European Commission

Investing in success

Research and innovation
to boost growth and jobs
in Europe

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FOREWORD

On 30 November 2011, I announced Horizon 2020, the European Commission's proposed €80 billion package for research and innovation funding, and a critical element of the drive to create sustainable growth and high value jobs in Europe.

Between 2014 and 2020, Horizon 2020 will bring all EU research and innovation funding together under a single programme with three key objectives:

- **Excellent Science:** Strengthening the EU's position as world leader in science and attracting the best talents to work together across Europe;
- **Competitive Industries**: Strengthening industrial leadership in innovation to get Europe back on the path to growth and job creation;
- **Better Society**: Innovating to tackle societal challenges shared by all Europeans, across six key themes: Health, Demographic Change and well-being; Food security, sustainable agriculture, marine and maritime research and the bio-economy; Secure, clean and efficient energy; Smart, green and integrated transport; Climate action, resource efficiency and raw materials; and Inclusive, innovative and secure societies.

We need a new vision for European research and innovation in a dramatically changed economic environment. Horizon 2020 will provide a direct stimulus to the economy and provide real European added value. It will secure our science and technology base and industrial competitiveness for future decades, promising a smarter, more sustainable and more inclusive society.

Horizon 2020 will be the main financial instrument implementing **Innovation Union**, one of the Europe 2020 flagship initiatives aimed at securing Europe's global competitiveness. It will also help to bridge the gap between research and the market by helping innovative enterprises develop their scientific and technological breakthroughs into viable products and services with real commercial potential. Funding provided by Horizon 2020 will be easier to access thanks to simpler, streamlined programmes, a single set of rules and less red tape.

The Commission will make major efforts to open the programme up to more participants from across Europe by exploring synergies with funds under the EU's Cohesion policy. Horizon 2020 will identify potential centres of excellence in less performing regions and offer them policy advice and support, while EU Structural Funds can be used to upgrade infrastructure and equipment and build capacity.

International cooperation will be further promoted in Horizon 2020, in order to strengthen the EU's excellence and attractiveness in research, to tackle global challenges jointly and to support EU external policies.

Building on the success of previous research framework programmes, this brochure presents a selection of results from EU funded projects that have shown great strides in innovation and will make a positive change to our daily lives. I believe that with Horizon 2020, we can achieve even more at European level, bringing our brightest and best together to really tackle the societal grand challenges, while contributing to European economic recovery and growth.

Máire Geoghegan-Quinn,
Commissioner for Research, Innovation and Science.

Supporting an **excellent science** base

SILKBONE

Using spiders to weave a cure for joint damage

Participants

Germany, Netherlands, Sweden, ***United Kingdom*** *(Coordinator)*

www.silkbone.org									
FP7	Proj. N°	18060	Total costs:	€ 2 070 000	EU contribution:	€ 1 600 000	Duration:	from:	Oct. 2005
								to:	Mar. 2008

For many of us, spiders are our worst phobia, the stuff of nightmares. But these scuttling, eight-legged creatures could be on the brink of delivering a major benefit to human health.

The key to this sudden transformation of the spider, from the shudder-inducing creepy-crawly we all know into beneficent fairy godmother, lies in its web.

Staggeringly, spider silk is six times as strong as steel. Which means that this hitherto overlooked substance is quite possibly the perfect material to help repair damaged human joints.

The potential is enormous, say scientists. Knee injuries are just one area where spider silk could provide the answer, ending years of agony for sufferers and billions of euros of costs for national healthcare systems.

Knee injuries can cause crippling disability in both young and old, often leading to osteoarthritis and eventually requiring knee joint replacements. That could all be about to change, thanks to the despised – and, sadly, often squished - spider.

"Spiders are the product of 400 million years of evolution and they really are incredible little bio-engineers," says Dr Nick Skaer, CEO of Oxford-based medical company Orthox, which is at the forefront of the research.

Not only is spider silk incredibly strong. It is also very elastic and resilient. Most importantly, perhaps, it is also what scientists call "biocompatible". In other words, human tissue can grow around and along it.

There was just one problem with this new miracle material, says Dr Skaer. Spiders don't exactly produce a lot of it.

Aided by a grant of 1.6 million euros from the European Commission as part of its programme to promote research by small and medium-sized enterprises (SMEs), Dr Skaer and his colleagues came up with the perfect answer to this supply problem: silkworms. Although they do not produce quite the same thing as spider silk, silkworms provide silk which is similar enough to be used as a kind of raw material – and in much bigger quantities.

By adding an enzyme to this raw material, researchers made an important discovery. Its molecules could be aligned exactly as they are in spider silk, thus replicating its amazing qualities. The replicated silk was patented under the name "Spidrex".

It is this material, with a name that sounds more like a children's comic book hero or a new hi-tech sports clothing fabric than a medical breakthrough, which promises to revolutionise the treatment of joint injuries.

Spidrex's combination of qualities gives it a unique dual function. Its strength makes it an ideal material to make inserts to replace, say, a damaged section of cartilage. At the same time, its "biocompatibility" makes it a perfect base on which the body can re-grow damaged or missing tissue. This allows the joint to heal naturally and completely in a way which often does not happen under current treatment methods.

At a time when, according to one study, the developed world is facing a 500% increase in knee replacement operations in the next two decades, the benefits of Spidrex in both medical and monetary terms are clear.

And those benefits are not limited to knee joints alone, although that is where current research is focused. Spidrex technology is potentially applicable to a wide range of injuries requiring cartilage and bone repair.

With clinical trials due to start in 2012, Dr Skaer is excited about the future.

"It's quite simple, it's quite straightforward and it's quite cheap," he says. "We're very close to having a product which is ready for implantation in humans now, so it's not science fiction, it's really close to being a reality."

Next time you see a spider, treat it with care.

SFERA

New technology combats fake medicines and saves lives

Participants

Belgium, **France** (Coordinator), Italy, United Kingdom

www.sfera-research.eu

FP7	Proj. N°	222057	Total costs:	€ 1 460 000	EU contribution:	€ 990 797	Duration:	from: Apr. 2008 to: Mar. 2010

For the global pharmaceuticals industry, the fight against counterfeit drugs is one of the greatest challenges of modern times. According to the World Health Organisation, some fake medicines are so cleverly manufactured that they fool even health professionals. And the results, of course, can be fatal for patients.

While human lives and health are the most important concern, counterfeiting is a problem that plagues other industries too. High on this list are perfume manufacturers, with large sums of money at stake in sales of high-class, luxury branded items.

Meanwhile, the proceeds of counterfeiting go to feed organised crime, possibly even terrorism, and result in huge costs in the form of lost tax revenues.

The problem is simple: many medicines, and almost all perfumes, come in glass containers which are hard to protect against the counterfeiters. Ink-based markings are easily erased. The tags needed for Radio Frequency Identification (RFID) can be removed or altered. Laser marking might be the answer, but existing techniques produce microscopic cracks in the glass.

It was to find a solution to this problem that the EU-funded SFERA project was set up, using funding from a programme designed to stimulate innovation by fostering cooperation between small and medium sized businesses around Europe.

The result of the two-year, 1.5 million euro project was a unique new laser engraving technique known as 'Filiglass'. The high resolution system allows tamper-proof bar codes to be engraved on the inside of bottles at the time of packaging. In combination with specialised reading machines, 'Filiglass' makes it possible to detect even the most sophisticated counterfeits.

Critical to the success of the project was the need to produce a system which was not just a reliable safeguard against counterfeiting, but also one which was practical to deploy. One of the key achievements of SFERA, involving 9 SMEs from Belgium, France, Italy and the UK, was to produce a system capable of applying the engravings at a rate to match the pharmaceutical industry's demanding production speeds – a dizzying 600 items a minute.

Combined with a high-speed reader, the new technology has already been recognised within the industry as the perfect answer to the scourge of pharmaceutical counterfeiting.

While its speed is crucial to industries like pharmaceuticals, another of the features of 'Filiglass' makes it the ideal solution for the different requirements of the perfume industry. In a sector where aesthetics are crucial, the laser engraving is almost invisible. More than that, it can even be used to produce attractive light diffraction effects that actually enhance the product – a real 'win-win' situation.

Back with the pharmaceuticals industry, the new system guards against another major risk: the danger of bottles getting mixed up during production. On high-speed production lines, the right bottles need to be filled with the right medicines. Obviously, mistakes can be catastrophic. The SFERA system means that bottles can be instantly identified and re-routed where necessary.

With the recognition it has already gained, it is hoped that the technology developed through SFERA will rapidly become a global standard within the pharmaceutical industry – safeguarding human health and finally putting an end to a crime which, in the pharmaceutical industry alone, is estimated by the WHO to cost the world more than 12 billion euros a year.

NA-NOSE

The simple breath test that can detect cancer

Participants

Israel (Coordinator)

http://lnbd.technion.ac.il									
FP6	Proj. N°	42348	Total costs:	€ 1 730 000	EU contribution:	€ 1 730 000	Duration:	from: to:	Apr. 2007 Mar. 2011

No-one wants to be told that they have cancer. But the earliest possible diagnosis is often the key to ensuring survival.

So a new technique developed by scientists which can ins-tantly detect cancer even in its very earliest stages, using just a simple breath-test, offers the clear hope of a major breakthrough in improving cancer survival rates.

Designed to mimic a dog's highly sensitive sense of smell, the new "electronic nose" takes a sample of the patient's breath and gives an instant reading - not only of whether cancer is present, but how far advanced it is. Early tests for the device have already shown extremely exciting results.

Known as the NA-NOSE (short for Nano Artificial Nose), the test works by spotting microscopic changes in the body that occur when cancer is present.

By detecting cancer without having to wait for tumours to grow, the NA-NOSE offers a unique early warning system that could save thousands of lives, allowing cancers to be diagnosed and treated earlier than has ever been possible before. It would be especially valuable in diagnosing cancers that are otherwise hard to detect in time.

Nor does it stop with cancer. The NA-NOSE will potentially be able to pick up early signs of other serious diseases as well, such as Parkinson's, Kidney Disease, Liver Disease, Alzheimer's or MS – making it truly a "'wonder device".

"At first, I thought to myself this is science fiction. It can't be true," says Professor Abraham Kuten, one of the scientists involved in developing the NA-NOSE.

But based on the successful results so far, Professor Kuten says, it could turn out to be "a very important tool in the early detection of cancer."

The potentially breakthrough project was funded by a 1.7 million euro Marie Curie Excellence Team grant from the European Commission. These grants are designed to enable promising researchers to carry out leading-edge research of particular importance to Europe. In the case of the NA-NOSE, that grant could be repaid many times over in saved health care costs, if early test results are anything to go by.

When breath-tests were carried out on an initial group of 62 volunteers – some with head and neck cancer, some with lung cancer, and some of whom were healthy – the NA-NOSE correctly diagnosed all of the patients with the two types of cancer. It also correctly identified all but two of the healthy patients.

The secret of the NA-NOSE lies in a row of sub-microscopic (nanoparticle) gold sensors, which can detect tiny molecular changes that occur in the blood of cancer patients. They can do this at levels of concentration so low that it has been likened to detecting one single flower in a vast field of flowers - using the sense of smell alone.

Using these tiny molecular traces, the device can not only detect cancer but also distinguish between different types of cancer including lung, breast, colorectal, prostate and head and neck.

The scientist who led the research, Professor Hossam Haick of the Israel Institute of Technology (Technion), was inspired to carry out the research after witnessing the sufferings of a friend who had leukaemia.

Extensive further testing of the NA-NOSE will be required. But if all goes well, says Professor Haick, it could be in use for breast and colorectal cancer patients within three years and for other types of cancer in about seven years.

Thanks to this revolutionary new "electronic nose", with its promise of reliable, non-invasive and inexpensive early diagnosis, screening for cancer could be on the verge of entering a whole new world.

The ability to literally "sniff out" cancer and other major diseases could indeed become a reality.

ENTANGLED BALKANS

Revisiting Balkans history to achieve a more unified future

Participants

Bulgaria *(Beneficiary)*

http://entangledbalkans.eu

FP7	Proj. N°	230177	Total costs:	€ 1 560 000	EU contribution:	€ 1 560 000	Duration:	from:	Jan. 2009
								to:	Dec. 2013

As anyone who has tried to study it will know, the history of the Balkans is as complex as that of any region in the world. It is an area into which are compressed a large number of ethnic groupings and national identities, characterised by shifting borders and alliances, and long-held grievances, rivalries and tensions.

A visit to the Western Balkans shows how deep the scars of the bloodshed of the 1990s, after the break-up of Yugoslavia, were and still are. As TV images and newspaper reports made clear on an almost daily basis, the scale of violence exceeded our common understanding, with human rights abuses, massacres, torture, rapes and ethnic cleansing on all sides.

Despite this inextricably interlinked experience, the 'entangled history' of the Balkans has rarely been studied from a 'relational' or 'transnational' perspective. To the contrary, the area's history has been formulated almost exclusively along national lines. Individual national identities have been entrenched in the historiography, which in turn has led to even deeper entrenchment of those feelings of separate national identity and division.

Aided by a European Research Council (ERC) grant awarded in 2008, Professor Roumen Daskalov from the New Bulgarian University of Sofia, is aiming to bring a fresh new perspective to this history.

'Modern Balkan history has traditionally been studied in the national paradigm as separate national histories taking place within bounded state territories. (...) [However] these national historiographies show some transnational aspects which have been forged throughout time from various economic, political and cultural influences from abroad,' says Professor Daskalov.

The complexities of the Balkans and their long-standing relations both with the West and with Russia have made this approach, based on a transnational and cross-disciplinary perspective, particularly relevant. It also contributes to 'global history', a new trend in historical studies that revisits national histories to place them in a more global perspective, thus transcending established disciplinary boundaries between history, sociology, political science, international law and linguistics.

The relevance of this approach quickly becomes clear when one considers, for example, how interconnected and 'entangled' were the Greek, Romanian, Bulgarian and Macedonian nationalisms over the years. Despite their rivalries and hostilities, they also copied and borrowed from each other extensively.

This pattern was repeated many times throughout the Balkans, as minorities and refugees interacted with the dominant nationalities in the region.

Supported by an ERC grant of €1.5 million for five years, Professor Daskalov and his four team members aim to present a new vision of the modern history of the Balkans that will challenge the entire historical landscape of the region.

'The "entangled history" approach does not aim to harmonise the past and smooth out past conflict. The contacts, movements, exchanges, transfers, etc. were more often asymmetrical and violent than harmonious and peaceful. Still there is some positive and integrative value in showing how "entangled" the histories of the present-day Balkan nations and states were and still are,' says Professor Daskalov.

Achieving lasting peace and reconciliation in this troubled part of the European continent is an immense challenge. But Professor Daskalov hopes to see his research results contributing to that process of reconciliation, and to the better integration of the Balkans region into a wider Europe.

'I can imagine such research as promoting good neighbour relations rather than fostering divisiveness and separation,' he says.

Building **industrial leadership** in Europe

CHILL - ON

Enhancing safety at every step in the food supply chain

Participants

Brasil, Chile, China, France, ***Germany*** *(Coordinator), Island, Israel, Italy, Netherlands, Spain, Turkey, United Kingdom*

www.trace.eu.org/index.php

FP6	Proj. N°	16333	Total costs:	€ 15 530 000	EU contribution:	€ 10 100 000	Duration:	from:	Jul. 2006
								to:	Dec. 2010

Few would dispute that the emergence of chilled and frozen food technologies in the last century was a major advance for modern society, transforming all our lives and bringing convenience and choice. In Europe today, consumption of chilled and frozen foods is rising by more than 10 per cent a year.

But there is a downside. The safety issues associated with the handling of such food products remain a major public concern. Food scares regularly hit the headlines. And food poisoning caused by the incorrect handling of these products can be fatal.

The problem is the large number of stages in the production process 'from farm to fork' – from farm producers to intermediate suppliers to final manufacturers, all through a range of transportation links. Many stages, in other words, when a small lapse can easily go unnoticed and have catastrophic results.

CHILL-ON, a major EU-funded research project, set out to provide a solution to this problem. The ambitious goal was to achieve seamless control and monitoring from start to finish of the supply chain, thus allowing risk to be assessed, controlled and minimised in a way never possible before.

If it could be achieved, it was a precious prize indeed, not only for the consumer, but also for the food industry, with strict regulations to observe, competitive pressures to deal with, and precious reputations to protect.

Led by the Technology Transfer Centre of Bremerhaven and involving 26 partners from 13 countries, the 15.6 million euro project took four and a half years. It was truly multi-disciplinary, bringing together experts in fields ranging from bio-chemistry to information technology, from genetics to packaging, and from microbiology to logistics, engineering and mathematics.

The numerous breakthroughs incorporated in the final CHILL-ON system included methods not only to detect the presence of food pathogens - the bugs which can cause poisoning – but also to predict their future growth in given temperature conditions.

A 'Shelf-Life Predictor' allows a product's remaining shelf life to be assessed at any point along the supply chain. And clever devices called 'Time Temperature Indicators' are labels attached to each product which change colour in accordance with exposure to different temperatures over different time scales. This information can be transmitted wirelessly to a control centre.

All this information, and much else besides, is fed into the heart of the system – an information management system accessed via the web known as TRACECHILL. Through this, users can gain real-time information on the exact freshness and previous history of every single product, wherever it is on its journey from farm to fork.

In effect, this radical new system provides not just a 'snapshot' of any product at any point, but a continuous 'video' of its journey along the supply chain. Tests have already tracked Atlantic cod from Iceland to France, hake being transported from Chile to Spain, and frozen tilapia as it journeyed right through the supply chain to China.

Where consumer food safety is concerned, there is no room for compromise. Safety and confidence are vital. For the food industry, reputation is vital – and easily lost. As a result of the CHILL-ON project and its unique combination of specialisms, society can today enjoy the enormous benefits of chilled and frozen food in greater confidence than ever before.

FIREROB

Video games inspire real-life firefighting robot

Participants

Greece, **Croatia** (Coordinator), United Kingdom, Spain

www.dok-ing.hr/index.php/new-projects/mvf-5/

FP7	Proj. N°	222303	Total costs:	€ 1 050 000	EU contribution:	€ 803 315	Duration:	from: Jul. 2008 to: Jun. 2010

Reckless of the raging heat and the billowing fireballs, the firefighter advances undaunted towards the blazing car. Getting within range to start dousing the flames, the firefighter spots a person slumped unconscious over the steering wheel and messages back to colleagues to summon help.

Even though the driver survives the inferno as a result, the firefighter never receives a bravery medal - or indeed any kind of recognition. This kind of dramatic rescue is just part of a routine day's work

The reason? This firefighter is a highly developed robot, not a human being.

Meet Firerob, a unique firefighting machine packed with state-of-the-art technology.

It may sound like something out of the film Robocop, but it is already a reality. Thanks to Firerob, blazes impossible for conventional firefighting techniques can now be successfully overcome - in collapsing buildings, in confined spaces like tunnels, or in other hazardous locations.

The potential for saving human lives is clearly enormous.

Developed by Croatian firm DOK-ING, better know for producing mine-clearing machines, Firerob is remotely controlled by an operator using a joystick.

"It's very simple to drive," says Zoran Boskovic, the man in charge of Research and Development at DOK-ING, during a practical demonstration. "We actually took the idea from video games."

Looking part fire-engine, part bulldozer and part military tank, Firerob moves on caterpillar tracks. Up front, it has a bulldozer blade equipped with a gripper tool. In true Robocop style, it can punch through brick or concrete walls and pick up objects weighing up to 5 tonnes.

On-board, Firerob boasts seven cameras, including a thermal imaging system which allows it to spot people.

"It can recognise human silhouettes in smoke and inform the operator, so the operator can pull back the machine and send the firefighters to rescue," says Boskovic.

Firerob also has a GPS system enabling it to be navigated accurately, and software which lets it "see" and recognise objects – such as dangerous or flammable materials which need to be removed.

The cost of developing the Firerob prototype was largely met by an 800,000 euro European Union grant. That grant was made under a scheme designed to help small and medium sized business in Europe work together and come up with innovations that would otherwise be impossible if they worked alone.

In the case of Firerob, one direct benefit of the grant was that it put DOK-ING in contact with a Scottish firm, Scot-ATRI, which provided special heat-resistant paint allowing the machine to work for longer in the intense heat of a blaze.

As DOK-ING's Sales Manager, Mladen Jovanovic, points out, the potential of Firerob is vast. "This machine can be used in nuclear power plants, the chemical industry, oil refineries, ammunition depots. That means in all industries and situations where the object might explode any second," he says.

Two Firerobs have been sold to the Russian government, and R&D director Zoran Boskovic is already planning further improvements. He wants to make Firerob even more autonomous. "I think a real robotic vehicle has to do everything alone, without the operator," he says.

Freed from the need to control the Firerob's movements, the operator would be able to concentrate exclusively on the camera images and determine the correct strategy to fight the fire. "That is the next goal," says Boskovic.

From an idea provided by video gaming to saving lives in the most hazardous of real-life situations, scientific innovation really is turning fiction into reality.

PROPRALINE

The Hi-Tech recipe for the perfectly preserved praline

Participants

*Belgium, Czech Republic, Denmark, **Sweden** (Coordinator), Hungary, United Kingdom, Switzerland*

www.sik.se/propraline/programme.htm

FP7	*Proj. N°*	*218423*	*Total costs:*	*€ 3 790 000*	*EU contribution:*	*€ 2 760 000*	*Duration:*	*from:*	*Oct. 2010*
								to:	*Sept. 2011*

We have all experienced the disappointment. Opening a box of expensive praline chocolates with pleasurable anticipation - only to discover that they appear to have gone off, even though it is well before their 'use-by' date.

Covered with a dull, white film, they look as if they have gone mouldy.

In reality, it is not as bad as it looks. That apparent mould is nothing more than what is known in the chocolate industry - admittedly unappetisingly - as 'fat bloom'. Caused by fats penetrating from the praline centre to the surface of the chocolate and forming a thin crystallised layer, it is no danger to human health.

But it is fatal to our enjoyment of the chocolates. They certainly cannot be offered to friends and guests. More often than not, the chocolates end up in the bin – or taken back to the shop.

It is a major problem for the European chocolate industry. As much as 143,000 tonnes of chocolate are affected either by 'fat bloom' or by cracking, with a cost to the European industry of 1.2 billion euros a year.

The European chocolate sector is a world-leader, comprising around 2,000 firms, mostly small or medium sized enterprises (SMEs), employing some 200,000 people. Its exports are worth 3 billion euros a year.

And yet it is beset by what seems an intractable problem. Its products, which consumers quite reasonably expect to be presented in perfect condition, are extraordinarily vulnerable to the dangers of fat bloom and cracking. The reputation of a fine luxury brand can be destroyed in an instant.

On the flipside, if the industry could find a way of extending shelf-life and creating more certainty that its products would reach the consumer unspoiled, it could create a huge boost in sales and exports.

That was why the EU chose to fund a research project called PROPRALINE, a three year programme involving leading brand chocolate producers including Belgium's Guylian, large suppliers to the industry, specialist research institutes and SME asso-ciations, to come up with a much-needed solution.

The group conducted intensive research into ways of preventing both fat bloom and cracking. Cracking is caused when liquid content from the filling passes into the outer casing of chocolate, making the sugar and cocoa particles there swell. This results in stresses to the chocolate, which lead to cracks.

As a result of the research, funded under an EU programme intended to stimulate cooperation and innovation among SMEs, the teams identified a number of key control factors. High on this list is the process of 'tempering' the cocoa butter – the treatment of it before it crystallises and becomes solid. A consistent, reliable and reproducible process is vital. The cooling of the chocolate is also key, as is the shape and thickness.

The composition and processing of the filling are also important considerations, with the type of oil used in fat-based fillings being a key determinant of bloom development. Cracking can be exacerbated when the filling and the casing contract differently during cooling.

The PROPRALINE project clearly demonstrated that the world of high-class praline chocolates is a refined and technically complex one. There is indeed more to that box of chocolates than meets the eye.

Fortunately, with the research results due to be made available to the industry through a series of workshops and other initiatives, it can be confidently expected that fat bloom and cracking will be things that meet the consumer's eye with much less frequency.

And Europe's chocolatiers can continue to lead the world.

SPEED-FX

Breakthrough film technology paves the way towards Oscars

Participants

*Portugal, **Spain** (Coordinator), United Kingdom*

www.speedfx.org									
FP5	Proj. N°	34337	Total costs:	€ 3 514 018	EU contribution:	€ 2 100 000	Duration:	from:	May 2002
								to:	April 2004

Millions of people saw the multi-Academy Award winning film, The King's Speech. What few people will know is that this box office hit was made possible, at least in part, by a groundbreaking research and development project funded by the European Commission.

Thanks to carefully targeted EC funding, a small UK start-up company was able to team up with a leading Spanish university to revolutionise the world of cinema post-production.

Post-production includes all of the film-making work that takes place after the end of the actual shooting of the film – including key tasks such as editing, adding special effects and transferring the original motion picture to video or digital format.

As a result of the project, known as SPEED-FX, UK company FilmLight was able to develop a radically more efficient, more flexible – and cheaper - system for cinema post-production than anything previously available. The impact was to bring post-production within the reach and the budget of far more users than ever before, and to propel FilmLight from a standing start to recognised industry leadership.

Previous post-production systems required users to buy expensive proprietary hardware suites. Each time a user needed to upgrade, an entirely new system had to be bought. Working in close cooperation with Universitat Pompeu Fabra (UPF) in Barcelona, the unique contribution of FilmLight was to create a system which bypassed this need for specialised hardware.

By creating purpose-built software programmes, FilmLight made it possible to link ordinary personal computers into a single system, thereby creating a kind of 'super-computer' to replace the old-style hardware requirement.

Founded by a small group of former employees from a large cinema production company, FilmLight was aided by experts at UPF who provided the technical research and development input to provide the new applications required, and who ensured that the new open architecture system would be reliable.

As well as using standard PCs, the new product, Baselight, incorporates industry-standard technologies for other key parts of the system such as computer memory, storage devices, graphics cards and networking capabilities. With the whole system running on Linux, an open-source operating system, the package can be easily upgraded as necessary.

This flexibility also means the system is unlikely to become obsolete, in the way that a purely hardware-based solution would do.

As a small start-up, FilmLight's founders had the vision and commitment, but like all start-ups they needed an equivalent financial commitment. Thanks to the 3.5 million euro SPEED-FX project, of which 2.1 million euros was provided by the EU, FilmLight was able to out-compete more established players and establish itself as a clear market leader, quickly achieving sales that dwarfed the initial project cost.

From this initial breakthrough, FilmLight went on to win a highly prestigious UK accolade - the 2006 Queen's Award for Enterprise in International Trade. In 2010 it scooped the Scientific and Engineering Academy Award.

The King's Speech may have been about King George VI's battle to overcome a crippling stutter. But there has been nothing at all stuttery about FilmLight's dramatic rise to international success as a result of the vision of the SPEED-FX project.

Tackling societal challenges for a **better society**

AQUAFIT4USE

Helping industry conserve the world's most valuable asset

Participants

The Netherlands *(Coordinator), Belgium, Czech Republic, Germany, Denmark, Spain, France, Italy, Sweden, Slovenia, Poland, United Kingdom*

www.aquafit4use.eu									
FP7	Proj. N°	211534	Total costs:	€ 14 470 000	EU contribution:	€ 9 650 000	Duration:	from:	Jan. 2008
								to:	May 2012

In a 21st century world facing the twin challenges of climate change and rapid population growth, there seems little doubt that water is set to become the most precious resource on the planet. Its sustainable use is going to become ever more vital for human survival.

Industry accounts for a large proportion of our water use. Its total consumption is projected to increase by more than 50% between 1995 and 2025 as industrialisation spreads, reaching an estimated 1,170 cubic kilometres. That is enough to fill a 100 meter deep swimming pool covering the entire area of Paris.

Four of the most water-intensive industries are paper, food, textiles and chemicals. The pulp and paper industry, for example, uses more water to produce a ton of its product than any other industry.

The potential impact such industries can have on the world's ability to make more sustainable use of its finite water resources is clear. The question is: how?

Some of the answers are starting to come from a major European Union project bringing together 34 partners including research institutes and, crucially, a high proportion of industrial water users. Running for four years until the middle of 2012, the 14.5 million euro 'AQUAFIT4USE' project aims to help these four water-intensive industries to reduce their freshwater needs in a significant way.

As the project name implies, the fundamental approach involves examining more closely than ever before the precise quality of water needed for specific industrial processes. In other words, to define and manage the provision of water 'fit for use'.

As the project's co-ordinator Willy van Tongeren puts it: "Nowadays, it is common that the quality of water used is unnecessarily high – often drinking water – to be on the safe side. This is not needed, but most industries do not really know what the real demands for their processes are."

In response to this, the aims of the AQUAFIT4USE project are to provide ways of achieving sustainable water use in the four industries by identifying and precisely meeting these 'real demands'. The hope is that this should lead to a reduction in freshwater needs of as much as 30 per cent.

Already, the project has recorded notable successes:

- New water quality management software has helped industrial users define their water quality needs better. This alone has cut freshwater use by between 20 and 50 per cent, depending on the industry.
- By developing a new technology to remove salt from cooling water, which can then be re-used, AQUAFIT4USE has allowed freshwater use for cooling towers to be cut by an impressive 80 per cent.
- Pilot tests of a new non-chemical technology to prevent biofouling (the growth of organisms like algae) at a chemical plant in Sweden have resulted in an 80 per cent reduction. Biofouling is one of the biggest water-related costs for industry and usually requires chemical treatment.

Ultimately, the aim is to 'close the water cycle'. This means making it possible for water to be managed and re-used so that fresh water intake is no longer needed. There is still a long way to go, but through the AQUAFIT4USE project Europe has shown its ability to take the lead in the effort to preserve the world's most precious resource.

No longer is water the consumable that it was seen as in the past. In the world of today, it is a highly valuable asset, to be managed and sustained.

DE-LIGHT

Adapting Formula 1 technology to aid the rail industry

Participants

The Netherlands, Poland, Latvia, Finland, United Kingdom, ***Germany*** *(Coordinator), Norway, Portugal, Sweden, Croatia, Romania*

www.delight-trans.net									
FP6	Proj. N°	31483	Total costs:	€ 3 710 000	EU contribution:	€ 2 500 000	Duration:	from:	Jan. 2006
								to:	Jan. 2010

At first sight, train drivers' cabs and Formula 1 cars may not seem to have much in common. But a research project funded by the European Commission has led to a potential breakthrough for the rail industry - by adapting technology most commonly found in high performance racing cars.

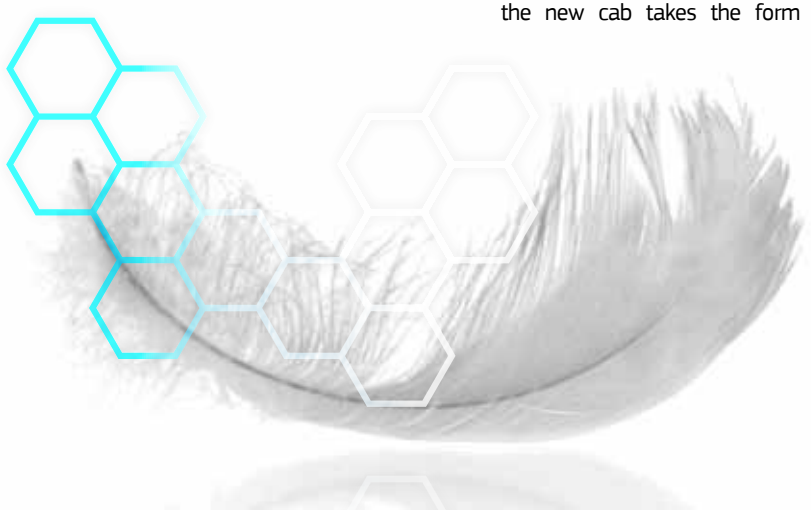
The results promise to provide the rail industry with trains that are more environmentally-friendly, easier and cheaper to produce, and less costly for rail companies in terms of track maintenance. An all round win-win situation.

The rail industry's needs are clear: lightweight materials for trains in order to increase energy efficiency and reduce the damage to tracks, and reduced costs. All, of course, without compromising safety.

The problem is that conventional train cabs, made from welded steel units, can weigh up to one tonne each. With a cab at each end of the train, the potential for weight reduction is clear. On top of that, traditional cab designs tend to be very complex, incorporating a large number of parts, all made from different materials. That is because they need to meet a range of physical demands, including strength, crashworthiness, aerodynamics and insulation. As a result, assembly costs are high.

Formula 1 cars use extremely strong, lightweight materials known as carbon composites to help achieve the high performance they need. But such materials are highly specialised and uneconomic for extensive use in trains.

The answer for the rail industry came through a multi-year project funded under the European Commission's DE-LIGHT programme, which was aimed at developing improved light-weight materials for use in a wide range of transport systems. After three years of research, a team from Newcastle University in the UK, working in collaboration with Bombardier Transportation and Portuguese manufacturing firm AP&M, succeeded in producing a prototype lightweight train cab which reduces the weight of the traditional cab by a remarkable 40%.



The breakthrough technology behind the new cab takes the form of a 'sandwich' construction, in which an aluminium honeycomb structure and a polymer foam core are enclosed in outer layers of special glass-reinforced plastic. The effect is similar to the composites used in Formula 1 - but at much lower unit cost.

Crucially, the inherent strength of the new construction eliminates the need for steel elements. This reduces not only the weight, but also the number of separate parts required. In addition to the 40% weight reduction, the new cab reduces the number of separate component parts by up to 75%. And this in turn reduces overall costs by up to 20%, as assembly and outfitting are far simpler than before.

All of this is achieved while still meeting stringent crashworthiness requirements.

"It's great to finally see the cab in real life," says lead designer Conor O'Neill of Newcastle University's rail research centre. "I've been staring at a virtual model on my computer screen for the last three years, and it's very satisfying to see the real thing."

It is intended that the cab will first go into commercial use in Bombardier's Spacium trains on suburban services in Paris.

LIFEVALVE

Grow your own: The “living” heart valve replacement

Participants

Hungary, Netherlands, ***Switzerland*** *(Coordinator), Germany, Austria*

www.remedi.uzh.ch/lifevalve.html									
FP7	Proj. N°	242008	Total costs:	€ 16 070 000	EU contribution:	€ 9 880 000	Duration:	from:	Nov. 2009
								to:	Oct. 2014

It is high on the list of every expectant parent’s anxieties. Of every 100 newborn babies, one is born with a congenital heart defect. Of these, half will need open-heart surgery to replace a heart valve. It is a traumatic and life-threatening operation.

Even if this operation is successful, the problems are far from over. Replacement heart valves risk rejection by the body, require permanent medication, and are prone to wearing out or breaking.

Most importantly of all, perhaps, they are not capable of growing with the baby’s body. Eventually, they have to be replaced to keep pace with the growing heart.

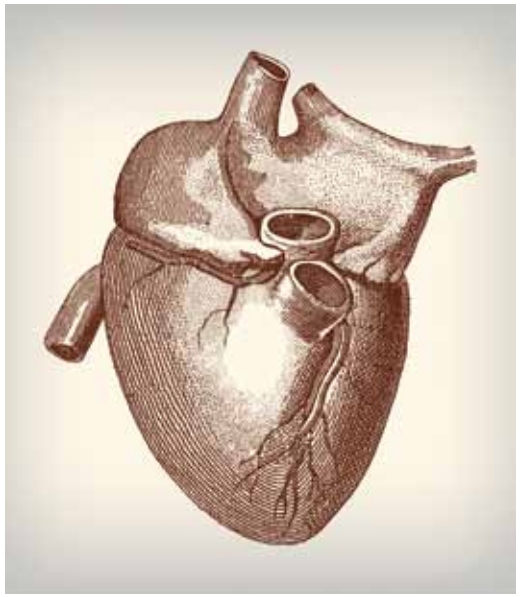
So babies born with heart problems face not just one traumatic operation, but potentially a lifetime of them – each one a new risk to survival. For many families in this situation, it must feel like an almost endless game of Russian roulette.

All that could be about to change. As a result of an EU-funded research project known as “Lifevalve”, two breakthrough technologies are being combined to provide a solution.

A “living” heart valve, made from the baby’s own tissue and able to grow with the baby, could now be just a few years away. Moreover, doctors would be able to perform the valve implant without the need for open-heart surgery.

“The aim of our project is to create living heart valves made of the patient’s own cells,” says Simon Hoerstrup, Director of the Swiss Centre of Regenerative Medicine at the University Hospital in Zurich.

The key to this is a new technology called “tissue engineering”. Cells taken from the baby by means of a minor biopsy are cultivated and multiplied in the laboratory. These cells are then “seeded” onto a 3D model of a heart valve, on which they continue to grow.



As Professor Hoerstrup explains: “We take the cells of the baby, we put them onto a material that has the shape of a heart valve, and then it grows in and forms a new heart valve, a living heart valve.”

Eventually, the framework which supports the cells at the start of the process biodegrades, leaving only the living tissue heart valve.

The second pioneering technology concerns the way the new valve is inserted into the patient. Instead of a major operation, as now, which involves cutting through the breastbone and actually stopping the heart, the Lifevalve project has developed “minimally invasive” tech-nology. Using a catheter, the new valve can be inserted into a blood vessel in the patient’s leg, for example, and then simply pushed up into position in the heart.

Funded by a grant of 9.9 million euros from the EU’s programme to assist innovation in the health arena, Lifevalve brought together eight partners from all over Europe. With each of those eight contributing different aspects of the technology, Professor Hoerstrup says the EU involvement was crucial. “I think it’s only with such a combination that you can really go forward quickly,” he says.

The first “living valve” could be implanted into a patient as soon as 2014.

63 years after the first ever replacement operation in 1951, medical science is on the brink of a radical transformation which promises an end to the tragic loss of young lives, and the repeated trauma, caused by heart valve surgery.

For the parents of that one baby in every 100, that must seem nothing short of miraculous.

NITROEUROPE

Shedding light on an overlooked threat to our planet

Participants

Poland, Hungary, The Netherlands, Germany, Italy, Estonia, Denmark, Switzerland, Spain, Sweden Norway, France, Italy, Russian Federation, China, Zimbabwe, Belgium, Ukraine, Ireland, ***United Kingdom*** *(Coordinator), Slovakia, Croatia, Finland, Austria, Portugal*

www.nitroeurope.eu									
FP6	Proj. N°	17841	Total costs:	€ 26 970 000	EU contribution:	€ 16 600 000	Duration:	from: to:	Feb. 2006 Apr. 2011

As the overwhelmingly dominant element in the atmosphere around us, and one of the four most common elements in living organisms, it gets surprisingly little attention.

Especially when its impact on humans and the planet has been described, by a recent expert report, as "one of the biggest challenges of the 21st century".

Nitrogen makes up 78 per cent of the air we breathe. It is an essential building block in all living things. But its story demonstrates that it is possible to have too much of a good thing. Despite its life-giving benefits, nitrogen also poses a growing threat to humans.

That threat has now reached such proportions that "business as usual" is no longer a viable response. It was to address this issue that an EU-funded, five year project called "NitroEurope" was set up in 2006, bringing together 62 partner organisations from 24 countries.

Nitrogen in the air is harmless. To be used, it needs to be changed into "reactive nitrogen" (Nr). This transformation occurs mainly as a result of natural bacterial activity, or by human intervention in the form of chemical engineering.

Perhaps the most familiar form of reactive nitrogen is in fertilisers. Here, the beneficial effect of Nr is clearest. It is estimated that, if humans had not started using it in fertiliser in the early 1900s, half of today's population would not be alive.

But excess quantities of reactive nitrogen cause a range of problems. It damages soil and water quality, pollutes the air and contributes to the greenhouse effect. Nitrates in water affect human health, increasing the risk of bowel cancer. In the air, reactive nitrogen creates pollutants which can lead to respiratory and heart disease.

All of which explains why the recently published European Nitrogen Assessment, to which NitroEurope made a major contribution, described the issue as one of the biggest challenges of the 21st century.

In order to tackle the problem, it is important to understand it. This was the primary aim of the NitroEurope project – studying the Nr issue in unprecedented detail, in order to understand exactly how Nr behaves and impacts the environment.

One achievement of the 27 million euro project was the establishment of a 'European Nitrogen Budget'. This showed that Europe produces 15.6 million tons of Nr per year, with almost three quarters coming from fertilisers. The remainder is produced by combustion from transport or industrial processes.

The researchers were able to put an economic value on the effects of nitrogen pollution, estimating the total cost of the impact on human health, biodiversity and climate change at as much as 320 billion euros per year. Meanwhile, air particles based on Nr are reckoned to reduce average European life expectancy by six months.

The project also revealed that, of the reactive nitrogen present in crops in Europe, only 15 per cent is used to feed humans directly, with 85 per cent used to feed animals. From this, a key conclusion was clear. Reducing meat and dairy consumption would provide a major part of the solution to the world's nitrogen problem.

The Nr threat is clear. But so, too, is the way forward. As a result of the understanding created by the work of NitroEurope, there is no reason why humanity cannot now start to tackle this major 21st century challenge.

OPENAIR

How a holistic approach can help aircraft noise reduction

Participants

Romania, Germany, United Kingdom, ***France*** *(Coordinator), Russian Federation, Egypt, Italy, Switzerlad, Belgium, Greece, Spain, Sweden, Poland, The Netherlands, Finland*

www.xnoise.eu/index.php?id=387									
FP7	Proj. N°	234313	Total costs:	€ 30 140 000	EU contribution:	€ 18 270 000	Duration:	from:	Jan. 2009
								to:	Mar. 2013

For millions of people around the world, the unwelcome and often deafening intrusion of jet aircraft roaring overhead is a daily annoyance. More than that, the stress it causes is increasingly being associated with physical and mental health problems.

The problem is not confined to those who live in close proximity to an airport. People living miles away but under the take-off or landing paths can find their lives similarly plagued. So, also, can those who live under the areas where aircraft are kept 'stacked' as they wait to land at ever more busy airports.

At the same time, the demand for aviation, both from private consumers and from businesses, is growing rapidly. The inexorable move towards more and more flights (and more and more airports or runways), means the need to find ways of making aeroplanes significantly quieter is an urgent one.

Aircraft noise is caused by two things. One is the air rushing over the aircraft fuselage and its wings. The other is the noise from the jet engines. Although it may be hard to believe, progress has been made over the years in reducing this noise. Modern aircraft are quieter than their predecessors of 20 or 30 years ago. But there is still a long way to go.

Previous efforts at noise reduction have all focused on isolated aspects of the problem. But a large-scale project set up and largely funded by the European Commission is aiming to revolutionise the way that the modern blight of aviation noise pollution is tackled.

Involving 47 partners worldwide, including major players in the aeronautics field such Dassault, Rolls Royce, Volvo Aero and EADS, the 'OPENAIR' project is focused on taking a holistic view of the aircraft.

Rather than looking, for example, at the engine fan blades or the wingtips on their own, OPENAIR was set up with the specific purpose of taking a whole aircraft approach. In this way, it is able to take the interaction between all the different parts into account. Using a complex model that has been developed as part of the project, it is possible to assess the real effects as perceived by people on the ground when the aircraft is flown in 'real' life.

The 18 million euro project is using the latest techniques in computer analysis of the ways in which air flows behave and how aerodynamic forces interact with surfaces to create noise. With 15 months still to go of the four-year life of the project, large-scale testing of a number of new technologies and methods is well under way.

Key to the project's success is the unique collaboration it has been able to generate between a range of organisations across Europe. This has been the crucial factor enabling the researchers to take a holistic view of the issue and to develop techniques which make it possible not just to know what noise reduction is achieved at, for example, a wing tip, but to measure the total effect people on the ground would actually be hearing if an aircraft were flying overhead.

Given the extensive participation in the project of major players from the aviation industry, any positive results should be quickly implemented in future aircraft construction, as well as being retro-fitted where possible on existing aircraft.

It is hoped that the results will make major contribution to the aviation industry's official goal of reducing aviation noise by 50% by 2020, compared with the year 2000.

OPTIX

New device boosts fight against terrorist bombs

Participants

Spain (Coordinator), Germany, The Netherlands, Lithuania, Austria, Sweden

www.fp7-optix.eu

FP7	Proj. N°	218037	Total costs:	€ 3 290 000	EU contribution:	€ 2 490 000	Duration:	from:	Nov. 2008
								to:	Apr. 2012

It is an all-too familiar scene. A suspect package in a crowded public place like a shopping mall, a train or an airport. Is it harmless? Or is it a bomb?

The improvised explosive device, or IED, is the weapon of choice in some 60% of terrorist attacks - so easy to carry around and deploy unnoticed. Or noticed only at the very last moment.

In the fightback against the ever-present threat posed by the terrorists who use these deadly devices, security forces require powerful tools and techniques of their own. High on the list of such tools is something which can rapidly, safely, and remotely identify which suspect package is indeed a bomb, and which is just the harmless result of someone's absent-mindedness.

That 'something' may now be close to reality, as a result of a three and a half year research project funded by the European Union. Due to conclude in spring 2012, the OPTIX project, undertaken as part of the EU's programme of stimulating collaborative research and development across member states, is the most technologically ambitious attempt ever implemented in Europe to make it possible to carry out remote explosives detection.

The EU contributed around 75% of the project's total 3.3 million euro cost.

Led by Spain's leading IT company, Indra, and bringing together a range of technical and industrial partners from 6 EU member states, including specialist businesses, research institutes, universities and Spain's Guardia Civil security force, the OPTIX project aims to provide law enforcement and security agencies with a method to identify explosives at distances of up to 20 meters.

With its ability to detect even microscopic traces of explosives - for example on the outside of a package, or the door of a suspicious car - OPTIX represents a real potential breakthrough: the possibility of carrying out a quick, reliable, remote identification of explosive materials, without the need for dangerous close-quarter investigation.

To date, no system in the world has been able to offer sufficient accuracy to be used by the police for this purpose.

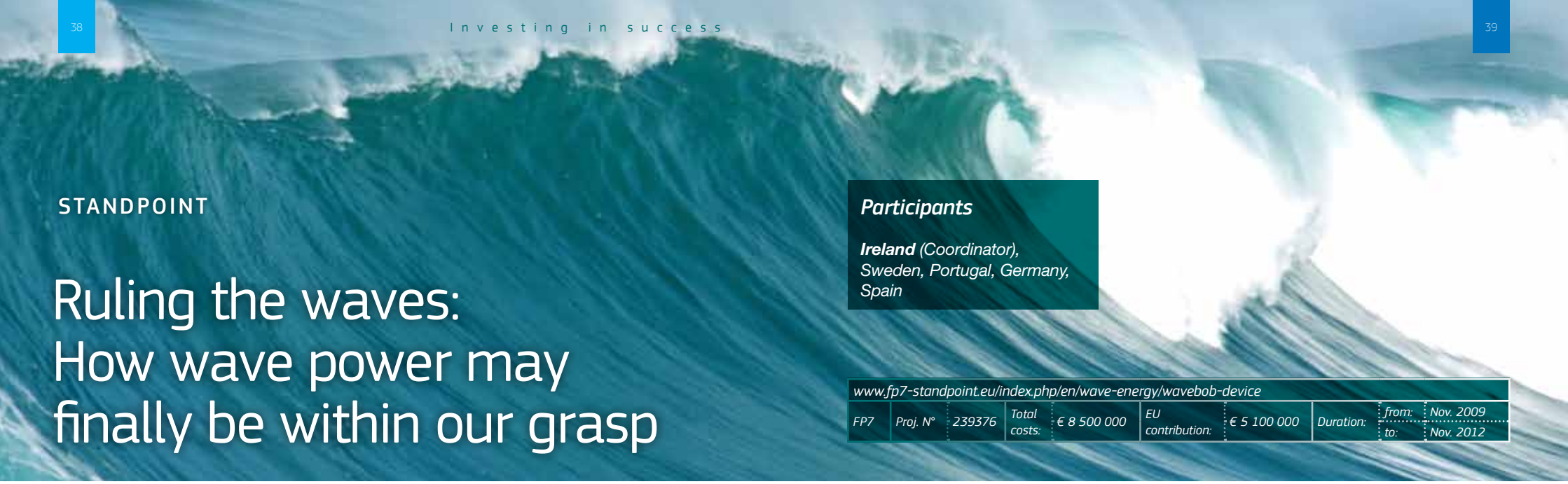
The unique feature of the OPTIX device is that it combines three separate advanced technologies to provide different ways of assessing a suspect package. One is the infrared technology that we are all familiar with. The others use lasers to analyse the molecular nature of the target substance and to determine not only if it is explosive, but also, if it is, which explosive it is.

Such technologies have already proved very useful in intercepting counterfeit drugs, analysing their 'molecular fingerprint' through the packaging, without the need to open them.

Combining three technologies in one device, while keeping that device portable, was one of the key challenges the OPTIX consortium had to overcome. Its success in this was a key stride towards making the device significantly more reliable and sensitive in detecting explosives than anything that has existed before.

As well as detecting and analysing suspect IEDs, the OPTIX system will also be an important tool in detecting traffickers who may be transporting the ingredients for bombs that are yet to be made, thus choking off the terrorists' crucial supply chain.

If all goes well with the current OPTIX prototype testing, the way could very soon be clear to a rapid and major step forward in the global fight against terrorism - thanks to an ingenious and innovative act of collaboration between a unique group of dedicated and specialised European partners.



STANDPOINT

Ruling the waves: How wave power may finally be within our grasp

Participants

Ireland *(Coordinator), Sweden, Portugal, Germany, Spain*

www.fp7-standpoint.eu/index.php/en/wave-energy/wavebob-device

FP7	Proj. N°	239376	Total costs:	€ 8 500 000	EU contribution:	€ 5 100 000	Duration:	from: Nov. 2009 to: Nov. 2012

As the world devours more and more energy, the hunt for a source of power which is efficient, reliable and above all clean is like a quest to find the Holy Grail. That Holy Grail, it seems, could be all around us: in the sea.

Think for a moment of those huge holiday-poster waves, enticing us to the spectacular surfing beaches of Hawaii, Australia or California. Now imagine the immense power locked up within just a single one of those waves - and what it could mean if that power were to be harnessed and used in a consistent and reliable way.

The science of capturing wave power is still in its infancy compared with other renewable energy sources such as wind power. But a project funded by the European Union is aiming to turn the massive potential of wave power from dream to reality in the shortest time possible.

If it can be done, wave power offers much greater potential than wind power. Waves are 1,000 times denser than wind. That means far more energy can be produced from waves than from wind, given an equally sized farm. And, as any holidaymaker or sailor knows, waves are far more predictable than wind.

It all adds up to a potentially significant reduction in our dependence on fossil fuels. In the US, the Electric Power Research Institute estimates that 10 years from now wave power could be enough for around 4.3 million American homes. In Europe, it is reckoned that countries near the Atlantic coast, where wave power is most abundant, could use it to meet 10% of their electricity requirements.

At the heart of the 8.5 million euro project, which has received 5 million euros of EU funding, is a device developed by an Irish company called Wavebob. To the untrained eye, it looks like a slightly large buoy on the surface of the ocean. Beneath the surface, the device – technically known as a wave energy converter (WEC) – contains an oscillator. In simple terms, the waves activate the oscillator, and this movement is used to generate electricity.

It might sound simple but it isn't. Coming up with a device that can harvest as much energy as possible from the waves, without absorbing so much that it gets destroyed in the process, is a difficult line to tread. The device also needs to adapt quickly to what can be dramatically changing wave patterns and conditions.

Faced with such challenges, the design and testing process is expensive, with no guarantee of success at the end. As a result, no internationally accepted method of harnessing wave power has yet been devised.

Working as part of a consortium called 'STANDPOINT', which includes five other partner companies from Sweden, Germany, Portugal and Spain, Wavebob is convinced that its device is advanced and sophisticated enough to meet this crucial need for an internationally standardised technology – and so open the way for wave power to become a commercially viable proposition.

"The STANDPOINT consortium believes that large-scale commercial wave farms will be developed much sooner if best-practice approaches are adopted internationally," explains Wavebob chief Andrew Parrish. "This project is an exciting step in the development of wave energy technology, and in the development of viable wave farms which will have a major impact on reducing carbon emissions worldwide."

As part of the project, a full-size, grid-connected Wavebob device will be tested for a 12-month period off the coast of Portugal, starting in late 2011.

There is no doubt that the results will be eagerly awaited. If all goes well, wave power could be commercially viable in as little as three to five years time.

As the Wavebob website puts it: "Every hour of every day thousands of dollars worth of ocean energy wash up on our shores. This immense, never-depleting, clean energy source is unlimited and untapped. Imagine the ability to harness that clean, free energy resource and put it to good work."

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