern at a time when decision-makers increasingly think in terms of life-cycle assessments. Well aware of this issue and the urgency of solving it, the Institute of Chemistry and Technology of Polymers (ICTP) in Italy is investigating new waste-management

processes with partners under the EU-funded SUSRAC<sup>1</sup> project.

Dr Mario Malinconico, who coordinates the project, told the *research\*eu results* magazine about the consortium's achievements so far, their importance for the continued growth of the market and the remaining challenges before the end of the project.

### What are the main objectives of the project?

Thermoplastic and thermoset composite materials are used in a wide range of applications, and about 1 million tonnes of composites are manufactured each year in Europe. This requires the setting up of specific strategies for composite-waste disposal, in particular for the recycling of this waste. Poor recyclability can be a barrier to the

development — or even continued use — of composites in some markets.

The purpose of this research, which is part of the EU-funded Joint Technology Initiative 'Clean Sky', is to develop recyclable thermoplastic composite materials capable of handling high weight loads. Those would be made from ground thermoplastic, thermoset aircraft-waste composites, such as 'carbon-fibre-reinforced polymers' (CFRPs), and recycled expanded polystyrene from loose-fill packaging.

### How important is it to solve this problem?

Addressing sustainability issues related to plastic materials is one of the core activities at the Institute of Chemistry and Technology of Polymers. This is of utmost importance if

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you consider that the worldwide demand for carbon fibres (CFs) reached approximately 35 000 tonnes in 2008 and that this number is expected to double by 2014, representing a growth rate of over 12% per year.

CFRPs are now used in a widening range of applications, with the aircraft industry being one of the most impressive examples: CFRP accounts for 50% of the weight of the new Boeing 787 and Airbus A350, and military aircraft are following a similar trend. The quick growth of the composite market raises the question of waste management, and it is only logical that recycling has become a high priority.

At same time, plastic packaging materials account for almost 40% of all plastic consumption in the world, and loose-fill packaging materials are among the most difficult items to recycle due to their extreme lightness (on average one cubic metre of expanded polystyrene weighs only 30 kg).

The idea to combine both materials to make a thermoplastic composite for building or furniture applications requires an innovative process, which is where SUSRAC comes in.

### What is new or innovative about the project and the way it is addressing these issues?

Two compounding methodologies were explored, namely traditional melt mixing and innovative cold mixing. In the latter, a low-boiling-point industrial solvent was employed to dilute and guarantee the homogeneity of the thermoplastic matrix at the micro- and macroscopic levels. It is a purely physical approach, in a closed-loop strategy, which we have been studying since 2005. It was first applied to glass-fibre-reinforced thermosetting matrices resulting from the dismantling of boats. The results so far prove that the cold-mixing approach results in a material with mechanical properties up to four times higher than those obtained with a classical melt-mixing approach.

### What are some of the difficulties you have encountered and how did you solve them?

The main difficulty appeared at the very beginning of the process, as we needed to obtain a controlled size reduction of thermosetting materials made of stiff resin and very hard carbon fibres while ensuring low energy input and safe operation. This has been achieved in cooperation with an Italian producer of grinders, who designed an effective industrial grinder for us. Another problem was the handling of the industrial solvent necessary for the emulsification. This solvent needs to be recycled internally to get a closed loop, and we are on the way to solving this problem.

### What are the concrete results from the research so far?

One of the most concrete results is the fact that we can claim to have obtained, at a pre-industrial scale, highly-filled thermoplastic composites made from end-of-use materials. Those come with properties that make them comparable to composites made of virgin materials. Moreover, the resulting composites are thermoplastic, with the advantage that they can be recycled all over again at the end of their second life.

### When do you expect the project results to benefit the sector?

At the moment, SUSRAC is in the third semester of a two-year project, and we have already started an industrialisation phase with an Italian company specialised in the design of industrial production plants. At the end of this industrialisation phase, planned for the middle of 2014, we will have a clear view of the investment costs, and we will be able to propose the results to interested companies. We hope to be ready by the middle of 2015.

### What are the next steps of the project, or next topics for your research?

The next step is the realisation of demonstrators of a big-enough size for testing in a



© Dr Mario Malinconico

Dr Mario Malinconico

full-scale environment, such as the production of a specific element or aircraft part. This could be important, because it will allow the reuse of materials from dismantled aircraft in new aircraft production. In a similar way, in the automotive industry nowadays, car parts are made using materials originating from the dismantling of old cars.

The SUSRAC project is coordinated by the Italian national research council (CNR). It also includes the Spanish research centre, Tecnalia, as a partner with a specific role in the validation of the fire resistance of the final material.

1 'Sustainable recycling of aircrafts composites'.

Funded under the FP7 specific programme 'Cooperation' via the 'Clean Sky Joint Undertaking' (CSJU), one of the EU's 'Joint Technology Initiatives' (JTI).  
SUSRAC project website:  
<http://www.susracproject.com/>  
Clean Sky JTI website:  
<http://www.cleansky.eu/>

## Better aviation testing for structural safety

*Advances in software and simulation technology are empowering aeronautics manufacturers to lower the costs of testing for structural safety.*

An ongoing drive to increase safety in the aeronautics industry has the potential to save lives and maintain Europe's position as a pioneer in the industry. In principle, aeronautical components are designed based on the damage tolerance concept, which

requires very accurate knowledge on fracture resistance and crack growth rate, among other crucial indications.

One new high-tech approach in this direction embraces the introduction of

simulation-supported 'probability of detection' (POD) and 'non-destructive testing' (NDT) simulation. In this context, the EU-funded project PICASSO<sup>1</sup> built powerful new NDT software to detect structural flaws in components more efficiently.

In particular, the project team worked on advanced ways to determine the curve that calculates the probability of detecting defects (probability vs. defect size). This generally requires complicated and costly POD procedures, an issue that



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PICASSO has overcome using novel NDT simulation tools, to yield less costly and more reliable POD determinations.

To achieve its aims, the project team characterised the defects and described the components in question. It employed

three-dimensional (3D) tools and 'computer-assisted design' (CAD) technology to create the NDT software, integrating a modelling strategy for uncertainties and validating their observations through simulation runs. Results of the project so far have been the successful validation of simulation-supported POD, including implementation strategy and involved methodology.

This advanced technology is expected to contribute to the European standard in testing damage tolerance and advancing safety. The end results will be increased safety for passengers and crew, as well as a stronger and more competitive industry.

The project was coordinated by SNECMA in France.

- 1 'Improved reliability inspection of aeronautic structure through simulation supported POD'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Transport'.  
[http://cordis.europa.eu/result/brief/rcn/11455\\_en.html](http://cordis.europa.eu/result/brief/rcn/11455_en.html)  
 Project website:  
<http://www.picasso-ndt.eu/>

## Exploring and exploiting engineered oxide interfaces

*An EU-funded project has successfully integrated an oxide super-lattice into a prototype electronic device. Using the new-found capabilities of the interfaces between complex oxides could revolutionise the electronics sector.*

Thin layers of oxide materials can display an astonishing variety of electronic and ionic phenomena. However, despite considerable advances in the field, there are many experimental and theoretical challenges to address before the potential applications can be realised.

With this in mind, the OXIDES<sup>1</sup> project, funded by the EU, set out to target the engineering of 'exotic phenomena' at oxide interfaces.

The main aim of the project was to develop techniques to model the most relevant types of oxide interfaces. In addition,

the objective was to use these tools to design a new generation of layered nanomaterials with unique properties.

In line with these aims, the OXIDES team developed new theoretical and simulation techniques, and contributed to the identification and

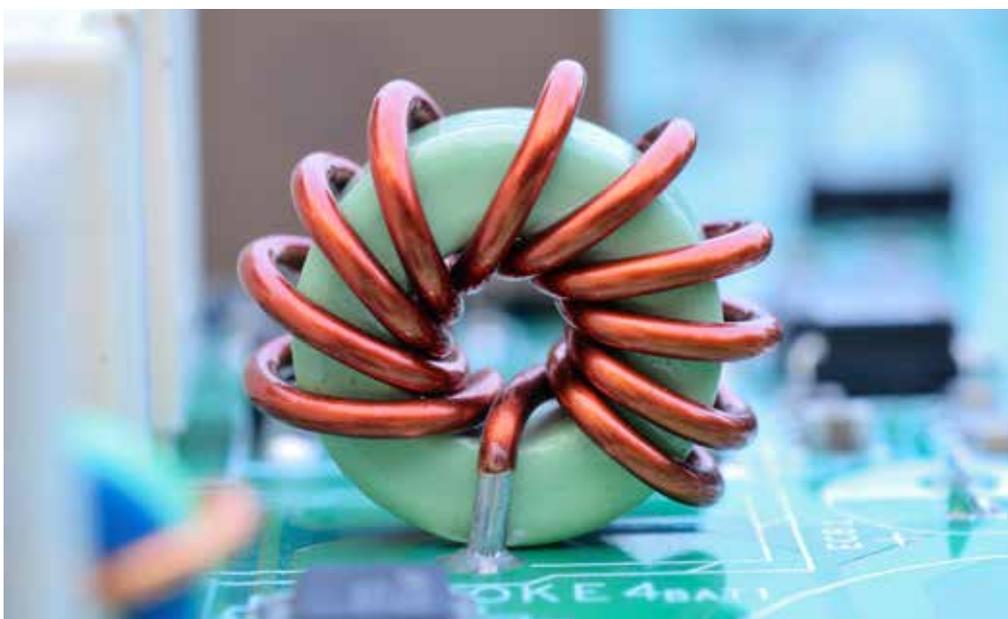
characterisation of structured layers of highly promising oxides. The researchers also investigated the possibilities of including these layered materials in practical devices.

By the end of the project, OXIDES had developed one such prototype device, which opens the door to specific electronic applications not usually accessible via the normal silicon-based technology. The patent for this invention is being applied for and action plans for future work are being drawn up to capitalise on the achievement.

The project was coordinated by the University of Liège in Belgium.

- 1 'Engineering exotic phenomena at oxide interfaces'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Nanosciences, nanotechnologies, materials and new production technologies' (NMP)  
[http://cordis.europa.eu/result/brief/rcn/11041\\_en.html](http://cordis.europa.eu/result/brief/rcn/11041_en.html)  
 Project website:  
<http://www.oxides.ulg.ac.be/>



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## Creating value and reducing waste by exploiting animal by-products

*The animal by-products industry is a vital link in the global food production chain, creating new products and reducing waste. However, new, safe biotech tools and processes are needed to meet growing markets and ambitious environmental goals. This is why a European project has developed a new way of converting previously unmarketable poultry remains into products ranging from animal feed to biodiesel.*

The EU-funded PROSPARE<sup>1</sup> project set out to develop a technological platform for the multi-purpose processing of 'animal by-products' (AB-P), particularly poultry. Using a novel biocatalytic approach, unmarketable poultry remains can now be converted into value-added proteins — peptide hydrolysates — that can be used in marketable end products.

The project started out by examining how value-added peptide mixtures could be obtained from raw materials. It then sought to make this process available to industry for larger-scale processing. The ultimate objective was to make these peptide mixtures exploitable to the

food, feed and biochemicals (cosmetic and microbiology) sectors.

The technology platform has focused on bringing forward several key benefits. The first is utilisation — making AB-P potentially interesting to a range of industries through the development of a novel conversion process based on a biocatalytic approach. This in turn should create value, by converting these residues into peptide hydrolysates for food additives and feed, for example. The accompanying fat and tallow (rendered animal fat) can also be exploited for renewable energy and the production of organic chemicals.

Another focus of the project has been functionality. New ingredients must meet consumer expectations if they are to succeed in the market place. Therefore, the project looked at achieving the necessary sensory characteristics required for nutritional ingredients — taste, aroma and digestibility — in order to improve their commercial potential. The functional properties of newly produced food additives have been investigated by using standard and new assay methods.

Importantly, the project also prioritised safety. A range of complementary low-cost techniques for monitoring microbial contamination and novel tracing tools for mycotoxin detection have been developed, to ensure that developed food additives comply with regulations.

The PROSPARE project represents a radical breakthrough because it demonstrates how previously unmarketable AB-P can be exploited through efficient bio-conversion methods and biocatalysts (enzyme and/or enzymatic

compositions). It is also novel in that it is highly interdisciplinary, applying biotechnological, chemical, biophysical, immunological and toxicological expertise. In addition, it has involved industrial partners who have trialled the proposed technologies for evaluation. The first pilot production plants (in Russia and Belgium) achieved the required standard of full productivity and sustainability.

It is expected that this technological breakthrough will help to reduce unnecessary waste. While exploiting such products safely has consistently been a major challenge, the new processing technologies developed through PROSPARE should meet broad EU food-safety requirements while being economically sustainable.

The project was coordinated by the University of Parma in Italy.

1 'Progress in saving proteins and recovering energy'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
<http://cordis.europa.eu/news> > search > 35880  
 Project website:  
<http://www.prospare.eu/>



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## Wood bark and peat — getting value from waste

*Huge amounts of widely available bark and peat are underutilised in the European Union and Russia. A three-year European project has investigated how to use these as raw materials in environment remediation, as well as in agriculture and the pharmaceutical, health-care and chemical sectors.*

Peat and bark are widely available waste by-products that are a potentially profitable and environmentally friendly resource.

FORESTSPECS<sup>1</sup>, funded by the EU's Seventh Framework Programme (FP7), is working to

optimise the economic value of these two materials by developing cost-effective extraction techniques and applications in various industrial sectors. A project partner has developed efficient microwave-assisted extraction processes for bark

and peat. The new technology uses fewer solvents and is faster than conventional techniques.

FORESTSPECS research to date has shown that bark extracts like betulin derivatives and suberin

show promise as bioactive agents in pharmaceuticals, coatings, surfactants, lubricants, pest control, adhesives (polymers), fungicides and cosmetics. Also, project members have found that humic acids obtained from peat could be used as adhesives and chelating agents in water purification and mining.

Studies have also identified natural compounds in bark and peat that protect



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plants by modifying pest behaviour. This has the potential to provide plant protection without pesticide residue issues or resistance build-up in pests.

Products from bark can also be used as compost.

Bioactive agents from bark and peat could also be used for the

remediation of soils contaminated with organic and heavy-metal pollutants. They could also improve soil fertility by increasing water retention capacity and slowing down decomposition.

FORESTSPECS activities have shown that investing in waste products like bark, and by-products like peat, can be a viable alternative for existing technologies in greener, more cost-effective ways. These products could have applications in the agriculture, health-care, pharmaceutical, chemical, mining and construction sectors.

The project was coordinated by the University of Helsinki in Finland.

- 1 'Wood-bark and peat-based bioactive compounds, speciality chemicals, and remediation materials: from innovations to applications'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Food, agriculture and fisheries, and biotechnology' (KBBE).  
[http://cordis.europa.eu/result/brief/rcn/11165\\_en.html](http://cordis.europa.eu/result/brief/rcn/11165_en.html)  
 Project website: <http://forestspecs.eu/>



## New device for search-and-rescue operations

*Time is critical in search-and-rescue operations. To minimise the period required for finding trapped victims, the SGL FOR USAR project team designed and tested a novel locator capable of detecting minute concentrations of human scent.*

Urban search and rescue involves the location, extrication and initial medical stabilisation of victims trapped in confined spaces due to natural disasters, structural collapse and transportation accidents. Quite often, victims of the collapse remain unconscious — which makes locating bodies far more difficult. To address this issue, the SGL FOR USAR<sup>1</sup> project team designed a second-generation locator for urban search-and-rescue operations.

Building an ultrasensitive device requires a lot of expertise. The consortium consists of 10 academic and research groups — as well as nine small and medium-sized enterprises (SMEs) and two rescue teams.

The project team designed a device and tested its capacity to recognise human scent. The research involved 20 healthy volunteers to identify the

specific signature of human odour spontaneously emitted from their bodies. The device contained both a visual camera and a highly sensitive mass spectrometer to locate human bodies, both dead and alive. It also contains a 'global positioning system' (GPS) to map the location, an audio processor and a carbon dioxide (CO<sub>2</sub>) gas sensor to trace victims of entrapment.

Project engineers and researchers combined sophisticated equipment with telemedicine, monitoring vital signs and medical parameters of the potential victim. They also designed a motorised antenna for satellite communication.

The success of this project could save many lives in situations of urban entrapment, such as after earthquakes and mining accidents. It will also expedite search-and-rescue operations and significantly increase their efficiency.

The project was coordinated by the National Technical University of Athens in Greece.



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- 1 'Second generation locator for urban search and rescue operations'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Security'.  
[http://cordis.europa.eu/result/brief/rcn/5977\\_en.html](http://cordis.europa.eu/result/brief/rcn/5977_en.html)  
 Project website: <http://www.sgl-eu.org/>



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## Keeping an eye on Europe's biodiversity... from space

*The Natura 2000 programme helps to protect and preserve Europe's threatened biodiversity, but monitoring progress is challenging given the diversity of sites and data. An EU-funded project has developed a system for aggregating and analysing satellite-based Earth Observation (EO) data.*

Biodiversity is under threat from numerous factors, yet it is essential to the proper functioning of ecosystems and the well-being of humanity, and it is beautiful in its own right. The EU's Natura 2000 programme — described as the 'centre-piece of EU nature and biodiversity policy' — was a response to the loss of biodiversity in Europe. The initiative created a network of protected and designated sites across Europe, both on land and in water.

To gauge the performance of Natura 2000, standardised monitoring of all the sites is required, with detailed reporting by Member States every six years. However, given the sheer diversity of sites, this is a major challenge.

The EU's Global Monitoring for Environment and Security (GMES) system addresses this challenge through satellite-based EO. The

MS.MONINA<sup>1</sup> project has developed EO-based services that can collect relevant information cost effectively at different scales across the Natura 2000 network and beyond. The EU-funded project helps stakeholders to meet the Natura 2000 reporting, monitoring and management needs at three geographical scales: for individual sites, for each Member State, and for the EU as a whole.

MS.MONINA started by matching thematic and user requirements to available expertise; i.e. it recorded Europe's mapping capabilities. This categorisation helps the MS.MONINA site to offer thematic services and products, such as maps and indicators of landscape configuration, vegetation, habitats and conservation efforts. To refine the developed tools further, MS.MONINA has a dedicated user-engagement programme.

In light of the diversity of data sources and formats, as well as user requirements, the project rolled out a sophisticated serial digital interface known as Nature-SDIplus. In order to optimise the impact of the platform, MS.MONINA will continue to develop, refine and promote the service.

The project is coordinated by the Paris Lodron University of Salzburg in Austria.

1 'Multi-scale service for monitoring Natura 2000 habitats of European community interest'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/11395\\_en.html](http://cordis.europa.eu/result/brief/rcn/11395_en.html)  
 Project website: <http://www.ms-monina.eu/>

## SPACE

## Advanced systems for spacecraft protection

*Spacecraft are subject to extreme temperatures on atmospheric re-entry due to friction with air molecules. EU-funded scientists are employing novel multifunctional materials for improved heat shielding in such extreme conditions.*

Specially designed heat shields or 'thermal-protection systems' (TPSs) prevent spacecraft from burning up during re-entry, thus saving lives. Given the growing number of unmanned satellites in space, TPS also preserves expensive equipment and years of research. In addition, this has a positive impact on public opinion regarding expenditure on such programmes.

Scientists are breaking ground with a novel reusable TPS based

on multifunctional hybrid ceramic materials that provide excellent insulation and oxidation resistance. EU funding of the project SMARTTEES<sup>1</sup> is enabling the development of a multilayer concept incorporating 'high-temperature ceramics' (HTCs) and 'ultrahigh-temperature ceramics' (UHTCs) with tailored properties.

The external layer will have oxidative resistance at re-entry, and the middle layer high thermal conductivity to distribute

heat homogeneously. The third and innermost layer is designed for thermal insulation. The multilayer materials are joined either to conventional structural 'ceramic matrix composites' (CMCs) or to novel porous sandwich structures. These are then attached to metallic frames.

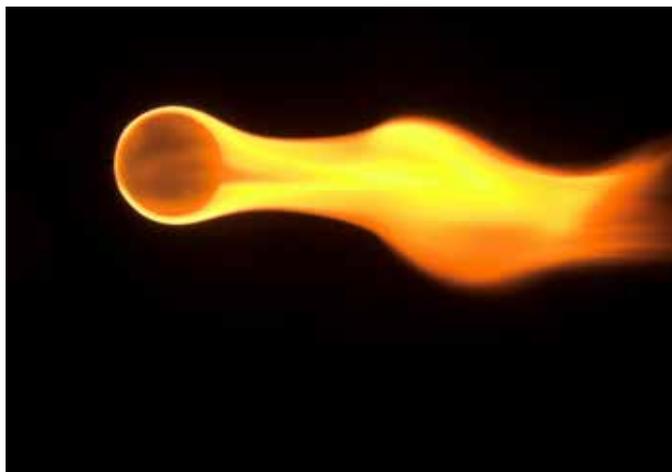
Following definition of the TPS design, the project proceeded with materials development and manufacturing for the multilayer ceramics, foams and sandwich structures. Methods that comply with TPS specifications were selected for joining the three levels. Scientists have produced several bonded joints using a subset of bonding processes for characterisation.

Partners are developing models of the individual components as well as the entire TPS using a digital reconstruction from X-ray 'computed tomography' (CT). Preliminary thermal and thermo-mechanical simulations have been performed using the model of the entire TPS. In addition,

the re-entry chamber for ground testing has been updated and the first foams have now undergone thermal testing.

The SMARTTEES TPS will improve Europe's access to space critical technologies with expected benefit of safe return of the 'next-generation launcher' (NGL) and the International Space Station (ISS). Reusing valuable space technology and instrumentation is not only cost saving for the aerospace industry but also enhances public support of space investment.

The project is coordinated by Tecnalia Research & Innovation in Spain.



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1 'Multifunctional components for aggressive environments in space applications'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/11393\\_en.html](http://cordis.europa.eu/result/brief/rcn/11393_en.html)  
 Project website  
<http://www.smarttees-project.eu/>

## Spotting species from space satellites

*A European initiative has come to the aid of protected areas in no less than three continents. Employing satellite and in situ data, the BIO\_SOS project is developing an ecological monitoring system to measure biodiversity and its changes within protected sites.*

Just over 20 years ago, the EU drew up legislation to protect the continent's most seriously threatened ecosystems. The resulting Habitats Directive was translated into the basis of the Natura 2000 network of protected areas.

The EU-funded BIO\_SOS<sup>1</sup> project is monitoring Natura sites in southern Europe, Brazil, India, the Netherlands and Wales to support management decisions in

sample areas. The project aims to develop an ecological modelling system to identify impacts that human-induced pressures may have on biodiversity.

An ecological modelling system requires real-time reliable data input from ecosystems under surveillance for accuracy. The information sources used are satellite-based measurements and data collected on site. Output from this system will

also provide reliable biodiversity indicators.

In the first year of the project, the 'Earth Observation (EO) data for habitat monitoring' (EODHAM) system was tested and taken through its paces for all three system stages. These are provision of EO input images, output of land cover (LC) maps from the images and, lastly, habitat and habitat change maps. The third deliverable also provides

biodiversity indices and their trends through ecological modelling.

BIO\_SOS scientists expect to be able to supply geo-information with a particular focus on biodiversity indicators regarding agricultural and urban expansion, including road construction. Also of great concern to the integrity of threatened ecosystems are invasive species, and habitat connectivity and fragmentation.



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Project data will help to define buffer zones around designated sites to prevent habitat fragmentation in the surrounding area. Buffer zones must exist to minimise the impacts of adjacent land use.

Indicators will facilitate dynamic monitoring of the different

planning processes. Moreover, if any conservation policies have been applied, monitoring can determine if these have been implemented.

BIO\_SOS project will be multi-resolutional and multi-scale for the production of landscape conservation maps from a highly

diverse range of ecosystems. Overall, the EODHAM system will enable its managers to appreciate the complexity of pressures in multiple ecological and human environments.

The project was coordinated by the National Research Council in Italy.

1 'Biodiversity multi-source monitoring system: from space to species'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/11394\\_en.html](http://cordis.europa.eu/result/brief/rcn/11394_en.html)  
 Project website: <http://www.biosos.wur.nl>



## Softer and safer landings enabler for future spacecraft

*Propulsion systems in spacecraft are critical for take-off and landing. EU-funded scientists are developing precisely controllable propulsion systems for soft and accurate landings on future targets such as Mars and Jupiter's moons.*

Spacecraft are launched and maintain flight by burning fuel to produce a forward push in response to the release of exhaust gases from behind. Better control of the propulsion process is paramount to orbital insertion and soft landings on planetary bodies of interest.

Scientists initiated the EU-funded project SPARTAN<sup>1</sup> to enable precise control of rocket thrust. Such control will facilitate future planned space missions to the Moon, Mars and even Jupiter's moon Europa, where robotic missions and eventually manned ones must land under difficult conditions.

The hybrid propulsion system under study consists of the engine, fuel and fuel housing as well as the oxidiser injection system adapted to enable precise throttle by controlling the combustion process. System

testing requires development of a flying test bed for validating landing capabilities.

To date, scientists have designed and tested a measurement device required to determine the fuel regression rate — essentially the speed at which the fuel is burned, integrally related to the specific impulse or thrust. The regression law differs for each oxidiser/fuel pair.

In addition, numerical codes are supporting the optimisation of engine and engine injection design. A preliminary landing test was carried out to optimise the test plan for validating the throttleable engine. Further, a detailed design of the flow control valve to regulate propellant flow is now being converted to a breadboard model for testing. Finally, scientists have defined detailed >



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## SPACE

requirements for the specific mission profile. Selected 'guidance, navigation and control' (GNC) components were subjected to preliminary tests.

SPARTAN expects to deliver space-propulsion technology capable of enabling soft and precise landing and to provide

for the demonstration of a European soft landing by performing a drop test using an autonomously guided Lander module. Results should stimulate future research leading to improved capability for access to planetary surfaces and give Europe a competitive edge in the space race.

The project is coordinated by Thales Alenia Space in Italy.

1 'Space exploration research for throatable advanced engine'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/10492\\_en.html](http://cordis.europa.eu/result/brief/rcn/10492_en.html)  
 Project website:  
<http://www.spartanproject.eu/>

## Satellite surveillance for illegal logging

*It is estimated that every year the world loses an area of forested land the size of Portugal, often through illegal logging. An EU-funded satellite observation project aims to develop a space-based, early-warning system for hot-spot monitoring.*

Deforestation causes environmental, societal and climatic problems. Although international recognition has led to sustained efforts to address and reverse the practice and its effects, deforestation continues on a global scale, often illegally.

The EU-funded REDD-FLAME<sup>1</sup> project aims to design, prototype and demonstrate a system capable of monitoring tropical and sub-tropical forests. It is using high-resolution radar and optical imagery

acquired by Earth Observation satellites. Early detection of logging activities through 'synthetic aperture radar' (SAR) and optical remote-sensing data will provide the means to quickly identify the first signs of deforestation from space. This information will then be disseminated rapidly to the appropriate authorities.

REDD-FLAME is currently working with partner organisations in Brazil, Indonesia and Mozambique. It has been testing its system on a

cross-section of tropical and sub-tropical environments while tailoring it to each partner nation's specific monitoring requirements. Project partners will develop a tool to control resource use and sustainable development and build capacity in the host countries to manage forest resources and carbon balances.

Currently, technical development is focusing on new methodological insights and the latest sources of high-resolution imagery, as well as the

research and development of new algorithms. The objective is to detect changes in forest state and to generate new products.

Project members intend to present the results and experiences from each of the countries involved at workshops. At the end of the project, these will be organised in each country to showcase the system and make recommendations for its operational implementation.

The aim of these workshops is to inform policy-makers, provide input to monitoring programmes, facilitate law-enforcement efforts or provide local communities with evidence to protect against illegal encroachment on forests.

The project was coordinated by Remote Sensing Applications Consultants Ltd in the United Kingdom.

1 'REDD fast logging assessment & monitoring environment'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/11360\\_en.html](http://cordis.europa.eu/result/brief/rcn/11360_en.html)  
 Project website:  
<http://redd-flame.info/>



## A new data-driven cryosphere monitoring tool

*Accurate and up-to-date knowledge of the snow and ice conditions in Europe is important for environmental and socio-economic activities. An EU-funded project aims to provide a real-time ice-and-snow monitoring service to ecologists, meteorologists and industry players.*

The area of the Earth covered by snow and land ice, 'the cryosphere', varies considerably over time, depending on the season and local conditions. These are important considerations in weather forecasting, commercial and private water use, and natural hazard prediction. Satellite monitoring is the only effective way to ensure that accurate and timely data reach those who need it.

The CRYOLAND<sup>1</sup> project was established to provide a service to monitor snow and land ice. The idea is to use data

from the Global Monitoring for Environment and Security (GMES) system, now called 'Copernicus', to create an important set of services relating to snow and ice monitoring for a wide user community.

To achieve this, CRYOLAND first assessed the needs of potential users. The results of these surveys are shaping the development of the system's software and interface, and a prototype is already being tested. The system has produced various maps and other indices, and these will be

evaluated to establish guidelines for the future operation of CRYOLAND. Much of the work involves assessing and improving the system to provide standardised and high-quality data to a wide range of users. The project will also provide technical training for its potential users.

CRYOLAND is thus an important part of the EU strategy for climate and environmental management. Once the system is operational, it will provide valuable information for use in water resources, including

hydropower, natural hazards such as avalanches and flooding, agricultural management and tourism.

The project is coordinated by ENVEO in Austria.

1 'GMES service snow and land ice'.

Funded under the FP7 specific programme 'Cooperation' under the research theme 'Space'.  
[http://cordis.europa.eu/result/brief/rcn/11418\\_en.html](http://cordis.europa.eu/result/brief/rcn/11418_en.html)  
 Project website:  
<http://www.cryoland.eu/>



## EVENTS

### International workshop on the socio-economics of ageing

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*The third 'International workshop on the socio-economics of ageing' will be held on 25 October 2013 in Lisbon, Portugal.*

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Ageing societies are a central issue in the social sciences, and the analysis of the challenges and opportunities that are offered to policy-makers is crucial to guarantee an adequate level of welfare in the future. This workshop will consider both the economic dimension and the social dynamics of ageing societies. It will discuss topics such as economic growth, life-cycle consumption, labour-market behaviour, well-being or happiness, social exclusion, care arrangements, intergenerational transfers and research.

*For further information, please visit:*

[http://pascaliseq.utl.pt/~socius/IWSEA2013/?Call\\_for\\_Papers](http://pascaliseq.utl.pt/~socius/IWSEA2013/?Call_for_Papers)

### Regenerative medicine: from biology to therapy

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*An event entitled 'Regenerative medicine: from biology to therapy' will be held from 30 October to 1 November 2013 in Cambridge, United Kingdom.*

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Few topics in contemporary medicine have attracted more attention than stem cells and their potential for enabling the discovery of new regenerative therapies. The conference will look at the biology that underpins the success or failure of regeneration, and will clarify the relationship between stem-cell biology and regenerative biology so that both can be fully exploited to treat disease.

*For further information, please visit:*

[http://registration.hinxton.wellcome.ac.uk/display\\_info.asp?id=369](http://registration.hinxton.wellcome.ac.uk/display_info.asp?id=369)

### Green electronics 2013

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*A workshop entitled 'Green electronics 2013' on resource efficiency in the electric and electronics industry will be held from 4 to 6 November 2013 in Budapest, Hungary.*

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This workshop builds on the ZEROWIN<sup>1</sup> project, an initiative which organises an exchange of by-products, energy, water, materials and waste between 30 industrial partners from 11 countries, with the aim of reducing greenhouse gas (GHG) emissions by 30%, raising recycling levels to 70% and reducing fresh-water consumption by 75%.

Participants will be informed about the current state of the art and future trends in resource efficiency, as well as learn about ecological legislation directly from the European Commission. Leading companies will present their visions on resource efficiency in the 21st century.

<sup>1</sup> 'Towards zero waste in industrial networks'.

*For further information, please visit:*

<http://www.care-electronics.net/greenelectronics/>

### OPENCHINAICT final conference on strengthening cooperation in ICT research between 'Europe and China'

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*The 'OPENCHINAICT final conference on strengthening cooperation in ICT research between Europe and China' will be held on 5 November 2013 in Vilnius, Lithuania.*

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The EU-funded OPENCHINAICT<sup>1</sup> project aims to facilitate cooperation in ICT-related research between Europe and China. Marking the project's final exhibition, the conference will focus on EU-China ICT cooperation opportunities and build upon the results of the OPENCHINAICT project. Sessions include the current status of EU-China collaboration, perspectives for cooperation on ICT research under Horizon 2020, and project cooperation priorities.

<sup>1</sup> 'Opening European-Chinese cooperation on ICT research'.

*For further information, please visit:*

<http://openchina-ict.eu/project-events/final-conference/>

## International conference of agricultural engineering

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*The 71<sup>st</sup> 'International conference of agricultural engineering' will be held from 8 to 9 November 2013 in Hannover, Germany.*

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One of the main challenges facing agriculture is the need to double world food production by 2050. European policy-makers have recently made reform proposals with an emphasis on sustainable farming practices, innovation, research and the spread of knowledge — as well as a fairer support system for European farmers to help them meet the challenges of tomorrow.

Within this context, the conference will focus on 'Components and systems for better solutions', and the importance of suppliers in machine development and manufacturing processes. The aim is to increase productivity and efficiency in a sustainable manner.

For further information, please visit:  
<http://www.vdi.de/landtechnik-ageng>

## e-nova 2013

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*A conference entitled 'e-nova 2013' will be held from 14 to 15 November 2013 in Pinkafeld, Austria.*

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The revised version of the European Union's Energy Performance of Buildings Directive (EPBD 2010/31/EU) has paved the way for sustainable constructions in an effort to develop 'greener' architecture. Clear goals were set, which are to be met by 2020. On the other hand, these requirements have yet to be implemented in conformity with the optimised life-cycle costs and ecological sustainability. It is essential to consider buildings in this challenging environment as part of a single system. Buildings must be well balanced in their social, economic and ecologic aspects and integrated in the technical, social and economic environment.

The conference will focus on green technologies, fuel efficiency, safety and comfort and recent design concepts.

For further information, please visit:  
<http://www.fh-burgenland.at/forschung/e-nova-2013-english/>

## ICT for language learning

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*The sixth edition of the 'ICT for language learning' conference will be held from 14 to 15 November 2013 in Florence, Italy.*

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As technological advances grow ever-more sophisticated and their complexity increases, researchers are developing modernised ICT applications to assist in language-learning and -teaching techniques.

This conference aims to share good practice and intensify transnational cooperation in the application of technology to language learning and training. It will also provide an opportunity for the presentation of previous and current language-learning projects funded by the European Commission and other organisations. Topics of discussion include ICT-based language-teaching approaches, second-language acquisition, language learning to support international mobility and e-learning solutions.

For further information, please visit:  
<http://conference.pixel-online.net/ICT4LL2013/index.php>

## MedTech and diagnostics innovations summit

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*The 'MedTech and diagnostics innovations summit' will be held on 21 November 2013 in Düsseldorf, Germany.*

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The medical-device industry is one of the most innovative sectors in health care. Many Europeans are now able to live healthier and more independent lives as a result of medical technology.

This summit will bring together companies focused on mergers and acquisitions, alliances and innovation in the medical-technology industry. In parallel with sessions on investment and collaborative opportunities, other areas of discussion include regulation and reimbursement in addition to devices and diagnostics.

For further information, please visit:  
<http://www.sachsforum.com/mdif13/index.html>

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