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- Interviews:
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EU science is setting an example for water cooperation

Looking at climate change and its effects, there is no denying the fact that water will become increasingly scarce, especially in those regions already experiencing drought conditions or low rainfall. In this context, the United Nations chose the theme ‘Water cooperation’ as the focus of World Water Day which took place on 22 March.

In the words of Hans d’Orville, UNESCO Assistant Director-General for Strategic Planning: ‘Water cooperation refers to the peaceful management and use of water resources among various players and sectors and at different levels.’ This definition just happens to fit relevant FP7 research like a glove: scientists from different institutions and countries, working with industry, decision-makers and other stakeholders on issues such as water quality, climate-induced water scarcity and its likely impact on peace in Europe and beyond.

To highlight these examples of cooperation, this issue of research*eu results magazine focuses on ‘Water of life: desertification, access to clean water’, and showcases 14 projects aiming to protect future generations from the consequences of low water quality or availability. We interviewed Professor Roberto Ronson, who opens the ‘environment’ section by explaining the WasserMed project and its contribution to avoiding water-related conflicts.

Up next is Professor Peter-Wyn Jones, who introduces us to Viroclime, a project aiming to improve virus-detection methods in water.

Other ‘specials’ are spread across the ‘environment’, ‘social sciences and humanities’, ‘industrial technologies’ and ‘space’ sections. They start on page 13 with ‘Climate change, water conflict and human security’.

The ‘biology and medicine’ section opens on page 6 with ‘Doctor in a cell’, an article which suggests that diseases could soon be diagnosed and treated by micro-computers the size of a blood cell navigating within the human body. The ‘energy and transport’ section starts on page 17 with an equally groundbreaking story entitled ‘Testing a hydrogen-fuel-based transport infrastructure’.

The ‘IT and telecommunications’ section begins with ‘A boost to your mobile signal’ on page 30, followed by the ‘industrial technologies’ section and its special ‘Collecting water from thin air’, on page 35. Finally, the ‘space’ section reveals new satellite technologies for ‘Keeping an eye on rising sea levels’, on page 40.

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

The editorial team

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Watch this space! Coming up in issue 22 of research*eu results magazine — a special dossier called ‘Rare diseases and genetic disorders under the microscope’.
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Doctor in a cell

By combining computer science and molecular biology, researchers have been able to work on a programmable biological computer that in the future may navigate within the human body, diagnosing diseases and administering treatments. This is what Professor Ehud Shapiro and his team call a ‘Doctor in a cell’.

The history of the Biomolecular Comp project goes back to 2009, when Prof. Shapiro and doctoral students Tom Ran and Shai Kaplan presented the prototype of an autonomous programmable molecular system. Based on the manipulation of DNA strands, the system was capable of performing simple logical deductions and marked the first simple programming language implemented on a molecular scale. Introduced into the body, this system has immense potential to accurately target specific cell types and administer the appropriate treatment, as it can perform millions of calculations at the same time and ‘think’ logically.

Biomolecular computers made of DNA and other biological molecules exist in very few laboratories. Prof. Shapiro’s team aims to make these computers perform highly complex actions and answer complicated questions, following a logical model first proposed by Aristotle over 2000 years ago. These biomolecular computers are extremely small: 1 trillion computers can fit into a single drop of water. If they were instructed that ‘all men are mortal’ and that ‘Socrates is a man’, they would conclude that ‘Socrates is mortal’. Multiple rules and facts were tested by the team and the biomolecular computers answered all of them correctly.

The team also found a way to make these microscopic computing devices ‘user-friendly’ by creating a compiler — a program for bridging between a high-level computer programming language and DNA computing code. They sought to develop a hybrid in silico/in vitro system that supports the creation and execution of molecular logic programs in a similar way to electronic computers, enabling anyone who knows how to operate an electronic computer, with absolutely no background in molecular biology, to operate a biomolecular computer.

The possible future biomedical applications of these ingenious nano-scale doctors were already demonstrated in a test tube where a tiny biomolecular computer identified the presence of cancer symptoms in 2004. The computer, equipped with medical knowledge, analysed the situation, diagnosed the type of cancer and then released the appropriate drug that may kill cancer cells. In 2011, together with a research fellow Professor Yaakov Benenson, Prof. Shapiro showed the operation of a molecular computer with a similar concept but different design in living cells. This research direction may pave the way for future smart drugs and other applications in the health sector.

The project was coordinated by the Weizmann Institute of Science in Israel.

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

1 ‘Biomolecular computers’.
Named Plaprova, the project was the successful result of an unprecedented co-funding initiative between the EU and Russia, with both regions providing EUR 2 million. Consisting of six research teams from various EU countries, four from Russia and one from South Africa, the Plaprova consortium focused on the use of plant proteins to produce vaccines against diseases such as avian flu, bluetongue, foot-and-mouth disease, and porcine reproductive and respiratory syndrome.

Plants have already been used to produce pharmaceuticals in the past, but the three-year Plaprova project developed a technique for doing this much more quickly than previously possible — an advance which has revolutionary implications for future vaccine production. The research is so promising that its lead researcher even won a major innovation award.

Known as ‘transient expression’, the method developed by the Plaprova group involves introducing a modified virus, which has been engineered to contain specifically chosen genes, into the leaf of a plant. This triggers the production of proteins which are of potential pharmaceutical interest as the basis for new vaccines. In contrast with previous methods, which required the genetic transformation of the entire plant to produce a protein — and which took years to produce a single protein in any sufficient quantity — the procedure developed by the Plaprova team can produce large quantities of new plant proteins in a matter of weeks.

In the words of Plaprova’s project coordinator, Professor George Lomonossoff of the John Innes Centre in the UK, the new technique turns the host plants into ‘mini-factories’, but without resorting to permanent genetic modification of the entire plant. The foreign genes that are transiently introduced are not inherited by subsequent generations of the plant.

The crucial advantage of Plaprova’s method is that researchers are now able to produce and assess large numbers of proteins in a very short time, thus opening up much wider possibilities for genuinely novel vaccines. Previously, the timescale required before results were known for just a single protein meant researchers naturally played safe and tended to produce ‘biosimilars’, i.e. vaccines which replicated already existing ones. It was a situation which discouraged the search for new products.

Now, says Prof. Lomonossoff, it has all changed: ‘You don’t have to place all your money on one particular construct, then wait five years and hope you made the right selection,’ he says. ‘The great thing is, you get your failures quickly. If you are not sure which of 20 options will be best, you can just try all 20 and then select. You can be much more adventurous.’

The speed of the new process is also a critical factor when dealing with seasonal outbreaks when a vaccine needs to be created urgently, usually in a matter of months from the time the strain of disease is identified.

The success of Plaprova has already generated significant commercial interest. Discussions are in progress with vaccine manufacturers in South Africa for the production of a bluetongue vaccine. And a Canadian firm, Medicago Inc, has successfully applied the technique to the discovery and production of pandemic flu vaccines for humans, on which it has recently completed a Phase II clinical trial.

The revolutionary impact of the new Plaprova technique, with the possibilities it opens up for future work in vaccine discovery, was recognised with the naming of Prof. Lomonossoff as Innovator of the Year 2012 by the Biotechnology and Biological Sciences Research Council (BBSRC) in the UK.

The project was coordinated by the John Innes Centre in the United Kingdom.

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Food, agriculture and fisheries’ (KBBE). http://ec.europa.eu/research > Information Centre > search > 29273
Dissecting mechanisms of bone breakdown in disease

Advancing our knowledge of the process of bone development will improve treatment success of various autoimmune diseases involving pathological bone resorption. The NRLIOD project provided significant insight into the mechanisms underlying bone breakdown by specialised cells known as osteoclasts.

The pathology of many osteolytic diseases such as osteoporosis and rheumatoid arthritis (RA) are linked with osteoclast-driven bone breakdown. This process of bone resorption results in the release of mineralised bone matrix and calcium into the bloodstream.

Researchers in the field believe that the answer to the aberrant process of osteolysis lies in a better understanding of the mechanisms involved in osteoclast development. To this end, the EU-funded NRLIOD project was designed to identify osteoclastogenic signals operating in osteolytic diseases, with particular emphasis on the receptors and ligands regulating osteoclast development.

Prior work had identified the ‘osteoclast associated receptor’ (OSCAR) as being involved in the process through binding to collagen structural proteins at sites of diseased joints. During the NRLIOD study, scientists generated a mouse knockout for OSCAR and analysed the bone phenotype. They also investigated the function of the receptor in a mouse model for arthritis that exhibits great disease penetrance. Results revealed a novel pathway of osteoclastogenesis to be associated with post-menopausal osteoporosis and to be up-regulated in RA. A new OSCAR ligand, the so-called ‘Surfactant protein D’ (SP-D), was identified as conferring a protective role in RA.

NRLIOD did not only shed light on the process of osteoclast development but also led to the discovery that OSCAR signalling in osteoclasts is involved in diseases such as osteoporosis. Project results have the potential to lead to the development of novel therapeutic reagents that suppress inflammation in lung disease and RA.

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

Targeted cancer treatment shows real promise

Scientists are working to overcome current chemotherapy-related challenges. They are developing a new method which directs drug delivery exclusively to tumours, increasing effectiveness while avoiding side effects. Trials of the new treatment are planned for 2013 and industrial partners are already keen to commercialise the biotechnologies resulting from the project.

Latest Eurostat figures show cancer is still a major cause of death across the EU-27, with about 167 fatalities per 100 000 inhabitants in 2010. The most common forms included malignant ‘neoplasms’ of the larynx, trachea, bronchus and lung, colon and breast.

Fortunately, cancer treatments are continually improving, and while the risk remains unacceptably high, a diagnosis of cancer no longer means there is no hope of survival. But today’s cancer treatments still present problems, including unpleasant and sometimes dangerous side effects.

Coordinated by the Institute for Medical Science and Technology (IMSaT) at the University of Dundee, the EU-funded Nanoporation project is developing a new treatment method that solves some chemotherapy-related problems by concentrating drug delivery on specific areas where it is needed.

‘Cancer is one of the most common causes of death in the EU,’ says project coordinator Andreas Melzer. ‘Our aim is to fight this deadly disease using a non-invasive therapeutic solution based on nano-capsules and focused ultrasound drug-delivery techniques.’

As IMSaT Director, Dr Melzer coordinates a multinational team made up of young and senior researchers — around 10 of them are Marie Curie fellows — based in Israel and Scotland.

Targeted attack

Conventional chemotherapy involves the administration of toxic chemical substances that damage rapidly dividing cells, a hallmark of cancer cells. But because these substances also permeate the whole body, they also damage healthy cells that divide rapidly, such as blood cells and cells lining the mouth and gastrointestinal tract.

Under the Nanoporation technique, anti-cancer substances are placed inside advanced nano-capsules.
that only deliver the substances when focused ultrasound is applied.

‘This means we can activate delivery in very specific areas,’ explains Dr Melzer. ‘Magnetic-resonance-guided, focused ultrasound is applied to the tumour itself, inducing cell membranes to open and the nano-capsules to unload the drug, thus crossing cell barriers that often make tumours impenetrable. The nano-capsules are destroyed and subsequently metabolised. The drug kills the cancer cells, whilst nano-capsules in the rest of the body remain inactive and are extracted via the kidney, preventing healthy cells from being exposed.’

**Harmful side effects eliminated**

Typical side effects of chemotherapy include bone-marrow suppression, hair loss, nausea and vomiting, diarrhoea, inability to concentrate, and others. Dr Melzer says his team hopes to reduce these side effects and increase the efficacy of chemotherapy at the same time. This would result in higher survival rates and better quality of life for patients. The aim is to reduce most of the classic symptoms we see as side effects of chemotherapy, through enhanced focal concentration of anti-cancer drugs at the tumour site.

‘We are planning to target various cancers; pancreatic, breast and liver cancers are first on the list, with brain cancer as an additional potential target,’ Dr Melzer explains. According to him, Nanoporation has established clear evidence that the new technique works. In its 2011 mid-term review, the project was flagged as a success story and it was stated that the new technique of focused ultrasound delivery of chemotherapy works. New experiments are now being conducted with mice, and human clinical trials are expected to be launched in 2014.

The scientist says the project has truly been a team effort. ‘We have put in place cutting-edge biomedical technologies, bringing in a company that develops ultrasound equipment and a producer of drug-delivery systems based on nano-capsules. Our two industrial partners, both based in Israel, are now laying plans to commercialise the results.’

As regards EU-support received by the Nanoporation project, Dr Melzer is very satisfied: ‘The Marie Curie Actions are absolutely fantastic. I needed funding and I needed highly qualified researchers. I got what I needed. It is definitely a great programme.’

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

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**Reducing mycotoxin contamination in food**

The very nature of the food chain makes it inherently prone to infection by various micro-organisms. Being equipped to detect and handle such infections is of primary importance for containing their spread.

Mycotoxins are fungal secondary metabolites capable of entering the food chain and contaminating foods before and after harvest. Accumulating evidence indicates that certain mycotoxins are potential carcinogens or neurotoxins, posing a serious health threat to humans and animals.

The aim of the EU-funded Mycored project is to develop novel detection methodologies, handling procedures and practically-useful tools to reduce toxin contamination. A multidisciplinary effort is concentrating on the whole food and feed chain of wheat, maize, grapes, nuts and dried fruits.

Among the project’s objectives is improving prevention of mycotoxins in products, and reducing contamination risks at a global level. Through the development of innovative strategies, Mycored partners are addressing the problem of mycotoxin contamination at the detection and detoxification levels.

Through in vivo fungal inoculation experiments, the consortium is in the process of determining the in vivo toxicity of mycotoxins. Researchers have set up highly specific real-time ‘polymerase chain-reaction’ (PCR) assays for distinguishing different fungal species of Aspergillus, Fusarium and penicillia such as Penicillium, thereby improving current detection methods.
BIOLOGY AND MEDICINE

Partners based their strategies on natural microbial antagonism as a means of biological control, and in particular on various yeast strains to detoxify aflatoxins and ochratoxin A. Also, ozone ($O_3$) and various other novel compounds have been screened for efficacy and control of mycotoxins. Scientists are hopeful that, after the in vivo trial, they will be able to use certain agricultural by-products to adsorb mycotoxins and reduce their bioavailability and toxicity in animals.

Predictive models based on the fungus life cycle have been established to determine the effect of environmental factors and host plant conditions on mycotoxin contamination. These models also have the potential to safely predict the emergence of new toxigenic species due to climate changes or changes in agronomical practices.

The Mycored initiative overall will provide a viable solution for preventing and minimising mycotoxin contamination through precise assessment tools and effective counteractive measures.

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

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Breaking the cycle of antibiotic resistance

A large class of antibiotic-resistant bacteria responsible for life-threatening infections is soon to meet its match. Scientists are developing industrially scalable production methods for what may be the 21st century equivalent of penicillin.

In 1928, Alexander Fleming made a discovery that would change the course of history, saving countless lives from infections we now consider harmless. Fleming named the substance he isolated from the Penicillium mould.

Penicillin turned out to be an extremely potent infection-fighting agent. It also launched the pharmaceutical industry and the search for new antibiotics — substances derived from bacterial sources and used to treat bacterial infections — to conquer some of the world’s most deadly infections.

In recent years, extensive exposure to antibiotics has rapidly increased development of resistant strains of bacteria while development of new antibiotics has seen a decline, making it difficult to treat life-threatening infections.

A new antibiotic called ‘lantibiotic NAI-107’ has shown great potential in fighting a broad class of such infections — those caused by multidrug-resistant gram-positive pathogens. It is currently undergoing toxicological testing for the first phase of clinical trials. However, its success in fighting infections will depend not only on its efficacy and potency but also on its ability to deliver large quantities of high-quality product. It will not do much good if it cannot be mass-produced.

A European consortium led by an Italian small and medium-sized enterprise (SME) is developing NAI-107 — thanks to EU funding for the Laptop project.

Laptop’s development of a promising new antibiotic against life-threatening resistant bacteria could have a great impact on human health, very much like the discovery of penicillin did nearly 100 years ago.

The project was coordinated by the New Anti-Effective Consortium in Italy.
Repair after spinal-cord injury

Detailed characterisation at molecular and cellular levels of the key components of the spinal locomotor circuitry was the subject of the Spinal-Cord Repair project. Results are expected to improve the rehabilitation procedures for patients who have sustained spinal-cord injury (SCI).

Repair after spinal-cord injury

The spinal cord is an integral part of the central nervous system. It relays messages to and from the brain. It is responsible for executing movements, receiving sensory information about the body, interacting with the environment and controlling many autonomic functions.

When spinal-cord function becomes impaired — because of a disease or injury (SCI) — this leads to a loss or difficulty of movement and sensation, accompanied by many organ dysfunctions.

The overall objective of the EU-funded Spinal-Cord Repair project was to restore motor function after SCI. The plan was to define the key elements of the vertebrate locomotor network during homeostasis and following SCI.

Using mouse and zebrafish models, project researchers identified neural populations as essential for rhythm generation and for coordinating the locomotor activity in the vertebrate excitatory ‘central pattern generator’ (CPG). In particular, ‘V2a interneurons’ were found to be connected to motor neurons, integrating and relaying sensory information. In the absence of sensor proprioceptors, several defects in the stability of the rhythm in the mutant mice were observed.

Various obstacles are believed to prevent repair of spinal-cord function after SCI, including the presence of growth inhibitors and the insufficiency of appropriate neurotropic growth factors. Work towards the regeneration potential of damaged neurons showed that the enzyme chondroitinase and the activation of integrins enhanced neuronal regeneration.

Chondroitinase treatment was as good as rehabilitation and restored axonal conduction when administered one month after injury. Blocking the myelin-associated inhibitor ‘Nogo A’ with antibodies also offered a neuronal growth-promoting effect. However, scientists found that there was a specific time window for administering combinatorial therapies and they should not be given concomitantly.

Experimental evidence also indicated that further improvement in locomotor ability could be achieved by exploiting neuronal plasticity through functional training.

By gaining fundamental understanding of normal spinal-cord function and its development, the Spinal-Cord Repair initiative was able to propose biological interventions aimed at protecting and repairing the injured spinal cord. These are expected to form the basis for motor function-restoring approaches after SCI.

The project was coordinated by the Karolinska Institutet in Sweden.

Novel diagnostic tools to detect cancer

Groundbreaking advances in nanotechnology have enabled European researchers to create tools that diagnose cancers at a very early stage and can remove them before they become dangerous.

Cancer affects 3.2 million people every year in Europe and takes the lives of over 1.7 million people, not least because diagnostic technology is not sensitive enough to catch the disease early. The EU-funded project Namdiatream1 is working on taking cancer diagnosis to the next level. It is developing a sophisticated nanotechnology-based toolkit to detect common cancer cells early in the disease’s life.

With a dynamic consortium of high-ranking research institutes from France, Germany, Ireland, Italy, Spain, Switzerland and the United Kingdom, the project is investigating groundbreaking technology in the field. The toolkit involves novel, highly sensitive nanodevices based on the concepts of lab-on-a-bead, lab-on-a-chip and lab-on-a-wire that exploit the photo-luminescent, plasmonic, magnetic and unique optical properties of nanomaterials. This represents...
Preventing type-1 diabetes in children

Understanding the mechanisms underlying autoimmunity in ‘type-1 diabetes’ (T1D) is central to designing preventive or therapeutic strategies. European scientists found a potential time window during childhood development during which preventive approaches would be most effective.

T1D is an autoimmune disease in which the body attacks and destroys the insulin-producing islet cells in the pancreas. As a result, patients suffer from high blood glucose levels which have to be treated with insulin for the rest of their life.

The aim of the EU-funded Diaprepp project was to study the events that lead to ‘islet autoimmunity’ and T1D. The consortium consisted of 11 academic members and two small and medium-sized enterprises (SMEs). It focused on understanding how we can immunise our bodies against islet antigens.

As a first step, the consortium generated a bio-bank of unique samples (blood, pancreas, islets and lymph nodes) from children with T1D who had been followed from birth to disease onset. Diaprepp findings showed that there was no islet autoimmunity prior to six months of age, due to an inefficient immune system or other protective factors.

Interestingly, scientists found an association between disease occurrence and genes that affected the hosts’ responses to viruses. Although virus material could be detected in the pancreas of T1D patients, no association with a particular virus was found. The Diaprepp partners did, however, identify virus-mediated pathogenetic mechanisms capable of inducing or exacerbating the body’s autoimmune reaction to the beta cell.

1. ‘Diabetes type-1 prediction, early pathogenesis and prevention’

Metabolome analyses of children at birth who later developed T1D or remained disease-free showed clear differences, indicating that certain pathways influenced susceptibility and activation of islet autoimmunity. A potential candidate for the causal mechanism of the disease, the enzyme DHAPAT, is responsible for catalysing phospholipid biosynthesis.

Apart from basic science, the Diaprepp consortium developed commercially exploitable technologies such as an assay for detecting ‘zinc transporter 8 autoantibodies’ (ZnT8A). This patented technology, combined with other project findings, are expected to improve disease prediction at an early enough stage that effective preventative measures can be taken to reduce the incidence of childhood diabetes.

The project was coordinated by the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin in Ireland.

1. ‘Diabetes type-1 prediction, early pathogenesis and prevention’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Nanosciences, nanotechnologies, materials and new production technologies’ (NMP).

http://cordis.europa.eu/marketplace > search > offers > 9949
Climate change, water conflicts and human security

The Mediterranean, Middle East and Sahel have a long history of conflict, and water issues could pose new threats in this regard. An EU-funded project looked into the likelihood of climate change-induced water scarcity, droughts and floods exacerbating social tensions, intra- and inter-state conflicts in this region.

Much has been made of disputes arising over access to water in the Nile basin, for example. CLICO1 examined such conflicts and found that water wars are extremely rare. In some disputes, water may be cited as a cause, but political, economic and social issues actually play a much stronger role in triggering conflict. Water is used as a means of control in war, the project found; it is not itself the cause of war. Neighbouring countries having to share water resources across national boundaries is more likely to stimulate cooperation.

Although there is a higher incidence of disputes over access to water within nations, the likelihood of their escalation into violence is remote. There is less domestic water conflict in non-democratic countries, but it is much more violent than in democratic countries. Importantly, it is increased water consumption due to economic growth that increases domestic tensions, not climatic variability. In some circumstances, conflict and cooperation coexist. In fact, conflict can be beneficial when it spurs action for change to reduce vulnerability, while conversely, cooperation can mask oppression and maintain suffering.

According to CLICO scientists, the current mapping of certain areas as climate change conflict ‘hot spots’ may be counterproductive or downright dangerous, creating a self-fulfilling prophecy. Governments should proceed with extreme care when it comes to such classifications and favour information on institutional capacities as a much better predictor of conflict.

Although violent conflict is unlikely, climate change directly threatens human security. Loss of life and massive displacements are likely effects of floods, landslides or sea-level rise. The conditions of social exclusion and inequality, poverty, weak institutions, inadequate infrastructure and lack of information create a state of vulnerability.

Marginalised people tend to be ignored by governments when climate change
adaptation is considered: seasonal migrant workers of Kurdish origin in Turkey are largely excluded from adaptation policies formulated by the state, found the project, as are Bedouins in Egypt.

In the event of a natural disaster or in heeding warnings about the need to adapt to impending climate change effects, massive state interventions such as large dams can exacerbate the situation. Similarly, solutions involving population displacement or higher energy emissions can do more harm than good.

Other project findings include the fact that small-scale interventions of a social rather than technical nature are more effective in reducing vulnerability and damage; demand-side water management is more effective than new dams and canals; land-use zoning reduces damage from floods or landslides; and subsidised insurance, public early-warning systems and public health care reduce the impacts of floods more effectively than engineering works. Finally, treaties and good transboundary institutions can be effective in alleviating international tensions over water, the team stresses.

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

Integrated approach for teen sexual health

The EU is committed to promoting healthy lifestyles, even beyond its borders. In this context, one initiative is working to deliver innovative programmes for positive change in sexual practices among adolescents in Africa.

The Prepare project has set its sights on developing interventions that will effectively reduce the spread of sexually transmitted diseases and drive down rates of unplanned pregnancies. The approach aims to teach consistency and safety in the use of protection, delay first-time experiences and limit the number of partners.

This goal of promoting sexual and reproductive health among young adolescents is strengthened by an innovative approach considering aspects influencing sexual behaviour. These include parent-child communication on the topic, cultural and environmental factors (norms, beliefs and attitudes), ‘action planning’, and gender-based violence.

Based on the results of formative research and studies as well as examination of materials used in prevention approaches up to now, project partners are focusing on developing comprehensive best practice programmes to be applied through an integrated community prevention approach. Schools represent an important gateway in this endeavour, and to this end four test sites have been selected.

In Cape Town (South Africa) and Dar es Salaam (Tanzania), comprehensive, best practice and effectiveness studies will be implemented. In Limpopo (South Africa) and Kampala (Uganda), researchers will carry out focused efficacy studies. Specifically, more focused interventions on parent-child communication and parental support for healthy sexual behaviour will be administered in Kampala, while actions in Limpopo will take into account culture-specific beliefs, attitudes and norms.

To date, project meetings have been held in Cape Town, Bergen, Norway and Kampala, with more planned as the project progresses. A Prepare website has been established and is regularly updated with project documents accessible to all involved partners. These include reports on the formative phase and research already carried out in each African site.

Students aged between 12 and 14 have been selected from schools, and interview instruments for focus groups have been drafted, piloted and adjusted. The Prepare staff also received training for conducting interviews.

Future activities will centre on delivering the envisioned focused and best practice instruments and intervention packages. By supporting curriculum- and classroom-based health education activities and prompting coordination across the community, the Prepare approach is set to encourage meaningful changes in sexual behaviour among young teenagers.

The project is coordinated by the University of Bergen in Norway.
Unveiling intangible investment in Europe

A much clearer picture of a country’s economy can emerge from factoring in the different forms of ‘intangible’ investments. One enterprising EU project team has led the way in understanding their effects.

‘Intangible investments’, such as investment in know-how, reputation, organisation and training, are crucial for advancing Europe’s knowledge-driven economy and competitiveness. However, there has not been much research in this relatively new field, or any serious attempt to estimate the real scale and impact of such investments.

The EU-funded project Coinvest aimed to highlight how these investments affect innovation, growth and productivity in Europe. The project brought together European experts and researchers to understand such ‘hidden’ investments, which are generally not integrated in gross domestic product (GDP) and for the most part neglected in financial or economic reports. The researchers examined data from the market economy and industry, and then drafted guidelines for harmonising related definitions of such investments and data use across the EU.

Importantly, the project team estimated intangible assets by country and cross-compared them, revealing large investments in different intangibles and an increasing trend in this direction. From these results the project team calculated how intangibles affected output and productivity, specifically the impact of intangible expenditures on total factor productivity (TFP). It also used novel statistical software to establish relative productivity calculations, starting with pilot analyses for the United Kingdom and the United States.

After a series of high-level meetings with stakeholders, Coinvest disseminated its results to interested parties such as the European Commission and the Bureau of Economic Analysis in the United States. Furthermore, the Organisation for Economic Co-operation and Development (OECD) adopted the project’s findings and methods for its own innovation strategy. These findings were highlighted in world-class articles and have already begun to influence policy-making, yielding a much more effective and accurate picture on how intangible investments shape the European economy.

The project was coordinated by the Imperial College of Science, Technology and Medicine in the United Kingdom.

Getting youngsters excited about the Universe

An international network of more than 40 countries is promoting science education and inspiration for young children with astronomy as the touchstone.

The international UNAWE programme was founded at Leiden University to inspire interest from young children aged 4 to 10, particularly those from underprivileged backgrounds, in astronomy. It has become a unique, innovative and proven programme for fostering education and providing skills in science and technology throughout the world and particularly in developing countries.

Building on UNAWE, the EU-funded EU-UNAWE project is exploiting EU and South African (SA) achievements in the field of space sciences. The EU-UNAWE website (http://www.eu-unawe.org) was launched in 2011 as the central information hub. Visits to the site have increased approximately 30% per month since then.

Early achievements have attracted more and more countries to the network which now boasts UNAWE programmes in 40 countries.
EU-UNAWE national project managers (NPMs) in each of the six participating countries are developing educational materials and running workshops. Together, they provide primary school educators with ideas, resources and confidence to bring astronomy and space science into their classrooms.

Many events have been held for children and the EU-UNAWE International Office has organised an astronomy news service for kids called Space Scoop. It has already published about 50 stories based on press releases from major astronomical observatories and astronomy organisations that have been translated into 14 languages. Particular emphasis has been given to targeting girls and encouraging them to take up careers in science, technology, engineering and mathematics (STEM).

EU-UNAWE is using the wonders of the Universe to inspire young children all over the world, encourage a lifelong interest in science and technology, and foster a feeling of international community. Its potential impact may have no boundaries, much as some have proposed for the Universe itself. The project was coordinated by Leiden University in the Netherlands.

Surveying child abuse and neglect in the Balkans

Researchers are generating a wealth of information on the prevalence of child abuse and neglect in the Balkans. In the long term, the project activities and outcomes will offer valuable tools for driving down the rates of incidence of this phenomenon.

A team of European researchers are building a comprehensive knowledge base on ‘child abuse and neglect’ (CAN) through their work in the EU-funded project BECAN. Covering nine countries in the Balkan region, the project focuses on reported and detected cases of CAN in the general population of 11- to 16-year-olds.

Given the lack of consolidated information on the phenomenon for this particular geographic area, project members first conducted a comprehensive review of the current available data. The results for all nine countries were made available on the project’s website.

National networks have also been created in participating countries, comprising more than 400 governmental and non-governmental agencies working in child protection. Along with the BECAN website, a portal and specific forums have been set up to facilitate communication among network members, as well as improve public awareness of the problem.

Two questionnaires, based on the Child Abuse Screening Tools (ICAST) — ICAST-CH for children and ICAST-P for parents — from the International Society for Prevention of Child Abuse and Neglect (ISPCAN), will be administered simultaneously to matched pairs of children and parents in order to map the prevalence of CAN in the Balkan countries. However, the questionnaires first had to be modified, translated into official national languages and culturally validated, while an accompanying protocol had to be developed for their administration. For identification of relevant cases, a specialised tool for the ‘Case-based surveillance study’ (CBSS), pre-coded forms for data entry and an ‘Operations booklet’ for field researchers also had to be produced.

Pilot studies and core field epidemiological surveys were begun in eight of the countries, with over 200 young researchers employed to carry out the field surveys. By the end of the project’s first reporting period, 527 schools were already taking part in the study.

Beyond the scientific added value of the project, BECAN outcomes will offer a number of social utility advantages, given that the ‘cycle of violence’ phenomenon tends to reproduce and become established. Interrupting this cycle effectively addresses unhealthy behaviour in children and adults, and will thus also minimise the attendant psycho-social, legal and financial burdens of CAN on individuals and modern societies.

The project was coordinated by the Institute of Child Health in Greece.
Testing a hydrogen-fuel-based transport infrastructure

The Scandinavian Hydrogen Highway Partnership (SHHP) is road-testing a fleet of hydrogen-fuelled cars and a state-of-the-art refuelling station. Thanks to EU research funding, the region may soon be the first with an active hydrogen transport infrastructure.

European Lighthouse Projects (LHPs) are projects with high visibility of a supply-and-demand nature. They are supported by a deployment strategy encompassing both infrastructure and socio-economic issues. The first EU-funded LHP for hydrogen-fuel-cell cars is the ‘H2moves.eu Scandinavia’ project, which kicks off a series of ‘H2moves.eu’ demonstration projects focusing on hydrogen for transport.

H2moves.eu Scandinavia is focused on making the Scandinavian region (Denmark, Norway and Sweden) one of the first in Europe to have hydrogen-fuelled vehicles readily available and widely used, with a network of refuelling stations. Its goal is establishing a network of 15 main and 30 satellite refuelling stations together with a hydrogen-fuelled fleet of 100 buses, 500 cars and 500 speciality vehicles by the year 2015.

EU-funding enabled the SHHP to establish a state-of-the-art full-service hydrogen refuelling station in one of the densest hydrogen fuelling station networks in Europe. Located in the urban environment of Oslo, the station boasts pre-cooling technology that enables fast refilling and onsite hydrogen production from electrolysis based on certified renewable energy.

The project is evaluating close to 20 fuel-cell test vehicles including sedans and two-seater city cars for daily operation in Oslo and a second demonstration site in Copenhagen. Some will also cover specific routes in southern Norway, western Denmark and elsewhere in the SHHP region.

At least two of these cars will participate in a three-week European demonstration tour to raise public awareness regarding the state of readiness of hydrogen-fuel-cell vehicles. For this purpose, a mobile refuelling system was developed which can provide hydrogen while producing almost no carbon dioxide (CO₂) emissions.

A safety study has already been published, with a focus on certification gaps in Scandinavia which tend to slow down commercialisation. Results will be extended based on further stakeholder input in the coming months. Furthermore, project performance is currently being evaluated against benchmarks and scientists have added assessment of hydrogen quality and fuel-station performance to its portfolio of reports.

H2moves.eu Scandinavia is expected to boost progress towards a functional Scandinavian hydrogen fuel-cell transportation and refuelling infrastructure — providing a significant example for other countries to follow.

The project was coordinated by Ludwig-Bölkow-Systemtechnik GmbH in Germany.

Funded under the ‘Fuel cells and hydrogen joint undertaking’ (FCH JU), a Joint Technology Initiative (JTI) contributing to research themes of the FP7 specific programme ‘Innovation’. http://cordis.europa.eu/marketplace > search > offers > 10044

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1 ‘H2moves.eu Scandinavia’
ENERGY AND TRANSPORT

New aeroplanes to fly in cleaner skies

An EU-sponsored initiative studied the requirements of regional airlines in order to facilitate the design and eventual commercialisation of eco-friendly aircraft.

Demand for regional commercial flights is increasing as the EU grows and European mobility and trade flourishes. However, the resulting noise and air pollution are not in line with EU climate change policies. The EU-funded FRARS\(^1\) project explored ways to encourage regional air transport that fits with Europe’s increasingly green regulatory framework.

Funded under the EU’s Clean Sky and Green Regional Airline initiatives, the project outlined the requirements for new aircraft configurations to help advance this ambitious vision. Working closely with different airlines and partners, it studied several airlines’ size, fleet, revenues, customers, environmental considerations and future outlook to understand how they are evolving.

FRARS then outlined desirable requirements, weights, design parameters and aspects to produce a methodology and toolset that support aircraft manufacturers in producing new aircraft configurations. This also included technological capabilities, development costs, manufacturer’s considerations and other important issues to achieve the optimal design. Once a viable design is validated, resulting aeroplanes are expected to be not only greener but also highly competitive, in line with the requirements and priorities of client airline companies. Towards this goal, the project highlighted the success of an enterprising Greek company working closely with Italy’s Alenia Aeronautica to create invaluable synergies and new business opportunities.

In addition to fostering a more competitive aeronautics industry, the project has the potential to create significantly cleaner and quieter skies over Europe, giving Europe’s aerospace industry a generous boost.

The project was coordinated by Anonými Etaireia Systimátov Organósis Leitourgiáis in Greece.

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Low-cost, high-efficiency silicon solar cells

European scientists are working to reduce the amount of expensive silicon required for efficient solar energy conversion — reducing the cost of solar energy.

Highly purified silicon can account for up to 40% of the overall costs of conventional solar-cell arrays. Reducing the thickness of the silicon used in their manufacture, while maintaining high efficiency of energy conversion, is one way to reduce their cost.

European scientists set out to do just that with EU funding of the 20PLμS\(^1\) project. The project addresses all components of the process, including the wafering of silicon ingots, light trapping, solar cell and module processing, and the handling of thin wafers.

In addition, the pilot process will be transferred to an industrial partner to achieve a production yield comparable to standard production conditions, but with increased efficiency, on a thin silicon wafer. Scientists studied the interaction between materials’ properties and solar-cell processing. They have demonstrated improved passivation — making a metal ‘passive’, or chemically less reactive — for better light trapping.

Prototype solar cells of 100 micrometres (μm) in thickness with 19% efficiency were fabricated and a life-cycle analysis (LCA) of the new processes was carried out. The pilot will be transferred to the industrial production line in the next phase of the project.

The project is coordinated by the University of Konstanz in Germany.

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\(^1\) Future regional aircraft requirements study

Funded under the ‘Clean Sky joint undertaking (CSJU), a Joint Technology Initiative contributing to research themes of the FP7 specific programme ‘Cooperation’. http://cordis.europa.eu/marketplace > search > offers > 9965

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Energy’. http://cordis.europa.eu/marketplace > search > offers > 10064
**ENERGY AND TRANSPORT**

### Metals make clean and renewable transportation fuels

For the first time, scientists have investigated the use of a novel form of metal as fuel for standard car engines. The concept includes combustion free of harmful emissions and the recycling of spent fuel.

Internal combustion engines (ICEs) dominate the transportation market. Combustion or burning of fossil fuels in the presence of an oxidiser (usually air) converts the chemical energy in molecular bonds into useful mechanical energy — but produces harmful greenhouse gas (GHG) emissions.

Among the many green mobility solutions on the horizon are hydrogen-powered and lithium-ion battery-powered vehicles. For the first time, scientists investigated the potential of metallic nanoparticles, particles of metals that are ten thousand times smaller than the width of a human hair, to act as clean fuel for ICEs — thanks to EU funding of the Cometnano project.

Ideally, combustion of metals produces energy and metal oxides without harmful emissions. The consortium investigated the in-principle feasibility of clean combustion together with recyclation of spent fuel via renewable technologies. Based on studies of availability, toxicity, market price and power density, investigators chose iron, aluminium and boron for further study.

Results of preliminary engine-like testing highlighted the promise of iron-air combustion. Aluminium-air combustion was also investigated due to broader scientific interest, although aluminium was found to possess less-favourable combustion parameters, higher environmental impact and production costs.

Scientists developed customised simulations of iron-air combustion based on experimental data with the goal of developing iron nano-powders compatible with simple ICEs. Results supported the in-principle feasibility of an ICE running on iron nano-powders and indicated areas for further research and development to optimise the process. At the same time, scientists developed a process to upgrade iron-based waste from steel industries for the synthesis of iron nanoparticles and successfully employed the synthesis procedure under laboratory-scale conditions.

The consortium demonstrated technology for 100% recovery of utilised nanoparticles using customised approaches of the well-established diesel particulate filters technology. An investigation into nanoparticle toxicity included studies on partial failure scenarios regarding combustion, and incorporation of simple fail-safe modules. Cost analyses indicated that under certain conditions metallic fuels could become competitive with carbon-taxed fossil fuels and less expensive than several other alternative renewable fuels.

Cometnano successfully proved the in-principle feasibility of using metallic nanoparticles as fuel in ICEs. Results pave the way for further research and development with important potential benefits for the automotive and metal industries as well as for the environment.

The project was coordinated by the Centre for Research and Technology Hellas in Greece.

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1. "Technologies for synthesis, recycling and combustion of metallic nanoclusters as future transportation fuels."

Funded under the FP7 specific programme "Cooperation" under the research theme "Nanosciences, nanotechnologies, materials and new production technologies" (NMP).

http://cordis.europa.eu/marketplace > search > offers > 10029

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### Changing direction to minimise impact on global warming

Scientists are developing a novel flight-trajectory planning tool to optimise travel routes for minimal climate impact. The tool should help reduce global warming effects related to air transport.

Like other modes of transportation, aeroplanes produce emissions related to the combustion of fossil fuels. These emissions include gaseous and particulate matter.

The most common gas emitted is carbon dioxide (CO₂). The main non-CO₂ emissions affecting climate are oxides of nitrogen (NOₓ), soot, condensation trails (contrails) and cirrus cloud formation.

Condensation refers to a change from a gas to a liquid, in this case the formation of...
ENERGY AND TRANSPORT

Water vapour as exhaust gases condense. Water vapour is an important greenhouse gas in that it contributes to global warming by forming a kind of blanket over the Earth.

The formation of condensation trails is highly dependent on altitude, location and atmospheric conditions. Cirrus clouds that normally cover about 20% of the Earth may also be induced by contrails. These clouds are found at very high altitudes and very low temperatures, contain a large volume of ice crystals and are known to contribute to increasing average surface temperatures.

European scientists are developing a modelling tool identifying low-impact flight altitudes and routes with EU funding in the React4C project.

Researchers are developing so-called climate cost functions for the various climate impact factors. The functions enable four-dimensional (4D) descriptions of emissions, defined in terms of variation in space (3D) — latitude, longitude and altitude — and time (1D). Optimisation routines will enable the planning of flight trajectories and altitudes to minimise their impact on global climate.

Within the first 18 months, modelling parameters, including typical weather patterns and cost functions, were characterised. Separate cost functions are calculated for NOx emission, water vapour, soot and CO2. Scientists are now preparing a multimodal climate impact assessment. Cost functions will be used as an interface between the climate impact model and a flight planning tool based on Air Traffic Management (ATM) techniques.

Aircraft pre-design concepts for climate-optimised trajectories were developed and are themselves being optimised with respect to minimal operational costs or minimal climate impact.

The React4C project will deliver a novel flight planning tool to reduce the environmental impact of aircraft and their flight trajectories as well as new design concepts for greener aircraft.

The project was coordinated by the German Aerospace Centre (DLR) in Germany.

Safe adhesive bonds for lightweight aircraft

New quality-assurance technology could help certify large, lightweight aeroplane structures and ensure they are safe to fly. Widespread use of such structures will decrease weight, fuel usage, cost and emissions.

Historically, components for air and surface transport were made from heavyweight, heavy-duty steel components. With advances in materials science and the increasing need for a combination of low weight and high performance, such materials have now been replaced.

‘Carbon-fibre-reinforced polymers’ (CFRPs) are among this new generation of materials. Their application in the aerospace sector is growing tremendously. CFRPs rely on adhesive bonding rather than the riveting typically required by metals.

Use of CFRPs in primary structures, such as the fuselage airframe, has so far been limited due to a lack of adequate joint evaluation technologies (used to assess the region where two pieces are joined). Lack of accurate assessment technology has led to difficulties in certification. To overcome this issue, the EU-funded Encomb project is developing repeatable and reliable quality-assurance technology for adhesive bonds.

Conventional ‘non-destructive testing’ (NDT) methods that assess materials without damaging them are not compatible with the testing of adhesive bonds. Thus, scientists are developing novel ‘extended non-destructive testing’ (ENDT) methods to test both the physico-chemical properties and the structural integrity of surfaces to be bonded, the bonding materials and the bond itself. Based on seven application scenarios, scientists have identified specimens, test campaigns and specifications for ENDT methods for adhesive bonds.

Two of the seven sample sets were prepared and characterised to provide reference values for subsequent evaluation of ENDT. For this purpose, scientists used analytical laboratory methods for the physico-chemical properties and conventional NDT for structural integrity. Mechanical testing provided reference values for mechanical performance. Overall, 19 ENDT technologies have already been evaluated with respect to analysis of the surfaces to be joined and 12 for characterisation of CFRP adhesive bonds.

Encomb is identifying, screening and adapting ENDT technologies for characterisation of adhesive bonds. Providing validated quality-assurance technology should facilitate certification and thus extend the use of adhesive bonding for load-critical CFRP primary aircraft structures. In turn, this will translate into significant weight savings, cost savings in fuel and fewer emissions.

The project is coordinated by Fraunhofer-Gesellschaft in Germany.

1 ‘Reducing emissions from aviation by changing trajectories for the benefit of the climate’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Transport’.

http://cordis.europa.eu/marketplace > search > offers > 10052

1 ‘Extended non-destructive testing of composite bonds’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Transport’.

http://cordis.europa.eu/marketplace > search > offers > 9977
Preventing water-related conflicts in the Mediterranean

Many scientists across the globe consider water as the ‘new gold’, a resource whose increasing scarcity raises two questions: How can we better manage available sources of water and, if we fail, what will the consequences be for our societies? The WasserMed project is considering the second question, looking in particular at the socio-economic aspects.

Building on existing climate projections, WasserMed is addressing present and future uncertainties regarding the availability of water resources in Mediterranean countries. The concern is that a lack of water could have direct consequences for the region’s stability, in particular through the damage it would cause to agriculture and tourism.

Against this backdrop, the project is assessing potential impacts, proposing technological solutions and identifying better water-management practices. WasserMed’s main goal is to gain insight into climate change adaptation measures and strategies that would alleviate potential water-related security threats.

On 21 February, project scientists presented the results of their five case studies carried out in Italy, Tunisia, Greece, Egypt and Jordan. research*eu results magazine interviews Professor Roberto Roson, WasserMed’s scientific coordinator, to find out more about the project’s goals, its achievements to date and the expected impact on future decision-making in the Mediterranean.

What are the main objectives of the project?
The WasserMed project is analysing issues of water security and availability in the Mediterranean, in relation to climate change and socio-economic dynamics. This was flagged as an important issue in FP7 since most global climate models consistently predict significant reductions of precipitation in the Mediterranean, an area which is already affected by water scarcity.

What is new or innovative about how the project has addressed water availability?
The project is truly interdisciplinary, and adopts a peculiar approach in two ways. First, it involves policy-makers and stakeholders from the early stages of the research. Then, it considers a broader, macroeconomic scale of analysis, much beyond the usual unit of river basin/catchment.

What difficulties have you encountered and how have you solved them?
Interdisciplinary research is always difficult in practice. People from different backgrounds use different languages, methodologies and ‘philosophies’. In particular, a recurrent issue in our project was the need to ‘zoom’ in and out in terms of spatial and temporal scale. For example, we used both hydrologic models that typically refer to small catchment areas and daily (or even hourly) values, and macroeconomic models that are based on national accounts, considering years as time units.
ENVIRONMENT AND SOCIETY

What concrete results have been achieved so far?
Of course, we have the usual scientific/academic products like papers, etc. In addition, results from WasserMed have become key ingredients of policy packages in some of our case study areas. For example, in the Nile river delta around the city of Rosetta, WasserMed meetings between researchers and stakeholders (in particular, from the Ministry of Water Resources) have directly contributed to the local planning process.

We have also highlighted some important effects associated with impacts of changing water availability in strategic sectors of the Mediterranean economy, like agriculture and tourism.

How can your research help to tackle an issue with so many variables?
I would say that 'consciousness' is the keyword. Precisely because the problem is so complex, I hope we have made a contribution towards the need to consider the issue of future water availability in the Mediterranean from a broader, holistic perspective.

How do water availability, security issues and socio-economic factors affect one another in this region?
The global picture presents differences between the North and South Mediterranean. Northern countries will likely feel the reduction in precipitation and surface water (run-off), with possible implications for agricultural productivity. However, a number of adaptation measures could successfully be undertaken. These include enhanced irrigation methods, anticipated sowing or shortened growing periods for various crops.

In the South, we have countries that are used to living with little water and, paradoxically, they are less vulnerable to reduced precipitation, which has always been scarce anyway. In those countries, however, the most problematic aspect is the competition for water resources induced by rapid demographic and economic growth (e.g. in Egypt), although this is not directly linked to climate change. This is likely to exacerbate conflicts and to make the preservation of aquatic ecosystems very difficult.

What do you think could happen if mentalities do not change?
Honestly, I do not know. I think the mentalities will have to change, as water is such an essential resource. The real point is whether or not we want to manage the change, rather than being forced by the events.

What are the next steps in the project, or next topics for your research?
From a formal point of view, the project ended in December 2012, but we have got a three-month extension, during which we are planning our final conference, one more workshop and finalisation of the final report. Several papers, which are spin-offs of the project, are in the pipeline and WasserMed researchers will keep working on them until publication. In the longer term, I hope that new opportunities for research will emerge, in Europe or elsewhere, which will exploit the investment in human capital realised within WasserMed. I am referring, in particular, to the five or six graduate students (some of them now PhDs) who based much of their doctoral thesis on the research activities undertaken during the three-year project.

More water, healthier communities

Tackling water scarcity in the Mediterranean region is no easy task, but a research initiative is exploiting powerful strategies and technologies to accomplish this goal.

Water is scarce in the Mediterranean region, where the sun dominates, and helping communities to recycle waste water properly has the potential to bring relief to millions. The EU-funded project CB-WR-MED\(^1\) is supporting the Water Researches and Technologies Centre (CERTE) in Tunisia to achieve this aim. It is positioning CERTE as a global centre of excellence, encouraging partnerships within the country, increasing collaboration with European initiatives and responding to socio-economic needs for more water.

The project is helping the Centre work with European institutions and become part of the European Research Area (ERA), with the ultimate aim of protecting and reusing water. This would involve new treatment and sanitation technologies and strategies, the success of which could then be transmitted to other countries around the Mediterranean.

To achieve these ambitious goals, CB-WR-MED is building a national water database and developing indicators for water quality, in addition to advancing water use and waste water use in agriculture. The team is examining strategies for saving and reusing surface water and ground water, including sustainable desalination. Environmental impact is also being considered, with a focus on water footprints, the role of water in the green economy, and impacts of climate change on natural resources.

Water experts and the project team are also reinforcing the Centre’s capabilities and designing tools to improve water governance, as well as building synergies with related projects and programmes. The project has organised several workshops and training sessions on specific water-related topics and on joining EU initiatives. It has also facilitated funding opportunities for water-related projects in Tunisia to raise participation of the country’s researchers and of CERTE in EU-driven projects.

The project is coordinated by the Centre de Recherches et des Technologies des Eaux in Tunisia.

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1. ‘Water availability and security in Southern Europe and the Mediterranean’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Environment’. For further information, see: http://www.wassermed.eu/

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1. ‘Capacity building for direct water reuse in the Mediterranean area’

Funded under the FP7 specific programme ‘Capacities’ under the theme ‘Horizontal actions and measures in support of international cooperation’ (INCO). http://cordis.europa.eu/marketplace > search > offers > 10115
**ENVIRONMENT AND SOCIETY**

### A participatory approach to better water management

The challenges of water scarcity on a global level have scientists seeking out innovative ways to better manage existing resources as well as the agricultural practices in impacted communities.

The Sirius project aims to develop and provide user-driven services for efficient resource management in water-scarce environments. It focuses on water for food production from the perspective of sustainable agriculture. Partners are approaching their objectives in the context of integrated river-basin management with a view to bridging and integrating sustainable development and economic competitiveness.

Among the services to be developed for water managers and food producers are maps detailing irrigation water requirements in different areas, and estimates of crop water consumption. In addition, Sirius is working to offer information products supporting sustainable use of irrigation water and management under conditions of scarcity and drought.

In the first year of the project, the foundations were established for collaboration with stakeholders and core users identified for each pilot area. The work centred on developing and consolidating the required technical and social tools, data and frameworks. Pilot-scheme case studies were started in countries representative of the variety of conditions found worldwide. They cover Brazil, Egypt, India, Italy, Mexico, Romania, Spain and Turkey.

Researchers are integrating ‘Public participatory geographic information systems’ (PPGIS) and social multi-criteria evaluation to develop a ‘Global monitoring for environment and security’ (GMES) service that accounts for the economic, environmental, political, social and technical dimensions of the food-water challenge.

It is hoped that such integration will strengthen the participatory process and lay the foundations for community involvement in the evaluation of Sirius services and their sustainable implementation. Notably, the ‘System of participatory information, decision support, and expert knowledge for irrigation and river-basin water management’ (Spider) — which was developed in the Sixth Framework Programme (FP6) Pleiades project — has been adapted for global application. The system is designed to be easily installed and configured by the project partners responsible for each pilot-scheme area.

Team members have developed and refined a detailed Spider Training Kit and consolidated and documented a portfolio of Earth Observation (EO) products and methodology. Furthermore, a framework has been outlined for the sustainable implementation of Sirius services. It integrates all aspects of sustainability assessment into a common simple system of indicators, including socio-economic analysis, climate variability assessment and water footprints.

Sirius plans to complement Spider by including an ‘Integrated irrigation water-management service’ (IWMS), ‘Integrated drought-management service’ (IDMS) and ‘Integrated farm advisory service’ (IFAS). These new technologies for better irrigation-water management have the potential to prevent or resolve conflict arising from water scarcity and related dwindling resources.

The project is coordinated by the University of Castilla-La Mancha in Spain.

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1. “Sustainable irrigation water management and river-basin governance: implementing user-driven services”
2. “Participatory multi-level ED-assisted tools for irrigation water management and agricultural decision-support”

*Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Space’*

http://cordis.europa.eu/marketplace > search > offers > 9957

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### Water robots home in on pollution

Cutting-edge technology has enabled a team of experts to build remote buoys and robot platforms incorporating miniaturised sensors. Capable of identifying pollution types and measuring concentrations in large bodies of water, it represents an ingenious advance for environmental monitoring.

Climate change, challenges to biodiversity and different forms of pollution are increasingly menacing our rivers, lakes and seas. Scientists have been looking for ways to monitor our bodies of water more effectively, and many new relevant technologies have emerged in recent years.

The EU-funded project Hydronet has come up with one of these highly promising technologies. It brought together experts in environmental science, biology, chemistry, robotics and sensor systems from Israel, Italy, Russia, Slovenia and Switzerland.
ENVIRONMENT AND SOCIETY

The project designed a floating platform based on microelectronics and micro-fabrication sensor technology (i.e. miniature sensors that are integrated in a network of independent floating robots and fixed buoys). The sensors are embedded in an ambient intelligent infrastructure for interactive configuration, tasking and monitoring.

Laboratory tests and field tests were conducted to demonstrate the success of the prototype. Once the testing period was successfully completed, the team met with end-users such as environmental protection agencies and coast guard authorities. It contacted ports, ocean surveyors and governments who wanted to upgrade their environmental monitoring.

The project developed a cata-maran robot to monitor coastal areas and lakes, as well as a flatboat robot for rivers and lagoons where the water is shallower. The robots feature syringe samplers and a physical probe to collect water at different depths. The accumulated samples are then processed by the sensor devices to measure levels of pollutants such as mercury, cadmium, chromium and petroleum hydrocarbons.

Hydronet tested the robots and buoys in different Italian sites, including the Gulf of Trieste, the Marano Lagoon and Isonzo River and the northern sea coast of Tuscany. It also tested all wireless and radio communications that control the robots remotely and guide them autonomously to search for a pollution source. The project results have already reached interested key parties through publications and dedicated events, promising a new area in water monitoring once the technology has been fully exploited.

The project was coordinated by the Scuola Superiore di Studi Universitari e Perfezionamento Sant’Anna in Italy.

Membrane bioreactor technology for safer water

Scientists are improving waste-water-treatment technology in an effort that should help to facilitate access to clean water for drinking and sanitation.

Water is essential for life. A person can survive for about three weeks without food but will die in three days without water. Unfortunately, drinking contaminated water can also kill. Diarrhoea is little more than an inconvenience in the EU but, globally, it is the leading cause of death. Most deaths result from a lack of access to safe drinking water and basic sanitation.

A technology that was developed around 45 years ago is now seeing rapid growth in a variety of applications, among them waste-water treatment. ‘Membrane bioreactor’ (MBR) technology relies on a combination of bacterial breakdown of waste and a membrane filtration process to separate clean water from biological (organic) solids.

MBRs could contribute tremendously to sustainable water management and are already being used in a variety of industrial sectors in Europe, as well as in the Middle East and North Africa (MENA). However, despite proven technical feasibility, problems with membrane fouling have prevented more widespread uptake.

A European consortium is developing a new class of low-fouling membranes for use in MBR, thanks to EU funding of the Bionexgen1 project. The scientists are pursuing a concept to facilitate high and constant water flux with excellent rejection of small organic pollutants and minimal energy consumption.

To date, the consortium has carried out tests on waste water contaminated with olive oil, textiles and cosmetics using existing MBR technology. In addition, lab tests with common industrial foulants have been conducted using a flat sheet membrane.

Computer modelling has been employed to design modifications for the membranes already produced at partner companies. Laboratory experiments on the modified membranes have yielded promising results. Partners have also begun studies on the functionalisation of membranes with anti-microbial agents.

Bionexgen technology should make a significant impact on decentralised wastewater reclamation and reuse in European and MENA countries.

Delivery of high-performance MBR technology could save millions of lives, many of them children under the age of five lost to one of the scourges of the 21st century, lack of access to clean water and sanitation.

The project is coordinated by Hochschule Karlsruhe – Technik und Wirtschaft in Germany.

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1 *‘Floating sensorised networked robots for water monitoring’*

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Environment’. http://cordis.europa.eu/marketplace > search > offers > 10299

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1 *‘Development of the next-generation bioreactor system’*

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Nanosciences, nanotechnologies, materials and new production technologies’ (NMP). http://cordis.europa.eu/marketplace > search > offers > 9951
Water needs of the future

Hydrological studies in the Mediterranean region can help preempt future water shortages, provide tools to find alternative water sources and alleviate regional tension.

As the economic crisis deepens, Mediterranean governments are limiting their expenses, including those which are essential to water-resource management, agricultural productivity and even drinking water. In this context, the EU-funded project CLIMB\(^1\) is reducing uncertainty and identifying risks through a new monitoring and modelling system. It is investigating threats such as droughts, flooding, salinisation of coastal aquifers, desertification and soil degradation to protect the region’s hydrology and pre-empt tensions arising from water scarcity.

CLIMB is developing adaptation guidelines and initiatives based on true estimates and forecasts of hydrological changes, including natural and related social impacts. It has already gathered the appropriate data to articulate these guidelines through geophysical field campaigns and remote-sensing analyses, among other efforts, at seven different sites. It has also encouraged data exchange through several workshops, an online platform and a website publishing the latest news, events and issues.

In an effort to boost collaboration in the field, CLIMB has teamed up with two other EU projects (CLICO\(^2\) and WasserMed\(^3\)) to create the ‘Cliwasec’ research cluster. The cluster aims to publish science policy briefs from the results it is gathering, as well as a brochure and a scientific paper on the topic. It is also working on data collection through sophisticated geophysical techniques such as ‘electrical resistivity tomography’ (ERT), ‘ground-penetrating radar’ (GPR), ‘frequency-domain electromagnetics’ (FDEM) and microgravimetry to identify important hydrological properties. Such high-level cooperation will help the project team to draft accurate models that describe hydrological processes at catchment level and to predict impacts of climate change. The results should help diffuse tension among Mediterranean countries that share water resources and assist in preventing future shortages.

The project is coordinated by Ludwig-Maximilians-Universität München in Germany.

Making plants resistant to drought

A major reason for crop losses worldwide is water shortage. An international initiative aims to develop new strategies for identifying and developing plants that can withstand long dry periods.

Water scarcity is a challenge faced by many countries around the world, especially during the summer season. Weather forecasts predict that climate change will probably exacerbate this phenomenon.

It would, therefore, be desirable to identify or develop plants that could resist fluctuations in water levels and provide crops throughout the year. To this end, the EU-funded DROPS\(^1\) project is planning to identify plant genotypes that are resistant to drought.

The consortium is focusing on four plant traits, namely seed abortion, maintenance of vegetative growth, root-system architecture and transpiration efficiency. The experiments centre around maize and durum wheat, as well as bread wheat and sorghum.

Field experiments are combined with a newly developed crop model capable of estimating the effects of various alleles on crop growth, yield and efficiency of water usage. Novel methods are being used for high-throughput precise phenotyping of traits. The collected data will lead to the estimation of trait heritability within each species and correlations between traits.

Identification of genes and genomic regions involved in these traits will form the basis for future breeding.
programmes of specific genotypes, thereby saving time and money. By understanding the physiology of plant responses to water stress, the DROPS project partners are obtaining genotypic parameters and collecting information to simulate the position of the crop cycle (sowing, flowering and harvest dates) all over Europe. Climatic data have been collected in 55 sites and simulations based on changing climates have been included, thereby making it possible to estimate the consequences of genetic variability in current and future climate conditions.

Dissemination of the project’s deliverables will help breeders choose the appropriate phenotypic traits and genotypes suitable for a particular European region. This is expected to significantly reduce crop losses and benefit the agriculture-based economy in the region.

The project is coordinated by the Institut National de la Recherche Agronomique in France. Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Food, agriculture and fisheries, and biotechnology’ (KBBE). http://cordis.europa.eu/marketplace > search > offers > 10252

Impact of climate change on freshwater ecosystems

A consortium of environmental scientists and biologists are studying Europe’s freshwater ecosystems to find how best to protect them and the biodiversity they support from the impacts of climate change.

The Refresh project is helping water-resource managers design cost-effective restoration programmes for freshwater ecosystems. The initiative also considers future climate and land-use change within the context of the European Union’s Water Framework Directive (WFD) and Habitats Directive (HD). The WFD commits Member States to achieving a good status for all water bodies by prescribing the steps that need to be taken, whereas the HD aims to protect habitats and species.

A clear understanding of how freshwater ecosystems will respond to climate change is essential if they are to be shielded from its effects. However, freshwater ecosystems are also vulnerable to pollution, changes in land use and the growing demand for water. Refresh will provide scientists with a clearer understanding of the challenge they face, thereby enabling the necessary measures to be implemented. The focus is on the three principal climate-related factors: increasing temperature, changes in water level and flow, and excessive nutrients.

The initiative’s main objective is to develop a process-based evaluation of the necessary measures needed to minimise the effects of climate change on freshwater quantity, quality and biodiversity. It also builds upon the achievements of the earlier EU Sixth Framework Programme (FP6) project Euro-Limpacs which examined the direct and indirect impacts of climate change on European freshwater ecosystems.

Project partners have produced and published two reviews concerning adaptation strategies in freshwater management. Climate and land-use change scenarios have also been generated, together with a case study of land-use change in the River Dee catchment in Scotland, which links socio-economic drivers with climate change scenarios. In addition, researchers have developed a toolkit for investigating quantitative land-use change. The first case study of cost-effective adaptation measures to cope with the anticipated effects of climate and land-use change has also been published for the River Thames catchment area.

Policy-makers and implementers were invited to a workshop in London to discuss future changes and challenges to the WFD and HD. Workshops were also held in Scotland and Greece, for local stakeholders from the River Dee and the River Louros catchments, respectively, in order to identify potential barriers to the implementation of water-management legislation.

Refresh researchers simulated natural conditions by conducting field experiments to investigate biological responses to climate-induced changes in lakes, including the effects of fish predation and increases in temperature and nutrients. Sampling strategies and protocols were also developed for
More than water

How water interacts with different elements around it, such as soil, ice and structures can reveal much about evolving climate patterns and help find ways to address global warming.

With an increase in natural disasters brought about by global warming, researchers are constantly trying to unravel climate-related phenomena so as to manage events such as floods and hurricanes. The EU-funded project Hydralab IV is improving access to relevant research infrastructures in Europe to deepen our understanding of climate change.

Under the theme ‘More than water’, the initiative is consolidating all efforts of the first three Hydralab projects to create a superlative network of research infrastructures. Topics that converge under this powerful new platform include water, environment, sediment, structures and ice, which represent the latest changes in hydraulic research and interaction of all these elements. This enables researchers to conduct high-quality research in a simpler and more cost-effective manner, reinforcing the European knowledge triangle of research, education and innovation.

To achieve its aims, the project is articulating methods to exploit research tools on several fronts, for example experimental, theoretical and numerical. Another important objective is to transfer cutting-edge knowledge to the next generation of young, skilled researchers across Europe.

As part of its drive to communicate information to stakeholders, Hydralab IV has organised two key events and three workshops that deal with developing experimental hydraulic infrastructure in the future. It is also updating and improving the Hydralab website in addition to disseminating results of recent experiments to stakeholders, many of which are being conducted under Hydralab IV, such as on sediment flow and environmental threats associated with bodies or manifestations of water such as rivers, lakes, floods and rainstorms.

The project was coordinated by Stichting Deltares in the Netherlands.

1 More than water: dealing with the complex interaction of water with environmental elements, sediment, structures and ice.

Funded under the FP7 specific programme ‘Capacities’ under the theme ‘Research infrastructures’.

http://cordis.europa.eu/marketplace > search > offers > 10042

1 ‘More than water; dealing with the complex interaction of water with environmental elements, sediment, structures and ice’.

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Environment’.

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1 Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems.

2 Integrated project to evaluate the impacts of global change on European freshwater ecosystems.
Is bathing in lakes and rivers a thing of the past?

Dr Peter Wyn-Jones

While taking an improvised bathe in a nearby lake or river may have sounded like a great idea to previous generations, concerns over water-induced diseases have pushed the scientific community to start questioning this practice. Faecal waste, be it from agriculture, industry or sanitary sources, is the focus of their concern as it can cause widespread water pollution when not treated properly.

The Viroclime project has been looking into the occurrence of noro- and adenoviruses in water, as well as possible changes in their presence in areas susceptible to climate change. Over a period of 18 months, researchers surveyed riverine sites in five different locations. They aimed to determine the quantities of target viruses and their sources, and to estimate the risk of disease associated with climate-related changes.

A couple of days before the project’s final conference in Cardiff, UK, the research*eu results magazine had the chance to interview Dr Peter-Wyn Jones, coordinator of the Viroclime project.

What first drew you to research in this area?

I’ve been doing water virology since 1980. I was drawn to it from clinical virology, when I realised it was possible to apply some clinical virological techniques to environmental situations. At that time, it was clear that people were becoming ill through recreational water activities and that water companies were not doing enough to clean up the effluents. I thought that it was time to start developing methods and techniques for measuring these viruses, to put any regulations and decisions on a firm scientific basis. A UK Water Virology Group started in 1980 and, with groups from other countries around the world, we made significant progress in uncovering the picture of enteric virus pollution of recreational waters and water used for drinking after appropriate treatment.

What are Viroclime’s main objectives?

Viroclime is actually a follow-up to an FP6 project named Virobathe, which developed inter-laboratory methods for the detection of human pathogenic viruses in water. Viroclime takes the Virobathe techniques forward to allow for quantification of the viruses, which is very important for two reasons. First, for the EU’s Revised Bathing Water Directive to be scientifically sound in this regard, and secondly because it is generally recognised that most diseases caused by polluted water are viral, not bacterial. Therefore, we really need to know where these viruses come from, how long they persist and whether they actually constitute a risk to human health.

Viroclime is based on an 18-month surveillance programme of four different sites in Europe that are considered sentinel environments for climate change, as well as the centre of the Amazonian forest in Brazil. We focused on rainfall changes, asked computer modellers to model the sites’ hydrology and to make predictions on how virus conditions may change.

What are the lessons learned from the project so far?

Viroclime targeted two kinds of viruses: adenoviruses and noroviruses. Adenoviruses are very useful indicators and fairly easy to find, while noroviruses probably account for most of the illnesses related to recreational water use. The latter are more difficult to find and measure because fewer people will be shedding them at any one time. However if you have many people infected in the same town, there is a good chance we will find noroviruses in the water.

Our modelling team tried to determine the occurrence of noroviruses as a result of different climate change scenarios. This information is still being processed, but we have already found that the risk is not greatly enhanced at most of our study sites. This may be because there isn’t much change in the exposure value as people don’t usually modify their recreational use of water and, to a great extent, viruses are diluted. However, we do expect to see changes in river and lake levels over the next 15 to 50 years. We still have some way to go to finalise our risk assessment, and we may still have some surprises over the next six months or so.

How is this project a step forward for water virology?

There are two major contributions, the first being in the area of microbial source-tracking which helps us identify the origin of pollution and whether it is due to human or animal sources. We have developed and enhanced highly specific probes for various viruses so that we can discriminate between cattle, sheep or bird viruses, and human viruses. Using these probes we can already identify specific sources and we should soon be able to say how much of the pollution at a particular site is human and how much is animal.
The second highlight is that we have created the largest dataset in Europe, and possibly the world, of the virological surveillance of water. Almost 2000 samples were analysed for at least two viruses and in many cases three or four viruses. This has not been attempted before and contrasts quite dramatically with other surveillance programmes based on small numbers of samples. This dataset will be made available on the Viroclime website for interested scientists to use.

What are the main difficulties you faced?
The most difficult thing for us was to ensure the reproducibility of the method. Unlike bacteriologists, who have had 100 years to get this right, our discipline is still relatively young. The techniques we use to concentrate viruses in the water and detect them are very good as presence/absence methods, and Viroclime has gone some way to making them reproducible across laboratories for delivering reliable concentration data. However, we think it is still too soon to propose the method for regulatory use, as this requires consistent reproducibility between accredited laboratories.

To achieve this, it will be necessary to understand better the nature of the physico-chemical interactions between different viruses and environmental matrices, and between viruses and the matrices used in concentration processes. It is likely that these interactions will be different for different kinds of virus, and it may be that concentration methods will have to be tailored to each particular virus type. We will only know more when some fundamental studies have been done.

What were the main advantages of making this an EU project?
For Viroclime, we needed trans-European participation to cover most types of climate-susceptible areas. This would not have been possible in the UK. In Virobathe, we had 16 laboratories across Europe, which allowed us to experience different approaches to how sewage and water are treated, and how regulatory parameters are applied in different Member States. It was also really nice to see how water virology has developed in different EU countries.

You have been involved in both Virobathe and Viroclime, so what is the next step?
Personally, I would say let’s just wait a moment and do the basic scientific studies on interactions between different kinds of viruses and different components in the concentration process referred to earlier. In the US, a paper was published in which they suggest that different viruses behave differently in the concentration process. This is something which I have believed for a long time. If, for example, you try to concentrate enteroviruses, then they will behave differently from noroviruses and adenoviruses. They may not be concentrated as efficiently by only one single process.

From a consortium point of view, the next challenge is to refine approaches to sampling and concentration, and then to ascertain which virus should be used as a viral indicator. In the old Bathing Water Directive (1976), the enterovirus parameter was used as indicators because enteroviruses could be detected in sewage, following on from work on the development of poliomyelitis vaccine in the 1940s. Now it is thought that adenovirus would be a better candidate, although more evidence is still needed to support this, and I think this is where other colleagues would want to go.

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1. “Impact of climate change on the transport, fate and risk management of viral pathogens in water.”

Funded under the FP7 specific programme “Copernicus” under the research theme “Environment.” For further information, see http://www.viroclime.org/
A boost to your mobile signal

When using your mobile phone, it does not take much to lose that precious signal — just walking around a corner or getting on a train can be enough. EU-funded research is developing new technologies to eradicate those annoying ‘black holes’ in wireless coverage while, at the same time, freeing up some mobile network capacity.

We live in a 24/7, always-on, mobile and wireless world. Wherever we go we are connected — to each other, to the web, to all our favourite apps, to whatever data we need, exactly when we need it.

Or so we like to think. The reality is quite different. There are corners of our homes where the web will not work. There are black spots in towns and huge holes in the wireless network in more remote areas. Coverage is far from complete.

To compound the problem, even when they have a good signal, smartphones often struggle to download the data they need because the mobile networks are saturated. The airwaves are at full capacity.

Europe has always been at the forefront of innovation in telecommunications and a pioneer of the next generation of mobile technologies. So watch out for ‘femtocells’ — small mobile telephony cells that improve both connectivity and coverage at a local level.

Better signals

The principle is quite simple. Instead of mobile operators having to invest millions in powerful long-range base stations to extend coverage over a wide area, they can move mobile connections to more localised small cells. A residential femtocell, for example, would improve coverage for just one house, or perhaps a block of flats. A commercial small cell might boost mobile connectivity for a whole office while a mobile femtocell could provide passengers on public transport with a strong and static signal (sparking their battery and eradicating sudden drops in signal).

Femtocells are far more than mobile booster stations; they can also help to divert data traffic off the mobile airwaves. This offloading creates more network capacity. Wired into the fixed line broadband network, a femtocell can reroute data and voice traffic down wires, freeing up the precious airwaves for even more traffic.

Fast forward

Significant research is still required to turn these practical ideas into reality. There are so many dots to join up. How do you prevent femtocell signals from interfering with signals to and from main base stations? How do you decide whether to route connections through fixed lines? What protocols should you use in the layers of the ‘communications stack’?

The FP7 Befemto1 project unites several industry giants in mobile telecommunications equipment, mobile operators, small companies with key technologies and several technology R&D organisations to solve these issues and demonstrate prototype femtocells at work.
‘Europe recognises that mobile connectivity is a powerful social and economic driver,’ explains Dr Thierry Lestable, the project coordinator. ‘EU support for the development of cheap technologies to enhance and boost innovative services is really important for growth, not just growth for telecoms manufacturers and providers, but for the entire economy. Most businesses rely now on mobility and permanent connectivity.’

‘By adding femtocells and small cells into the mobile network mix we make it possible for mobile operators to improve their spectrum efficiencies through heterogeneous networks (HetNets) and seamless integration of the fixed-line telecoms network,’ Dr Lestable continues. ‘But this rerouting has to be optimised and intelligent. We have been developing and testing self-managed femtocell connections which are programmed to pick their wireless protocols and frequencies and route traffic depending on a whole host of contextual data.’

Befemto has developed advanced cooperation, self-organising, healing and switching algorithms. The built-in intelligence allows femtocells to optimise their use of radio frequencies (depending on traffic densities, for example) and fixed broadband networks. They can also communicate with macro-base stations without any interference or effect on macro signal quality or capacity.

‘These new algorithms allow femtocell networks to work together to provide top-quality coverage for users and support seamless, low-power and low-cost relief enhancement to the mobile service,’ Dr Lestable remarks. ‘We are focusing on the newly launched “long-term evolution” (LTE) or “fourth generation” (4G) networks because customers are paying a premium for these and will expect a true broadband experience: fast, reliable and unlimited access to everything everywhere. Femtocells and small cells will allow operators to meet these expectations and lower their operational costs at the same time.’

Active all areas
The project partners have applied for an impressive 12 patents for the technologies developed within the project. These patents range from novel network-monitoring software to mobile traffic optimisation algorithms. The project has also improved radio-frequency front-end technology to improve signal quality and reduce interference between femtocells and other wireless devices.

On the international stage, Befemto has played an important role in proposing and supporting industry standards for femtocell protocols and the mechanisms for migrating data traffic between mobile, WiFi and fixed-line architectures. The project partners have made a total of 27 direct contributions to the ‘3rd Generation Partnership Project’ (3GPP), the international standards organisation for mobile technology.

They have also held five international workshops worldwide and run two training sessions to share the project’s findings and build a common understanding of these technologies within the community. To date, the partners have published more than 70 international papers.

The Befemto technologies and system architectures have been tested in five pilot demonstrations. Trial results show that femtocells significantly reduce load on mobile networks while boosting signal strength and quality at a local level. Work within the project will support mobile operators to reach two major technical targets: high spectral efficiency (8 bits/s/Hz per cell) — meaning more and better use of scarce airwaves — and a maximum mean transmit power of 10 mW — for lower levels of interference.

‘Most importantly, our trials also prove to mobile network operators that the small-cell model is a good one,’ says Dr Lestable. ‘We’ve looked at several different business models for their deployment; no matter which one you follow, femto- and small cells will save mobile operators money and help them to create value — a sure way to get them to market.’

It looks like that dream of 24/7 fast connectivity could be just around the corner — a corner that no longer gets in the way of your calls.

The project was coordinated by Sagemcom SAS in France.

1 ‘Broadband evolved femto networks’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Information and communication technologies’ (ICT).

http://cordis.europa.eu/marketplace/search/offers > 10272

Very small, high-power microwave devices

Scientists are developing novel devices that may revolutionise microwave technology applications in fields such as radar, satellite communications and electronics.

Microwave oscillators are devices that generate electromagnetic radiation at microwave frequencies. They are used in radar devices, radio broadcasting, satellite communications and, of course, microwave ovens.

Nanoscience, the science of the incredibly small (on the scale of atoms and molecules), is impacting more and more fields every day. Microwave oscillators are no exception. Around 20 years ago, scientists predicted the ability to manipulate the magnetisation of a nanomagnet without an externally applied magnetic field. They also suggested the system could undergo sustained oscillations at microwave frequencies under the appropriate conditions.

In less than 10 years, scientists had already directly observed microwave emissions in nanoscale devices now commonly called ‘Spin-transfer nano-oscillators’ (STNOs). These are highly tuneable, very small and operational over a wide temperature range. In addition,
Traffic management goes high-tech

Although wireless technology to enhance traffic management exists in limited forms, there is a need for a platform that consolidates disparate data sources and transmits them effectively to the relevant authorities.

Managing traffic has become easier with the advent of ‘global positioning system’ (GPS) and ‘global system for mobile’ (GSM) technologies, used for example by bus companies to assess punctuality and service quality. But full data sharing with traffic control operators has not happened yet due to incompatible standards and lack of formal agreements among stakeholders.

The EU-funded project Viajeo1 designed a system that connects different data sources to facilitate real-time traffic management, improve transport planning and enable travel information services. The project worked on implementing the system in different locations worldwide, particularly for Athens in Greece and São Paulo in Brazil, as well as for Beijing and Shanghai in China. In a bid to minimise duplication of information and increase its availability, it aimed to facilitate data for transport operators, research institutes and information service providers.

The project team successfully outlined the system’s requirements and specifications, designing a powerful open platform that interfaces with a wide range of mobility services. It negotiated agreements with the necessary data owners and secured access to key data sources in order to ensure integration of all the data required.

In Athens, the system has begun collecting real-time traffic information for transport authorities, improving taxi management, facilitating multi-modal trip planning, promoting route navigation and extending real-time traffic services. In São Paulo, the platform was installed to read data from 100 vehicles in order to estimate real-time traffic conditions, enhance safety standards, avoid congestion and assist travellers online.

As for Beijing, the system has been encouraging the use of public transport, facilitating passenger information, collecting travel data, forecasting travel times and even highlighting safe cycling routes. Shanghai saw the system forecast bus arrival times and display them at bus stops, in addition to merging environmental data with traffic information to assess environmental impacts of road transport.

If these pilot cases catch on and stakeholders adopt the system wholeheartedly, it may become standard technology in large cities, improving traffic control and commuter comfort phenomenally.

The project was coordinated by the European Road Transport Telematics Implementation Coordination Organisation (Ertico) in Belgium.

1 ‘International demonstrations of platform for transport planning and travel information’

Funded under the FP7 specific programme ‘Co-operation’ under the research theme ‘Transport’.

http://cordis.europa.eu/marketplace > search > offers > 5921

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http://cordis.europa.eu/marketplace > search > offers > 5921
Exploiting the potential of high-power electronics

New high-power transistors require novel heat-dissipation mechanisms to be useful in electronic devices. European scientists are developing the appropriate packaging.

Reducing size and increasing performance of electronic devices is of critical importance to spacecraft technology. Recently, amazing breakthroughs in microwave electronics have made high-power gallium nitride (GaN) transistors commercially available. Use of such transistors in large devices has the potential to increase power density (ratio of output power to device size) by more than 10 times compared to previous devices.

Electronics equipment manufacturers and particularly those in the field of space applications are eager to integrate the technology into new designs. However, increased power generation means increased heat generation. That heat must be dissipated to protect temperature-sensitive devices.

Thanks to EU funding, the Agapac project is addressing this issue. The project team are developing advanced packaging technology to reduce thermal resistance and therefore enhance heat dissipation. The technology should ensure that advantages at the component level can be transferred to the module and equipment levels with a focus on space satellite applications.

Agapac’s partners are also working to establish a European supply chain for the packaging solutions, given that the transistor technology originated in Japan and the United States.

Scientists have successfully produced the first Agapac prototype packages. Selection of novel materials including carbon nanofibres will facilitate testing of alternatives for design optimisation.

Agapac should have a significant impact on European competitiveness in the electronics sector. GaN transistors are expected to see strong growth in the near future. Establishment of packaging technologies independent of non-European manufacturers will stimulate that growth with important benefits for the EU.

The project was coordinated by Thales Alenia Space in France.

Computer ‘games’ could teach crisis management

Training to learn the skills needed to effectively deal with air and sea transportation emergencies, will soon be available via realistic computer simulations that feature active role playing.

Crisis management in the field of air and sea transportation requires overcoming numerous challenges. Mobilising diverse and sometimes conflicting human resources and coordinating them cohesively under extreme time pressure is the fundamental pillar of success. Simultaneously, crisis managers are faced with ambiguities in or lack of information, as well as human issues such as emotional and cognitive difficulties induced by unexpected events.

Effective crisis management requires preparedness, and simulation-based learning experiences provide a forum to master the needed skills. A European consortium initiated the EU-funded L4S project to develop an innovative platform fostering collaborative competence among transportation crisis managers. In fact, L4S goes beyond this by providing tools to train managers, organisations, employees and the broader public.

The project has developed the ‘Advanced Collaboration in Crisis Management’ (ACCM) framework, which consists of five ACCM simulation games. Together, they address competency in high-performance collaboration during crisis, individual leadership, decision-making in diverse teams facing a crisis and barriers to effective crisis management. Users participate in realistic role-playing incidents in which they learn through experience.

L4S prototypes have been tested by nearly 500 pilot users resulting in valuable input for optimisation. Additional pilot and commercial activities are planned engaging hundreds more players and a detailed market analysis has been carried out. A multilevel exploitation plan has been defined for execution at project completion.

The project L4S has clearly demonstrated the platform’s high potential for important impact in crisis management in the air and sea transportation sectors. L4S’ ultimate aim is to extend and customise the platform to other critical infrastructures such as energy, financial services and the food industry. The consortium also plans to incorporate deployment modes such as smartphones and other hand-held devices.

The project was coordinated by Deloitte Business Solutions Anonymi Etaireia Symvoulion Epicheiriseon in Greece.

IT AND TELECOMMUNICATIONS

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Space’. http://cordis.europa.eu/marketplace > search > offers > 10087

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Information and communication technologies’ (ICT). http://cordis.europa.eu/marketplace > search > offers > 10081

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Information and communication technologies’ (ICT). http://cordis.europa.eu/marketplace > search > offers > 10081
Lenses in optical instruments are currently rather standard fare for manufacturers. They are hard materials made to see things of certain sizes at specific ranges of distance.

The lens of the human eye, however, is deformable and made of tissues that can change shape in a process called accommodation to focus on virtually anything over large distances. Contraction and relaxation of small muscles attached to the lens change the curvature and thicken or flatten the lens as needed.

The ability to mimic nature’s capabilities by manufacturing flexible, tuneable lenses has exciting potential for a number of applications in biomedicine and consumer electronics. Such technology is directly applicable to ‘intraocular lens’ (IOL) implants and would enable enhancements in performance for such devices as mobile phone cameras and flexible LCD screens.

Scientists are developing such technology with EU funding of the Parylens¹ project. A previous Framework Programme project (Multipol²) demonstrated the use of a polymer thin film, ‘Parylene’, deposited on liquid surfaces to hermetically seal the liquid without deforming it.

External forces, from either the body’s eye muscles or transpar- ent conductive electrodes — using electrically activated polymers (EAPs) — can then deform the lens to change its focal length. The project team set out to develop the appropriate flexibility of the lens to enable this, while maintaining the many favourable properties of Parylene, including biocompatibility, transparency and chemical non-reactivity (inertness).

To date, the flexibility issue has been addressed and nanoparticles have been deposited on the surface to make use of their antibacterial properties. In addition, scientists have exploited a process (the so-called ‘sol-gel process’) that produces a wet, solid-like material to make the liquid body of the lens compressible.

Finally, a first prototype of a flexible LCD has been produced. Parylens is going beyond the state of the art in solid-on-liquid encapsulation, paving the way for the next generation of optical devices.

The project is being coordinated by the Haute Ecole Spécialisée de Suisse Occidentale in Switzerland.

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1 'Parylene-based artificial smart lenses fabricated using a novel solid-on-liquid deposition process'
2 'Multifunctional polymer materials and systems with tailored mechanical, electrical and optical properties'

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Nanosciences, nanotechnologies, materials and new production technologies’ (NMP). http://cordis.europa.eu/marketplace > search > offers > 10036

Desktop printer for the nano world

European researchers have developed the first low-power, compact laser printer for three-dimensional (3D) glass micro-components with nano-scale features. This paves the way for a new generation of home-made microelectronics.

EU-funded scientists have developed a desktop printer for 3D glass micro-components, opto-fluidics and opto-mechanical systems. Thanks to the Femtoprint¹ project, 3D patterns can now be etched into glass using low-power femtosecond laser beams. These patterns can then be used to make integrated optical components — or further formed into 3D structures, such as microfluidics channels and micro-mechanical components.

This simple process can be applied to a variety of systems with micro- to nano-scale features and, in particular, Microsystems that combine optics, fluidics and mechanical functionalities in a single substrate. This offers unprecedented levels of integration compared to competing micro-fabrication processes.

The size of a big shoebox, the femtoprinter includes state-of-the-art laser technology and specialised components, such as laser-scanning heads. New photonics devices, including polarisation converters and transparent actuators, were also created for the femtoprinter.

The ground-breaking Femtoprint project attracted media attention through articles in Laser Focus World and the British newspaper The Independent.

The project was coordinated by the Technical University of Eindhoven in the Netherlands.

1 ‘Femtosecond laser printer for glass Microsystems with nano-scale features’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Nanosciences, nanotechnologies, materials and new production technologies’ (NMP). http://cordis.europa.eu/marketplace > search > offers > 10221
Collecting water from thin air

Humans have been extracting liquid water from water vapour for centuries, but novel materials can improve the efficiency and capacity of techniques for capturing water from thin air. They are set to help meet the growing challenge of water shortages.

For centuries, Bedouins and other desert dwellers have been using a variety of traditional techniques to capture, and make usable, the water present as vapour in the air — such as collecting the dawn dew. It is even believed that the ancient city of Feodosiya in the Crimea used a sophisticated system of ‘air wells’ to gather water from the atmosphere.

With climate change being accompanied by a growing demand for water, more and more regions of the world are becoming water-stressed, pushing scientists to bring vapour-capturing technology into the 21st century.

One promising avenue being pursued by the EU-backed CAPWA project is the use of novel membranes to harvest water from industrial installations, namely power plants, water-cooling towers and paper mills. CAPWA is developing a commercially viable denim-based composite membrane, as well as exploring alternative coatings.

To date, the project has been running according to plan, although there have been some teething problems with some membrane modules. CAPWA partners have decided on the size and capacity targets for the pilot membranes: 100 litres per hour (L/hr) at a gas- and coal-fired power plant, and 20 L/hr at paper mills in the Netherlands and South Africa.

Moreover, an alternative approach employing hydrophobic membranes will be tested in a cooling tower (which sits above a geothermal well) in Tunisia. Using this technology, the heat exchanger area is reduced by some 25%.

These alternative membranes are showing promising results, in particular for thermal distillation processes. For the rest of the project term, research activity is moving forward in anticipation of the beginning of end-user testing.

The project was coordinated by Kema in the Netherlands.
**INDUSTRIAL TECHNOLOGIES**

**Compostable textiles**

Scientists are developing novel textiles from 100% renewable and natural materials. Ground covers and insect screens are among the numerous products targeted for the application of this eco-friendly technology.

Europe is committed to reducing the greenhouse gas (GHG) emissions associated with the use of non-renewable materials based on fossil fuels. In assessing the future of textiles and clothing, bio-renewable polymers have emerged as a promising alternative to conventional petrochemical-based polypropylene (PP) materials.

Bio-renewable polymers are widely used for low-end products such as packaging materials. However, their properties, lifetime and biodegradation schedules after use do not currently support their application to the desired end products. Although market share of bio-based polymers is growing, extending applications through material improvement will be key to continued success.

The EU-funded Bioagrotex project is levelling the playing field. It is formulating 100% renewable agro-textiles via combination with natural fibres and bio-resins.

In the first case, natural fibre-based ground covers are being upgraded through application of furan-based bio-resins to significantly enhance service life. In the second case, starch-based or ‘polylactic acid’ (PLA)-based melt-processable biopolymers are being made into a range of products including yarns and tapes. Further processing is being exploited using standard techniques to produce a range of products such as ground covers and insect screens.

Scientists have developed a wide range of biopolymers and evaluated their compatibility with production methods (e.g. textile extrusion). Different formulae for their composition are being assessed and optimised. The consortium has also evaluated a number of natural fibre types for processing characteristics, yield and properties leading to important improvements. A number of water-based bio-resins have also been developed and tested on an industrial scale. Preliminary biodegradation tests confirmed an extended product life of biopolymers treated with bio-resins and of PLA-based materials in general.

Partners are carrying out field tests on industrial demonstrators of all processes at selected locations, and the first agro-textile products are being brought to market. Longer lifetimes and compatibility with composting should be important benefits — as well as reduced GHG emissions associated with materials and processing.

The project was coordinated by the Centre Scientifique et Technique de l’Industrie Textile Belge in Belgium.

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Components, whether for consumer devices or industrial equipment, are becoming smaller and smaller — often driven by the demand for increased performance and functionality in a small package. The use of polymers, including plastics, has become widespread. Polymers offer light weight, low cost and ease of processing. They are also often combined with other materials as fillers and reinforcement to provide additional functionality.

Large plastic components are typically produced using an extruder, a large syringe-like machine that features a screw-shaped plunger. The screw mixes and pushes the melted plastic into moulds (injection moulding), where the plastic sets, taking the form of the desired product.

Micro-moulding, the moulding of small parts required by current technological design trends, has faced certain limitations. Injection moulding processes used so successfully for large parts introduce issues of dosage precision, process accuracy and repeatability when used to manufacture miniaturised components.

An earlier project, Sonoplast, previously funded under the Seventh Framework Programme (FP7), successfully demonstrated a prototype injection-moulding machine based on...
ultrasound technology. It melted plastic material and filled small cavities with higher quality compared to conventional injection moulding.

Scientists initiated the SONO'R'US project to optimise the technology and develop a market-ready ultrasonic moulding machine for miniature parts. Within the first nine months of the SONO'R'US project, scientists made major improvements and are well on the way to pre-industrial machine validation.

The optimised machine was achieved through a novel, high-accuracy feeding system, redesign of the ejection system and development of an enhanced control system. SONO'R'US technology also provides significant cost benefits in terms of energy consumption (100 times less than current technology) and raw material usage.

On completion, SONO'R'US is expected to deliver a market-ready micro-injection-moulding machine that overcomes difficulties currently faced by industry. It is optimised to market needs with special consideration of the electronic/electronics, automotive, optics and telecommunications sectors.

After finishing the validation of the equipment, and a technological feasibility study for new markets, SONO'R'US will be in a position to provide a broad range of manufacturing sectors with cost-efficient and high-precision manufacturing of mini- and micro-parts.

The project is coordinated by Mateu y Sole in Spain.

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Europe’s wonderful water technologies

It is a little-known fact that the EU has been developing amazing water technologies over the last decade. Now that these technologies are ready for industry and may well lead to new water policies, the Union is spreading the word.

There are a lot of opportunities in the EU’s water sector, both in terms of new technology and for jobs. Scientists, especially students and young researchers, as well as policy-makers, businessmen and the general public need to know more.

In response to this, the EU has invested in a large-scale communication drive known as the Stream1 project. It is an innovative approach that involves e-learning, summer schools, videos, posters, pamphlets and webinars.

During the first year of the project, water experts and science communicators presented the first summer school in Barcelona to participants representing 12 different nationalities. They also released the first module of an e-learning course.

Amsterdam’s water week provided the perfect platform to reach target researchers, politicians, non-governmental organisations (NGOs) and industries.

The seminars held there were streamed to over 540 online viewers. The project team plans to use all major upcoming water events to disseminate more water technology information.

Raising awareness of available tools in the water sector is a step forward in addressing Europe’s water challenges. The technologies need to be properly exploited on a large scale in order to foster sustainable development and economic growth.

The project was coordinated by Minerva Consulting & Communication in Belgium.
Steel structures, such as ships, bridges and offshore marine constructions, are subjected to large and constant loads during their service lifetimes. Fatigue and corrosion can create dangerous changes in the structural integrity of components. Fatigue cracks are usually repaired by renewing part of the weld, welding cracks in the panel or replacing the panel itself. Corroded members are replaced, but such interventions can be both costly and time consuming. Composite patch repairs and reinforcements overcome most of the difficulties encountered with conventional repairs. They have been used with great success in the aerospace industry. However, normal repair costs of an aerospace structure are quite different from those for a bridge or marine structure. In addition, there are technical considerations which must be evaluated for implementation.

European scientists sought to demonstrate their environmental safety and feasibility with EU funding of the Co-patch project. The first 18 months of the project saw selection of the civil infrastructure and marine test cases as well as creation of a strong partnership with various stakeholders. Scientists developed the inspection procedure tailored to subsequent patch repair, unfolded a quality assurance plan for patch production, and identified non-destructive testing (NDT) methods that were appropriate for the project’s goals. The consortium is currently collecting data on material properties that will provide vital input to ‘finite element models’ (FEMs) of patches and the patch-to-metal joint.

A composite patch was designed, produced and applied to the deck of a sea-going oil tanker showing that patch repairs can be a viable, cost-effective and permanent alternative to traditional repair methods.

Co-patch technology is innovative, cost effective and applicable to a variety of steel structures. It should enhance the competitive position of the already strong European shipbuilding and repair industry as well as generate new jobs for skilled technicians ready to fly quickly to any site where repair is needed. The project is coordinated by National Technical University of Athens in Greece.

Automated adaptation of plastics-processing parameters

Scientists are developing process-control technology for novel plastics. Online sensing and automatic process adaptation will help small businesses bring new products to market more efficiently — taking less time, costing less money and producing less material waste.

While not everyone can define the term polymer, it would be difficult to find a person in the EU who does not use or benefit from polymers on a daily basis. Polymers are molecules made of long chains of repeating subunits (monomers) — with plastics being perhaps the most familiar polymers in everyday life. With the advent of nanomaterials (compounds with at least one dimension on the scale of atoms and molecules), ‘polymer nanocomposites’ (PNCs) have become a rapidly growing field of research. PNCs combine the already ubiquitous polymers with advanced and multifunctional nanoparticles. Such compounds have a tremendous and largely untapped potential for improving performance of known polymers and for the development of novel functionalities in new applications.

As is the case with every new class of materials, optimisation of processing parameters can be time consuming and expensive when wanting to produce the desired product with the required specifications. It can
also generate a considerable amount of waste material.

A European consortium initiated the Nanoonspect project to accelerate the commercialisation of PNCs with process optimisation technology. A characterisation tool, the ‘Onbox’, using novel sensors together with process control technology based on an ‘artificial neural network’ (ANN) and expert system (ES), will enable precise production of PNCs without waste.

To date, five sensors have been designed and incorporated into the Onbox tool pilot device, designed to provide 2 to 10 times higher resolution than existing technology. Scientists have developed a novel production process based on integration of ‘Nexxus’ wetting technology (to wet the dry polymer-particle combination) for improved dispersion of nanoparticles.

The plastics supply chain is dominated by small and medium-sized enterprises (SMEs). Technology from the Nanoonspect project should provide a significant market boost to these companies by decreasing associated costs and speeding time to commercialisation of novel PNCs and related products. In addition, sensor, processing and control technologies have high potential for adaptation to numerous other products and industries.

The project is coordinated by Fraunhofer-Gesellschaft in Germany.

**On-demand production of spare parts**

*Scientists have developed a successful business model based on rapid, on-demand manufacture of individual spare parts. Exploitation should significantly reduce warehouse stock and associated costs.*

Rapid manufacturing (RM) technology, as its name implies, is a process that enables fast manufacture of often-complex parts. It has proved quite beneficial for the production of prototypes and small volumes of novel products, which are particularly important for small and medium-sized enterprises (SMEs).

RM enables cost-effective manufacture of one-off parts on demand. Its obvious advantages as an alternative to warehouses full of — potentially useless — spare parts have inspired the EU-funded Directspare project. The project involved integrating computer-aided engineering (CAE) techniques with a unique set of design rules for the development of a truly knowledge-based system (KBS).

Process automation was included wherever possible and new, rapid-design tools were developed. Directspare scientists standardised processes in manufacturing, product logistics, process certification and business management. In addition, they developed a total quality management (TQM) system and software tools for CAE and RM input data, process control and final product quality.

To ensure its effectiveness, the system also required the creation of the necessary information and communications technology (ICT) to catalogue all parts.

All project objectives have been achieved and successfully applied to selected spare parts in various industries. In addition, a selection tool was developed to assess the suitability of a given part for RM processes, and future research activities and business opportunities were identified.

Directspare processes and tools should help reduce warehouse stock and prevent capital depreciation, as well as lower energy consumption related to warehouse management and wastage when parts become obsolete. These cost savings, combined with the rapid replacement of necessary parts, are expected to boost European competitiveness and to benefit SMEs in particular.

The project was coordinated by Materialise NV in Belgium.
Keeping an eye on rising sea levels

Advanced satellite imaging and novel high-tech modelling techniques are helping Europe unravel the complexities of melting ice caps and rising sea levels, enabling researchers to address impending threats more readily.

The polar caps are melting at an alarming rate, and sea levels are rising faster than predicted. It is crucial to understand these climate changes and address them if we want to ensure the safety and livelihood of our coastal cities.

To this end, the EU-funded project Ice2sea is investigating the loss of continental ice, which includes mountain glacier systems, ice caps and ice sheets. By understanding the key processes behind melting ice, the project is improving projections of sea-level rise through satellite technology and high-tech modelling approaches that can predict likely changes over the next 200 years.

To perfect the proposed solution, Ice2sea is looking at processes in the cryosphere by conducting experiments in Greenland, as well as in the Arctic's Svalbard archipelago and across the Antarctic region.

So far, the project team has begun measuring the impact of melting ice in Greenland on basal water pressure to estimate the flow speed of ice towards the sea. It is monitoring the calving of icebergs from tidewater glaciers in Svalbard and measuring snow redistribution caused by wind in Antarctica. The work builds on new satellite technology that measures elevation, mass and velocity changes, as well as enhanced remote sensing to gather field data. Importantly, the team also built global digital inventories of mountain glaciers and island ice caps to improve climate-change modelling.

Based on intensive testing and ongoing studies, the project is expected to yield comprehensive, evidence-based projections of rising sea levels, particularly with respect to European coastlines. It will help predict extreme events, improve coastal defences and assist Europe in adapting to rising sea levels. Ice2sea will support the global debate over climate change mitigation and provide invaluable knowledge regarding the interaction between ice, oceans and atmosphere.

The project is coordinated by the NERC British Antarctic Survey in the United Kingdom.

1: ‘Estimating the future contribution of continental ice to sea-level rise’

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Environment’
http://cordis.europa.eu/marketplace > search > offers > 9973
More efficient and versatile space propellants

Scientists are increasing the efficiency of state-of-the-art space propellants for small satellites. The technology should provide a significant boost to the competitiveness of the EU space industry.

Plasma-propulsion rocket engines use plasma instead of solid, liquid or gas propellants to generate part or all of the thrust. They ionise conventional propellants with electrical energy and accelerate the resulting plasma. Although they are less powerful than conventional thrusters, plasma-or electric-propulsion systems can operate at higher efficiencies for longer periods of time.

With small satellites commonly finding applications in the field of ‘Earth observation’ (EO), they have recently received renewed interest — having first been used in a space mission in 1964.

Helicon thrusters are at the frontier of plasma propellants. Scientists initiated the EU-funded HPH.COM project to design and optimise a space plasma thruster based on helicon radio-frequency (RF) technology. They are investigating its use to enhance micro-satellites’ altitude and position control. The study also assesses the possibility of developing a combined two-mode thruster. It would enable both a low-thrust, high-efficiency plasma mode and a high-thrust, low-efficiency hydrazine mode exploiting the flammable liquid hydrazine.

To date, scientists have developed the necessary plasma simulation tools to allow for detailed modelling of very complex physical phenomena. These tools, along with intensive experimentation, helped investigators develop an innovative helicon technology with ionisation efficiency 10 times as high as conventional helicon sources in the low-power regime. A feasibility study was also conducted for the dual-mode combination thruster, demonstrating its potential benefits.

The HPC.COM thruster is based on helicon technology but gets an extra boost in terms of size and power. It should be highly attractive for a variety of space missions, including exploration, scientific research, EO and telecommunications.

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

Keeping satellites on track

Scientists are developing a predictive tool to maintain satellite operation during periods of extreme solar activity. It should also help keep space assets safe while reducing dependence on foreign technology.

Many satellites, often called ‘low Earth orbit’ (LEO) satellites, orbit in the outer layer of the Earth’s atmosphere, where space shuttles and the International Space Station (ISS) are also operating. This region, known as the thermosphere (literally, ‘heat sphere’), is exposed to extraordinary amounts of energy from the Sun. Temperatures rise with altitude and eventually reach more than 1 000 degrees Celsius (°C).

As if this were not enough, conditions in the thermosphere can change not only rapidly but significantly as a result of responses to space weather — i.e. solar and geomagnetic activity. Because there is a short time lag between geomagnetic forcing and response in the thermosphere, rapid thermosphere modelling is required for satellite orbit computation and debris surveillance. Unpredictable changes in altitude and...
trajectory can result in loss of tracking ability, collisions and even damage to ground assets during an uncontrolled re-entry.

To prevent such problems, Europe lacks a near-real-time thermosphere prediction model for regular ‘nowcasts’ and forecasts. Thanks to EU funding of the ATMOP project, scientists are developing an advanced predictive ‘drag temperature model’ (DTM) and a global physical model — a ‘Coupled middle atmosphere-thermosphere model (CMAT2) — able to assimilate near-real-time data.

The models are based on the most comprehensive data available, assimilating acceleration measurements from instrumentation on-board two satellites as they experienced extreme space weather events during the previous solar cycle.

During the first reporting period, scientists made important progress in constructing databases and defining model parameters and dependencies. They also designed the thermospheric data-assimilation systems. Several model trials were carried out to test both model performance and data integration. Furthermore, researchers developed an observation quality-control protocol to use in determining which observations should be included in the databases.

ATMOP will provide the first European satellite drag modelling and prediction tool. It will help keep space assets safe from extreme space weather phenomena while reducing the EU’s dependence on foreign technology for the purpose.

The project is coordinated by Deimos Space in Spain.

Funded under the FP7 specific programme ‘Cooperation’ under the research theme ‘Space’.

http://cordis.europa.eu/marketplace > search > offers > 10330

‘Advanced thermosphere modelling for orbit prediction’.

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**Close-up on coastal waters**

**High-tech, cutting-edge advances for evaluating the quality of water in coastal zones will have a positive impact on aquaculture, offshore projects and the environment.**

With the advent of climate change, increasing pollution and threats to ecosystems, researchers are looking for smarter ways to monitor coastal areas and marine environments. The EU-funded project Aquamar is providing Earth observation-based water-quality services to support monitoring agencies and industries focusing on coastal areas. It is improving assessment of marine water quality in cost-effective ways and through better modelling techniques.

In line with EU directives on marine water quality, the project is developing indicators for algal bloom forecasting, aquaculture precision farming, and bathing water quality. It aims to develop innovative products and services to test the water by using advanced software algorithms and sophisticated remote-sensing methods. This will involve harmonisation and implementation of a service quality validation process, as well as dissemination of best practices to the community of service providers.

Progress on sustainability of coasts, advanced sensor technology, related processes and valuable coastal assessment tools has already been highlighted on the project website and communicated to stakeholders. Dissemination has
included brochures, newsletters, publications and information which have appeared on several governmental or professional websites specialising in this field of research.

The emerging research and development is expected to help support the sea transport sector, among others, particularly in relation to the energy sector and large offshore infrastructure such as maritime wind parks. It will also boost services under the EU’s Water Framework Directive, bringing enhanced sustainability and an array of services that could protect our coasts and mitigate environmental damage.

The project was coordinated by Thales Alenia Space in France.

### EU-sourced space electronics

*Scientists are improving key semiconductor technology for space applications. Capabilities will eliminate dependence on non-EU sources and enhance the competitiveness of the European space industry.*

Gallium nitride (GaN) is the most exciting semiconductor material since silicon (Si). Power electronic devices made from GaN promise to operate reliably at very high temperatures and voltages compared to their Si and gallium arsenide (GaAs) predecessors. Ability to withstand very high levels of radiation extends the range of potential markets, and makes the material particularly appealing to the space industry. Silicon carbide (SiC) is another semiconductor material of interest that has been around for a bit longer but whose development has been delayed due to technical difficulties associated with the manufacture of SiC substrates.

A European consortium is focusing on these two materials using EU funding for the EUSIC project. Currently, Europe is dependent on non-EU sources for such technologies in future space applications. However, most of the process chain is in place. Providing the
Natural brakes for spacecraft

European scientists are developing more fuel-efficient space travel, thereby providing more room for crew and cargo. Manned missions bringing back heavy samples are the impetus.

Space vehicles travel at astonishingly high speeds. They use propulsion techniques (relying on the use of their propellants or fuels) to slow and guide them so they can be captured into orbit around a planetary body. For any such body with an atmosphere, aerocapture is an attractive alternative. It is an orbit-insertion technique that relies on atmospheric drag to decelerate a spacecraft and place it in its circular orbit.

Aerocapture allows a spacecraft to slow itself from interplanetary to orbital speeds by passing through the atmosphere just once — with some additional brief corrective propulsive manoeuvres.

Although it has never been tested in a real mission, the technology has been studied and developed for over 20 years and is now coming to fruition. If conclusive, it could save up to 30% of payload mass at launch time by reducing fuel requirements. This is particularly important in manned missions in which samples need to be brought back to Earth.

Such missions are already on the horizon for the Moon and Mars, and the new technology will also be necessary for docking and exchange missions between ‘low Earth orbit’ (LEO) and ‘geostationary orbit’ (GEO) satellites. Thus, aerocapture is expected to become one of the core capabilities for planetary exploration.

A European consortium is raising the ‘technology readiness level’ (TRL) for aerospace capture thanks to EU funding of the Aerofast project. The overarching project goal is to lay the groundwork (a TRL of three or four) for a flight demonstration. Actual operational readiness requires a TRL of six.

Aerofast scientists made significant modifications to algorithms...
Past space missions have demonstrated the feasibility of human survival and high-level functioning in space for extended periods of time. Technological, medical and psychological issues associated with even longer missions however must be addressed before humans are able to venture further afield or stay in space for longer.

The European Space Agency (ESA) has identified returning to the Moon and human exploration of Mars as key drivers of its high-level space architecture development. Both the ESA and the National Aeronautics and Space Administration (NASA) have developed strategies and roadmaps for achieving future space exploration goals. However, Europe itself does not have its own roadmap approved and endorsed by European scientific and industrial communities.

A European consortium initiated the EU-funded Theseus project to fill this critical need while maintaining synergy with the ESA strategy. Scientists developed an integrated life sciences research roadmap to address such issues as life support systems, behaviour and performance, prevention of bone loss and recycling technologies.

Theseus formed and coordinated 14 expert groups (EGs) of European and international experts in related disciplines. The EGs succeeded in identifying 99 key scientific issues representing the most important challenges and opportunities for future human space exploration. These were used to formulate three main themes consisting of adaptation to space environment, countermeasures to multiple stressors, and tools and methods. The Theseus roadmap was finalised and officially launched in March 2012.

The consortium is now preparing to publish project results in scientific journals, and is actively seeking future directions based on the successful foundations that have been laid by the Theseus project.

The project was coordinated by the European Science Foundation in France.
**EVENTS**

**Protein engineering: new approaches and applications**

The Biochemical Society’s conference ‘Protein engineering: new approaches and applications’ will take place from 10 to 12 April 2013 in Chester, UK.

Protein engineering allows scientists to manipulate the very coding sequence that underlies the folding, structure and function of proteins. It is currently undergoing a renaissance with the advent of new technological approaches, and will prove central to areas ranging from synthetic biology to bioprocessing and nanotechnology.

The conference will be an opportunity for researchers and diverse groups of world-leading protein engineers to exchange information and ideas on these recent advances.

For further information, please visit:
http://www.biochemistry.org/tabid/379/MeetingNo/SA143/view/Conference/default.aspx

**Third International Conference on Microgeneration and Related Technologies**

The Third International Conference on Microgeneration and Related Technologies will take place from 15 to 17 April 2013 in Naples, Italy.

Microgeneration is the small-scale generation of heat and electric power by individuals, small businesses and communities to meet their own needs, as alternatives or supplements to traditional centralised grid-connected power.

The conference will bring together stakeholders working in the field to share their knowledge on issues such as high-efficiency distributed energy systems, diffusion of low-carbon microgeneration technologies for residential and small commercial applications, building integration, and grid interconnection.

For further information, please visit:
http://www.microgen3.eu/

**Water Innovation Europe 2013**

The conference ‘Water Innovation Europe 2013’ will be held from 16 to 18 April 2013 in Brussels, Belgium. It will focus on ‘Water in the urban environment — bringing research to the market’.

Water is not only a resource — it has now become a serious political issue, too. The key to successful water governance is to find the right balance between science and policy. Organised by COST, the intergovernmental framework for European Cooperation in Science and Technology, and the Water Supply and Sanitation Technology Platform (WSSTP), the conference will focus on issues related to water in the urban environment and water governance. It will be a forum for scientists and decision-makers to discuss these issues and create a market for research in this field.

For further information, please visit:
http://www.cost.eu/events/wie2013

**Saving Energy Now**

A conference entitled ‘Saving Energy Now’ will be held from 16 to 17 April 2013 in Brussels, Belgium.

The EU aims to cut its energy consumption by 20 % by 2020. However, current estimates tend to indicate that the EU is not on track to achieve this objective. As a result, new measures on energy efficiency are now being proposed.

The European Promise project — launched in 2012 and funded by the European Commission under the Intelligent Energy — Europe (IEE) programme — will host a European-awareness conference on energy-efficient consumer behaviour in European islands. The aim is to promote tried-and-tested methods for reducing the energy consumption of households.

For further information, please visit:
http://brusselsconference.ieepromise.eu/
First International Conference on a European Research Strategy for Intermodal Transport

The First International Conference on a European Research Strategy for Intermodal Transport will be held from 17 to 18 April 2013 in Las Palmas de Gran Canaria, Spain.

There has been continuous growth in traffic in Europe but, in contrast to the positive effects of increased mobility, this change raises concerns at the European level. Suitable policy measures and the upgrade of existing networks are needed to achieve a balanced use of different transport modes.

The conference will see researchers, industry and policy-makers discussing a targeted research strategy for intermodality that will be implemented in the new programming period 2014-2020.

For further information, please visit:
http://www.intraregio.eu/intconference/

Second International Conference on Food and Environment

The Second International Conference on Food and Environment will take place from 22 to 24 April 2013 in Budapest, Hungary.

Food and agriculture have been and remain at the heart of civilization. However, they raise concerns in terms of food scarcity and variety, which were previously answered by intensive farming, to the detriment of other aspects such as environmental impact and food quality.

The conference will address the impact of modern food-production processes on the environment and human health. It will also initiate discussions on the best ways to produce food which complies with strict quality, quantity and sustainability standards.

For further information, please visit:

Fostering Innovation and Strengthening Synergies within the EU

A conference entitled ‘Fostering Innovation and Strengthening Synergies within the EU’ will be held from 29 to 30 April 2013 in Dublin, Ireland.

A Knowledge and Innovation Community (KIC) is a highly integrated, creative and excellence-driven partnership which brings together the fields of education, technology, research, business and entrepreneurship. It aims to innovate and inspire others with new innovation models.

The conference will answer questions regarding the role and contribution of KICs, within the framework of a wider discussion on the future of EU innovation policies and the integration of the so-called Knowledge Triangle (business, research, innovation) within the EU and globally.

For further information, please visit:

European Brain Research Successes and Next Challenges

A conference on ‘European Brain Research Successes and Next Challenges’ will be held within the framework of the European Month of the Brain on 14 May 2013 in Brussels, Belgium.

Brain-related disorders affect at least one in three people, and treating them already costs some EUR 800 billion in Europe every year. Although research into the brain has shown great progress in recent years, further advances in neuroscience are crucial to keep our ageing societies and our economy healthy.

This conference will raise awareness of the benefits, added value and impact of EU-supported research in the area of brain research and health care. Discussions will be centred on emerging and future scientific challenges in this field.

For further information, please visit:
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cordis.europa.eu

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