



EUROPEAN
COMMISSION

European
Research Area

Research for Europe



A selection of EU success stories

This publication presents a selection of 40 of the most successful EU research projects and initiatives from the Sixth Framework Programme for Research. Between them, the projects cover almost every aspect of our lives: from our health, our environment and the food we eat, to the way we travel and how our energy is produced.

Crucially, they have provided us with new knowledge, technologies and solutions to help tackle some of the biggest challenges facing society today. In many cases, these research results have an immediate practical impact – by improving consumer products, preventing or curing diseases or by changing the way business works. Furthermore, by linking up the best European scientists in their respective fields, these projects are laying the foundations for research networks that will last long after the projects have ended, therefore helping to reduce fragmentation and the duplication of effort in European research in the future. All of them are paving the way to create and reinforce, in an open and coordinated way, the establishment of a European Research Area, which will combine the best of National and Regional research programmes, EU Research initiatives and existing European research facilities.

The Commission is grateful to the coordinators of the featured projects for their invaluable assistance in the production of this publication.

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Research for Europe Examples of successful EU projects



European Commission

Research for Europe



A selection of EU success stories

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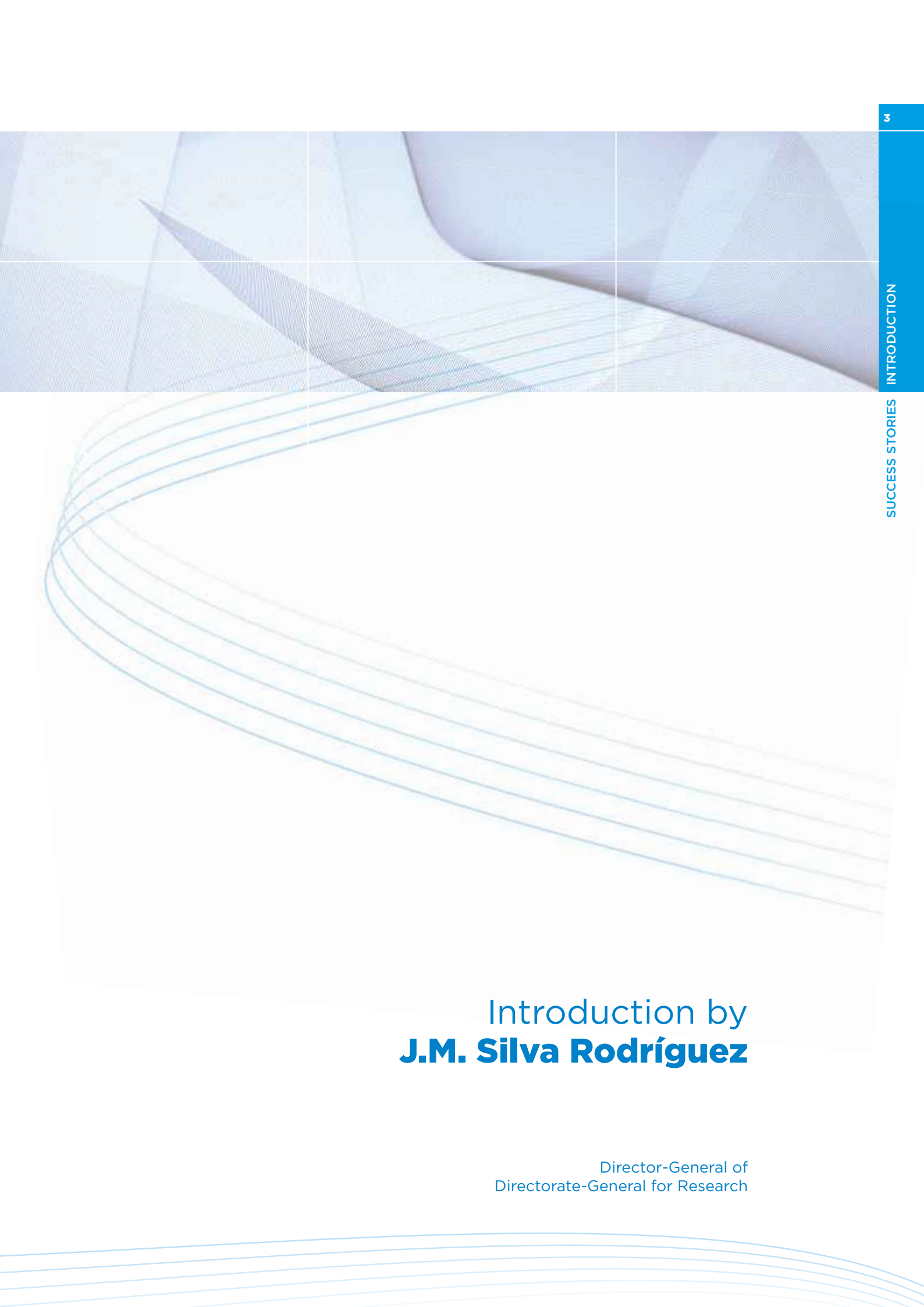
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Introduction by **J.M. Silva Rodríguez**

Director-General of
Directorate-General for Research



I am very pleased to present this selection of success stories from the EU's Sixth Framework Programme for Research.

It would take a much bigger publication than this to cover all the research and new knowledge created by this multi-disciplinary, international research programme. We have, however, tried to include enough exciting and innovative projects to give you a good overall picture.

In the following pages you will find researchers working in locations as diverse as the frozen wastes of the Arctic, the depths of the oceans and the windswept deserts of central Asia, as well as many more who work in the more traditional setting of the laboratory. They work in disciplines ranging from chemistry to the economy (and many, many more) and come from every corner of the EU and beyond.

Between them, the projects covered here touch on every aspect of our daily lives, from our health, our environment and the food we eat, to the way we travel and how our energy is produced.

These projects will provide us with important new knowledge to help us tackle some of the biggest challenges facing society today.

Climate change is widely regarded as one of the most serious of these challenges. Thanks to the Framework Programme we now have a better idea of how Europe will be affected and what we have to do to change how we live, work and travel in order to limit the damage to the environment and prevent more calamitous changes to our climate.



We have included a number of projects which show how research has contributed to the search for new and better ways of reducing our greenhouse gas emissions, technologies to help us to drastically reduce CO₂. Other projects offer an exciting glimpse of the cleaner, greener travel options of the future: covering sustainable fuels, more efficient railways and aircraft and even completely new concepts in public transport.

In the field of health, you will find projects looking for ways to prevent or cure existing diseases such as cancer, HIV and diabetes as well as how to react quickly to the emergence of new viruses.

Other projects included here are investigating how we can produce safer, healthier and more affordable food while respecting environmental and animal welfare concerns.

However, we should not lose sight of the fact that these projects are not only creating new knowledge and solutions to existing problems. Training features heavily in a number of the projects, helping to ensure that Europe will have a pool of talented, highly skilled researchers long into the future. These projects are also laying the foundations for networks which will bridge the gaps between researchers and between institutions and that will endure long after their work has been completed. Many also involve the building of global links involving researchers from all over the world.

The EU's research initiative complements the national and regional programmes run by member states, as well as existing European international research schemes.



Looking even further, FP6 gives added value to European research, and through the projects it supported, was designed to establish the building blocks of a single European Research Area (ERA). The ERA aims to generate world class public research inter alia through cooperation, networking and the free movement of researchers, funds and knowledge – the so-called fifth freedom. FP6 contributed directly to what has become known as the ‘Lisbon Strategy for growth and jobs’ by acknowledging the part research has to play in stimulating the European economy by providing jobs, services and new products.

Of course, the full implementation of ERA will require a further effort to increase and improve the free circulation of scientific information. The current Seventh Framework Programme for Research is now doing this with even more funding than before and a greater emphasis on creating clearer strategies and partnerships for research in Europe, so as to avoid fragmentation and dilution of research work.

There will be no solutions to the big societal challenges that Europeans face (such as climate change, energy transition, an increasingly ageing society) without further research effort. This publication is but one small example of our efforts to explain and justify why and what we are doing in EU Research and why it is so important to us all.

I hope you find it interesting and enjoyable.

A handwritten signature in blue ink, reading "Xosé U. I.", with a horizontal line underneath.

J.M. Silva Rodríguez
Director-General

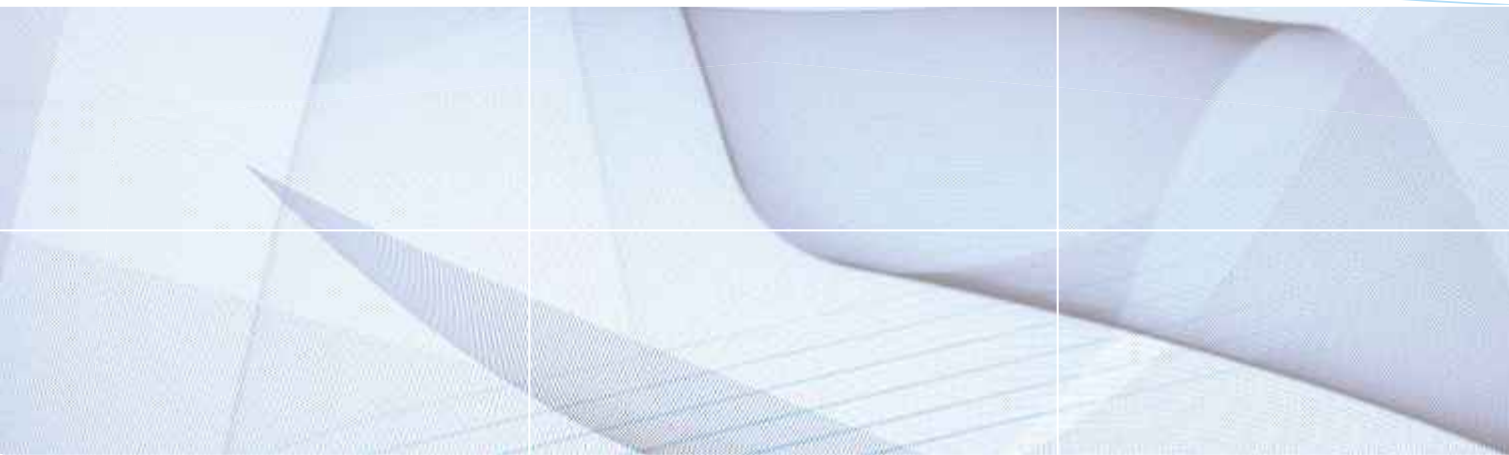


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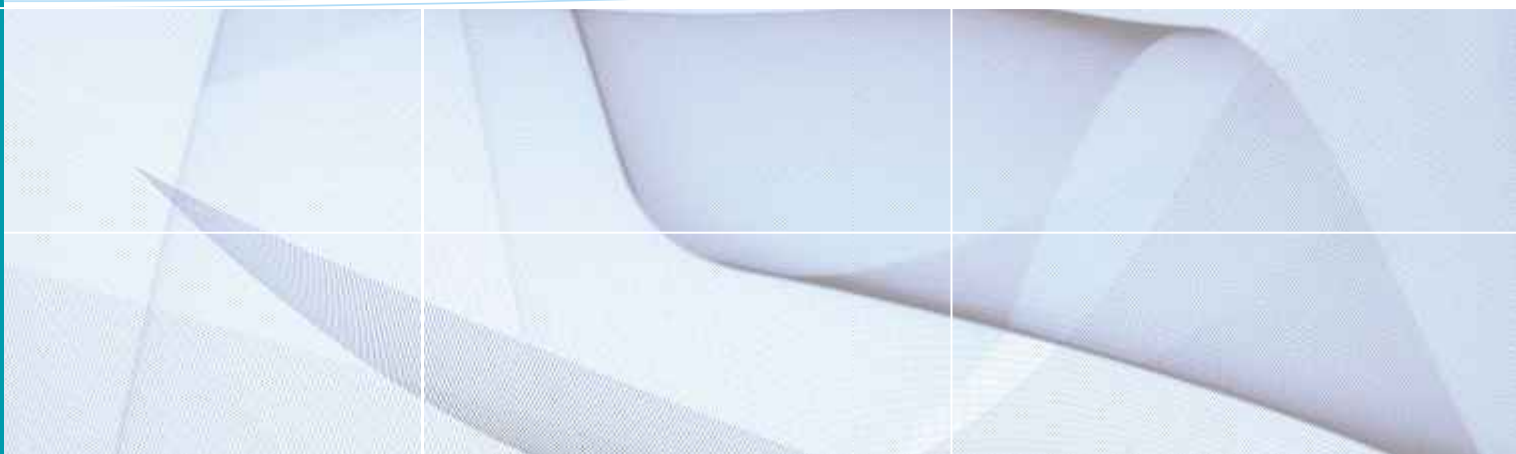
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SUCCESS STORIES
**AGRICULTURE
AND FOOD**

Research to **cut carcinogens** out of our food

In 2002, the food safety world was rocked by the discovery that many processed foods such as chips and crisps contained high levels of a potentially carcinogenic molecule called acrylamide.

Acrylamide had long been used in the manufacture of plastics, glues, paper and cosmetics, and in the construction of dams and tunnels. When it was found in food, very little was known about how it was formed, or its impact on our health, although it had already been found to cause cancer in animals, and the International Agency for Research on Cancer had classified it as 'probably carcinogenic in humans'.

The World Health Organization (WHO) and the Food and Agriculture Organisation quickly set up an international network of researchers studying acrylamide in food, and the HEATOX ('Heat-Generated Food Toxicants, Identification, Characterisation and Risk Minimisation') project represents a key EU contribution to this effort. HEATOX features in the EU's acrylamide information database, which in turn feeds into the WHO's acrylamide infonet.

Thanks to HEATOX, we now have a much better understanding of how acrylamide is formed, its effect on our health, and importantly, how different methods of preparing and cooking food affect the levels of acrylamide in the final product.

The project brought together 24 partners from 11 EU Member States as well as Norway, Switzerland, Turkey and Chile.

'Know thy enemy'

Research has revealed that acrylamide is formed when carbohydrate-rich foods are heated, for example by toasting bread, roasting coffee or frying potatoes. At the heart of acrylamide formation is a process known as the Maillard reaction, which takes place when the amino acid asparagine reacts at high temperatures with certain sugars.

The problem is that this reaction is what gives fried foods their distinctive flavour and golden brown colouring. The challenge for food scientists is to develop methods of food preparation that keep acrylamide levels low while preserving the special tastes and colours that come from the Maillard reaction.

The HEATOX project partners studied the Maillard reaction in great detail, and developed models to predict the levels of acrylamide formation in different foods and at different temperatures.

A toolbox for the food industry

The HEATOX findings fed into a toolbox produced by the food industry with the aim of helping food manufacturers reduce the amount of acrylamide in their products. The toolbox covers potato products, bread, biscuits and bakery wares, breakfast cereals, and coffee. For each food type, the entire production chain is addressed, from the farm, through processing, to final preparation.

For potatoes, for example, the toolbox recommends using low-sugar varieties, and frying them at temperatures between 145 °C and 170 °C. For breads, the project highlighted the importance of long yeast fermentation; new baking technologies such as the use of infrared radiation can also reduce acrylamide levels. In coffee, the amount of acrylamide in the final product is influenced by the variety of coffee bean used (Arabica varieties tend to form less acrylamide than Robusta varieties) and how long the beans are roasted.

According to the project partners, if all these mitigation measures are applied to these basic foods, acrylamide consumption can be reduced by up to 40%.



Title | Heat-generated food toxicants – identification, characterisation and risk minimisation

Acronym | HEATOX

EC Contract number | 506820

Website | www.heattox.org

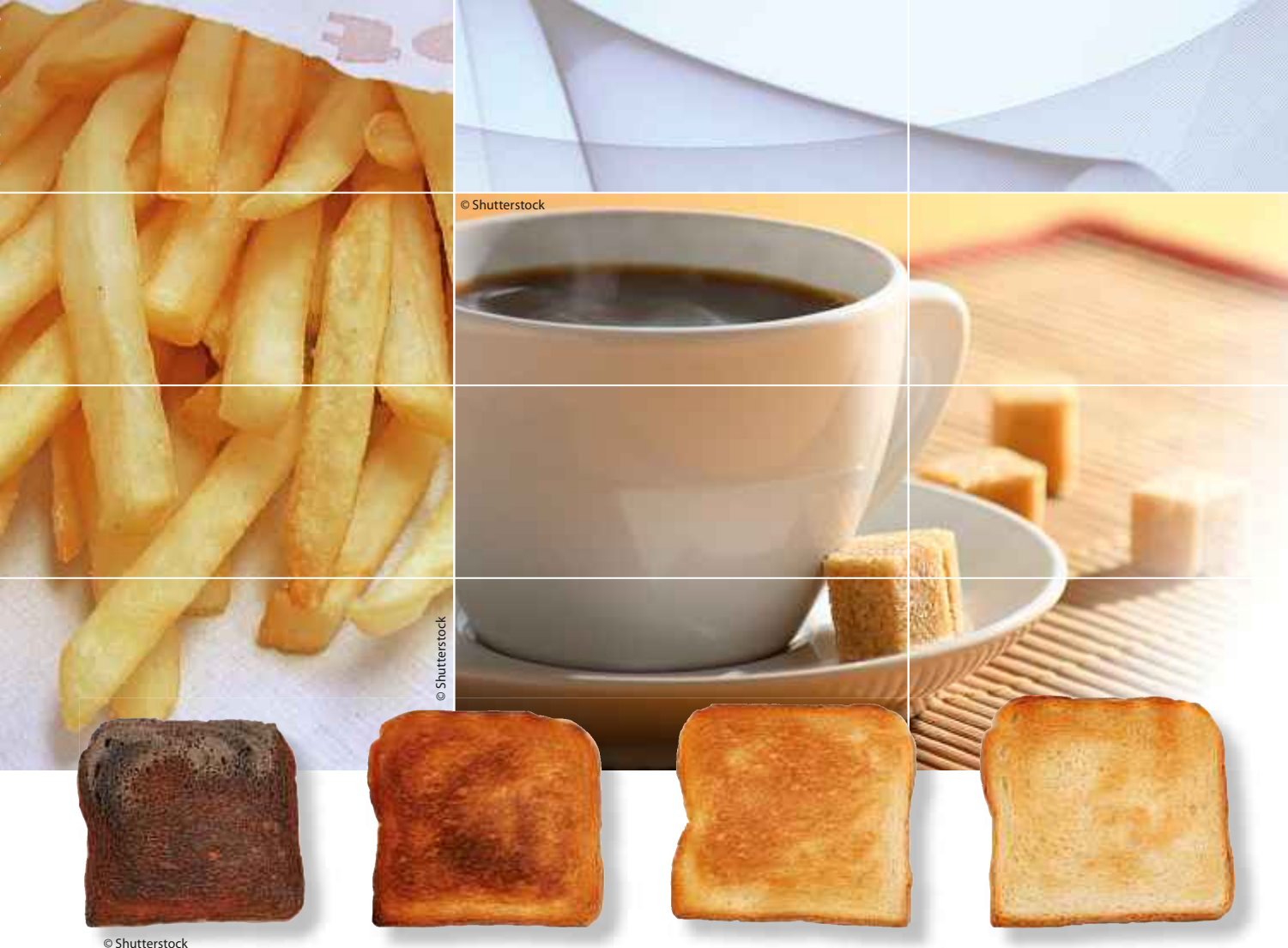
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- Tübitak-Marmara Research Center (Turkey)
- Stockholm University (Sweden)
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- Norwegian Institute of Public Health (Norway)
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How worried should we be?

Having established that it is not possible to totally eliminate acrylamide from these foods, the HEATOX team set out to investigate how dangerous the substance is. The results of tests in animals were alarming – even a low exposure to acrylamide constitutes a risk.

Very young mice exposed to low doses of acrylamide shortly after birth, during the period when the brain's growth spurt takes place, showed signs of developmental neurotoxicity. This can cause lasting neurological defects.

Another study in humans found that women with higher levels of acrylamide in the blood appeared to have a higher risk of developing breast cancer, and particularly oestrogen receptor positive breast cancer. The researchers emphasise that their study does not prove the existence of a direct link between acrylamide in food and cancer. Nevertheless, it does underline the importance of carrying out further research on the matter.

Next steps

The project partners also devoted some of their efforts to the identification of other compounds which could be formed in a similar way. It turns out that acrylamide is just the tip of the iceberg; in heated foods there are some 40 to 50 similar compounds whose chemical structure marks them out as potential carcinogens. According to scientists, more research into these compounds is urgently needed.

Tips for cooking in the home

When discussing the risks associated with acrylamide, it is important to bear in mind the fact that people have been heating starchy foods for centuries, and the food group forms an important part of a healthy diet. Most of the foods which contribute to our acrylamide intake are industrially produced, so the contribution from home cooking is relatively small but dependent on cooking practices.

As acrylamide is mainly found in carbohydrate-rich foods, eating a low-fat diet will probably reduce the intake from products such as crisps.

Furthermore, there are things we can do to minimise the production of this harmful substance in our kitchen. The main advice is to avoid overcooking foods, as most acrylamide formation happens during the last few minutes of cooking. This means aiming for a golden yellow colouring, as opposed to golden brown, when toasting bread or roasting or baking potato products in the oven.

The French Paradox in a capsule

They call it the French Paradox – the fact that the French enjoy a rich diet yet have one of the lowest rates of heart disease in Europe. The key to this phenomenon is red wine, which is rich in antioxidants – chemicals which are known to provide protection against a range of diseases, including heart disease and cancer.

Now the PARADOX ('French paradox – red wine extract food additives') project has captured the health giving properties of red wine and turned them into an alcohol free additive which can be easily added to a wide range of foods and drinks without altering their flavour.

Tests in the lab and in human volunteers have proven the effectiveness of the substance and work is now underway to include it in products such as muesli bars, bread and dairy products.

The PARADOX project brought together 16 partners, including wine producers, research laboratories and food manufacturers, from 9 EU Member States.

Getting to the heart of the mystery

The idea that wine might have medicinal properties is nothing new; Hippocrates, the father of medicine, recommended certain wines to cure fevers and disinfect wounds. More recently, in 1979, a study by British researchers noted that countries where moderate wine consumption is the norm tend to have lower than average levels of heart disease.

Red wine owes its healthy reputation to its high levels of powerful antioxidants such as polyphenols. Extensive research has revealed that a diet rich in antioxidants is good for our health.

Antioxidants play an important role in preventing disease by destroying the free radicals which damage our DNA and our cells. They promote good cardiovascular health by decreasing cholesterol and lowering blood pressure, thereby helping us to avoid blocked arteries, heart attacks, strokes and other diseases. Antioxidants have also been found to prevent a range of cancers, protect us from age-related neurodegeneration and boost our immune systems when they are weakened.

The PARADOX project partners set out to identify and isolate the antioxidants found in red wine, and transform the resulting extract into a food additive with an acceptable flavour and a long shelf life. This last point is particularly important because many existing antioxidant food additives quickly lose their effectiveness.



Title | French paradox – red wine extract food additives
Acronym | PARADOX
EC Contract number | 508649

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From waste product to valuable raw material

The raw material for the PARADOX project came in the form of grape pomace, the mass of grape skins and seeds which is left over after the grapes have been pressed for wine making. Until the PARADOX project came along, the pomace was seen as a waste product and discarded accordingly. Nevertheless, like wine, grape pomace contains high levels of antioxidants.

The project partners set about investigating how best to extract the antioxidants from the pomace to get high yields as economically as possible. Once obtained, the extract is dried, giving a powder that is a 100 per cent concentrate of polyphenols and other health giving molecules.

Analyses revealed that the extract contained several important antioxidant compounds, including tannins and a number of polyphenols such as flavonoids, which are thought to boost the immune system and protect the body from toxins produced by bacteria. Another compound found in the extract was resveratrol, which is believed to be the main ingredient which gives wine its anti-cancer properties.

Tests in the lab showed that the extract reduces oxidative stress in living cells and blocks the action of an enzyme called ET-1 which is involved in the destruction of blood vessels. The substance also has a strong inhibitory effect on prostate and breast cancer cell lines.

New technologies to protect a new product

In theory, the powder form of the extract could have been added straight to foods as it was. However, like other grape extracts which are rich in antioxidants, the pomace extract quickly loses its beneficial properties. This is because a combination of industrial processing methods and time leave the antioxidants vulnerable to oxidation.

The PARADOX team therefore developed a new microencapsulation technology to protect their precious product from oxidation, light, temperature and pressure stress. The resulting substance has a much longer shelf life than similar functional foods. The researchers called their product Paradox 41.

The microcapsules are minute – just a fraction of a millimetre across. When swallowed, they dissolve in the acidic juices of the digestive system, and their antioxidant contents are liberated. The microencapsulation process has now been patented.

Paradox 41 is designed to be added to a wide range of foods and drinks. To assess its health benefits, the partners carried out two clinical trials on volunteers who were given orange juice containing microencapsulated grape pomace extract every day for two weeks. By the end of this period, the volunteers had higher levels of antioxidant circulating in their blood.

The product therefore offers protection against the many diseases which are largely caused by oxidative stress, such as cancer and cardiovascular disease.

Paradox 41 is now commercially available; it is marketed as a product called PARADOX PLY by GAT Food Essentials, the company which coordinated the PARADOX project. Food manufacturers can add PARADOX PLY to their products to create functional foods with a clear added value for consumers.

As a result, the benefits of the French Paradox could soon be enjoyed by all Europeans, not just those with a penchant for red wine.

© Dr. Víctor Casaña-Giner

Organic food: higher quality, lower costs

Europeans will soon be able to enjoy high quality organic food that is cheaper and safer than ever before, thanks to research by the Quality Low Input Food (QLIF) project.

Food safety scares as well as environmental concerns mean that the organic food sector is booming. In 2006 the global market for organic products was valued at around EUR 25 billion, with most of the demand coming from Europe, North America and East Asia. On the supply side, some 30.4 million hectares of farmland worldwide are certified as organic, of which a quarter are in Europe. In the EU, over six million hectares of agricultural land, equivalent to around 4 per cent of the total agricultural area, are either fully organic or under conversion. The country with the highest percentage of its agricultural land in organic production is Austria, with 11 per cent.

Farming with a softer touch

The aim of organic and other 'low input' farming systems is to reduce the use of chemosynthetic mineral fertilisers, crop protection products (herbicides, pesticides and fungicides for example), veterinary medicines (such as antibiotics) and animal growth regulators and food additives.

Instead, these systems rely on a range of management techniques designed to prevent problems, such as pests, diseases or weeds, from arising. When problems are found, they are treated using methods which are less harmful to the environment than conventional farming techniques. For example, in low input systems, pests are controlled by their natural enemies, and not by pesticides.

However, the lower yields and resulting higher prices of organic and 'low input' foods prevent many consumers from buying them.

Making something good even better

The QLIF project has four aims: to improve the quality and nutritional value of organic and low input foods; to bring down their cost; to minimise food safety risks along the food chain from the farm to the fork; and to bring down the environmental impact of these farming systems still further.

The first step of the project was to find out what Europeans want and expect from organic and low input systems, and to this end the project partners carried out a pan-European survey.



Title | Improving quality and safety and reduction of costs in the European organic and low input supply chain

Acronym | QUALITY LOW INPUT FOOD

EC Contract number | 506358

Website | www.qlif.org

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- Northumbria University (UK)
- Institute of Vegetables and Ornamental Crops (Germany)
- CCS Aosta (Italy)



This revealed similar priorities right across Europe, with the absence of microbial pathogens, chemical residues such as pesticides and genetically modified organisms (GMOs) coming top of the list. Consumers also expressed a desire for tastier foods containing higher levels of key nutrients such as minerals, vitamins and antioxidants. These findings were used to focus the project's research goals.

Organic vs Conventional – which is healthier?

An important part of the project entailed comparing the nutritional value of organic foods against their conventionally produced counterparts. The results showed that for fruit and vegetables, the organic foods were found to have up to 40% more antioxidants, while organic milk contained up to 60% more antioxidants and healthy fatty acids.

From the lab to the field

To do their research, the QLIF team took to the fields, where they grew a range of crops (tomato, lettuce, onion, potato, carrot, cabbage, apples and wheat) using different organic and low input techniques to find out what would give the best crop in terms of quality, safety and price. They also reared animals to investigate the low input production of pork, dairy and poultry products.

In the crop strand of the project, the team identified the most effective low input management techniques, such as novel seed treatments, disease-suppressive composts and crop rotations, in which the same field is planted with different crops in different years. This technique avoids the accumulation of crop specific pests and diseases in agricultural ecosystems. They also selected the crop varieties and strategies which enabled farmers to reduce chemical inputs while delivering on the taste and nutritional desires of consumers and boosting overall crop yield.

Meanwhile the goal of the dairy strand of the project was to investigate feeding regimes and health management practices that would optimise animal health and welfare while reducing mastitis incidence and associated antibiotic use. The project partners also identified the diets most likely to boost the production of milk, which is higher in fatty acids and antioxidants and can therefore be said to have 'enhanced nutritional quality'.

A major challenge in poultry and pig management is animal health, and the project partners invested considerable effort into investigating the use of alternative treatments, such as herbal medicines to control gastrointestinal pathogens and parasites.

The consumer survey also revealed that food safety is a high priority, and so detailed risk assessments were carried out on the transfer of enteric pathogens, mycotoxins and heavy metal contamination in organic and low input systems.

The studies revealed that there is no significant difference in food safety risks between low and high input systems, and in some cases, the risks were actually lower in organic and 'low input' systems.

For example, the risk of pigs shedding Salmonella in their faeces was shown to be lower in organic and conventional free-range production systems, while the heavy metal content in several crops fertilised with manure compost was lower than that of crops treated with mineral fertilisers.

Spreading the word

The project's findings are being translated into a series of manuals designed to help farmers apply the techniques studied in their own fields. According to Professor Leifert, coordinator of QLIF, the knowledge generated during the project, together with findings from other, related projects, could be used to create a European strategy on food production. This could be applied to boost public health by improving food composition and nutrition and, importantly, boost consumer confidence in foods produced in Europe.

SEAFOOD is **catch of the day**, confirm scientists

Seafood is so often the source of conflicting advice: eat it and you will live a long and healthy life. At the same time it is a common cause of food poisoning. Whatever the risks and benefits, seafood makes a regular appearance on dinner plates the world over. In 2002 (latest figures), average consumption per person in developed countries was 16.2 kg for the year. Finding out more about the health benefits of this food, as well as the risks, is clearly of great consequence.

The SEAFOODplus project is an advocate of eating more fish. Research by the mammoth 68-partner project, with teams from 14 EU Member States, plus Norway, Iceland and Canada, has backed up commonly held beliefs on the health benefits of eating seafood and this information is being used to encourage fish consumption. Findings on consumer attitudes to fish and seafood are facilitating this process, while results on production methods are improving the quality of fish and seafood.

The partners worked in fish farms, laboratories, processing facilities and hospitals and had significant breakthroughs. Results include the discovery of a previously unknown micro-organism that causes histamine poisoning, and new knowledge on how to avoid this illness in the future. The SEAFOODplus team has also carried out new analyses of

epidemiological data, finding new evidence of positive effects on post-natal depression.

The key to a long and healthy life?

A 200g portion of fish meets around half of an adult's daily protein requirements. Sea fish is a source of iodine, fatty fish species contain high levels of vitamin A and D, lean fish are rich in B vitamins and fish oil is rich in eicosapentaenoic acid (EPA), essential for cell growth and regeneration.

One of the project's breakthroughs was new ways of getting selenium into the human diet. Selenium has an antioxidative effect in the body - evidence suggests that it protects against cancer. Europeans typically



Title | Health promoting, safe seafood of high eating quality in a consumer driven fork-to-farm concept
Acronym | SEAFOODPLUS
EC Contract number | 506359
Website | www.seafoodplus.org

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- TNO Nutrition and Food Research (The Netherlands)
- AquaNet (Canada)
- Coopérative de Traitement des Produits de la Pêche (France)
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- Universidade da Coruña (Spain)
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- Teagasc – Agriculture and Food Development Authority (Ireland)

- Statens Serum Institut (Denmark)
- Double Delta Kereskedelmi Termelő Es Kutatásfejlesztési Betéti Társaság Ltd (Hungary)
- Université de La Rochelle (France)
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- Rijksinstituut voor Volksgezondheid en Milieu (RIVM) (The Netherlands)
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- Institute of Ichthyobiology and Aquaculture of the Polish Academy of Sciences (Poland)
- Zeeland Vis BV – Fish Farm Yerseke BV (The Netherlands)
- Royal Greenland Seafood AS (Denmark)
- EUROFISH International Organisation (Denmark)
- Fjord Seafood ASA (Norway)
- Trace Tracker Marine AS (Norway)
- Albacora SA (Spain)
- GEASA/Gestión Empresarial Alavesa SA (Spain)
- EWOS Innovation (Norway)
- Fish Farm Tomasz Król (Poland)
- NIFA – Fiskeriforskning (Norway)
- Consejo Superior de Investigaciones Científicas (Spain)
- Universitetet i Tromsø (Norway)
- Université de Bretagne Sud (France)



have an inadequate intake, and fish is an important source. The amount of selenium contained in a portion of fish can be raised if garlic grown in soil – particularly rich in selenium – is mixed with fish feed for a few days before the fish are killed. Selenium is then present in the fish flesh and enters the diet as a natural functional food.

Taurine is another substance present in fish which is beneficial to human health. It facilitates the passage of vitamins and minerals into the bloodstream and stimulates the burning of fats. But as the SEAFOODplus team illustrated, much of this is lost if the fish is deep-fried, microwaved or steamed. Cooking the fish in foil or grilling were found to have the highest taurine retention rates. This will influence advice given by nutritionists. The team also found two ways in which to enrich fish with taurine. The first involves injecting taurine, while the second sees pieces of fish soaked in a solution and rotated in a cylindrical container. No side-effects have been found, and tasters were unable to identify which samples had the added taurine.

The team also found benefits for weight control of a fish-rich diet. Volunteers from three countries took part in a trial. Those taking a fish oil capsule once per day lost 7kg over eight weeks. Not only did the volunteers lose weight, they also reduced the amount of fat in their blood and improved glucose and insulin levels. Cholesterol levels also dropped considerably, and most significantly in those fed three portions of lean fish per week.

One person's fish is another person's poison

The above are all good reasons to increase consumption of fish and seafood. But if the project partners were to win over consumers, they would have to take a closer look at the illnesses sometimes occurring after eating fish and other seafood.

Here too the SEAFOODplus team has made huge advances, the results of which could lead to a real reduction in the most frequently occurring incidences of food poisoning. One such breakthrough has been the discovery of a new micro-organism that causes histamine poisoning, even when seafood is stored at low temperatures. The micro-organism seems to have been overlooked by previous studies. The project team established its life conditions and is now able to advise processors on how to handle seafood so as to avoid future incidences if histamine poisoning.

The team developed new detection methods for two of the viruses most frequently occurring in bivalve molluscs, as well as novel technology to avoid contamination by predicting where the viruses may show up. A real-time polymerase chain reaction (RT-PCR) was used to detect the presence of Norovirus or Hepatitis A. This enables industry to give guarantees to consumers on the safety of their seafood products.

Changing consumer perceptions

In an ideal world, these substantial findings on health benefits, as well as new techniques for drastically reducing the risk of food poisoning, would be enough to convince consumers of the benefits of a seafood-rich diet.

Before attempting to influence consumer behaviour, the SEAFOODplus team had to first find out what it was up against. Surveys confirmed that the vast majority of the general public is aware that eating fish offers health benefits. But many are apparently put off by bones, the flavour or the smell of fish. The team therefore came up with ways of enhancing fish products so that they contain more of that which makes them so attractive nutrition-wise, but fewer of the characteristics that put off consumers.

Questionnaires on the ethics of fish farming were also used to investigate consumer behaviour. Shoppers confirmed that they were pleased to see labels on how the fish had been farmed, favouring a stress-free environment.

Other breakthroughs include a new molecular biology-based technique that facilitates the rapid identification of fish species, and further, novel mild processing methods for smoking, dehydrating and sterilising fish have been studied applying the so-called hurdle technology. The new methods have cost, taste and health benefits for the consumer, and are more efficient for industry.

The results will affect society and industry alike: awareness of the health benefits is increasing demand while improving consumers' health. Industry meanwhile has been gifted with novel, sustainable and efficient methods for satisfying this demand.

Happier animals for happier consumers

Surveys show that Europeans are becoming more and more concerned about the welfare of the animals that end up on our plates. Furthermore, people are increasingly aware that raising farm animals in good conditions contributes to the quality of food products.

Now the WELFARE QUALITY project is responding to consumers' wishes by developing tools to assess the animal welfare status of a range of farmed animals and make this information available to consumers.

It brings together 44 partners from 17 countries, including 13 EU Member States. The partners include scientists specialising in animal science and behaviour, sociology and philosophy as well as experts from the fields of farming and genetics.

The project has already shed new light on consumer attitudes to animal welfare and is developing detailed strategies to improve farm animals' quality of life. It also aims to develop easily understandable product information systems, so that consumers interested in the welfare of farm animals can make an informed choice about what they buy.

The researchers do not restrict their activities to the farm; for example they are investigating animal welfare issues at slaughterhouses. They are also working closely with stakeholders from all stages of the food chain, including farmers, processors, retailers, the food service sector, academia, government authorities and non-governmental organisations (NGOs).

Furthermore, the participation of project partners from countries as diverse as Brazil, Mexico, Chile and Uruguay will ensure that European farm animals will not be the only ones to benefit from the project.

To advance the aims of the project, the European Animal Welfare Platform was established. This brings together a wide range of stakeholders in the food industry and is committed to improving farm animal welfare and supporting the implementation of the WELFARE QUALITY findings.



Title | Integration of animal welfare in the food quality chain: from public concern to improved welfare and transparent quality

Acronym | WELFARE QUALITY

EC Contract number | 506508

Website | www.welfarequality.net

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- Université Pierre et Marie Curie (France)
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- Wageningen University (The Netherlands)



A new tool for assessing animal welfare

The project's overarching goal was to create practical, standardised methods for assessing farm animal welfare on the farm and elsewhere, for example at slaughter. Biologists and social scientists agreed on a common approach based on four key principles: good feeding (no hunger, no thirst); good housing (comfort, temperature, ease of movement); good health (absence of injuries and disease as well as absence of pain from animal management procedures); and appropriate behaviour (expression of social and other behaviours, good human-animal relationships, absence of fear).

To address each of these principles, animal based measures have been designed specifically for different species and categories of animal: for sows and piglets, fattening pigs, dairy cows, beef cattle, dairy heifers and calves, veal calves, laying hens, broiler chickens and buffalo.

The assessment measures have already been checked for validity, reliability and practicality, and are being tested in real life situations on 600 farms and at 60 slaughterhouses across Europe.

The tools are designed so that the outcomes can be used by a wide range of people. Product chains can use the system to inform consumers. Farmers and processors can use them as a self-assessment tool to identify potential welfare risks and problems. Researchers can also use them to compare the welfare of animals living in different conditions.

Improving quality of life for Europe's farm animals

The partners are also looking at practical ways of improving the lives of Europe's farm animals. For example, up to 30 % of chickens reared for meat production suffer from joint and bone problems brought on by their fast rate of growth when they are very young. WELFARE QUALITY developed a special dietary regime under which birds grow more slowly during the first few weeks of life then develop faster once their bones have developed. This reduced lameness while bringing the birds up to standard slaughter weight in the same number of feeding days.

What do consumers want?

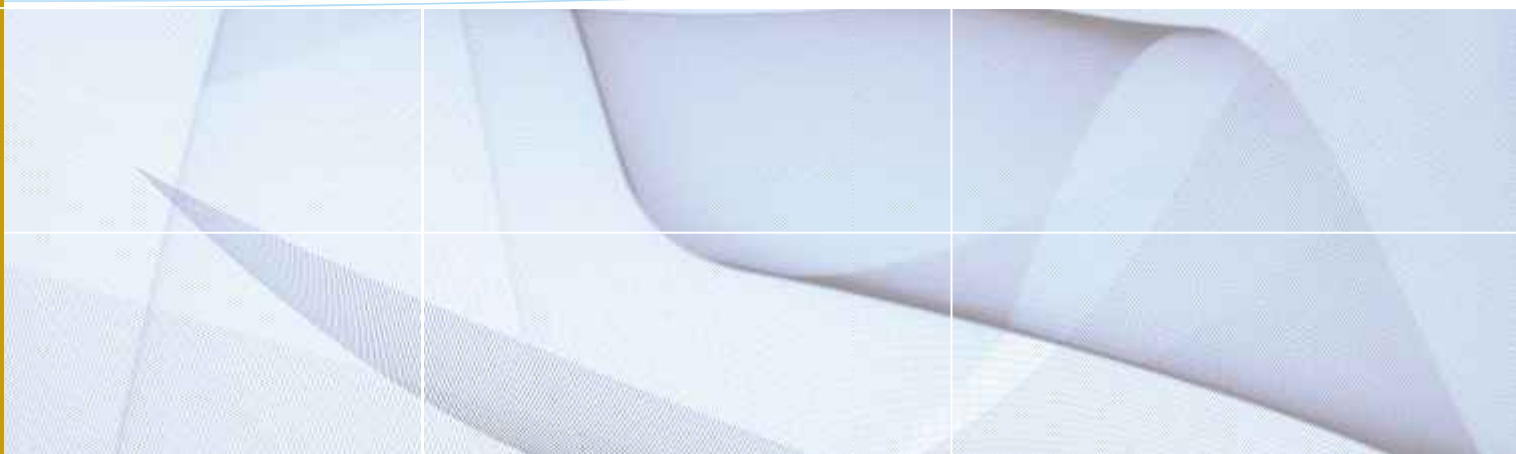
Another strand of the project is investigating consumers' opinions on and knowledge of animal welfare, as well as how these influence their buying habits. The researchers carried out surveys in France, Hungary, Italy, The Netherlands, Norway, Sweden and the UK. While the results varied from one country to another, a clear majority claimed that animal welfare issues were either important or very important to them.

However, this does not always influence their shopping behaviour. While over 80 % of Hungarian respondents considered animal welfare to be important, only a third of them actually thought of it when buying beef. Other respondents claimed that they simply found it too time consuming to find 'animal friendly' products.

Most of those interviewed felt that labelling was a useful source of information on the animal welfare aspects of food products, but many seemed unwilling to find out about the conditions in which the animals were reared. Others felt that responsibility for animal welfare lay with farmers and government rather than consumers.

These findings provide useful insights into consumer opinion and contribute to the development of the project's product information system. This system could use stars or colours to help purchasers easily identify animal friendly products.

Pressure from concerned consumers has already led to dramatic improvements in the living conditions of Europe's farm animals. Thanks to WELFARE QUALITY, farm animals both in Europe and the rest of the world can look forward to the prospect of further improvements in their welfare. Improved welfare brings clear benefits not only for the animals, but also for farmers and consumers.





SUCCESS STORIES **ENERGY**

Industrial emissions... but **without the CO₂**

There is a general consensus the world over that carbon dioxide (CO₂) emissions must be cut if we are to slow down climate change. The best way in which to do this is still under discussion by politicians and scientists alike, but one technical and immediate option that is increasing its profile is 'carbon capture and storage'.

The raised profile of this potential solution is due in part to the outstanding results of the CASTOR project, which include the world's largest carbon capture pilot facility. Among the achievements of this first-of-a-kind plant, located in Denmark, was a demonstration of the possibility of capturing 90% of the CO₂ that would normally be released into the atmosphere from a coal-fired plant.

Generally, the amount of CO₂ taken out of the atmosphere by plants and other natural carbon sinks such as oceans is roughly equivalent to the amount put into the atmosphere by respiration and decay. But this delicate balance is upset when additional CO₂ makes its way into the atmosphere due to human activities such as emissions. One of the conclusions of the European Research Project for Ice Coring in Antarctica (EPICA) was that the global atmospheric concentration of CO₂ has increased by 30% since the industrial revolution.

Making fossil fuels clean

While much of the attention has been focused on using alternatives to fossil fuels, carbon capture and storage involves trapping CO₂ as it is emitted and preventing it from entering the atmosphere. But it is not as simple as channelling the flue gas into a container and closing the lid. As it is not feasible to compress all of the gases, which may include oxygen, water vapour or nitrogen, the various components of the flue gas must be separated.

There are a number of industrial capture processes on the market already. Each has been developed for an individual field of application, adapted according to the nature of the flue gas composition, temperature and pressure. CASTOR uses post-combustion capture.

New records for carbon capture

For post-combustion capture, absorption technology is a leading option. However, integrating it into an existing power station will decrease the efficiency of generation by 15% to 20% and increase the costs of producing power by up to 50%. The CASTOR project, bringing together 30 partners from 10 EU Member States plus Norway, set about removing these deterrents to make post-combustion capture more appealing. The aim was to cut post-combustion capture costs from EUR 50 or EUR 60 per tonne of CO₂ to EUR 20 or EUR 30 without harming efficiency. In terms of volume, the ambition was to develop technologies that enable the capture and storage of 10% of all CO₂ emissions, which corresponds to around 30% of the CO₂ emitted by Europe's power and industrial plants.

The project succeeded in this. The pilot demonstration set up at a coal-fired power plant in Denmark as part of CASTOR was the first of its kind and remains the largest in the world. So successful was the facility that successive projects have reproduced parts of it when conducting separate studies on CO₂ capture. A glance at the pilot's results explains why: the team was able to demonstrate that a CO₂ recovery rate of 90% was feasible. The demonstrator is able to capture an impressive one tonne of CO₂ every hour for an estimated cost of Eur 35 per tonne of CO₂.



Title | CO₂, from Capture to Storage
Acronym | CASTOR
EC Contract number | 502586
Website | <https://www.co2castor.com>

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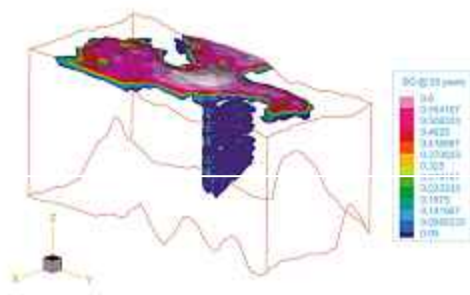
Partners

- IFP (France)
- StatoilHydro (Norway)
- TNO (The Netherlands)
- SINTEF (Norway)
- SINTEF Energy Research (Norway)
- SINTEF Petroleum Research (Norway)
- Norwegian University of Science and Technology (Norway)
- British Geological Survey (UK)
- BGR (Germany)
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- GEUS (Denmark)
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- Vattenfall AB (Sweden)
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- REPSOL (Spain)
- RWE Power (Germany)
- Public Power Corporation (Greece)
- EON UK (UK)
- ALSTOM Power (France)
- OGS (Italy)
- Doosan Babcock (UK)
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- BASF (Germany)
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- Twente University (The Netherlands)
- Vattenfall R&D (Sweden)



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Modelling of CO₂ migration in a geological structure using the IFP-developed Coores software



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Not all of the issues surrounding carbon capture have been solved. But the unique CASTOR facility means that current and future ideas can be taken from laboratory scale to pilot scale either by current CASTOR partners or other researchers. CASTOR's system relies on the amine washing process. This involves dissolving the CO₂ in a solvent and then recovering the liquid solvent with the CO₂ and other flue gases locked into it. The CO₂ is then extracted by heating.

These results should not be underestimated. 'When we launched the idea, CO₂ capture was a kind of dream rather than real technology that could be implemented,' says project coordinator Pierre Le Thiez. 'CO₂ capture was a concept. Now the technology is very much a reality, not just in Europe but worldwide.'

Once the CO₂ has been captured, it must of course be stored. Here the project team was looking for advances in terms of capacity, security and environmental acceptability. The results of geological model-building, reservoir simulation model-building, seismic simulation model-building and experiments on samples all provide clues as to the optimum storage facility for the future. The team also increased understanding of how to prevent CO₂ leaking through wells, rock and faults. The challenge now is to demonstrate this to the general public and gain acceptance of storage technology. Perceptions of CO₂ as a dangerous gas mean that resistance is currently quite deep seated.

The huge leaps in knowledge and technology made possible through CASTOR were no doubt in part due to the involvement of so many different stakeholders. The project brings together representatives from the oil and gas industries, power companies (CO₂ emitters), technology equipment suppliers and European research centres and universities.

Good for business as well as the environment

Each of these sectors is set to benefit if carbon capture and storage takes off. While industry is under pressure from local regulations and environmental groups to cut CO₂ emissions, it has added pressure from EU targets and international commitments. Under the EU Emissions Trading Scheme, strict limits have been set on CO₂ emissions from iron and steel plants and the glass, cement and brick sectors. As of 2008, plants must pay a fine of EUR 100 per excess tonne of CO₂ emitted. Cutting emissions will therefore boost competitiveness by lowering costs.

More research is needed before carbon capture and storage can become a permanent part of Europe's energy portfolio. But as governments and industry race to meet EU and international emissions commitments, the results of CASTOR suggest that the concept is a real contender at the starting line.

Cleaner coal power

Developing components for the next generation of coal-fired power stations is the aim of the COMTES700 ('Component test facility for a 700°C power plant') project. The technologies developed by the project will result in much more efficient power stations than those in use today. As a result, greenhouse gas emissions from coal-fired power stations could be reduced by up to a third.

In this way, the project is making an important contribution to the EU's efforts to reduce its greenhouse gas emissions and meet its international climate change targets, as agreed under the Kyoto Protocol.

A test facility developed by the project has been in operation in Gelsenkirchen in Germany since 2005, and the project results are already arousing the interest of the power industry, both in Europe and elsewhere. One of the project partners has already announced its intentions to take the concept further and construct a demonstration power plant.

The six project partners who are carrying out the research come from Germany and Denmark and include power plant operators and energy suppliers. The project is steered by the COMTES700 Partners Consortium, which is made up of a further 11 major European power generators from 6 EU Member States.

Coal – a crucial component of our energy mix

Like other sources of energy based on fossil fuels, coal-fired electricity generation is causing greenhouse gas emissions that must be reduced to avoid climate change.

Nevertheless, studies by the International Energy Agency and the EU's 'World Energy, Technology and climate policy Outlook 2030' (WETO) report suggest that fossil fuels such as coal will have an important role to play in meeting our energy needs for some decades to come, because energy demand is predicted to rise over the next few decades.

In addition to this, many existing power stations are nearing the end of their lives and will soon need replacing. Together, these facts mean that new coal-fired power stations will soon need to be built.



Title | Component Test Facility
for a 700 °C Power Plant
installed in Scholven Power Plant
Acronym | COMTES700
EC Contract number | RFC-CP-04003
Website | www.comtes700.org/

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- E.ON Kraftwerke GmbH (Germany)
- Electrabel NV (Belgium)
- Electricité de France (France)
- EnBW Kraftwerke AG (Germany)
- ENEL Produzione S.p.A. (Italy)
- Hitachi Power Europe GmbH* (Germany)
- Public Power Corporation SA (Greece)
- RWE Power AG (Germany)
- Siemens AG* (Germany)
- Vattenfall A/S – Nordic Generation (Denmark)
- Vattenfall Europe Generation AG & Co KG (Germany)
- Research Fund for Coal and Steel (Belgium)



The challenge is to find ways of making these plants as clean and efficient as possible, and this is where the COMTES700 project comes in. The aim of the project is to design, develop and operate a component test facility which will demonstrate how new, advanced materials and components perform in the next generation of coal-fired power stations.

Turning up the heat

The project partners aim to improve the efficiency of coal-fired power plants by ramping up the temperature and pressure of the steam that drives the turbines. Currently, the best commercially operating plants in Europe, which have an efficiency of 43 % to 45 %, run at temperatures of up to 600°C and pressure of up to 280 bar. In the power station of the future, the temperature will rise to over 700°C and the pressure will reach 350 bar.

As a result, the efficiency of the plant could exceed 50 %. In contrast, the average efficiency of plants in the EU is just 36 %. In other words, the new plants would reduce CO₂ (carbon dioxide) emissions by a third, while also saving precious fuel. More efficient power plants are also urgently needed in Asia; according to the WETO report, energy demand is predicted to rise sharply there between now and 2030, and much of this need will be met by coal.

The project's test facility is scheduled to operate for 20 000 hours during the project. This gives the project team ample opportunity to identify major problems, gather information on the technical requirements of the technology, determine the specifications for the components and work out the optimum operating conditions.

One of the biggest challenges facing the COMTES700 team was to produce components which could withstand the heat and pressure of the new system. This entailed using nickel-based alloys, which are much harder than the steel used in conventional power stations. Furthermore, the hardness of the materials means that it takes five to six times longer to manufacture the components.

Getting the best out of carbon capture technologies

By improving the energy efficiency of the coal-fired power plant, the COMTES700 concepts opens up the prospect of using carbon capture and storage technologies, thereby reducing greenhouse gas emissions still further.

When carbon capture technologies are added to a power plant process, it affects the plant's efficiency. Therefore, from a strategic point of view, it is better to attach carbon capture technologies to more efficient plants.

By taking coal-fired power stations over the 50 % efficiency threshold, COMTES700 is contributing to the feasibility of the use of carbon capture and storage technologies.

Today Europe, tomorrow the world!

The COMTES700 project has taken the 700°C technology a big step forward by developing components that can withstand the intense heat and pressure in the next generation of power plants.

Within Europe, the COMTES700 project partners are working on a prototype power plant based on the 700°C technology and integrating the components developed by the project. This is being built in the German coastal town of Wilhelmshaven, where supplies of coal can be easily delivered by ship and where cooling water is readily available. Building work is scheduled to start in 2010, and the plant should become operational in 2014, with a capacity of 500 megawatts.

The project's results have also aroused the interest of the power industry elsewhere in the world, notably in Japan and the USA, further underlining Europe's status as a leader in this important field.

Waste not, want not!

Convert CO₂ back into fuel

With the levels of carbon dioxide (CO₂) in the atmosphere increasing inexorably, scientists are urgently looking for ways to reduce emissions. At the same time, rising energy prices are escalating the need to find alternative fuel sources.

But what if we could kill two birds with one stone by capturing the CO₂ and converting some of it back into fuel? The EU-funded ELCAT (Electrocatalytic Gas-Phase Conversion of CO₂ in Confined Catalysts) project has proven the feasibility of a technique which could do exactly that. Although the technology is still in the early phases of development, the project partners hope it will be ready for application in around 10 years, when it could help to cut global CO₂ emissions by 5%. This would give a significant boost to EU targets to cut CO₂ emissions by 20% by 2020.

Meanwhile, ELCAT is already attracting interest from around the world, and the technology it is using is one of just 10 technologies to have been nominated for the USD 25 million (EUR 15.7 million) Virgin Earth Challenge award. Set up by former US Vice President Al Gore and British entrepreneur Richard Branson, the prize will go to the first scientists to come up with 'a commercially viable design which results in the removal of anthropogenic, atmospheric greenhouse gases so as to contribute materially to the stability of Earth's climate'.

An idea is born

The project evolved from an idea to an EU-funded consortium through a virtual laboratory created seven years ago by French, German and Italian scientists to generate ideas and hold discussions. During one of the sessions, ideas were swapped on how CO₂ can be addressed in an unconventional way, and from this grew the idea for ELCAT.

Scientists from the University of Messina in Italy, who were involved in the virtual laboratory, observed an electrocatalytic reaction, in which a catalyst was used to convert carbon dioxide into hydrocarbons and alcohols at room temperature and atmospheric pressure.

The products of the reaction were similar to those produced by the so-called Fischer-Tropsch (FT) process, in which carbon monoxide (CO) is converted into hydrocarbons and water. The FT process is widely viewed as a potential source of fuels and raw materials, and some countries are already using it to produce substitutes for diesel. However, it is not without drawbacks: it requires high temperatures and pressures to work, and it is difficult to control which hydrocarbons are released and in what proportions.

The scientists at the University of Messina immediately saw the potential of a process which could reproduce the results of the FT process at lower temperatures and pressures. The new reaction also had the advantage of using a major pollutant, carbon dioxide, as its raw material. The CO₂ could be extracted from exhaust or emission gases using the technologies developed for carbon capture and storage initiatives*.

However, the reaction originally observed by the Messina scientists did not work perfectly: the catalyst was quickly deactivated and the productivity of the reaction was relatively poor – it only converted about 1% of the CO₂. Another difficulty was the fact that most work on electrocatalysis had focused on liquid-phase electrocatalysis, and the new process involved gas-phase electrocatalysis.



Title | Electrocatalytic Gas-Phase Conversion of CO₂ in Confined Catalysts

Acronym | ELCAT

EC Contract number | 2400

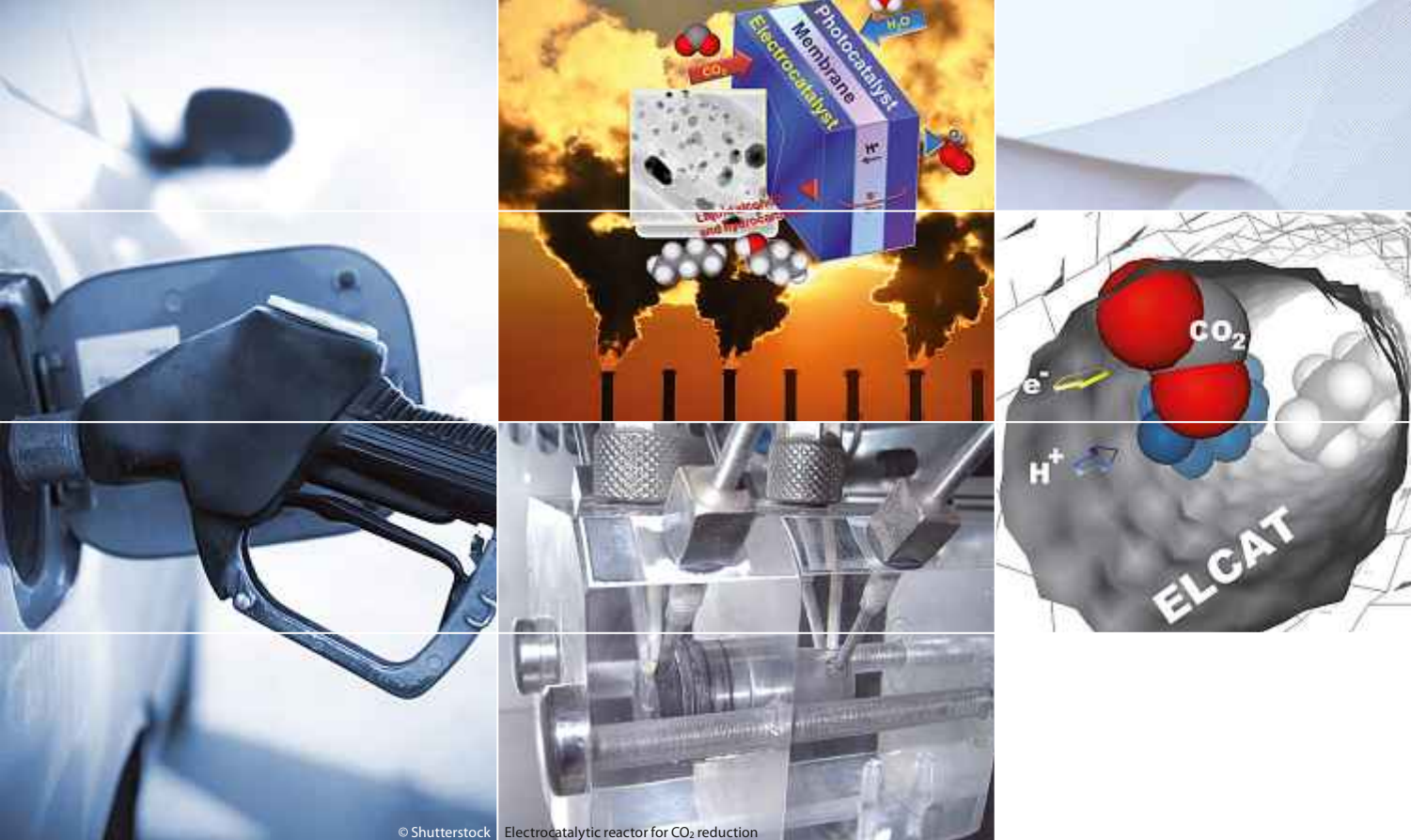
Website | www.elcat.org

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Electrocatalytic reactor for CO₂ reduction

The challenge for the ELCAT team was to overcome these hurdles and demonstrate that the process is a feasible option for recycling carbon dioxide from burning fossil fuels and turning it back into fuel, using apparatus that could be integrated into conventional technologies for carbon capture.

Proving the concept

The project's main achievement was to prove that it is indeed possible to work in the gas phase and use nanoconfined electrocatalysts to form long chain hydrocarbons and alcohols at room temperature and atmospheric pressure.

Meanwhile, the part of the process studied by the ELCAT project involved trapping the carbon dioxide inside the pores of a carbon nanomembrane along with a catalyst in the form of nanoclusters of noble metals such as platinum. The system diffuses the hydrogen ions from the first stage of the process through a membrane where they combine with the CO₂ to form hydrocarbons. The scientists found that by increasing the temperature they could improve productivity by one to two orders of magnitude.

The researchers emphasise that the technology is still very much in its early stages, but even so, the research has already resulted in advances in other fields. For example, the partners' nanostructured electrodes could improve the performance of fuel cells, and one of the project partners developed a better system for lithium batteries. Furthermore, the project also has applications in fields as diverse as the production of nanoconfined carbon-based matter and the use of nanocarbon materials for energy storage.

From 'carbon capture and storage' to 'carbon capture and re-use'

The project's results will also be of great interest to industries, which until now have seen carbon dioxide as a negative cost. Thanks to the new technologies developed by ELCAT, they may now start to look at it as a raw material which can be converted into other, more useful chemicals or fuels.

The scientists even speculate that their technology could prove useful for an eventual trip to Mars. Currently, a major challenge facing those considering such a journey is the question of how to produce, on the red planet, the fuel for the return trip to Earth. CO₂ makes up a large part of Mars' atmosphere and there is also water and sunlight. With the new technology, astronauts would be able to generate fuel onsite. Several studies have already been financed by NASA to search for solutions, including one to research the possibility of using an apparatus to produce carbon monoxide and water on Mars, followed by water electrolysis to produce oxygen and hydrogen.

**Another EU-funded project, CASTOR (pages 18-19), covers this subject.*

How can we **protect** the environment from radiation?

Those whose job involves protecting the environment from the damaging effects of ionising radiation now have a new tool at their disposal, thanks to the work of the ERICA (Environmental Risk from Ionising Contaminants: Assessment and Management) project.

The initiative brought together 15 partners, including universities, industry and research institutes, from 6 EU Member States plus Norway. Together they developed a procedure, called the ERICA Integrated Approach, which allows users to carry out a detailed assessment of the potential impacts of radiation on the environment in a given situation. The accompanying ERICA Tool guides users through the process, helping them to perform the assessment, evaluate the results and take decisions.

By using a tiered approach, the methodology can be used both in everyday situations by inexperienced users, as well as in complex situations requiring expert judgement.

Studies have shown the ERICA Integrated Approach to be effective in the field, and it is already used in risk assessments worldwide.

Ionising radiation

Background levels of ionising radiation are found naturally in our environment, for example in soil, water, air and living organisms. Man is also capable of creating radioactive matter, for example during the splitting of atoms in a nuclear reactor. In medicine, radiation is routinely used for both diagnostic purposes and in radiation therapy.

Research has shown that exposure can be dangerous for human health, leading to DNA damage that may eventually cause cancer and to some extent can be passed on from generation to generation. Plants and animals also suffer when exposed to ionising radiation, as many studies have shown, in laboratories, in the field and in the aftermath of accidents.

Towards an integrated assessment tool

A previous EU-funded project called FASSET ('Framework for Assessment of Environmental Impact'), which ran from 2000 to 2003, laid the foundations for an assessment framework for evaluating the environmental impacts of ionising radiation.

ERICA built on this work, and developed the 'ERICA Integrated Approach'. This is a methodology which guides users through the assessment process, while ensuring appropriate weight is given to the environmental exposure, effects and risks from ionising radiation with an emphasis on maintaining the structure and function of ecosystems. It integrates information on environmental management, risk characterisation and impact assessment.

Although it is designed primarily for use in planned exposure situations such as the disposal of radioactive waste, or existing exposure situations such as dealing with natural background radiation or exposure after an accident, it can also be used for emergency exposure situations.



Title | Environmental Risk from Ionising Contaminants: Assessment and Management
Acronym | ERICA
EC Contract number | 508847
Website | www.ERICA-project.org
www.ceh.ac.uk/PROTECT

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- Westlakes Scientific Consulting Ltd (UK)
- Svensk Kärnbränslehantering AB (Sweden)



Users are guided through the process by the ERICA Tool software, which also keeps records, calculates dose rates and interacts with other databases to provide information on issues such as radioactivity concentrations in the environment and the effects of radiation on different plants and animals.

The procedure was refined with the help of the ERICA End-Users Group. This was made up of national nuclear safety agencies, environmental protection agencies and organisations, environment ministries, researchers and non-governmental organisations, among others.

An easy to use tool

The first stage of the methodology is problem formulation. Here the user is required to identify possible causes or radiation exposure, the type of radiation and the ecosystems likely to be affected, for example.

At the assessment stage, data such as radioactivity levels in the environment (water, soil or air) are analysed and dose rates for the organisms living there are calculated. On the basis of this information, the risk of exposure to wildlife at the site in question can be evaluated.

Finally, the tool helps users evaluate the results of their assessment and take appropriate decisions. These could include selecting a different site for a planned facility, or imposing additional controls in cases of existing exposure.

Tried and tested

The methodology was tested at five different sites around Europe. The Drigg Coastal Sand Dunes in the UK, the Irish Sea and the River Loire in France are all contaminated with low levels of radiation by discharges from regulated nuclear facilities. The Komi Republic in Russia has high levels of natural radiation, while the Chernobyl exclusion zone in Ukraine is a highly contaminated site. Feedback from the users was positive and the case studies proved useful for fine-tuning the methodology and software.

The ERICA Tool is freely available online and it is already being used in assessments in different countries. The project partners have agreed to continue to maintain the ERICA Tool beyond the end of the project, and issue updates when new data and functions become available.

The ripple effect

The ERICA project has significantly boosted the ability of a wide range of users to assess the exposure of the environment to ionising radiation and respond accordingly.

The success of the project is underlined by the fact that its outputs have been taken up by more than a hundred registered users and key international initiatives in the field, among them the International Commission on Radiological Protection (ICRP), which issues widely recognised recommendations on radiological protection of both human health and the environment.

The future is bright: harnessing energy of the Sun and the stars

From around 150 million kilometres away, the Sun does a very good job of heating planet Earth. How convenient it would be if we could harness the energy that the Sun so clearly has, and use it to power our homes and factories here on Earth. This is exactly what the ITER team is seeking to do with the most ambitious international energy project ever, on Earth. The results could change the world's energy landscape for good, and for the better.

ITER, meaning 'the way' in Latin, has broken new ground in bringing together research teams to form the largest ever international research project. It unites seven international partners and has funding of EUR 10 billion. The EU has been an enthusiastic partner from the start, having been a leader in fusion research historically. It is joined by China, India, Japan, Russia, South Korea and the United States, meaning that over half of the world's population is represented in this pursuit of fusion energy. This scale of collaboration is comparable only with the International Space Station, and makes ITER a shining example of European research success.

The partners are building a reactor to test the feasibility of fusion power: the energy source of the Sun and the stars. The pioneering reactor is being constructed under the direction of an international team in Cadarache, southern France. The organisation responsible for delivering Europe's contribution to the project is based in Barcelona.

Traditionally we have used fossil fuels to heat our homes and run factories. But supplies are dwindling and dependence on oil-producing nations is growing. A rise in energy consumption due to economic growth in developing countries and an increased use of transport in industrialised nations has exacerbated concerns about the sustainability of our energy supply. The World Energy, Technology and Climate Policy Outlook forecasts that energy consumption will double between 2003 and 2030. The pressures of our growing energy demands are reflected in record prices on the world markets.

When atoms collide

In traditional nuclear fission power generation, the nucleus of a heavy atom is split. Turning this approach on its head, ITER will fuse light atomic nuclei together, replicating what happens in the Sun and stars. To produce fusion power, light nuclei – the hydrogen isotopes deuterium and tritium – collide at high temperatures and become fused together to form a heavier nucleus. As they fuse, a small amount of mass is lost and transformed into a release of energy.



Title | ITER Project
Website | <http://www.iter.org>

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Community (Euratom)



People's Republic of China



Republic of India



Japan



Republic of Korea



Russian Federation



United States of America



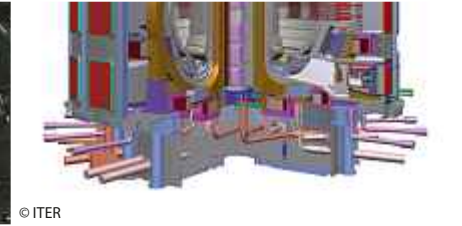
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To produce fusion, the deuterium and tritium isotopes must be heated to very high temperatures, and the resulting hydrogen plasma must be confined using powerful magnets. High-tech components to generate the strong electromagnetic fields have been designed and tested, and are now ready for demonstration in ITER.

From fossil fuels to fusion

Fusion energy is an attractive prospect. It has an almost limitless fuel supply and is environmentally friendly. Fusion releases no harmful greenhouse emissions into the atmosphere, and creates close to zero long-lived waste.

While the waste from traditional nuclear fission power stations remains radioactive for tens of thousands of years, waste from fusion will lose its radioactivity much more quickly. Only metal parts close to the fusion plasma become radioactive and this radioactivity will decay over several decades, with the possibility of re-use after around 100 years. And producing fusion energy does not involve uranium – the chemical element so often associated with the negative aspects of nuclear fission.

A single fusion power station could generate electricity for two million households, and is significantly more efficient than fossil fuels. The release of energy from a fusion reaction is 10 million times greater than that from typical chemical reactions, such as those that occur when fossil fuels are burned.

Bolder, bigger, better

Scientists have had the most success using a 'tokamak' (a Russian word to describe a doughnut-shaped magnetic chamber). The largest existing tokamak capable of operating with a deuterium-tritium fuel mix is the Joint European Torus (JET), located in the UK. JET has produced fusion power at the multi-megawatt level, but only for periods of several seconds. ITER will produce between 5 and 10 times more power than is necessary for keeping the plasma at fusion temperatures, thus proving the feasibility of fusion power. At 24 metres high and 30 metres wide, ITER will have 10 times the volume of JET.

When up and running, ITER will be capable of generating 500 million watts of fusion power continuously for up to 60 minutes. This is enough to power 1.7 million personal computers. ITER's planned successor, DEMO, will build on this, and once connected to the grid, will produce four times as much fusion power on an essentially continuous basis.

Setting the world on a path to a cleaner energy future

If scientists are to reproduce the fusion power of the Sun and stars to generate energy on Earth, they must meet a number of demanding conditions: the plasma must reach temperatures higher than those in the sun, be dense enough and be confined for long enough for the fusion reactions to be self-sustaining.

These conditions have already been achieved separately. Researchers have heated plasma to temperatures as high as 510 million degrees Celsius, which is more than 25 times hotter than the centre of the Sun.

When ITER begins operating in around 2018, scientists will be able to demonstrate that the necessary conditions can indeed be achieved simultaneously. Ultimately, ITER is enabling a global team of physicists and engineers to optimise the technologies, components and strategies needed for fusion power stations. Once they have done this, the Earth's energy supply will be as reliable as that of the Sun and the stars. What better present could we offer future generations?

FULLSPECTRUM

Catches all the **sun's rays**

Solar cells with the highest energy efficiency in Europe have been developed by the scientists of the FULLSPECTRUM ('A new PV wave making more efficient use of the solar spectrum') project. The cells are now being tested on an industrial scale in large pilot plants, paving the way for cheaper solar power in Europe and elsewhere.

FULLSPECTRUM brings together 19 partners from academia and industry from 7 EU Member States, as well as Russia and Switzerland. The project's objective is to develop solar cells which can convert all of the sun's rays into clean electricity.

Clean power for a clean planet

The burning of fossil fuels pumps large quantities of carbon dioxide into the atmosphere, contributing to the greenhouse effect. At the same time, rising energy prices and concerns about security of supply mean EU countries are increasingly reluctant to rely on imported energy sources.

With this in mind, the EU has set itself the goal of producing 20 per cent of its energy from renewable sources such as the sun, wind, waves and hydropower by 2020. Today, renewables account for just 8.5 per cent of our energy. Needless to say, solar power has an important role to play in helping Europe to achieve its renewable energy goals. However, electricity produced by photovoltaic cells is still considerably more expensive than electricity produced by more conventional methods.

One of the reasons for this is the low conversion rate of today's photovoltaic cells; the most efficient are only able to convert 24 per cent of the sun's energy into electricity, and most commercial solar panels are even less efficient, converting just 17 per cent. The problem with these conventional cells is that they only convert a narrow portion of the sun's spectral range into energy. FULLSPECTRUM is developing cells which are able to capture and exploit the entire solar spectrum. The project has already created cells with an efficiency of 37.6 per cent.

An introduction to photovoltaics

Conventional photovoltaic (PV) panels consist of many individual 'cells' made of semiconductor materials such as silicon. When photons of light collide with a PV cell, their energy is transferred to the electrons in the atoms of the cell. This energy enables the electrons to break free from their atoms and be captured to form an electric current.

So why do today's PV cells only capture a small portion of the sun's energy? The answer involves a phenomenon called the band gap. The band gap is the minimum amount of energy required to free an electron from its atom. Different materials have different band gaps. In the case of a silicon PV cell, for example, photons with less energy than silicon's band gap are simply not absorbed. On the other hand, the excess energy of photons whose energy is higher than the band gap is effectively wasted.



Title | A New Wave Making More Efficient Use of the Solar Spectrum
Acronym | FULLSPECTRUM
EC Contract number | 502620
Website | www.fullspectrum-eu.org

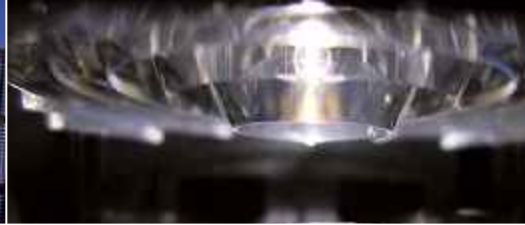
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- Rwe Space Solar Power GmbH (Germany)
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- Imperial College Of Science, Technology and Medicine (UK)
- Solaronix SA (Switzerland)
- Inspira SL (Spain)
- Commission of the European Communities – Directorate General Joint Research Centre (Belgium)
- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung e.V. (Germany)
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- Paul Scherrer Institut (Switzerland)
- Consejo Superior de Investigaciones Científicas (Spain)
- Universiteit Utrecht (The Netherlands)



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Breaking the efficiency barrier: a European record!

FULLSPECTRUM's innovation is the creation of a multijunction solar cell that makes better use of the entire solar spectrum. The technology uses solar cells made of different materials (including gallium, phosphorus, indium and germanium) with different band gaps stacked on top of each other. Any photons which are not absorbed by the cells at the top of the stack are absorbed by the cells beneath.

Tests have shown that these cells can convert as much of 37.6 per cent of the sun's energy into electricity, a European record. These cells are very expensive. However, their costs can be considerably reduced by arranging them in special panels which include lenses that focus a large amount of solar energy onto the cells.

Because the cells are much more efficient, fewer PV panels are required to achieve the same power output, giving them a major advantage over conventional silicon cells. Furthermore, the project partners believe that with further research and development, conversion efficiencies of 50 per cent could be achieved. Given the limitations of silicon cells, the project partners predict that their multijunction cells will eventually come to dominate the market.

The technology is now being tested on the industrial scale at the recently opened Institute of Concentration Photovoltaic Systems (ISFOC) in Castilla La Mancha, Spain. Some industrial FULLSPECTRUM partners, have installations at the institute. With these demonstration plants, the project partners aim to provide industry with valuable information on the reliability, suitability and efficiency of the new PV concentrator technology.

In another FULLSPECTRUM achievement, the project partners provided the first ever evidence of the intermediate band effect. This refers to the absorption of photons at three different energy levels, corresponding to three different band gaps. In practical terms, this enables the system to capture low energy photons that would otherwise pass through a conventional solar cell and be lost.

In the long term, intermediate band cells might substitute the complex high efficiency multijunction cells used today. This achievement has raised much attention all over the world and dozens of laboratories are now working on it.

Looking forward to a sunny future

The project's success in advancing new concepts in photovoltaics has not gone unnoticed; and research programmes in countries as far afield as the US and Japan have been inspired at least in part by FULLSPECTRUM. The project's coordinator, Antonio Luque of the Institute of Solar Energy at the Universidad Politécnica de Madrid in Spain, is optimistic about the project's legacy.

'These results are making an important contribution to significantly increasing the conversion efficiency of solar cells, which is the main route to cost reduction of solar electricity in the long term,' he states. 'Cost competitive photovoltaics will open the door to large-scale deployment, thus empowering Europe to produce green electricity and reduce the dependence of the EU on energy imports.'

LowHeat takes the heat out of hot water

Households across Europe could soon be saving both energy and money thanks to the results of the LowHeat project.

Every time we take a shower or bath, wash our clothes or do the dishes, large amounts of valuable energy are literally washed down the drain in the form of warm waste water. Now the LowHeat team have come up with a way of recovering the heat energy from the waste water to supplement the main hot water source.

The system can be easily installed by a professional plumber and is now ready for commercialisation, for use in homes as well as businesses that have a high hot water demand, such as laundrettes, processing plants and hotels. The innovation team behind the LowHeat project believe it could reduce utility bills by up to 10% in an average household, while in commercial properties the savings could be even higher.

Waste not, want not

With climate change already making its effects felt around the world, the race is on to clamp down on the big energy wasters and polluters. Often the finger of blame is pointed at energy intensive sectors such as the steel, paper and chemicals industries. However, there are also significant energy efficiency gains to be made in our homes.

Figures from Eurostat, the EU's statistical information service, reveal that households account for over a quarter of all energy consumption in the EU. Furthermore, although the EU plans to cut its overall energy use by 20% by 2020, household energy consumption is projected to rise by 20% over the next 30 years.

In a bid to reduce the impact of our homes on the environment, we are regularly encouraged to do our bit to save energy, for example by switching off lights and appliances when they are not in use.

Turning up the heat on energy wasters

But some sources of energy wastage are hard to spot and even harder to remedy. Take low-grade heat, for instance: large quantities swirl down the drain every day. Low-grade heat is the energy generated from an array of domestic appliances and fittings, such as washing machines, dishwashers, shower units, baths and sinks.

According to the LowHeat partners, there are some 58 million dishwashers, 232 million washing machines and 63 million shower units in the EU alone. It is estimated that 90% of the energy used by these goes into heating the water, a task which requires approximately 26 500 terajoules of thermal energy. Most of this energy is simply washed down the drain and lost.

Yet few have attempted to use this waste water as an energy source. A previous EU-funded project called WARMIT succeeded in developing a device which could capture the heat from shower waste water. The aim of the LowHeat project was to design a system which could capture the heat from an entire building's waste water system. The 12 partners from 9 EU member states included small and medium-sized enterprises, research institutions and national heating and plumbing associations.



Title | The development of a new domestic heat recovery technology for low grade heat in waste water
Acronym | LOW-HEAT
EC Contract number | 500399
Website | www.lowheat.iphe.org.uk

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- Convex Electrical Ltd (Ireland)
- CRS Engineering Ltd (UK)
- Metallisation Ltd (UK)
- K. Lund AS (Norway)
- Angewandte System-Technik GmbH (Germany)
- Robert Prettie and Co Ltd (UK)
- Pera Innovation Ltd (UK)
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Introducing the LowHeat system

The LowHeat system is surprisingly simple, comprising a drain device, heat exchanger and wireless control device (optional). As hot waste water is discharged, it passes through the drain device where its temperature is taken. If the water is hotter than 30°C, the system activates a pump which diverts the water through the LowHeat heat exchanger.

Depending upon the type of hot water system within a building, there are two different types of LowHeat heat exchanger. There is an 'inline' heat exchanger and a 'gatlin gun' heat exchanger and both heat exchangers use heat pipes for the heat exchange process. The 'gatlin gun' recovers the heat energy to directly heat a 'pre-heat' vessel, whereas the 'inline' heat exchanger uses the recovered heat energy to heat the water within the main hot water store.

The LowHeat device is not the first heat exchanger on the market. But what sets it apart from the rest is its ability to capture energy from waste water with temperatures as low as 30°C. Other heat exchangers only work with much higher temperatures and so are not suitable for use in domestic settings, such as in showers and dishwashers, where temperatures tend to be lower.

Another innovation is the system's wireless control device, which allows households to assess in real time the energy and cost savings being made.

The amount of heat captured varies from one appliance to another: in the case of washing machines, 84% of available heat energy is recovered, while for sinks and showers the figures are 40% and 35% respectively.

Big savings all round

The benefits of the LowHeat system are manifold. In terms of energy savings, the device could help households reduce their energy consumption by 1 000 kWh every year. The project partners have calculated that even with a relatively low market penetration of 6%, this could reduce energy consumption by 10.1 billion kWh in Europe alone. With energy prices rising, these energy savings will help families reduce their energy bills significantly.

The environment will also benefit greatly from the device, with the project partners estimating that the system could prevent the unnecessary release of up to 4.8 million tonnes of carbon dioxide every year.

According to the project partners, the device will also contribute to the European economy; the system could be worth as much as EUR 1.67 billion in Europe alone, and could create approximately 10 000 jobs.

A winning design

The potential of the system has not gone unnoticed; in 2006 it was highly commended in the UK's National Efficiency Awards as an 'example of how good research and development can identify an opportunity for energy and cost saving in a far from obvious application'.

Meanwhile, thanks to endorsements by the plumbing associations involved in the project, the LowHeat system has gained credibility within the industry, and work is now underway to bring the product to market.

Biofuels: friend or foe?

The concept of using biomass, or biological material, to reduce reliance on the Earth's natural resources and decrease harmful emissions has been hailed by some as the solution to global warming. But others have rejected it on account of the energy required to produce the fuel and its impact on food prices, as agricultural land once dedicated to growing food crops is switched to the production of crops for biofuels.

The RENEW project set out to establish what the real story is with biofuels, assessing various methods of biomass fuel production and Europe's potential to produce biomass material. The 31 partners from 8 EU Member States and Switzerland include representatives of the automotive sector, the mineral oil industry, electricity producers, pulp and paper production, process engineering and universities.

The results show that there are 'multiple opportunities' in Europe for producing 'biomass to liquid' (BtL), a type of biofuel made from ligno-cellulosic biomass such as wood, straw and energy plants. The researchers reached this conclusion after investigating BtL-diesel, as well as two other options: methanol/Dimethyl Ether (DME) and bioethanol.

Renewing what we know about biofuels

RENEW had three objectives: to further our understanding of BtL production methods and BtL's suitability for current and future vehicles; to assess Europe's regions' potential for producing biomass and analyse environmental, economic and technical aspects of production; and to provide recommendations for stakeholders.

The research involved tests at six gasifiers (facilities which convert biomass to gas) around Europe, while BtL was produced in quantities of several thousand litres in Freiberg, Germany. The team looked at the whole life cycle, from well to tank, and the technologies involved at each stage. Researchers assessed the economic costs of production and distribution, as well as the environmental impact of the biofuels. The environmental assessment covered global issues such as climate change and local impacts like the acidification and eutrophication of soils and water and local air quality (summer smog).



Title | Renewable fuels for advanced powertrains
Acronym | RENEW
EC Contract number | 502705
Website | www.renew-fuel.com/

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- CHEMREC AB (Sweden)
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- Biomasse – Kraftwerk Güssing GmbH und Co. KG (Austria)
- Deutsche BP AG (Germany)
- Centre for Research and Technology Hellas (Greece)
- STFI, Skogsindustrins Tekniska Forskningsinstitut AB (Sweden)
- Centre for Renewable Energy Sources (Greece)
- Clausthaler Umwelttechnik-Institut GmbH (Germany)
- DaimlerChrysler AG (Germany)
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- ESU-Services GmbH (Switzerland)
- Volvo Technology Corporation AB (Sweden)
- UET-Umwelt- und Energietechnik Freiberg GmbH (Germany)
- TOTAL France (France)
- Centralne Laboratorium Naftowe (Poland)



'Substantial' potential

The RENEW team concluded that synthetic BtL fuels could have a substantial effect on reducing emissions from transport. According to the European Environment Agency (EEA), carbon dioxide (CO₂) emissions for the whole of the EU would have fallen by 14% instead of 7.9% between 1990 and 2005 if CO₂ emissions from transport had fallen along with those from other sectors. Transport is actually the only area in the EU in which emissions are rising.

Tests in passenger cars and heavy-duty diesel engines showed BtL diesel and BtL DME to be the best fuels for use in today's diesel vehicles, although DME requires engine modifications. Fuel consumption was either equal to or lower than that of conventional fuels, and the RENEW team believes that future research will lead to even greater reductions in energy consumption.

The RENEW scientists also proved that biofuels do not have to be harmful to the environment, and demonstrated that the impact of biomass production on the environment can be reduced if more sustainable production methods are used. The project partners recommend cutting fertiliser use, and increasing yields by using new species of plants.

Where to start?

The regions with the highest biomass density were found to be central France, eastern Germany and western Poland. The team says that Europe has easily enough biomass material to warrant building around 50 industrial sized BtL plants by 2020. These plants could produce enough biofuel to replace 4% of the road transport sector's total expected diesel demand.

With the total biomass potential predicted for the year 2020, assuming that only 50% will be used for transportation, 12% of the overall fuel demand (17% of total diesel demand) for road transport could be substituted.

Naturally, government and industry want to know about the overheads involved in producing biofuels. Costs for biomass from short rotation coppice willow, in which shoots are harvested from the willow tree every few years, are in the range of EUR 4.3 to EUR 5.8 per gigajoule (GJ) of energy produced. Costs for straw and forest residues range from EUR 2.4/GJ to EUR 5/GJ. The project predicts a harmonisation of prices across Europe at around EUR 3.5/GJ or EUR 4/GJ. In comparison, energy from crude oil cost around EUR 5.5/GJ in early 2008, before refinement. Under optimum RENEW conditions, overall BtL production costs could range between EUR 0.5/l and EUR 0.9/l diesel equivalent.

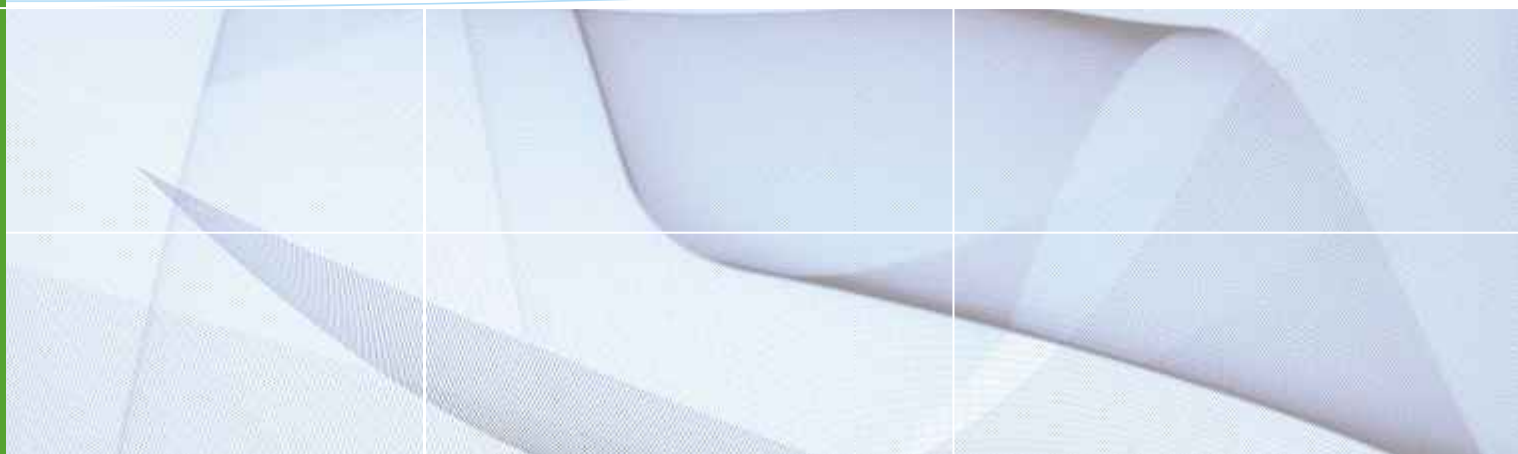
In terms of technology, two production methods met the project's efficiency, maturity and ecological requirements: the 'black liquor gasification concept with a DME synthesis' and the 'centralised entrained flow gasification with a Fischer-Tropsch diesel synthesis'. The first method involves integrating new technology into an existing pulp mill. The second method involves a stand-alone plant producing synthetic diesel that can be used in unmodified engines. Their conversion efficiency – the amount of biomass that they are able to convert into fuel – is 69% and 54% respectively, and both methods are flexible in terms of the category of fuel produced.

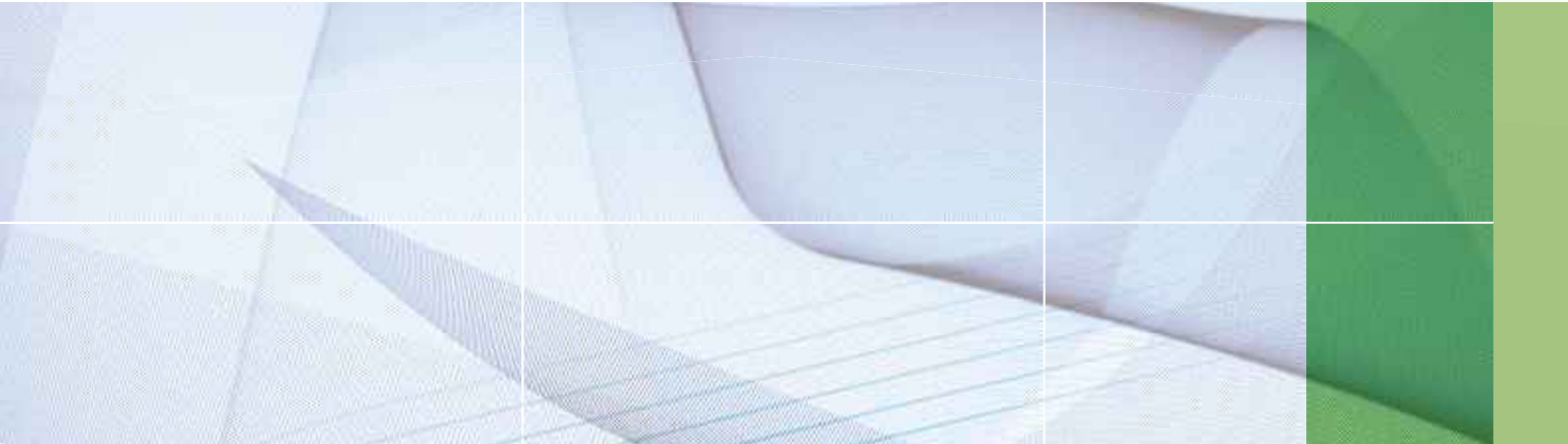
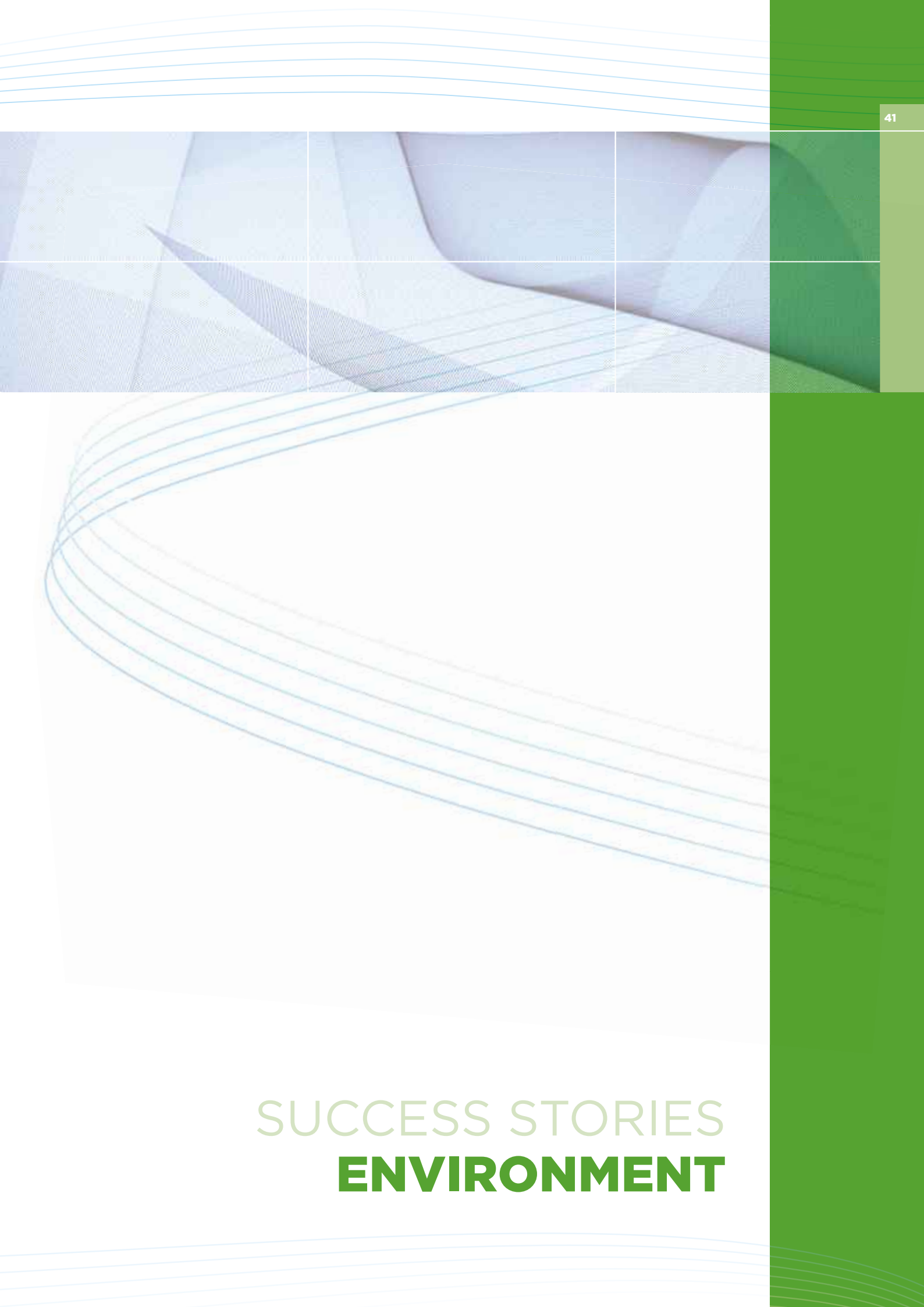
First steps first

The next step for the biofuel research community is to set up a demonstration project to test the concepts developed by RENEW at the 50-megawatt scale.

Looking even further into the future, the RENEW team identified the most suitable locations for the first industrial scale BtL plants. The researchers propose west Poland, which offers plentiful, low-cost biomass, and Sweden, which is already home to a well-established forestry industry, residues of which are currently available at relatively low costs.

RENEW's results provide a solid foundation for the further development of the next generation of biofuels, thereby ensuring that this important energy resource can contribute fully to Europe's energy supply in the future.





SUCCESS STORIES **ENVIRONMENT**

DAMOCLES reveals shocking scale of Arctic ice loss

The Arctic sea-ice pack is shrinking rapidly, and early results from the DAMOCLES (Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies) project suggest that the Arctic Ocean could be ice-free in summer in as little as 10 to 15 years from now, much sooner than had been predicted by most of the IPCC (Intergovernmental Panel on Climate Change) models.

The DAMOCLES team is gathering data on the Arctic environment on an unprecedented scale and using this to improve our understanding of the processes affecting the Arctic sea-ice, as well as the impacts its loss will have on both the environment and human activities.

The EU-funded project brings together Arctic experts from a range of disciplines based in over 40 institutions in 10 EU Member States plus Belarus, Norway and Russia, and represents a major EU contribution to the International Polar Year, which runs from 2007 to 2009. DAMOCLES has also formed partnerships with other non EU countries, such as the American SEARCH ('Study of environmental Arctic change') initiative.

The Arctic – a fragile system

Over the past few decades, the Arctic has warmed faster than the rest of the planet. One of the most visible signs of this is the shrinkage of

the Arctic sea-ice pack. In the early 1980s its average size at the end of summer was 8 million km². By the summer of 2007, it had dwindled to just 4 million km², a record low.

However, it is not just the ice extent that is changing. Early findings from the DAMOCLES project indicate that the remaining ice is getting much thinner too, and the perennial sea ice is being gradually replaced with new (first year) ice. Meanwhile, the onset of pack ice formation in winter is getting steadily later, and in summer over half the ice is covered in ponds of meltwater. It is the suddenness of these changes which led the DAMOCLES team to conclude that an ice-free Arctic could become a reality far sooner than many had predicted.

The Arctic sea-ice pack plays an important role in the global climate system. Because the sea-ice is white and consequently has a high albedo, it reflects 80% of the incoming solar radiation back out into space. However, when the ice melts, the ocean surface is exposed.



Title | Study of environmental Arctic Change – Developing Arctic Modelling and observing capability for long-term environment studies

Acronym | DAMOCLES

EC Contract number | 37111

Website | www.damocles-eu.org

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As the ocean is darker in colour, it readily absorbs 80% of the sun's energy, causing ocean temperatures to rise and making it harder for new ice to form.

The disappearance of the pack ice in summer and the subsequent warming of the upper layers of the ocean and lower atmosphere could accelerate the melting of Greenland's vast ice cap. This could cause sea levels to rise by as much as a metre by the end of the century, wiping low lying countries such as Bangladesh and small island states like Tuvalu off the map. Several major cities, including London, Tokyo, New York and Mumbai could also be affected.

In addition to this, the flow of freshwater from Greenland into the sea would reduce the salinity of the north Atlantic. This could disrupt the Gulf Stream, which carries warm water from the tropics up to western Europe. When the Gulf Stream reaches the cooler climes of the Arctic, it becomes denser and sinks to the bottom of the ocean. Because freshwater is less dense than salty water, a reduction in the salinity of the north Atlantic could prevent the Gulf Stream from sinking and effectively stop it in its tracks. This would trigger a drastic cooling in western Europe, and could also cause the tropical rainbelt to shift.

At the regional level, the loss of the sea-ice pack will also have serious consequences for Arctic wildlife, and changing environmental conditions will affect the region's fisheries.

The shrinkage of the Arctic sea-ice pack has serious socio-economic implications. Shipping in the region is likely to become more intense, and easier access to the region will facilitate oil and gas exploration and exploitation activities. These activities have the potential to seriously damage the fragile Arctic environment, and the consequences of an oil spill or industrial accident would be catastrophic.

DAMOCLES – turning the Arctic into a laboratory

Compared to other parts of the world, we have relatively little data on the Arctic climate system, and this is hampering efforts to understand the Arctic environment. To overcome this problem, DAMOCLES is peppering the region with state-of-the-art instrumentation.

Buoys attached to the ice measure the temperature and salinity of the ocean, as well as air temperature and pressure.

Below the ice, gliders travel through the ocean at different depths measuring temperature, salinity and pressure. Other devices anchored to the seabed enable scientists to monitor the state of the ocean in a specific place over a long period of time. Yet more instruments are devoted to measuring the thickness of the ice.

Many of these devices transmit their data to satellites, allowing scientists to monitor the situation in real time. In addition to the data coming from the instruments in the Arctic, the scientists are making use of satellite images to build up a more complete picture of what is going on.

One of the project's most exciting ventures involves a research boat called *Tara* that was encased in the Arctic ice pack for a year and a half. During that time, she followed the Arctic drift, while her crew gathered data from the ice, the ocean below and the atmosphere above.

Another boat which has made a vital contribution to the project is the *Vagabond*, which is effectively an Arctic base camp for DAMOCLES in the Svalbard Archipelago. The *Vagabond's* crew has been heavily involved in testing the new technology designed for the project.

Using computer models to paint a picture of the future

The challenge now for the DAMOCLES team is to analyse the data generated by the project and use it to develop models that will be able to reliably predict the fate of the Arctic sea-ice and determine more precisely the consequences of its loss.

Meanwhile, the initial project results highlight not only the urgency of the situation, but the fact that the loss of the Arctic ice sheet will have repercussions which will extend far beyond the confines of the Arctic Circle.

Is climate change turning continental carbon sinks into sources?

Climate change is already having a dramatic impact on the ability of Europe's terrestrial ecosystems to absorb carbon dioxide (CO₂) from the atmosphere, the CarboEurope project has revealed.

The aim of the project is to understand and quantify the terrestrial carbon balance of Europe; in short, how much CO₂ does the continent take up, and how much does it emit?

Terrestrial and oceanic ecosystems mop up just over half of all CO₂ emissions, effectively slowing down climate change. The fact that these vital carbon sinks are becoming less efficient means that it will be even harder for us to stabilise CO₂ levels and so ward off the most severe impacts of climate change.

Where does the carbon go?

Plants and other organisms take up carbon dioxide from the atmosphere by photosynthesis, during which CO₂ and water are converted into oxygen and sugars. This process is a key part of the global

carbon cycle. Recent research involving CarboEurope scientists revealed that land and sea plants absorb 55 % of all CO₂ emitted. Around 30 % is taken up by land ecosystems, and 25 % by oceanic ecosystems. The remaining 45 % accumulates in the atmosphere.

CarboEurope is building on work by previous EU-funded projects to shed new light on how carbon sinks work. Longer term observations are needed to reveal how the picture is changing, and to find out how forest and farmland can be managed to absorb the most CO₂.

An experiment on a continental scale

CarboEurope brings together 75 partners from 16 EU Member States plus Switzerland, with the aim of gathering the data necessary to create an accurate, high resolution picture of the carbon flows of an entire continent.



Title | Assessment of the European Terrestrial Carbon Balance

Acronym | CarboEurope

EC Contract number | 505572

Website | www.carboeurope.org

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The project has three aims: to determine the carbon balance of Europe and understand how it changes over time; to investigate the mechanisms which influence the carbon balance; and to develop an observation system which will be able to detect changes in carbon sinks and sources related to the EU's commitments under the Kyoto Protocol.

The Kyoto Protocol sets out countries' commitments to reduce their greenhouse gas emissions. CarboEurope's results will help the EU quantify its contribution to this important international effort.

What makes the project stand out is its application of a single, comprehensive experimental strategy. This means that the same techniques and experimental designs – ground based and atmospheric measurements – are being used right across the continent to measure CO₂ fluxes and atmospheric CO₂ concentrations on the local, regional and European scales. As a result, data can be easily compared, integrated and analysed.

A network of sites across Europe is gathering information on the carbon flows and carbon balance of the continent's main landscape types, and through the project's Atmospheric Observing System, atmospheric CO₂ levels are being measured by ground-based instruments, tall towers and aircraft.

Early results from CarboEurope highlight the devastating impact that climate change is already having on the ability of Europe's ecosystems to absorb CO₂ from the atmosphere. If this trend continues, it will seriously jeopardise our efforts to tackle climate change.

Summer 2003: when Europe switched from sink to source

In the summer of 2003, large parts of Europe were hit by a heat wave and a severe drought. Thousands of people died, crops failed and fires raged across large areas. However, results from the CarboEurope project published in the journal *Nature* in September 2005 reveal an additional, equally serious impact of that exceptionally hot summer: Europe's terrestrial ecosystems turned from a carbon sink into a carbon source.

The combination of extreme heat and low rainfall reduced plant growth by a third, and so less CO₂ than usual was taken up from the atmosphere. The CarboEurope team estimates that during July and

August 2003, 500 million tonnes of carbon were released into the atmosphere by Europe's fields and forests, around twice as much as the emissions from fossil-fuel burning in Europe during the same period.

The researchers warn that more frequent droughts in the future could turn temperate ecosystems from carbon sinks into carbon sources, thereby accelerating climate change.

Warmer autumns causing carbon release

It is known that rising temperatures in spring lead to increased carbon absorption at the start of the growing season, and many wondered if the same would be true in autumn. Research involving the CarboEurope project, published in the journal *Nature Geoscience* in 2008, revealed that both photosynthesis (which removes carbon from the atmosphere) and respiration (which releases it) increase during warmer autumns.

However, the increase in respiration is greater than the rise in photosynthesis, which is limited by lower light levels in autumn. The result is a net release of carbon in warmer autumns. What's more, the CO₂ released in warmer autumns almost entirely cancels out the extra carbon absorbed during warmer springs.

The global context – dwindling sinks contributing to rising CO₂ levels

CarboEurope's findings feed into an international initiative called the Global Carbon Project. In this global context, it becomes clear that the alarming situation in Europe is far from unique. Droughts around the world have led to the weakening of other terrestrial carbon sinks. Meanwhile out at sea, oceanic carbon sinks are also becoming less efficient.

According to the Global Carbon Project, the declining efficiency of the world's carbon sinks is one of the main reasons why atmospheric CO₂ levels are rising faster than expected.

The implications of this are clear: if we do not act now to reduce CO₂ emissions, the carbon sinks will continue to weaken and it will be even harder for us to avoid catastrophic climate change. The information on continental carbon sinks obtained by the CarboEurope project will be crucial if we are to tackle this problem head on.

Global Earth Observation – a new tool for sustainable development

Global Earth Observation, which provides a comprehensive overview of what is happening in the environment, offers important benefits in a wide range of areas. For example, in agriculture it can help agri-business boost yields by spotting where fertiliser needs to be applied. Now the GEO-BENE (Global Earth Observation – Benefit Estimation: Now, Next and Emerging) project is carrying out the world's first systematic study of the benefits of Global Earth Observation.

GEO-BENE brings together 12 partners from 5 EU countries plus Switzerland, South Africa and Japan with the aim of developing methods and tools designed to clarify the economic and social benefits of Global Earth Observation. From this, policies can be defined to support the implementation of international agreements on sustainable development in a range of fields.

The project covers nine areas: disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity.

Getting the better of the weather

Even with current technology, we still cannot provide completely accurate weather forecasts, and every year many people die and vast amounts of money are spent as a result. Being able to provide reliable weather forecasts would be a huge advantage for almost every European industry. GEO-BENE researchers have investigated the impact of climate change on weather and crop yields in the future, and developed a tool to quantify the value of weather-related satellite information.

Cherishing biodiversity

Global Earth Observation is also a useful tool to survey biodiversity and protect our ecosystems. Ecosystems form the basis of life on Earth; they provide us with food, air, water and energy. But they have been under threat for a number of years from pollution, climate change and intensive agricultural methods. Global Earth Observation can give us state-of-the-art information about the current condition of ecosystems around the world in order to promote sustainability and good resource management.

GEO-BENE has focused on the creation of a comprehensive observation system for biodiversity that can be used by natural resource planners, governments, scientists and researchers. Extensive data on biodiversity factors is not widely available in many developing countries, yet these nations are home to most of the world's unprotected biodiversity.

GEO-BENE research in South Africa revealed that poor quality data often led decision makers to overestimate the amount of land needed for conservation areas. Managing this extra land for conservation purposes costs a lot of money. Therefore, investing in the gathering of high quality data will help to make the establishment and management of conservation areas more cost effective and free up more land for other uses.



Title | Global Earth Observation – Benefits Estimation: Now, Next and Emerging
Acronym | GEO-BENE
EC Contract number | 37063
Website | <http://www.geo-bene.eu/>

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A secure food supply

In the area of agriculture, GEO-BENE's aim is to have a global land use and food distribution information service that can enable sustainable development through wise planning of land resources. For example, research so far has shown that the planned biofuels programmes of Europe, the US, Brazil, China and India may cost billions of euros more than anticipated.

Project results have also shown the benefits of using Global Earth Observation to identify geographic centres of malnutrition to efficiently plan aid operations. Other results from the project include the establishment of a database for global data modelling, the creation of an EPIC model (a system that can simulate agricultural ecosystem processes), an analyses of global nitrogen levels in cropland and a study of the impact of climate change on food production and agricultural water use around the world.

Energy and water: balancing supply and demand

Energy is vital to our day-to-day lives – in the food we cook, the work we do, our homes and our transport systems. It is also responsible for much of the world's current high pollution levels. GEO-BENE found that more certainty about climate sensitivity through the acquisition of better Global Earth Observation data will lead to better informed climate change and energy policies and more stable CO₂ prices. Under these conditions, energy producers' profits would be expected to rise, while CO₂ emissions are likely to fall.

Water conservation is becoming more and more important as a result of global warming and desertification in certain parts of the world. The EU needs clear water conservation and water resource manage-

ment policies. GEO-BENE surveys have highlighted areas of emerging water scarcity and availability using remote sensing information. This technique increases the availability of water quality information such as early warnings of water shortages.

Limiting damage from disasters

The project is also studying a range of natural and man-made hazards such as forest fires and earthquakes to help develop better disaster management policies.

In the health field, GEO-BENE is investigating how Global Earth Observation information on factors such as climate and weather could help health systems detect disease epidemics early on. Global Earth Observation data could then be used to plan vaccination programmes, if necessary. Another GEO-BENE study is looking at whether the season and weather affect the risk of a patient dying from acute myocardial infarction.

Putting Global Earth Observation in the spotlight

GEO-BENE has had a high public impact with articles in journals such as *Nature* and *Science*. Working with the Group on Earth Observation (GEO), it has had a direct impact on government policies, such as the UK's Gallagher Review on Biofuels, and on World Bank strategies and financing. Special focus has also been put on policy processes under the United Nations Framework Convention on Climate Change (UNFCCC).

Thanks to GEO-BENE's work, the usefulness of Global Earth Observation benefit assessment is now widely recognised, paving the way for its application in diverse situations around the world.

Climate change threatens Europe's cultural heritage

Urgent action is needed to protect Europe's cultural heritage from the effects of climate change, scientists from the Noah's Ark project warn. The project found that our historic buildings, monuments, museums and statues are likely to suffer increasing levels of damage as a result of climate change.

The good news is that the researchers have developed a Vulnerability Atlas, comprising the first ever maps of how climate change over the coming century will affect historic buildings, and a set of guidelines to help policy-makers assess the risk of damage in their country or region and take steps to protect and conserve their cultural heritage.

Climate change and culture: a forgotten problem

For a long time, those working on climate change focused on its impacts on agriculture and health, considering aspects such as water and energy supply and transport needs. Now the Noah's Ark project highlights the potential impacts of climate change on our cultural heritage.

The project's partners, who come from seven EU countries, include climatologists, chemists, geologists and biologists, conservators and curators. Insurance specialists also took part in the project, reflecting the immense attractiveness and value of cultural heritage to Europe's economy through the income generated by our tourism industry.

They used climate models to predict how factors which affect our cultural heritage, such as temperature, wind and rainfall, are likely to change across Europe over the coming century. As many of the weather-related situations which are most damaging to our monuments are not as simple as average temperatures or average rainfall, the researchers had to create special new parameters.

For example, rapid cycles of freeze and thaw are extremely damaging to stonework, so it is the range of temperatures, and how quickly they change, that is important.

Shedding light on the enemies of cultural heritage

Europe's monuments are already affected by environmental conditions. However, as the climate changes, the monuments will face new and different challenges, and those responsible for taking care of them will have to adapt their conservation strategies accordingly.

Carbonate stones, such as marble and limestone, are used in buildings across Europe, including Westminster Abbey, the Parthenon and the Coliseum. Increasing rainfall in northern Europe will leave monuments made of these stones vulnerable to a process called surface recession, whereby the rain literally washes the stone away. In contrast, rates of recession in southern Europe are set to decrease.

Marble and limestone monuments are also prone to a problem called thermoclastie which occurs when the material expands and contracts in response to rapid temperature fluctuations, causing it to crack. Thermoclastie is already a serious problem in southern Europe and it is likely to increasingly affect central Europe too.



Title | Global Climate Change Impact On Built Heritage and Cultural Landscapes

Acronym | NOAH'S ARK

EC Contract number | 501837

Website | <http://noahsark.isac.cnr.it/>

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Another problem for stone structures is salt deposition. Porous stones absorb moisture in the air, and when the water evaporates, the salt in the water crystallises and puts pressure on the surrounding stone. Sea salt crystallisation occurs when relative humidity falls below 75.5%. The bad news is that the conditions for salt deposition are likely to become more common across large parts of western and central Europe. Soft porous stones, such as those frequently used for gothic cathedrals, are particularly vulnerable to this process.

Outdoor wooden structures like Scandinavia's stave churches are prone to attack from fungi, which strike when moisture levels are high and temperatures rest around an optimum range for growth. A combination of increasing rainfall and rising temperatures will see northern and eastern Europe's risk of fungal attack go up, while drier conditions in southern and western Europe means the risk there will decrease.

Metal structures such as the Eiffel Tower are at risk of corrosion caused by acidifying pollutants; when a structure is wet, pollutants dissolve in the surface layer of the metal and act as corrosive agents. In the future, northern Europe's cultural heritage will face an increased risk of this problem.

The Noah's Ark Vulnerability Atlas shows how the risks of these and other problems will change in different parts of Europe over the coming century.

Cultural heritage – a non-renewable resource in urgent need of protection

Many of these problems can be addressed by implementing the guidelines put together by the project. Among other tips, these Noah's Ark guidelines recommend increasing inspections and carrying out minor repairs more regularly, instead of infrequent major repairs.

In some cases, structures may need visible changes, such as increasing the size and number of gutters and downpipes to help old buildings cope with higher rainfall levels. These alterations often lead to questions of authenticity, but the guidelines note that conservationists need to acknowledge that not all our cultural heritage can be saved unaltered. Opposition to alterations can be addressed by basing decisions on scientific evidence, and weighing up the vulnerability of the element to be altered against its significance.

The challenge now for the Noah's Ark team is to ensure that its conclusions related to the impact of climate change on cultural heritage are also included in future reports by the Intergovernmental Panel on Climate Change (IPCC). The team is also working to raise awareness of the project's results among those responsible for conserving our cultural heritage.

The stakes are high – Europe's monuments are part of our daily lives and they have stood sentinel over our towns and cities for centuries. As tourist attractions, they represent an important and stable source of income and employment.

Thanks to the Noah's Ark project, visitors and locals alike will be able to marvel at these treasures which define our cities, our roots, our Europe, for centuries to come.

HERMES – Shines a light into the depths of **Europe's seas**

The depths of Europe's seas are teeming with life, and biodiversity hotspots, such as deep water coral reefs and deep canyons, abound. Now the HERMES (Hotspot Ecosystem Research on the Margins of European Seas) project is shedding new light on where these oceanic oases are located, how they function and, importantly, how they are being affected by human activities.

Using cutting edge technologies, the project team is discovering new seafloor features and boosting our understanding of this hidden world. The research is crucial; interest in exploiting the biological, energy and mineral resources of the deep seas is growing. With this in mind, the HERMES scientists are communicating their findings to policy makers, to ensure that decisions regarding the management of our marine resources can be taken on the basis of the very latest scientific evidence.

An unexplored realm

The deep-ocean margin extends from the edge of the 200 metre deep continental shelf to a depth of around 4 000 metres where the ocean basin begins. Europe's deep ocean margins cover an area of 3 million km² and run for some 15 000 km, from the Arctic in the north to the Mediterranean in the south, and from the Atlantic in the west to the Black Sea in the east.

Yet this vast area remains largely unexplored and poorly understood. What we do know is that the deep ocean is a major carbon sink, and as such it influences the processes behind climate change. It also harbours unique, as yet largely untapped, genetic resources.

The aim of HERMES is to study this underwater world before it is irreparably changed or damaged by climate change and human activities. The project has a particular focus on 'biodiversity hotspots', locations where the environmental conditions contrive to enable large numbers of species, both known and unknown, to thrive.

The 50 project partners come from universities, government laboratories, non-governmental organisations, research institutes and private companies located in 18 countries. They include experts in marine biology, geology, oceanography, biogeochemistry, microbiology, geophysics, modelling and the socio-economic sciences.



Title | Hotspot Ecosystems Research at the Margin of European Seas
Acronym | HERMES
EC Contract number | GOCE-CT-2005-511234-1
Website | www.eu-hermes.net

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- Volcanic Basin Petroleum Research (Norway)
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- Median (Spain)
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- Olex AS (Norway)
- ArchimediX (Germany)
- Proteus (France)
- Jobin Yvon (Spain)



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With most of Europe's deep ocean margins lying within its 200 nautical mile Exclusive Economic Zone (EEZ), the project has particularly urgency. States have exclusive rights over the marine resources inside this area, and activities such as bottom trawling, hydrocarbon exploration and extraction and deep-sea mining are at an all time high. If policy makers are to successfully oversee the sustainable management of Europe's valuable marine resources, information from HERMES will be vital, as it is the first project to integrate research from many disciplines in a wide range of environments.

Diving down into the depths

In the first half of the project alone, the HERMES partners embarked on some 80 expeditions around the European margin, including the Nordic slope off the coast of Scandinavia, the Porcupine-Rockall area in the Atlantic, the eastern and western Mediterranean and the Black Sea.

The team used remotely operated vehicles, tethered to the mother ship and fitted with cameras to peer into this hidden world. Specially adapted tools attached to these vehicles enabled the scientists to collect data on biodiversity hotspots such as cold seeps, where hydrocarbon-rich fluids seep out of the seabed, cold-water coral mounds and reefs, canyons, and anoxic areas, where the sea water is low in oxygen. As information is gathered, it is archived and made available using the pan-European GIS (geographic information system).

Uncovering a hidden world

One of the project's most important findings highlights the link between biodiversity and ecosystem functioning. The scientists demonstrated that ecosystem functioning in the deep sea is exponentially linked to the number of species living there. In other words, if species are lost due to human activities or other causes, the consequences for these ecosystems could be dire.

Another finding has implications for the fishing industry. Fishermen often catch species other than those targeted; this 'by-catch' is discarded. Many of these by-catch species live over a wide depth range. As modern fishing gears reach down to depths of 2 000 metres, it is now having major impacts on deep-water ecosystems.

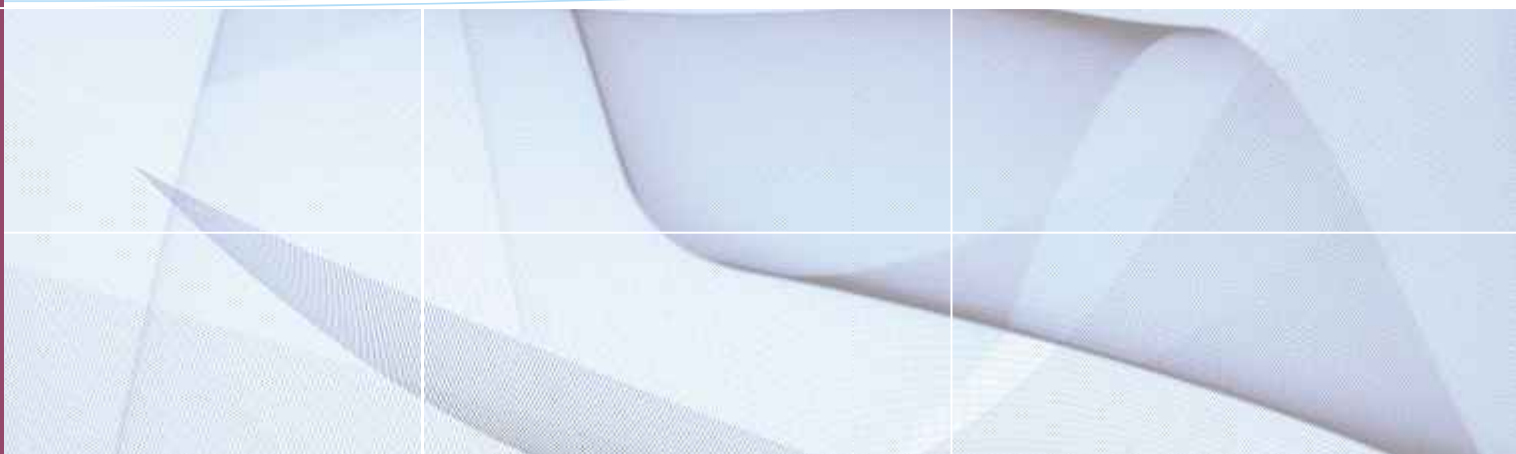
Other discoveries highlight how much we still have to learn about our continent's ocean margins. In the central Mediterranean, a 'hanging garden' of coral was discovered growing downwards from a reef, whilst a very rich deep water coral reef was found lying southeast of Scotland's Outer Hebrides islands. In the apparently barren deep Black Sea novel microbial communities have been discovered that may lead to new medicines.

Surveys of undersea canyons in the northwest Mediterranean are revealing how a type of seasonal current called Dense Shelf Water Cascading (DSWC) moves vast amounts of water and sediment to the deep ocean, reshaping the ocean floor and bringing with it oxygen and nutrients that recharge this hidden world and maintain significant shrimp fisheries. The HERMES team is concerned that climate change could reduce the frequency and intensity of this phenomenon, thereby affecting deep-sea ecosystems and the organisms that live there.

Elsewhere, scientists exploring the depths of the Tyrrhenian Sea were horrified by the amount of rubbish caught up in the coral there.

Spreading the word

The project's partners are working hard to transform their findings into policy advice for those responsible for managing Europe's deep sea environments and resources. For example, its Science Policy Panel brings together HERMES scientists and participants with representatives of key European agencies, industry and non-governmental organisations. Through this and other means, the HERMES team is helping to make sure that the people at the top know what is going on at the bottom of the sea.



SUCCESS STORIES
**LIFE SCIENCES
AND HEALTH**

New microbicides to **stop HIV** in its tracks

Scientists in the European Microbicides Project (EMPRO) are developing novel anti-HIV microbicides which will one day form a vital weapon in our arsenal against this devastating disease.

The initiative, which is the largest microbicides project in the world, brings together 27 partners in 11 countries, including 8 EU Member States, as well as Switzerland and 2 African nations. They include universities, research institutes, hospitals, pharmaceutical companies and small and medium-sized enterprises (SMEs) with expertise in molecular structure, the mechanisms of HIV infection, microbicide production and clinical testing.

Microbicides have an important role to play in preventing the spread of HIV. Because they can be used by women without the knowledge of her partner, microbicides empower women to take control of their own sexual health in situations where women are unable to force their partners to use a condom.

One product created by the project is already being tested in clinical trials, and the partners hope to have affordable microbicides, developed within EMPRO, on the market by 2012.

A global problem

According to the World Health Organization (WHO), in 2007 there were 33 million people around the world living with HIV. In the same year, 2.5 million people were newly infected with HIV, and 2 million people died of AIDS.

Sub-Saharan Africa bears a disproportionate share of the world's HIV burden; the region is home to 22.5 million HIV positive people (over two thirds of the global total), and AIDS is the leading cause of death there. Meanwhile, a number of Asian countries are also in the grip of HIV epidemics.

Antiretroviral drugs are helping to prolong the lives of many HIV sufferers. Yet these drugs do not completely eliminate HIV, and the high costs of antiretrovirals place them beyond the reach of most patients in the developing world.



Title | European Microbicides Project
Acronym | EMPRO
EC Contract number | 503558
Website | www.empro.org.uk

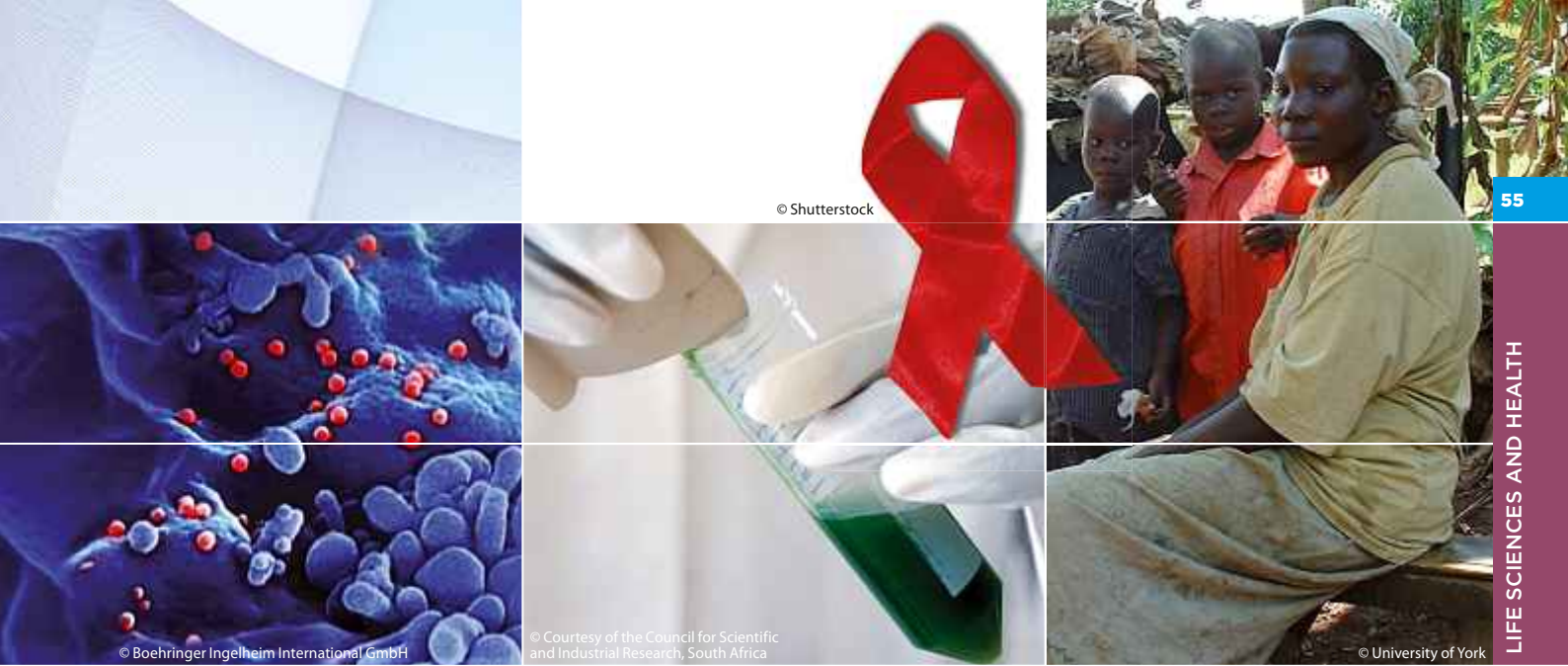
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- Polymun Scientific Immunobiologische Forschung GmbH (Austria)



Prevention is better than cure

While the hunt goes on for a cure for HIV, many researchers are focusing their efforts on ways to prevent the virus from being transmitted from one person to another in the first place.

According to the Joint United Nations Programme on HIV/AIDS (UNAIDS), 90% of cases of HIV are caught through sexual contact. Many campaigns designed to stop the sexual transmission of HIV use the ABC ('Abstain, Be faithful, Use condoms') approach. While useful, the ABC method is not without limitations.

In some areas of the world, abstinence is not an option for women who have no choice but to marry at an early age to survive. Fidelity is also no guarantee of protection: many women catch HIV from their husbands or long-term partners. Condoms are extremely effective at preventing HIV transmission, but many women are simply not empowered to force their partners to use them.

A good deal of effort is being invested in the hunt for an AIDS vaccine, although the tricky nature of the HIV virus means that an effective vaccine is still some way off.

Microbicides represent another potential tool which could stop HIV transmission through sexual contact. As yet, there is no effective microbicide on the market. Nevertheless, the potential impact of a good microbicide is immense. Studies carried out by the London School of Hygiene and Tropical Medicine suggest that even a microbicide that is only 60% effective could still prevent 2.5 million cases of HIV over 3 years, if just 20% of people in contact with local services in developing countries used it half the time.

Microbicides – empowering women

Microbicides are creams or gels that are applied to the vagina before sex to protect the woman against HIV and other sexually transmitted diseases. Because women can use them without the knowledge or consent of their partner, microbicides empower women to protect themselves against HIV.

Microbicides work in a number of ways. They form a physical barrier between the virus and the cells lining the vagina. They can also dam-

age the outer layers of the virus, prevent it from replicating, or stop it from binding to target cells. They can also be applied anally, to provide protection for men who have sex with men, as well as women who engage in anal sex.

EMPRO – delivering novel microbicides

EMPRO is investigating novel microbicides in the laboratory and taking the most promising drug candidates through the drug development process to the early stages of clinical testing.

One area under investigation is glyconanoparticle technology. Glyconanoparticles are nanoparticles that can mimic the carbohydrate structures found on the cell surface. They can block the carbohydrate-protein interactions which promote infection.

The project is also looking at the possibility of using small fragments of antibodies that can block the virus. These can be produced more efficiently and cheaply than conventional antibodies.

The best microbicide candidates are selected on the basis of scientific results from the laboratory plus a number of other criteria, such as the safety and efficacy of the drug, how easy it is to manufacture, how long it will take to develop, how much it will cost, what regulatory hurdles there might be, and whether it could generate drug-resistant HIV.

The project partners have already succeeded in taking three monoclonal antibodies to the clinical trial stage. The aim of this study is simply to see how the drugs, which have been formulated into a gel, behave in the human body, to establish the safe dose, and to find out if the drug causes any side effects.

Millions of lives saved

Despite extensive research efforts, there is still no effective microbicide on the market with which women can protect themselves. By getting a potential microbicide to the clinical trial stage, EMPRO has started to achieve its goals and also established itself as a leader in the field. The new microbicides coming out of the EMPRO project could therefore help to save millions of lives around the world.

Europe gets a head start in **synthetic biology**

Working at the interface between the life sciences and engineering, synthetic biology is an exciting new discipline which has potential applications in fields as diverse as medicine, energy and the chemical industry.

Synthetic biologists draw on engineering principles to create novel biological systems with functions that are not found in nature. For example, in the future, synthetic biology might provide us with biological tools which could detect damage in our blood vessels and repair them, or microorganisms designed to eliminate toxic waste from contaminated soil.

Although we are still some way from achieving these goals, there is growing awareness that synthetic biology has the potential to develop tools which will be of great social, environmental and economic importance. With this in mind, it is vital that Europe makes sure it takes a leading role in shaping this important new research field, and that is where the SYNBIOCOMM ('Towards a European Synthetic Biology Community') project comes in.

Linking up Europe's synthetic biologists

Europe's synthetic biology community is still rather small and scattered across different countries and different disciplines, such as molecular biology, industrial biotechnology, electrical, chemical and mechanical engineering, computer science and physics. The goals of the SYNBIOCOMM project were to bring together this diverse group of experts into a single, vibrant, synthetic biology research community, and ensure the future of synthetic biology in Europe by encouraging the next generation of scientists to get involved in this new interdisciplinary research area.

The project partners approached this challenge via two main activities: by sponsoring the participation of teams of European students in an international synthetic biology competition (iGEM), and by hosting a major conference on synthetic biology.

Sowing the seeds

The International Genetically Engineered Machines (iGEM) competition is an annual event held at the Massachusetts Institute of Technology (MIT) in Boston, US. It challenges teams of students to design their own biological systems and operate them inside living cells. The event is rapidly becoming a key event in the synthetic biology calendar: in 2007, over 700 students from 54 institutions in 19 countries, including 5 EU Member States, got involved.

One of the driving forces behind the increase in participation by European teams is the SYNBIOCOMM project. Many European synthetic biologists quickly saw iGEM as an excellent tool to bring biology and engineering students together in common research projects.

In early summer, each team undergoes an intensive training period. The students then decide on the biological design they want to create and how to go about it. The teams are provided with access to a library of 'biobricks', small DNA sequences whose biological functions are known and which the students can use to turn their ideas into reality. The teams present their finished products at the annual iGEM Jamboree, which is held at the MIT in late autumn.

SYNBIOCOMM funded the iGEM participation costs of European teams to the tune of EUR 10 000, which is equivalent to roughly half the team's total costs. The teams raised the rest of the funds from other sources.



Title | Towards a European Synthetic Biology Community
Acronym | SYNBIOCOMM
EC Contract number | 28809
Website | www.syntheticbiology.ethz.ch/synbiocomm

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Thanks to SYNBIOCOMM's support, 18 European teams took part in iGEM in 2006 and 2007. The teams sponsored by SYNBIOCOMM were highly successful; in 2006, the team from the University of Ljubljana in Slovenia scooped the top prize for designing cells which are able to stabilise the body's response to infections. And they were not the only Europeans on the podium!

The Ljubljana team worked on a condition called sepsis, which occurs when the immune system goes into overdrive and ultimately blocks the flow of blood to the organs. Sepsis is fatal in a third of cases. The Slovenians created a system which succeeded in stopping the immune response from going into overdrive while ensuring it was still able to respond to the infection.

What made the Ljubljana entry particularly remarkable was the fact that they worked with mammalian cells, which are more complicated than bacterial cells. Their project required 'biobricks' not found in the library provided for participants, and so they had to create them themselves.

Meanwhile, Imperial College London came second for their design of a device which can detect infections in urinary catheters in hospitals.

In 2007, European teams won prizes for Best Medical Project (Ljubljana, Slovenia), Best Environmental Project (Glasgow, the UK) Best Foundational Technology (Paris, France) and Best Presentation (ETH Zurich, Switzerland), among other things.

Spreading the word in Europe

Another of the project's main goals was to host the first major synthetic biology conference in Europe. The Synthetic Biology 3.0 conference was held in the Swiss city of Zurich in June 2007. The 350 participants included academics from fields as diverse as molecular biology, industrial biotechnology and chemical and electrical engineering, as well as students and representatives of industry and the media.

'Our conference was very well received. It was oversubscribed, and attracted an enthusiastic group of people,' explained Project Coordinator Sven Panke of ETH Zurich. 'Synthetic biology is a new research topic, and we were successful in spreading the word among students and scientists both.'

In fact, the conference attracted so much financial backing that the SYNBIOCOMM partners were able to increase the project's support for the student teams travelling to Boston for iGEM.

Reaping the harvest

SYNBIOCOMM has helped to create a single European synthetic biology community which is a key player internationally in this exciting new field of research. The project partners now hope to continue supporting Europe's fledgling synthetic biologists, so that as the discipline expands, Europe will be at the forefront of the latest developments.

New weapons against emerging viruses

When a new virus appears on the scene, it takes a long time to develop the drugs needed to stop it in its tracks. Now the VIZIER ('Comparative structural genomics of viral enzymes involved in replication') project is ensuring that in the future, scientists will be able to react rapidly and develop new drugs against a major class of viruses within weeks.

The project has already made important breakthroughs. New viruses carried by ticks and rodents have been identified, and findings made within VIZIER have been taken up by pharmaceutical companies developing drugs to treat Dengue Fever and Respiratory Syncytial Virus.

VIZIER is the world's largest structural genomics project to date, bringing together 23 partners from 9 EU Member States, plus Russia. The team brings together scientists from virology, protein work, biochemistry, crystallography and drug design, among other fields.

Waking up to the threat

The relative absence of deadly viruses in Europe has lulled many of us into a false sense of security about the threats to our health. But when the world was hit by Avian Influenza and Severe Acute Respiratory Syndrome (SARS) outbreaks in recent years, it became

more apparent than ever that Europe is not immune to the threats of new and lethal viruses. Meanwhile, known viruses continue to claim the lives of millions of people in less developed parts of the world.

The VIZIER project is focusing its efforts on RNA viruses, so named because of the ribonucleic acid in their genetic material. Over 350 RNA viruses which can infect humans have been identified, including gastroenteritis, measles, influenza, yellow fever and hepatitis C. Together they are the cause of millions of deaths every year, yet our knowledge of their genetic make up and structures is relatively poor.

The aim of VIZIER is to investigate over 300 of these viruses in depth with the aim of identifying new drug targets. The team's research takes place in five stages: collecting viruses, sequencing them, protein production, crystallisation and the initial steps of drug discovery and design.



Title | Comparative structural genomics of viral enzymes involved in replication

Acronym | VIZIER

EC Contract number | 511960

Website | www.vizier-europe.org/

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- Swedish Institute for Infectious Disease Control (Sweden)
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A step-by-step approach to understanding viruses

The research begins with the collection of viruses from around the world. When the project began, many of these viruses were already stored in some of the project partners' laboratories. But others had to be collected. In doing so, the project has created a series of biodiverse libraries that should help scientists to deal with any future virus outbreaks.

Once they have been collected, the genome of the virus is sequenced. Sequencing allows scientists to see what is involved in the replication of each individual virus and also create a three-dimensional model of the protein produced by the virus.

Using bacteria to farm proteins

The next stage of the project involves investigating the proteins involved in virus replication. The gene for the protein is injected into a bacterium, which is used as a factory to create the protein. While this works for some proteins, others have to be grown in a cell closer to that in which it would normally live. High-tech labs in France and the UK are being used for this part of VIZIER.

The next stage – crystallisation – is where VIZIER has had many of its breakthroughs. Indeed, the success of the project depended upon crystallisation of proteins, as crystals are essential for determining the molecular form of the protein that spreads a virus and thus for developing drugs. Results here have exceeded expectations, according to project coordinator Bruno Canard from the Université de la Méditerranée in France. Over 70 new crystal structures of original viruses within the RNA virus family have already been created.

VIZIER clears obstacles to crystal creation

Previous projects have had only limited success with creating crystals. Dr Canard believes that VIZIER succeeded where others experienced difficulties because of the multidisciplinary nature of the project and the exceptional communication between the partners.

The high-throughput methods used by the project also proved to be groundbreaking. Creating crystals is often the bottleneck of this type of research. The previously laborious process involved one scientist working solely on one protein. Discoveries could take years. VIZIER's high-throughput methods, involving robotics, are what made the creation of so many crystals possible.

Once the crystals are formed, they are put into a synchrotron. The ring of the synchrotron carries electrons travelling close to the speed of light. They produce an intense source of X-rays that can be used to illuminate the molecular form of the proteins within. Knowledge of this molecular form can help scientists to design a compound that will stop the virus from replicating.

Preparing for future epidemics

Knowing that one virus is similar in structure to another provides clues as to which compounds might work. When SARS emerged in 2002, previous work on related viruses meant that a potential drug was developed within weeks of the virus being identified. The epidemic claimed 774 lives, but this number could have been devastatingly higher. The VIZIER project was set up in the aftermath of this crisis, with the aim of ensuring that reaction times will be equally fast if and when a new virus emerges. All findings will be stored in databases that can be accessed by the scientific community.

We don't know where the next deadly virus will come from, or when it will strike, but thanks to projects like VIZIER, we will be better equipped to respond to it before it turns into a full-blown epidemic.

Tailored treatments for **breast cancer**

Breast cancer patients could soon benefit from highly individualised treatment, thanks to the diagnostic tools being developed by the TRANSBIG project. Among other things, TRANSBIG is running a major clinical trial to test the effectiveness of a tool to identify which women need chemotherapy after surgery (called adjuvant chemotherapy), and which do not.

If it works, the tool will spare many women from undergoing adjuvant chemotherapy unnecessarily, saving them from unpleasant side effects and also saving health systems the costs of treating patients with drugs they do not need.

TRANSBIG, which is coordinated by the Breast International Group (BIG), brings together 40 partners from 21 countries. They include universities, research institutes and hospitals with expertise in biomedical technologies and cancer treatment, patient organisations, cancer societies and small biomedical companies. Its overall aim is to translate the results of experiments in laboratories into tools that doctors can use to treat breast cancer patients more effectively.

Breast cancer basics

Breast cancer is the most common cancer among women in developed countries, where one woman in eight develops the disease

at some point in her life. According to the International Agency for Research on Cancer, 320 000 women were diagnosed with breast cancer in the EU in 2006, and 85 000 died of the disease.

If diagnosed and treated promptly, breast cancer is curable in roughly two thirds of cases. Many women are given chemotherapy or hormone treatments after surgery to prevent the cancer from recurring. These treatments bring with them a range of unpleasant side effects, which may include secondary cancers, heart problems, early menopause and reduced cognitive function.

While some women need these cancer treatments, others do not. It is thought that between 12 % and 20 % of early breast cancer patients are over-treated. The TRANSBIG consortium is drawing on the outcomes of basic research to develop tools which can help doctors answer two key questions: which patients need treatment, and what is the best treatment for each patient?



Title | Translating Molecular Knowledge into Early Breast Cancer Management: Building on the Breast International Group (BIG) Network for Improved Treatment Tailoring
Acronym | TRANSBIG
EC Contract number | 503426
Website | <http://www.breastinternationalgroup.org/TransBIG.aspx>

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- Imperial College (UK)
- The European Organization for the Research and Treatment of Cancer (EORTC) (Belgium)
- The University of Edinburgh (UK)
- Vienna General Hospital (Austria)
- Chilean Cooperative Group for Oncologic Research (Chile)
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- Institut Gustave Roussy (France)
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- Gruppo Oncologico Italiano di Ricerca Clinica (Italy)
- Centre Hospitalier de Luxembourg (Luxembourg)
- University Hospital (The Netherlands)
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- N. N. Blokhin Cancer Research Centre (Russia)
- Institute of Oncology (Slovenia)
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- Europa Donna – The European Breast Cancer Coalition (Italy)
- Instituto de Patologia e Imunologia Molecular da Universidade do Porto (Portugal)
- German Research Center for Environmental Health (Germany)
- Agendia (The Netherlands)
- International Institute for Drug Development (Belgium)
- Fundacion Institut per la Recerca Vall d'Hebron (Spain)
- Grupo Español de Estudio, Tratamiento y otras Estrategias Experimentales en Tumores Sólidos (SOLTI) (Spain)
- Swiss Institute of Bioinformatics (Switzerland)
- The Chancellors Masters and Scholars of the University of Oxford (UK)
- The University of Dundee (UK)



The way breast cancer develops varies from one woman to another. Traditionally, the aggressiveness of the tumour is determined on the basis of clinical and pathological criteria such as the patient's age, the tumour's size, the appearance of the tumour cells (their 'grade') under the microscope and the presence of hormone and HER-2 (human epidermal growth factor receptor 2) receptors on the tumour cells.

Advances in fields such as genomics mean that we now have a better understanding of the biological differences between tumours. One of the main messages is that breast cancer is a very heterogeneous disease with several different subtypes that behave quite differently. This is why we need more individualised approaches to treating breast cancer.

Testing new technologies to tailor treatments

The project's first major initiative is an international clinical trial called MINDACT (Microarray for Node Negative Disease may Avoid ChemoTherapy). Node-negative breast cancer is a cancer that has not spread to the surrounding lymph nodes and so has a lower risk of recurrence. Patients with this variety of cancer are often given chemotherapy, even though 15% of them do not need it.

The aim of MINDACT is to compare the traditional method of assessing a tumour's aggressiveness with a new method called the 70-gene prognostic signature (Mammaprint®). As the name suggests, the new method analyses the activity levels of 70 genes inside the tumour. Previous research suggests that the 'signature' pattern of these genes can accurately predict whether or not a woman's breast cancer will return.

In the trial, a tissue sample from the patient is sent to the laboratory where it is subjected to both traditional tests and the new test. If both methods indicate a low risk of recurrence, chemotherapy is not recommended. If both methods suggest a high risk of recurrence, the patient is advised to have chemotherapy.

However, in cases where the tests disagree, some patients are treated on the basis of the result of the traditional test, and some are treated on the basis of the result of the new test. Needless to say, all patients involved in the trial are closely monitored by doctors throughout the process. The trial includes some 6 000 women from 250 institutions around the world.

The project partners predict that using the 70-gene test in combination with the traditional clinical pathological analysis will provide a more accurate picture of the risk of recurrence for the patients. And some 10% to 20% of women with node-negative breast cancer will be able to avoid chemotherapy and the side effects that come with it.

Recently, the 70-gene test was validated as a tool in breast cancer involving one to three lymph nodes. Consequently, those patients will be able to enter the trial very soon. MINDACT's new name (Microarray for Node Negative and 1 to 3 Positive Nodes Disease may Avoid ChemoTherapy) reflects this development.

Leaving a lasting legacy

In addition to carrying out research, the project partners are also engaged in education and outreach activities. They provide traineeships for young scientists and physicians and work closely with patient groups to inform them of the latest developments in genomics research.

In the long term, the project partners hope to turn TRANSBIG into a permanent network for translational breast cancer research that will act as a bridge between the researchers working in laboratories and the physicians and patients in the clinic.

However, the project's real legacy will be the improved quality of life experienced by the many women who will be spared unnecessary adjuvant chemotherapy thanks to TRANSBIG's work.

BARP+ artificial pancreas gives high hopes to diabetics

People suffering from type 1 diabetes could soon see their quality of life improve dramatically thanks to the work of the BARP+ ('Development of a bioartificial pancreas for type 1 diabetes therapy') project.

As the name suggests, the aim of the project is to develop a bio-artificial pancreas which can be implanted into diabetics, freeing them from their regime of daily insulin injections and dietary restrictions. This artificial pancreas is not yet ready for implantation in humans, but it has already been successfully tested in small animals and preliminary experiments performed in pigs.

The project brought together 14 partners from 5 EU Member States. They include experts from fields as diverse as biochemistry, medicine, physiology, surface treatment, biomaterials, polymers and chemistry.

The project partners have already achieved a great deal; the concept for their bioartificial pancreas, in which insulin-producing cells are embedded in a membrane, has been validated by the project researchers and transplants have already been carried out in small pigs using a prototype of the device.

Dealing with type 1 diabetes

In healthy people, blood sugar levels are regulated by a hormone called insulin, which is produced by the β -cells of the pancreas. However, in people with type 1 diabetes, these β -cells are destroyed by the body's own immune system, and so the pancreas is unable to produce enough insulin.

Without insulin, blood sugar levels soar – a condition known as hyperglycaemia. Long-term exposure to high levels of glucose can damage the vital organs, and diabetics are particularly vulnerable to a range of health problems including heart disease, poor circulation, kidney problems, eye problems and nerve degeneration. Over 210 million people worldwide, including 25 million in the EU, suffer from diabetes, and 15 % of these cases are type 1 diabetes. Most type 1 diabetics are diagnosed early on in life.

Currently, sufferers of type 1 diabetes manage their condition by injecting themselves with insulin at least once a day and following a strict diet. Type 1 diabetics must also check their blood sugar levels regularly, and have frequent medical check-ups to pick up on the early signs of the complications associated with their condition.

Needless to say, many diabetics struggle with the self-discipline required to monitor their diet and lifestyle and none relish the thought of using a needle every day for the rest of their lives. Furthermore, the insulin injections do not always control blood sugar levels perfectly. All of this seriously affects diabetics' quality of life.



Title | Development of a bio-artificial pancreas for type 1 diabetes therapy
Acronym | BARP+
EC Contract number | NMP3-CT-2003-505614

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- Centre National de la Recherche Scientifique (France)
- Bayerische Julius-Maximilians-Universität Würzburg (Germany)
- Istituto di Ricerche Farmacologiche 'Mario Negri' (Italy)
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- Institut National de la Recherche Agronomique (France)
- Istituto Nazionale per la Fisica della Materia (Italy)



Recently, advances have been made in a new treatment which involves implanting replacement pancreatic cells into a diabetes patient. However, while this treatment is effective, it is not without limitations. The first problem is the small number of cell donors. However, the main challenge facing doctors is the fact that the human body is programmed to attack and reject any foreign tissue. To overcome this immune response, transplant patients must take immunosuppressant drugs. However, by definition, these weaken the immune system, leaving the patient vulnerable to infections.

Sneaking cells past the immune system

The BARP+ approach to the problem was to hide the implanted cells from the immune system by placing them inside a system of artificial membranes. The challenge for the researchers was to create a system which would allow the easy exchange of nutrients, oxygen and insulin while shielding the cells from the immune system.

The team had to overcome a number of problems in the design of the device, including a lack of oxygen (hypoxia), which the researchers addressed by adding fluorocarbons (inert liquid organic compounds) to the device.

The fluorocarbons also proved effective at having a beneficial effect on tissue preservation and also tackling another problem, namely the aggregation of pancreatic cells within the device. Another innovation was the use of multiple layers; this enabled the researchers to give different functions to different layers. Meanwhile, the use of a molecule which promotes the growth of blood vessels helped to ensure the device's blood supply.

The resulting bioartificial pancreas comprises a sheet of pancreatic cells which have been encapsulated in a layer of artificial membranes. Because the system removes the need for immunosuppressive treatment, it raises the possibility of xenotransplantation – the use of pancreatic cells from non-human origin.

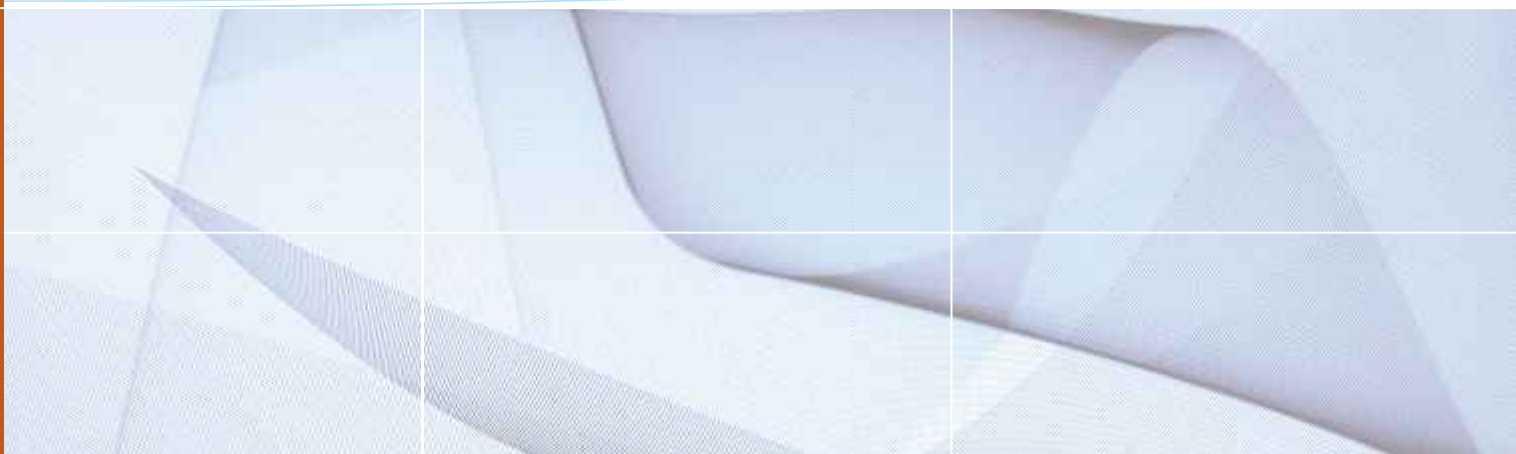
As there is a severe shortage of cells from human donors, animals represent an important potential source of cells and organs for transplant purposes. However, the strong immune response triggered by these animal cells represents a major barrier to xenotransplantation.

From laboratory to clinic

The team's designs have already been tested and validated in laboratory conditions. Tests in pigs are helping scientists to establish the best location for the implant. Ideally, it should not affect the functioning of other organs, but at the same time, the cells must be able to receive the nutrients and oxygen needed to keep them alive. The scientists must also establish whether or not the fragile device can survive in close proximity to other working organs. Other tests in this phase of the project include pig-to-pig cell transplants.

The information gleaned from this work is providing researchers with the information needed for performing this sort of operation on human diabetic patients in the near future.

Until recently, very little research into the potential of a bioartificial pancreas had been carried out. Thanks to the BARP+ project, Europe now leads this young field, and type 1 diabetics everywhere can look forward to the prospect of a healthier future and a better quality of life.



SUCCESS STORIES
**FUNDAMENTAL
RESEARCH,
INDUSTRIAL RESEARCH
AND NANOTECHNOLOGIES**

CHIRALTEM – a new spin on **microscopy**

In 2003, two physicists in Vienna were playing around with equations involving electrons. The resulting formula suggested that something which was once thought impossible might just be possible after all.

In short, it seemed that it might be feasible to use a Transmission Electron Microscope (TEM), of the kind found in labs around the world, to study the magnetic properties of materials in minute detail. At the time, these studies were carried out in synchrotrons, which are large, expensive and rather rare.

To see if their theory would work in practice, the Austrian scientists joined forces with a multidisciplinary team from the Czech Republic, Germany and Italy to work on the CHIRALTEM (Chiral Dichroism in the Transmission Electron Microscope) project. At the time, they were the only team in the world investigating this idea.

The researchers proved that TEMs can indeed reveal information on the magnetic properties of materials. Furthermore, the level of detail surpasses that of other techniques such as x-ray magnetic circular dichroism (XMCD). The discovery could prove useful for many applications, including quantum computers, which store data using the spin of electrons.

Probing matter with electrons

Since the 1930s, researchers have used TEMs to study materials at minute scales. They are used to study the interior of cells and the structure of crystals, for example.

TEMs work in a similar way to ordinary light microscopes, simply replacing the light with a beam of electrons, which is focused with magnetic lenses. As electrons have a much lower wavelength than visible light, TEMs offer much greater magnification and higher resolution than light microscopes.

One drawback of TEMs is their inability to examine the magnetic characteristics of certain atoms in a sample. In theory, a TEM could be used to do this if it could produce a polarised beam of electrons, in which all the electrons are spinning in the same direction. However, as the beam of electrons produced by TEMs is unpolarised, physicists simply assumed that they could not be used to study the magnetic properties of a specimen.

A tricky technique

Until now, the only available method for studying a material's magnetic properties was 'X-ray magnetic circular dichroism' (XMCD). XMCD exploits a phenomenon called circular polarisation. This occurs when electromagnetic waves, such as visible light, appear to spin around the beam of light's direction of travel, like an arrow spinning in flight.



Title | Chiral dichroism in the transmission electron microscope
Acronym | CHIRALTEM
EC Contract number | 508972
Website | www.chiralttem.physics.at/

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- Universität Regensburg (Germany)



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Vienna University of Technology

In XMCD, a polarised beam of x-rays is directed at a sample. The way the x-rays are absorbed by the material is affected by the direction of the magnetic field, an effect called dichroism. XMCD is not without drawbacks – the resolution is not as high as that achieved with a TEM, and one widely used technique – x-ray induced photoemission electron microscopy (XPEEM) – is only able to probe the surface of a material. The main problem with XMCD is the fact that it requires a synchrotron to generate the x-ray beam. Synchrotrons are extremely expensive and relatively rare.

Taking a gamble

The equation the scientists had worked out on paper appeared to challenge the idea that TEMs could not study the magnetic properties of a sample. But would it work in practice? The aim of CHIRALTEM was to find out, and if it worked, compare the new technique to XMCD. No one had tried anything like this before, and there was no guarantee of success.

The project partners investigated magnetic materials in a TEM, to see if the so called dichroic effects could be detected. To achieve this, the scientists had to determine the best way of preparing the samples and controlling the magnetic field within the TEM.

The team soon proved that it was indeed possible to detect magnetic effects using the ordinary beam of electrons found in a normal TEM. The CHIRALTEM researchers called their technique 'electron energy-loss magnetic chiral dichroism' (EMCD). Their results were published in the prestigious scientific journal *Nature* in May 2006.

EMCD offers many advantages over other techniques. The high resolution offered by the TEM means it can discern magnetic structures 10 times smaller than those identified by existing x-ray techniques.

With EMCD, TEMs can now study the crystallography, morphology, chemistry and magnetic properties of a sample in one go.

A wealth of possibilities

The successful outcome of the project opens up a wealth of possibilities, and EMCD could become a new method for analysing and characterising the magnetic properties of materials at the nanometre scale. It could also be used to improve our understanding of magnetic phenomena in certain chemical elements and is ideal for the study of thin magnetic films.

In biology, EMCD could be a valuable tool for those studying the large numbers of life forms which are able to detect the Earth's magnetic field and use it to navigate. Many creatures, including birds, bacteria and reptiles, have a built-in compass. Pigeons have magnetic material in their beaks, for example. Studying how living creatures use the Earth's magnetic field could teach us how animals navigate during migration, for example.

In industry, EMCD could be valuable for investigating the materials to be used in miniaturised recording devices, or in computers that store data on the spins of electrons.

The CHIRALTEM project partners are now working to promote contact between electron microscopists and synchrotron users, as these groups have had little to do with each other in the past and a closer working relationship will be of huge benefit to future study in this field.

By proving that something once thought impossible is in fact possible, CHIRALTEM has highlighted the pioneering nature of European research and opened up a new and exciting field of research whose full potential is just beginning to be realised.

Let there be light – Europe's brightest light sources

Scientists across Europe are benefiting from easier access to Europe's best synchrotron and free electron laser facilities thanks to the IA-SFS (Integrating Activity on Synchrotron and Free Electron Laser Science) project.

Synchrotrons and free electron lasers are extremely bright light sources which are used in disciplines as diverse as physics, materials sciences, chemistry, biology, imaging and microfabrication, allowing a wide range of applications including, among many others, the analysis of archaeology and cultural heritage artefacts.

Europe is home to several of the best facilities in the world in this field, and the aim of the IA-SFS project is to link up these important light sources and optimise access to them. The 16 project partners come from 7 EU countries plus Switzerland; 12 of the partners host a synchrotron source and 3 host a free electron laser. The consortium is completed by the European Molecular Biology Laboratory (EMBL), one of the world's leading molecular biology research institutions and a user of these facilities.

The result is the largest network of free electron lasers and synchrotrons in the world, serving several thousand European scientists, with access to the facilities based solely on merit.

Shining a light on molecular mysteries

Synchrotrons and free electron lasers have a wide range of applications. They can be used to explore the nature of chemical bonds in new compounds, investigate the bonding of molecules to a solid surface and probe the arrangement of atoms in a biological macromolecule. With these facilities, scientists can also obtain three dimensional images of tissue samples and even cut nanoscale patterns and devices for industrial applications.

The knowledge gained through these facilities can be used for anything from understanding diseases and designing drugs to data storage and developing energy efficient technologies.

Synchrotrons and free electron lasers explained

The first step in the process of generating synchrotron light involves firing a stream of charged particles like electrons and accelerating them to within a whisker of the speed of light. They are then injected into a storage ring, where powerful magnets force the speeding electrons to travel in a giant circle. As the particles are deflected by the magnets, they emit light spanning all wavelengths from the infrared to x-rays. This light can be selected by wavelength and channelled into narrow, intense beams which are projected to experimental stations where samples are placed.



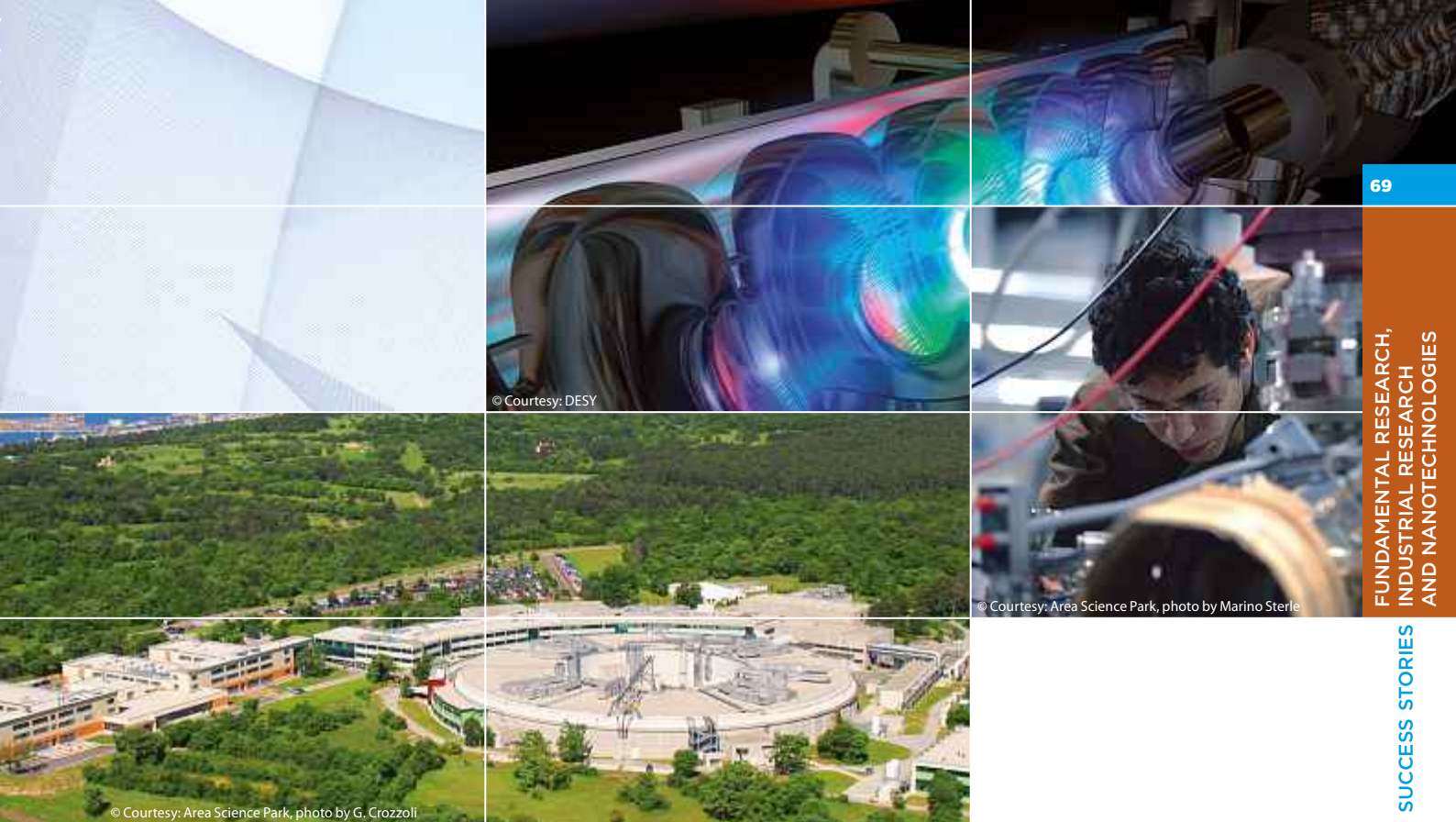
Title | Integrating Activity on Synchrotron and Free Electron Laser Science
Acronym | IA-SFS
EC Contract number | RI13-CT-2004-506008
Website | www.elettra.trieste.it/I3

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- Centre National de la Recherche Scientifique (CNRS) (France)
- Stiftung Deutsches Elektronen-Synchrotron (DESY) (Germany)
- Diamond Light Source, Ltd (Diamond) (UK)
- European Molecular Biology Laboratory (EMBL) (Germany)

- European Synchrotron Radiation Facility (ESRF) (France)
- Forschungszentrum Dresden-Rossendorf e.V. (FZD) (Germany)
- Stichting voor Fundamenteel Onderzoek der Materie (FOM) (The Netherlands)
- Aarhus Universitet (ISA-UA) (Denmark)
- Lunds Universitet (MAX-Lab) (Sweden)
- Paul Scherrer Institut (PSI) (Switzerland)
- Société Civile Synchrotron Soleil (SOLEIL) (France)
- Science & Technology Facilities Council (STFC) (UK)
- Istituto Nazionale di Fisica Nucleare (INFN) (Italy)



Free electron lasers work on a similar principle. Here, a beam of electrons travelling close to the speed of light is forced into a sinusoidal path by a series of magnets. These rapid changes in direction force the electrons to emit photons of light. The result is a powerful laser whose wavelength can be tuned to a wide range of frequencies, ranging from microwaves and infrared radiation, to the visible spectrum, ultraviolet light and x-rays.

Creating a European network of light sources

In a field of technology with such a broad range of applications, it is vital for Europe to streamline its activities and develop a coherent, continent-wide approach in order to avoid duplications, reduce waste and make the best possible use of resources. Only by doing this can Europe stay ahead of international competition.

The IA-SFS project is using a three-pronged approach to tackle these problems. Through networking activities they are reaching out to the next generation of users and stimulating new ideas and collaborations. At the same time, the project is organising joint research activities on new instruments and developing novel radiation sources.

However, the most important strand of the project is its work in facilitating cross-border, transnational access to the synchrotrons and free electron lasers involved in the project. The sole criterion for access to the facilities is scientific merit. This means that scientists based in countries lacking these infrastructures can now access them on equal terms with local scientists, and the benefits these infrastructures bring are no longer restricted to the small number of countries that can afford them, but are spread throughout the whole of Europe.

According to the President of the IA-SFS Council, Professor Giorgio Margaritondo of the Swiss École Polytechnique Fédérale de Lausanne (EPFL), this is one of the project's greatest achievements.

'By providing support for transnational access, the project opened up a large number of national facilities to scientists from all over Europe,' he explains. 'Almost 2 000 experiments were supported in the first three project years. This boosted the use of the facilities and the return of the corresponding investment – for a very small additional cost.'

Another plus point of this arrangement is that it helps to plug the brain drain. Because scientists can now make use of state-of-the-art light sources in other countries, scientists whose work requires the use of a synchrotron or free electron laser are no longer forced to migrate to develop their research potential. This is particularly important for junior scientists.

Furthermore, by linking up the light sources, IA-SFS has helped to further boost Europe's position as a world leader in the field, as the project has created a healthy level of competition between the facilities to attract the most prestigious users and the best research proposals. At the same time, the cooperative spirit of the partners ensures that facilities which are oversubscribed can channel users to other member facilities.

Towards an even brighter future

The project partners are keen to carry on their cooperation and push the boundaries of the technology to the limit, so that Europe's top scientists can continue to have access to the world class facilities Europe has to offer, wherever they may be.

Nanopatterning: tiny technology, huge impact

They may not be visible to the naked eye, but the minute trenches, ridges, curves and grooves of nano-structured patterns and surfaces have a very visible impact in a wide range of fields, from micronanoelectronics to photonics, security, biotechnology and medicine.

Creating patterns and structures at this scale (a nanometre is a billionth of a metre) is a delicate task which is only possible with special techniques and methods. Thanks to the NaPa ('Emerging Nanopatterning Methods') project, Europe's capabilities in this exciting new field are now stronger than ever. The project brought together 36 research groups from 12 EU Member States plus Switzerland and Russia. The team, which included some 80% of Europe's key players in the field, contained an even mix of scientists from industry, research institutes and universities.

By working together, they created a vibrant, united nanopatterning research community in Europe. In addition to developing new materials and tools for nanopatterning, the project partners filed several patents, published hundreds of articles and founded three spin-off companies. The project partners are continuing to work together to bring their results closer to commercialisation.

Creating common knowledge and standards

When the project started, Europe's nanopatterning research community was fragmented, and high costs, combined with a lack of standards, tools and processes, meant that this promising technology was not being fully exploited.

With this in mind, the first task of the NaPa consortium was to pool their nanotechnology knowledge and know-how and disseminate it across Europe. At the same time, the project partners worked on developing upscalable processes for nanopatterning.

An important product which came out of this work is the NaPa process library, which sets out the tools, materials and processes involved in the manufacturing of a number of products which involve nanopatterning, such as polymer-based optical elements, organic LEDs (light-emitting diodes), or lab-on-a-chip systems.

The library is designed for companies interested in developing products involving nanopatterning. Nanopatterning has applications in many fields, and so could potentially be used by a wide range of companies in Europe and elsewhere. They will be able to pick the appropriate nanopatterning process from the library, thereby saving them from having to develop it themselves.

Developing new nanopatterning devices

The project partners have also been working on new devices to make nanopatterning more effective. Previously, nanopatterns were created using a technique called e-beam lithography. However, this took a long time and only worked on smaller surfaces.

The new technique developed by NaPa is faster and works on larger surfaces. The researchers took their inspiration from the more traditional embossing process, in which a mould is pressed into a soft material to create the required pattern. The achievement of the NaPa team was to miniaturise this technique down to the nanoscale level.



Title | Emerging Nanopatterning Methods
Acronym | NaPa
EC Contract number | 500120
Website | www.napaip.org

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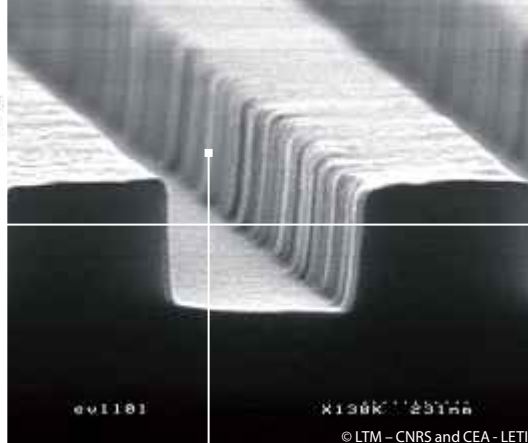
- Centro Ricerche Fiat Società Consortile per Azioni (Italy)
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- Istituto Nazionale per la Fisica Della Materia (Italy)
- Centre National de la Recherche Scientifique (France)
- Amo GmbH – Gesellschaft Für Angewandte Mikro- Und Optoelektronik mbH (Germany)
- International Business Machines Corp (US)
- Micro Resist Technology GmbH (Germany)
- Suss Microtec Lithography GmbH (Germany)
- Fundación Cidtec – Centro de Tecnologías Electroquímicas (Spain)
- EV Group E. Thallner GmbH (Austria)
- Fundación Inasmet (Spain)
- Linköpings Universitet (Sweden)

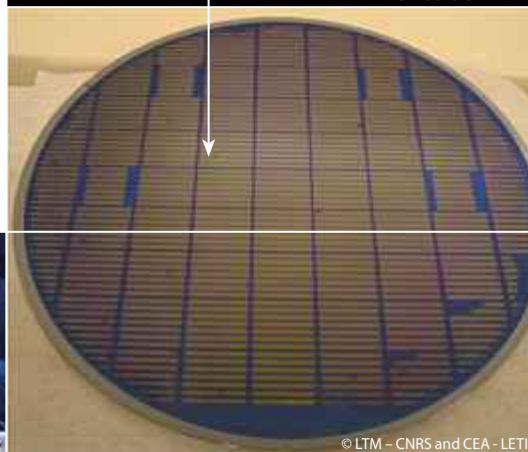
- Lunds Universitet (Sweden)
- Universiteit Twente (The Netherlands)
- Danmarks Tekniske Universitet (Denmark)
- Nanocomms Ltd (Ireland)
- NPL Management Ltd (Sweden)
- Obducat AB (Sweden)
- Paul Scherrer Institut (Switzerland)
- Fundación Tekniker (Spain)
- University Of Glasgow (UK)
- Politechnika Warszawska (Poland)
- IBM Research GmbH (Switzerland)
- SUSS Microtec S.A.S. (France)
- Smart Equipment Technology S.A.S (France)



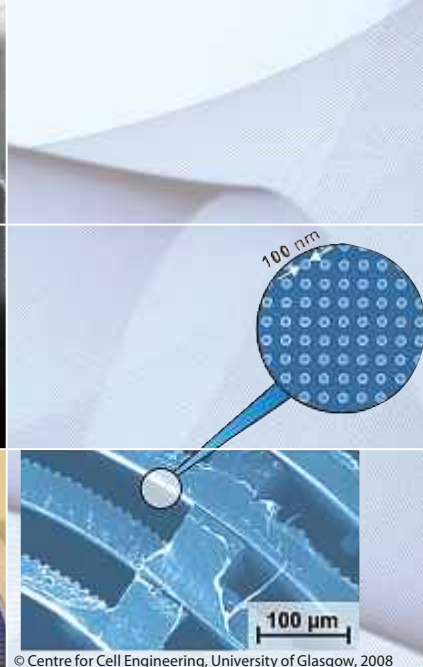
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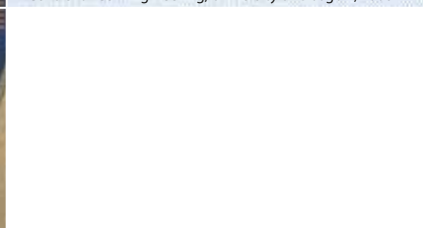
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In their system, a patterned silicon chip is used as a stamp, and the pattern is transferred to a polymer layer by imprinting. This method allows manufacturers to replicate sub-100 nm scale geometries on much larger areas. Another advantage of the system is its ability to create nanopatterns on optical and electronic materials and biomaterials. In electronics, for example, advances in nanopatterning are key to reducing the size of transistors in microchips, making them faster and more powerful.

Training up the next generation

Another important strand of the project involved education and training. As more and more nanotechnology applications emerge, it is estimated that in the next 10 years alone, the nanotechnology sector will need an extra 400 000 trained people, including scientists, technicians and engineers working in a wide range of disciplines.

To address this need, the project partners set up the highly successful PANAMA ('Patterning at the Nanoscale – Methods and Applications') summer school. Over 3 editions, more than 70 young scientists from a range of disciplines received training in nanopatterning through both theoretical classes and hands-on experiments. Combined with the postgraduates and young scientists, the number of young people trained in the project exceeds 200.

Targeting an even younger audience, NaPa also produced a video for children aged between 10 and 14. The film follows the adventures of two young children in nanotechnology; the aim of the product is to awaken young people's interest in nanotechnology and encourage them to see it in a positive light.

Next steps for NaPa

As a relatively new technology with potential applications in so many fields, nanopatterning clearly has great commercial potential. The project has already filed several patents for its technologies and even established three spin-off companies, in Denmark, France and Switzerland. The Danish company specialises in the manufacture of stamps for nanoimprint lithography (NIL), carries out nanoimprint services and offers nanoimprint consultancy advice. The French company provides services for innovative technologies, while the Swiss company does the same for nanopatterning.

According to the project partners, part of the project's success is due to the way the partners created a strong community spirit, thanks to which they have been able to benefit from the added value that comes from joining forces. As a result of their openness and cooperation, NaPa is now the state-of-the-art driver in the field.

Greener and faster: the NEXT generation of machines

Europe has long been a world leader in machine building, and now the NEXT project is helping to ensure that Europe maintains that position in the face of increasing competition from emerging economies and growing environmental concerns.

Europe's knowledge and innovative drive powered the industrial revolution, introducing machines into the production process and changing society forever. Since then, Europe's position as a leader in machine building has remained unchanged. But because of increased competition from other parts of the world, as well as pressure to reduce the environmental impact of the industry, following a traditional approach to machine building and manufacturing processes is no longer an option.

The NEXT project, bringing together 23 partners from 8 EU Member States and Switzerland, is ensuring that Europe stays ahead of the game in the field of production systems and devices. The project has five main aims: to make production machines more environmentally friendly; to make them more autonomous; to improve performance; to develop a new business paradigm for machinery; and to share new knowledge.

The NEXT results are promising in all of these areas. Project coordinator Dr Rikardo Bueno of Spain's FATRONIK-Tecnalia is confident that the impacts will be felt far and wide. He expects some of the project partners to be using new machines within a year of the project ending, and foresees other companies taking up the new designs soon afterwards.

'This is the first time that there has been such a large project, bringing together all the most relevant companies,' says Dr Bueno. Between them the partners represent the sectors that use machine tools the most: automotives and electronics.

Green machines

The aim when starting the project was to use recycled materials for machine elements, to reduce the energy consumption of machines by at least 25 %, to cut waste to zero, and to make the dismantling and recycling of machines the norm.

The NEXT project has made great strides towards achieving these goals. The prototype 'green machines' developed by the project consume significantly less energy and water than traditional machines, while building the machines also uses fewer resources.

These green machines are all close to the market. No less valuable for machine users is a new evaluation process for assessing the lifecycle of a new machine. The system will help potential customers to choose between the range of processes available and select the most appropriate machine. This will save companies time and money and thus boost competitiveness.



Title | NEXT Generation Production Systems
Acronym | NEXT
EC Contract number | 11815
Website | www.nextproject.eu

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- Ce.S.I Centro Studi Industriali (Italy)
- Danobat S. Coop (Spain)
- EX-CELL-O G.m.b.H. (Germany)
- Universität Hannover (Germany)
- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung eV (Germany)
- Ecole Polytechnique Fédérale de Lausanne (Switzerland)
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- Ona Electroerosión S.A. (Spain)
- Katholieke Universiteit Leuven (Belgium)
- Consiglio Nazionale delle Ricerche (Italy)
- Robert Bosch GmbH (Germany)

- Siemens AG, Automation & Drives, Motion Control Systems (Germany)
- Fidia S.p.A. (Italy)
- Rheinisch-Westfälische Technische Hochschule Aachen (Germany)
- Fundación Tekniker (Spain)
- EMCO MAIER Ges.m.b.H. (Austria)



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New ways of doing business

NEXT has also made breakthroughs in non-technical areas. The team was aware that both customer and machine builder could gain from changing the way they work together.

The team looked at various ways of transforming the usual commercial relationship into a long-term partnership, including a redistribution of responsibilities for the construction of the machine, its operation and its maintenance. In such a set-up, the risks of constructing and then using a machine are shared. The user benefits from the increased involvement of the machine builder during the apparatus' lifecycle, while the machine builder sees to what extent the customer is satisfied and modifies its products accordingly. The machine builder will also have more control over how the machine is used, as well as access to old parts for re-use.

Sharing the knowledge

The NEXT team has also carried out training sessions on new business models and evaluating quality. In addition to this, it has set up an e-learning platform in order to ensure that the new knowledge acquired during NEXT is disseminated as widely as possible.

While large machine building companies are likely to be the main benefactors from the project results, small and medium-sized enterprises (SMEs) will not be left out. A new SME office established by the project partners is making sure that small companies all around Europe are aware of the research being done by NEXT. The project also generated business for some SMEs not involved directly in NEXT by forging links between them and the larger companies participating in the project. Sometimes an SME can develop the solutions that a larger company is working on, or supply specific components.

It seems likely that Europe will remain the heartland of machine building for some time to come. This is good news for the continent's machine builders and also for the manufacturing sector as a whole: faster, environmentally friendly machines mean faster, environmentally friendly production.

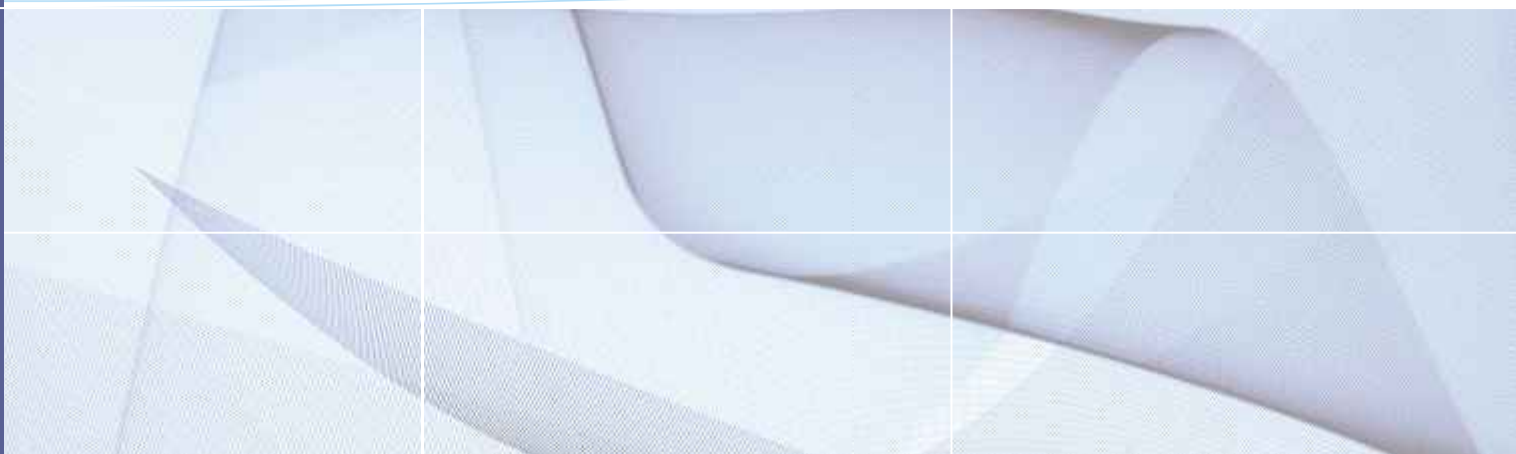
Easier to use

Any machine operator will say that their job would be easier if their apparatus needed less human instruction. The NEXT team has achieved this. The autonomous prototypes of milling machines have the bonus capacities to self-monitor and self-correct.

The automatic recognition of machining tasks and processes will be welcomed by machine users. It is achieved through thermal compensation (which stabilises the performance of a component), monitoring through sensors and the recognition of signals. Other NEXT innovations include automatic tuning for control. Setting up a machine for working on a new part is currently very time consuming, but automatic recognition means that this can be done in minutes.

New frontiers for production systems and devices

Ultimately what will make European machine builders more competitive is improving the performance of machines. The NEXT team uses new lightweight materials with high damping capacity and good thermal stability properties for machine components, enabling machines to work faster. The new materials also increase the lifespan of components, saving businesses money and saving on resources. For example, traditional cast iron is being replaced by lighter materials, thereby saving power consumption.



SUCCESS STORIES
**TRANSPORT
AND AERONAUTICS**

Imagine life without **traffic jams**

The CityMobil project is tackling the twin problems of congestion and pollution in Europe's cities by developing innovative automated public transport systems which can take passengers exactly where they want to go, when they want to go.

In many European cities, traffic jams and congested roads are a daily problem. Many cities have introduced emergency procedures which are implemented when pollution levels get too high. Other cities have introduced a congestion charge to actively discourage drivers from going into the centre of the city.

The 26 project partners come from 10 countries, including 7 EU Member States. They include public authorities, manufacturers and suppliers of transport systems, universities, research institutes and public transport organisations.

Removing the roadblocks to automated transport

Automated transport systems based on environmentally friendly vehicles offer a number of advantages, including reduced congestion

and improved traffic flow. By eliminating driver errors, the systems also improve road safety. As they do not require a driver's license, anyone can use them, including those with a physical disability and older people. Autonomous cars can also be moved easily to remote parking areas when not needed, freeing up urban spaces which would otherwise be turned into car parks.

However, before the vision of automated transport can become a reality, a number of hurdles need to be overcome. For example, current law states that the driver is always responsible for a vehicle. This means that if there is no driver, the issue of liability remains unclear. Furthermore, while manufacturers of ordinary vehicles have a clear set of safety standards with which they must comply, there is currently a lack of official safety standards for automated systems. Such standards are needed if the public is to have confidence in these new systems.



Title | Towards advanced road transport for the urban environment
Acronym | CITYMOBIL
EC Contract number | 031315
Website | www.citymobil-project.eu/

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- ENQ (Spain)
- ETRA Investigación y Desarrollo SA (Spain)
- Fundación Comunitat Valenciana Región Europa (Spain)
- GEA (Switzerland)
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- Ingegneria dei Trasporti srl (Italy)
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- Istituto di Studi per l'Integrazione dei Sistemi (Italy)
- ITS – Institute for Transport Studies – University of Leeds (UK)
- POLIS – Promotion of Operational Links with Integrated Services (Belgium)
- Rheinisch – Westfälische Technische Hochschule Aachen Institut für Kraftfahrwesen Aachen (Germany)
- ROBOSOFT (France)

- RUPS Consultancy & Projectmanagement B.V. (The Netherlands)
- SINTEF The Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology – Department of Safety and Informatics (Norway)
- Technion – Israel Institute of Technology (Israel)
- TNO Netherlands Organisation for Applied Scientific Research (The Netherlands)
- Transport & Mobility Leuven (Belgium)
- TRW Ltd, TRW Conekt (UK)
- University of Southampton Transportation Research Group (UK)
- Uniresearch BV (The Netherlands)



One of the aims of CityMobil is to identify these kinds of barriers and remove them, to make the implementation of automated transport systems possible.

At the heart of the project are three pilot demonstrations in major cities in Spain, Italy and the UK. These demonstrations are helping the cities involved to assess the economic viability of an automated system. Authorities also gain a complete overview of the operational issues linked to integrating an automated system into existing public transport systems. The reactions of users to automated transport can also be gauged, to make these new modes of transport more user-friendly and ensure that they meet the environmental and safety requirements of the city and its inhabitants.

Coming soon to a road near you

In Castellón, Spain, high-tech buses are being used along two stretches of road measuring more than 40 kilometres. They can be operated either in guided or manual mode depending on the road environment. In guided mode, a number of driving tasks are carried out by the automated system, although the driver is always in control of the vehicle. The vehicles run mainly on a reserved platform, but share road infrastructure for certain sections of the route.

In Rome, Italy, a fleet of fully automated, unmanned cybercars will operate in the car park of the new Rome exhibition centre, shuttling visitors between the parking area and exhibition centre. The system is designed to provide an on-demand service, and vehicle reservation is integrated into car park management. Each time a car enters the car park, the driver receives a parking space number indicating where he or she must leave the car. An automated vehicle then waits for the car's occupants at the closest stop to the allotted space. As the vehicles run on electricity, local air pollution is reduced.

The world's first personal rapid transit system is being tested at the new terminal five of Heathrow airport in London, UK. In the first phase of the project some 18 cabs are in place to carry people from the car park to the terminal, travelling along dedicated guide ways. Each cab

can carry up to four people with their luggage. The system is easy to use, reliable and rapid and offers a point-to-point service with no waiting around. The low-energy, battery-powered vehicles are also 50% more energy efficient than the ordinary buses used to provide these services. Tests reveal the vehicles to be safe in a collision situation and able to deal with any debris on the track. If the pilot project is successful, the system will be rolled out to cover the whole of Heathrow and other airports and will be linked to public services in the local area.

Cities queue up to take part

While Castellón, Rome and Heathrow are the main pilot demonstration sites, a number of other towns, including Uppsala (Sweden) and Lausanne (Switzerland), are hosting smaller demonstration projects. These towns are already extremely interested in deploying automated systems, but feel it wise to run a pilot project prior to full-scale implementation.

CityMobil is also running showcase events, lasting just a couple of weeks, in a number of other cities which are looking into the possibility of using automated transport. Daventry (UK), Hyvinkää (Finland), Genoa (Italy) and La Rochelle (France) are among the towns taking part.

The showcases assist local authorities in their decision making on automated transport and allow the general public to experience driverless vehicles on a test track.

In yet more towns across Europe, CityMobil is carrying out theoretical studies with the goal of investigating how automated transport systems could help to improve local transport networks.

Through its activities, CityMobil is proving the technical feasibility of automated transport systems and effectively dismantling administrative and operational barriers to their wider implementation. It is also helping to boost public acceptance of automated transport. Meanwhile, its results are already helping numerous towns pick the best automated solution to their transport problems.

Hydrogen vehicles: cleaner mobility

Hydrogen-powered internal combustion engines promise two things: to put cleaner automobiles on to our roads, and to launch Europe as a world leader in the hydrogen-based economy of the future. At the forefront of this drive appears a European research project HyICE, coordinated by the BMW Group and bringing together 11 partners from 4 EU Member States.

The project has made huge leaps towards these goals through the optimisation of hydrogen-powered internal combustion engines. The team made spectacular improvements to energy efficiency and engine power, and developed the components needed to make hydrogen-powered vehicles a reality. Furthermore, a hydrogen-adapted calculation tool for series development has been made commercially available.

This was the first time that a research project was able to concentrate exclusively on the hydrogen combustion engine and thus the specific properties of hydrogen. Previous engine designs were intended for both petrol and hydrogen due to a lack of hydrogen-equipped filling stations. But facilities are now being put in place in Scandinavia, Germany, Japan and North America for hydrogen-only vehicles.

A simple gas – not a simple issue

The aim of HyICE was to develop an internal combustion engine utilising hydrogen fuel. The new engines should be as efficient as diesel engines but without the pollution, and with as little trade-off as possible between engine size and power.

By use of the well-established internal combustion engine, the chemically bound energy of hydrogen can be converted directly into mechanical propulsion energy. Europe's competitiveness is linked to its ability to transport goods across and between countries efficiently and inexpensively. The environmental costs of transport are also of increasing importance, and another reason for research projects such as HyICE: hydrogen fuel generates practically zero emissions.

At its core, HyICE is about hydrogen fuel, but its peripheral influence is significantly larger than this. The technology discovered within the project could be shared, built upon and utilised in industries requiring stationary power generation in the near future.

The motivation behind developing hydrogen-based internal combustion engines revolves around these factors, and is additionally driven by the desire to free the EU of dependency on limited resources of fossil fuels. Furthermore, stringent EU environmental laws have pushed researchers and developers to investigate alternative fuels. Hydrogen constitutes the only carbon-free energy vector that glimmers with potential for the solutions needed.

The HyICE effect: more powerful than a standard modern engine

HyICE is structured around multiple sub-projects. For example, the project investigated two approaches for mixture formation – direct hydrogen injection and the injection of deep-frozen hydrogen into the inlet port of the engine. In this case the injection takes place at very low pressures at the same conditions as the hydrogen is stored in the fuel tank of the vehicle. Both approaches were found to be equally effective, producing a 25 % increase in power output. At the same time, sub-projects developed new hydrogen injectors fitting to the specific principles of mixture formation. To support the development process of future series hydrogen engines, Computational Fluid Dynamic modules have been adapted and validated by experiments. These proven modules have then been integrated into a commercial solver now available for any engine manufacturer.



Title | Optimisation of hydrogen powered internal combustion engines
Acronym | HyICE
EC Contract number | 506604
Website | www.hydrogen-engine.org

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- Hoerbiger Valve TEC GmbH (Austria)
- Institut Français du Pétrole (France)

- Irion Management Consulting GmbH (Germany)
- MAN Nutzfahrzeuge AG (Germany)
- Graz Technical University (Austria)
- Universität der Bundeswehr München (Germany)
- Volvo Technology Corp AB (Sweden)



A major success was an enormous improvement in energy efficiency by the hydrogen engine and a power density of 100 kW/litre displacement, which equates to a horsepower of around 136. This by far exceeds the level of the average modern car diesel engine, which is around 77kW/litre or 105 horsepower.

Engine-driven coordination

HyICE used expertise from across the globe. The team shared its findings on a regular basis with researchers from the US Department of Energy laboratories, as well as universities in the US. The EU and US have strong links in the area already, dating back to a 2001 agreement on cooperation in hydrogen and fuel cells research. The impact of HyICE will be seen far beyond Europe's borders, and while Europe is leading the way in innovative combustion engines, it is also ahead of the competition in hydrogen research in general. The EU has proposed a Joint Technology Initiative (JTI) on hydrogen and fuel cells, which receives EU funding and is driven by European industry.

A bridge to a hydrogen future

Today's gasoline and diesel engines represent economic energy converters. The production costs of monofuel hydrogen engines designed in line with the outcomes of HyICE will roughly be the same. The results of HyICE prove that hydrogen engines have the capability to surpass the efficiency of diesel-based technology and remain non-polluting.

In combination with an optimised energy management of the vehicle a consumption of 1 kg hydrogen/100 km, representing 3,7 l gasoline fuel should be achievable with a passenger car. All that is missing now is the infrastructure that must be in place to get these engines in vehicles and on the road. The next step will therefore be a deeper investigation of two major areas in this respect: hydrogen production, storage and supply. As always, laboratory research needs practical application so that it is tested and assessed. This is taking place in other EU-funded projects, such as HyFLEET: CUTE, which is putting 47 hydrogen buses in 10 major cities, from Amsterdam and Barcelona to Beijing, Reykjavik and Perth. They are operating under real-life conditions.

HyICE is not only conducting fundamental research and development in components vital for hydrogen-based engines, such as lubrication, piston rings and liners. It also heralds a promising future by offering an economic solution for the creation of hydrogen-based transport and a hydrogen-based economy.

All aboard the **MODTRAIN!**

Designing standardised, interoperable components for the European train of the future was the goal of the MODTRAIN ('Innovative modular vehicle concepts for an integrated European railway system') project. By standardising the numerous components that make up a train, as well as the interfaces between them, the project promises to improve performance in the industry and bring down costs.

MODTRAIN brought together 37 partners from 10 European countries, including 9 EU Member States. They included three big railway operators (Société Nationale des Chemins de fer Français (SNCF), Deutsche Bahn and Trenitalia) as well as partners from industry, railway research centres and universities. The project also maintained close links with railway operators not involved in the project, as well as other stakeholders in the train industry such as component suppliers and passengers.

Getting Europe's railway system back on track

The demand for transport across all modes is expected to grow by 40% for passengers and 70% for freight from 2000 to 2020. For cost, environmental and efficiency reasons, rail is well placed to take on the bulk of this increased demand. It is the only transport mode that can substantially increase its speed and capacity. But if passengers

and businesses are to rely on the railways, Europe must first increase the efficiency of its trains. With goods and people increasingly needing to cross national borders, interoperability is also a key to creating one European railway system.

However, efforts to boost cross-border rail traffic are currently hindered by wide differences between national networks. Factors such as power supply, signalling, operational procedures and even track gauge vary from country to country.

The aim of the MODTRAIN project was to address these issues to ensure that the trains of the future will be able to handle different country's railway systems and be driven by train drivers from across Europe. In the course of the project, the researchers redesigned everything from the traction systems to the controls, and even dabbled in interior design.



Title | Innovative Modular Vehicle Concepts for an Integrated European Railway System

Acronym | MODTRAIN

EC Contract number | 506652

Website | www.modtrain.com/

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- ERCIM (France)
- KMT Group Oy (Finland)
- Siemens AG (Germany)
- Technischer Überwachungsverein Nord e.V. (Germany)
- Instituto Superior Técnico (Portugal)
- IAS – Institut für Arbeits- und Sozialhygiene Stiftung (Germany)
- D'Appolonia SpA (Italy)
- Frensisemi Srl (Italy)
- Knorr-Bremse Systeme für Schienenfahrzeuge GmbH (Germany)
- Railway Industry Association (UK)
- Fédération des Industries Ferroviaires (France)
- ANIE/ASSIFER – Associazione Industrie Ferroviarie (Italy)

- Knorr Bremse GmbH (Austria)
- Lumikko Oy (Finland)
- Fundació Politècnica de Catalunya – Universitat Politècnica de Catalunya (Spain)
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- Forschungs- und Anwendungsverbund Verkehrssystemtechnik Berlin (Germany)
- AnsaldoBreda SpA (Italy)
- Bombardier Transportation GmbH (Germany)
- Dynamics, Structures and Systems International SA (Belgium)
- Union Internationale des Chemins de Fer – UIC (France)
- Société Nationale des Chemins de Fer Français (France)
- Università degli Studi di Firenze (Italy)
- University of Newcastle / NEWRAIL (UK)

- Deutsche Bahn AG (Germany)
- Trenitalia SpA (Italy)
- ABB Switzerland Ltd (Switzerland)
- Lucchini Sidermeccanica SpA (Italy)
- Alma Consulting Group SAS (France)
- Alstom Transport SA (France)
- F.A.R. Systems SpA (Italy)
- Fraunhofer-Gesellschaft zur Förderung der Angewandten Forschung EV (Germany)
- Technische Universität Berlin (Germany)
- Verband der Bahnindustrie in Deutschland e.V. (Germany)



Towards a common European train

The project's research focused on four areas which the partners felt were ripe for improvement. The MODBOGIE sub-project focused on improving the performance of the running gear, the working parts of the train, so that they require both less energy and maintenance. The MODCONTROL team worked on standardising trains' control and monitoring systems and the interfaces with the train's traction, heating system, doors and passenger announcement system, among other things. The MODPOWER sub-project was charged with optimising and standardising the on-board power system, which includes the interfaces between traction components, high voltage equipment and the pantograph, the device that collects electric current from overhead lines for electric trains. The interfaces between man and machine and between trains were addressed by the MODLINK team, whose results included a prototype of a driver cab and passenger coach.

An additional fifth sub-project was responsible for informing the relevant railway stakeholders, such as component suppliers and railway operators not involved in the project, of developments as they arose. This link ensured that the project team was able to react in good time to impacts on operation and production as they were defined.

Helping the drivers feel at home

An important part of the project involved redesigning the driver's cab. As part of this task, 17 train drivers from different European countries used a simulator to test the new design in different situations, including a high-speed journey, a slower journey with regular stops, and an emergency situation.

Feedback from the drivers helped the MODTRAIN team to make the system as user friendly as possible.

The safety aspects of the front of the train have also been improved, with a new shell to absorb energy in a crash situation and to protect

the driver. Meanwhile the driver's console is designed in such a way that the driver can easily escape in an emergency.

In addition to making the train's controls recognisable for any European train driver, the project team also wanted to make the train recognisable to any European passenger. This meant ensuring that the buttons for opening and closing doors, as well as calling for assistance or requesting an emergency stop, would be easily understood by passengers anywhere in Europe.

On track for standardisation

The MODTRAIN team is justifiably proud of two further outcomes of the project: a Functional Breakdown Structure (FBS) and component specifications. Both have already been transmitted to the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC) for the next steps in the standardisation process.

The FBS is a comprehensive list of all the functions of a train, together with a short definition of each function. Why is such a list important? Standardising the functions of the trains cannot take place without it. For each of the functions listed in the FBS, the project team also conducted a safety analysis. For those functions that have a direct or indirect impact on safety, safety requirements were outlined.

The project partners have also agreed on a standardised set of components and component interfaces so that they are interchangeable. Without a unified internal, onboard power supply voltage or a common electric interface between traction and auxiliary power system, trains are limited in where they can travel.

Trains built using components designed by MODTRAIN will thus be able to cope with all of the different signalling systems used throughout Europe, and at speeds of up to 300 km per hour. Thanks to MODTRAIN, the European trains of tomorrow will enjoy the same freedom of travel as the EU's citizens do today.

Flying high with innovative aircraft concepts

Turning the dream of cleaner, quieter, cheaper aircraft into a reality is the goal of the NACRE ('New Aircraft Concepts Research') project. The project's early results suggest that the aircraft of the future could look very different to the planes flying overhead today.

In a bid to boost quality, reduce costs and improve the environmental performance of aircraft, the project team is giving aircraft design – from the overall shape of the plane to its individual components – a radical overhaul.

An industry under pressure

The aeronautics industry is a key player in the EU's economy, accounting for around 2.5 per cent of GDP and generating over three million jobs. Maintaining the industry's competitiveness in the face of global competition will require new aircraft concepts like those being developed by NACRE.

Global air traffic is predicted to double over the next 10 to 15 years and triple in 20 years' time. Yet even as passenger numbers are set to grow, the industry is facing growing pressure to reduce its impact on the environment while keeping the costs of air travel down. According to figures from the International Civil Aviation Organisation (ICAO), air traffic is responsible for around 2% of global greenhouse gas emissions, and this is expected to grow by 3% to 4% per year in the future.

Aeroplanes also release nitrogen oxides (NO_x), which breaks down to produce ozone in the atmosphere. Another problem associated with planes is noise pollution.

In response to demands to improve its environmental performance, the European aviation industry has voluntarily agreed to cut CO₂

(carbon dioxide) emissions from aircraft by 50% and NO_x emissions by 80% by 2020. External noise emissions should be cut by half. These goals, which were proposed by the Advisory Council for Aeronautical Research in Europe (ACARE), were taken on by the NACRE project partners. Other ACARE goals taken on by NACRE include green aircraft design, manufacturing and maintenance.

The project, which is coordinated by Airbus, brings together partners from universities, research organisations and industry, including many major airline manufacturers, from 12 EU Member States plus Russia.

Radically rethinking aircraft design

For the past 50 years, aircraft designers have achieved significant gains in fuel efficiency and, by extension, environmental performance. However, if further improvements are to be made, entirely new aircraft concepts will need to be developed, and that is where the NACRE project comes in.

Their aim is not to focus on one specific type of aircraft, but rather to develop generic solutions at component level with a view to ensuring that the results can be applied to a wide range of new aircraft.

For each of the major aircraft components (cabin, wing, propulsion system, fuselage), the researchers are investigating aspects such as aerodynamics, materials, structure, engines and systems, to see how they would affect the quality, affordability and environmental performance of air transport.



Title | New aircraft concepts research
Acronym | NACRE
EC Contract number | 516068
Website | <http://fseg.gre.ac.uk/NACRE>

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- Aircraft Research Association Ltd. (ARA) (UK)
- Centro Italiano Ricerche Aerospaziali ScpA (CIRA) (Italy)
- Dassault Aviation (France)
- Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) (Germany)
- EADS Deutschland GmbH Innovation Works (Germany)
- Swedish Defence Research Agency (FOI) (Sweden)
- Aircelle S.A. (France)
- Ingenieurbüro Dr. Kretzschmar (IBK) (Germany)
- Integrated Aerospace Sciences Corporation (INASCO) (Greece)
- Instituto Nacional de Técnica Aeroespacial (INTA) (Spain)
- Messier-Dowty Ltd. (UK)
- MTU Aero Engines GmbH (Germany)

- Stichting Nationaal Lucht- en Ruimtevaartlaboratorium (NLR) (The Netherlands)
- Office National d'Etudes et de Recherches Aéropatiales (ONERA) (France)
- Projecto, Empreendimentos, Desenvolvimento e Equipamentos Científicos de Engenharia (PEDECE) (Portugal)
- Piaggio Aero Industries SpA (Italy)
- Rolls Royce Deutschland Ltd. & Co. KG (Germany)
- Rolls Royce plc (UK)
- Snecma S.A. (France)
- Federal State Unitary Enterprise Aerohydrodynamic Institute (TsAGI) (Russia)
- Vyzkumny a zkusebni letecky ustav, a.s. (VZLU) (Czech Republic)

- The Provost Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth Near Dublin (TCD) (Ireland)
- University of Greenwich (UK)
- Technische Universität München (Germany)
- Kungliga Tekniska Högskolan (KTH) (Sweden)
- Universität Stuttgart (Germany)
- Warsaw University of Technology (Poland)
- ARTTIC (France)
- University of Southampton (UK)
- Dowty Propellers (UK)



The project partners are working with three specific aircraft concepts in mind. The 'Pro Green' aircraft concept places an emphasis on reducing the environmental impact of air travel, while the 'Payload Driven Aircraft' concept aims to optimise payload and the quality of the aircraft for its end users. Finally, the 'Simple Flying Bus' concept is devoted to lowering both manufacturing costs and the costs of ownership.

Creating something 'very different from conventional aircraft'

In their quest for better aeroplanes, the NACRE team was not afraid to meddle with the shape of the aircraft. They have developed a 'Flying Wing' aeroplane, in which the entire aircraft is shaped like a giant wing.

The project partners have maximised the use of the inside of the aircraft to create a comfortable space for passengers. Experiments have proven that it is possible to evacuate passengers from such an aircraft within the time set by safety regulations.

The flying wing format significantly reduces drag, and the partners are busy refining the shape of the wing further so that air flows over it as smoothly as possible. Reducing drag slashes fuel consumption, and so benefits the environment and passengers' wallets.

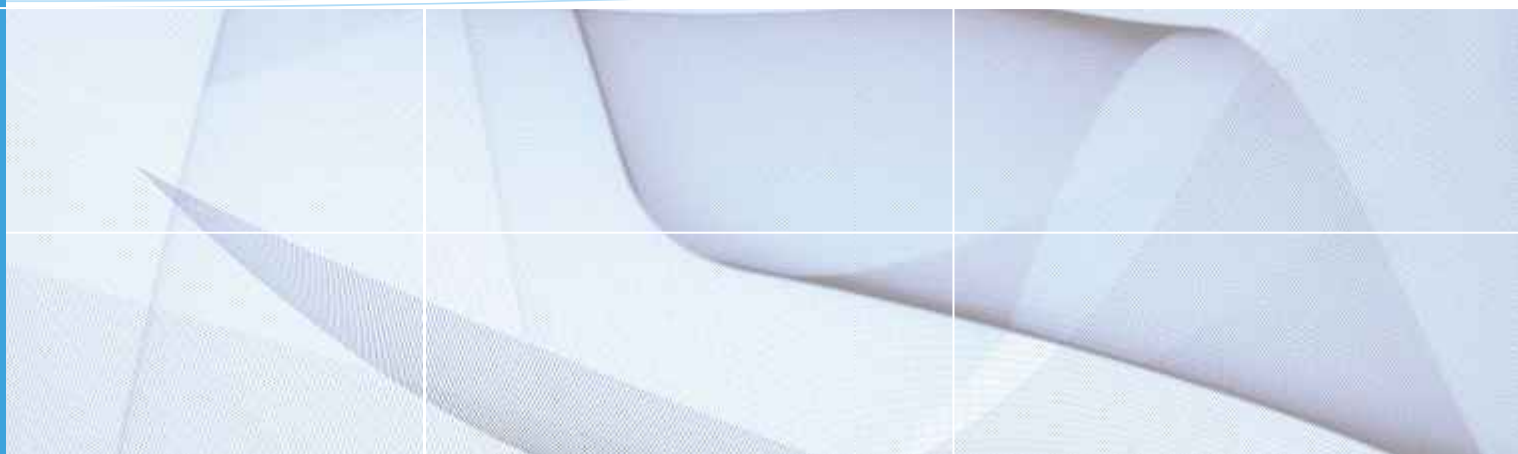
Turning ideas into reality

The project team cannot predict when developments made in the framework of NACRE will be ready for application; many of the technologies involve highly unconventional configurations, and so are more suited to the next generation of aircraft than the aircraft of today.

Nevertheless, many of the project partners are aircraft manufacturers, and they are keen to maximise the achievements of the project they have invested in. With this in mind, the project coordinator predicts that while the new aeroplanes coming online in the next few years will probably not feature NACRE-derived components, they may well feature on the aircraft coming after that.

Meanwhile a lot more research is needed before these technologies can be used commercially. The NACRE project partners are already launching new projects to carry out this research and move these exciting new technologies forward.

Meanwhile technologies which are closer to application could be taken up by the Clean Sky Joint Technology Initiative (JTI). The JTI is an industry-led, public-private initiative which brings together public funding agencies including the European Commission and the private sector. Many of the NACRE partners are also actively involved in Clean Sky, making them ideally placed to bring the NACRE results to the wider aeronautics research community.



SUCCESS STORIES
**SCIENCE, ECONOMY
AND SOCIETY**

The ethics of biometrics: the rights and wrongs of new ID cards technologies

The advance of biometrics is an outcome of globalisation. Commerce, migration and trusted exchanges of all types of information now take place globally on a daily basis. Transactions and mobility have increased the need for individuals to prove their identity and to be sure of the identity of others, meaning more effective forms of identification need to be developed.

Biometrics analyses characteristics such as fingerprints, eye scans and signature dynamics to identify individuals. But while some are convinced that the technology is a key component of security, others have ethical concerns about the storage of personal data and its possible abuse.

The BITE ('Biometric Identification Technology Ethics') project set out to promote research on the bioethical and ethical implications of emerging biometric identification technologies and initiate an international, public debate on the subject. The project brought together nine partners, including bioethicists and representatives of the biometric industries, from five European countries, including four EU Member States.

Finger prints, iris recognition and body odour

Biometric technologies confirm a person's identity by examining a biological feature, then matching it with a digital file containing those exact characteristics. Features can be physical, such as hand contours or retina patterns, or they can be behavioural, such as voice modulation or keystroke typing rhythms. Some are rather unusual; among the attributes being tested for individuality are knuckle creases, body odour and acoustic head resonances.

Applications of the technology include identifying known criminals, restricting access to secure premises, proving the identity of benefits claimants and checking the identity of voters at polling booths.

BITE's objective was to establish a forum for public conversation on the ethical and policy issues raised by these technologies. The project kicked off with a series of meetings with experts from industry, academia and the policy world. Coupled with reviews of the scientific evidence, this helped the project partners prepare for the next stage of the project – an online public consultation.

The consultation covered the legal, ethical and social implications of biometrics. It attracted over 5 300 responses from universities, small and medium-sized enterprises (SMEs), large companies and government bodies in Europe and beyond. 72 % of responses came from men, and the majority came from people aged between 25 and 50.

The outcomes of these activities contributed to the production of a report which is helping to set the agenda for public and political discussions on biometrics in the EU and elsewhere. The report was presented at a public conference, organised by BITE, held in Brussels.



Title | Biometric identification technology ethics promoting research and public debate on bioethical implications of emerging biometric identification technologies

Acronym | BITE

EC Contract number | 6093

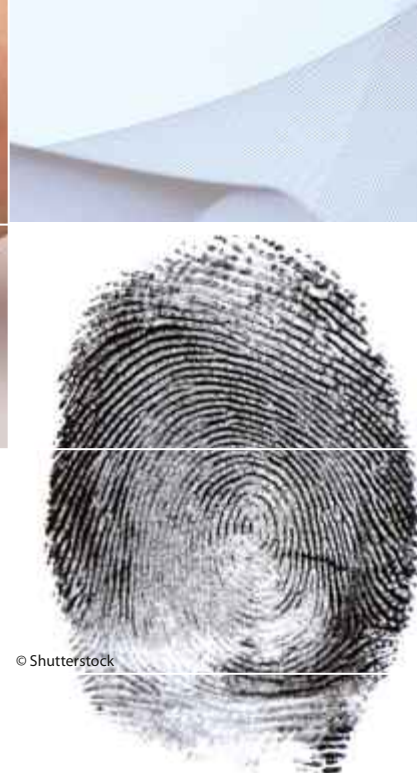
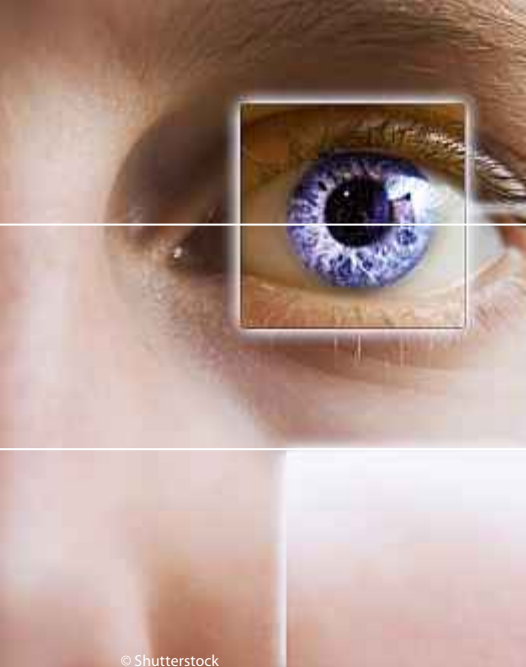
Website | www.biteproject.org/

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- Esa Communication (Italy)
- Erasmus Universiteit Rotterdam (The Netherlands)
- International Biometric Group Co (UK)
- International Organization for Migration (Switzerland)
- PBP Optel Sp. z o.o. (Poland)
- Università degli Studi di Roma 'La Sapienza' (Italy)



Giving the faceless a face?

The project investigated the bioethical and ethical issues arising from emerging biometric identification technologies, devoted particular attention to the use of biometrics in the biomedical field, studied the value of applications alongside the potential for misuse, and assessed the impact of biometrics on vulnerable groups.

A complex concern identified by BITE is that of loss of identity. Some worry that today's citizens will become biological data, as name, age, address and other traditional identifying characteristics are replaced by biometrics which could be used by companies and governments alike. On the other hand, many people in developing countries do not possess any documents with which they can prove who they are. These people are already vulnerable on account of their poverty, and the fact that they are unable to provide evidence of their identity makes it difficult to empower them.

Biometrics and medicine

Digitalising patient records makes healthcare more efficient, reduces fraud, lessens the likelihood of medical errors and saves lives. But digitised information is also at risk of theft, with perpetrators gaining not only medical records, but also a patient's name, date of birth and sometimes social security number.

If biometric identification technologies were used, these other identifying data would not be needed and access to archives of medical records could be better controlled. This would significantly reduce the risk of medical identity theft. The project partners believe that given the sensitive nature of medical data, the use of biometrics is justified in this case.

Biometric identification could also save lives by ensuring that medical conditions or allergies are known in an emergency. However, severe pain and serious injuries may prevent some patients in emergency wards from providing biometric characteristics. Systems must ensure that these issues do not delay treatment.

Avoiding stigma and discrimination

Another ethical concern identified by BITE is the risk of discrimination facing various groups, including the elderly and disabled. Fingerprints become less readable with age, while those who are visually impaired or have a limb missing may not be able to provide the requisite biometric data. For systems to be truly non-discriminatory, it is important that developers and operators consider the needs of those who will experience difficulties at the earliest stage of the design cycle, conclude the BITE partners.

Fail-safe security?

While there is a clear argument in favour of using biometrics for security purposes, BITE points out that there are ways to cheat the technology. Artificial devices could be used for mimicry, and the reliability of data is dependent upon the source that provided it.

It seems that the general public shares the project partners' concerns. The online consultation illustrated three principal demands: more research on the ethical, social and policy implications of biometrics; increased understanding of the ethical context of biometric technology; and the involvement of technologists and engineers in the ethical debate on surveillance technology.

Sex matters – in **life sciences** research

When it comes to the life sciences, sex matters, and scientists need to take this into account when carrying out research, according to the GenderBasic project.

Thanks to a combination of biological (sex) and social (gender) differences, men and women face different risks of a number of diseases and conditions; for example, women are twice as likely as men to develop multiple sclerosis, a chronic illness that affects the nervous system. Meanwhile, men have a higher risk of heart attacks, but many women suffer from a different form of heart disease that is easily missed by standard tests.

Furthermore, men and women often respond very differently to drugs. Yet all too often, scientists fail to take these differences into account when designing and performing research and analysing their results. As a result, many women are subjected to tests and given drugs which have only been tested on men.

The EU sought to address this problem by requiring projects funded under the research, technology and development (RTD) Framework Programmes to submit a gender action plan. However, evaluations revealed that there was often a gap between what was written in the gender action plan and what happened in practice.

Now the GenderBasic project has come up with a set of practical tools, examples and best practice recommendations to help scientists incorporate sex and gender differences into their research more effectively.

Getting down to basics

The project team, led by Dr Ineke Klinge of the University of Maastricht in The Netherlands, analysed the factors which facilitated or inhibited the incorporation of the gender dimension into basic, preclinical and clinical research in selected EU-funded life sciences projects and at leading European research institutes. They also commissioned international experts on sex, gender and health to write review articles on the relevant methodological, practical, ethical and financial issues as well as the impacts of sex and gender on a number of diseases and conditions. The articles appeared in a special edition of the journal Gender Medicine (Vol. 4, Suppl. B, Dec. 2007).

Based on their analyses, the GenderBasic scientists produced a set of recommendations to help scientists, funding agencies, the pharmaceutical industry, governments and other stakeholders ensure that sex and gender differences are given the attention they deserve.

When factoring in gender can save lives

The review articles commissioned by the project highlight the extent to which disease susceptibility differs between the sexes. For example, before puberty, asthma is more common in boys than in girls. In adulthood however, it is more common in women. The scientists speculate that a combination of hormonal changes and genetic susceptibility could contribute to the change in prevalence during adolescence.

Among other things, the paper calls for more studies in animals investigating the observed differences between males and females and their susceptibility to hormonal and environmental factors in relation to lung development. It also underlines the importance of studying differences in response to treatments.

Another article reveals how the absence of gender balance in research can also have negative consequences for men. The paper is about osteoporosis and fracture risk research. Sex hormones play an important role in bone development, and differences in the levels of these hormones mean that men have structurally stronger bones and so experience fewer fractures than women.

Currently, much of our understanding of osteoporosis and fracture risk is based on research on women, and most of the drugs used to treat osteoporosis were only tested on women. In contrast, detailed data on men is lacking.

Osteoporosis and fracture risk are underdiagnosed in women, but the problem is even greater in men. This problem is compounded by the fact that because women have more frequent screening opportunities than men, their problems are usually picked up at an earlier stage.



Title | Promoting the integration of the gender dimension in basic research in ERA/FP7

Acronym | GENDERBASIC

EC Contract number | 16630

Website | www.genderbasic.nl/

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• N/A



For both examples, studying the impact of gender role behaviour in relation to disease development and management was emphasised. The study of the interaction of sex and gender from a life-course perspective was firmly put on the research agenda.

Closing the gap – recommendations for gendered innovations in research

If the research community is to tackle this serious problem, action is needed on a number of fronts. Among other things, the project partners recommend that research studies and clinical trials should include both men and women as subjects, and if this is not the case, researchers should explain why one sex has been left out. Furthermore, results should be disaggregated by sex.

This consideration of the impact of sex on health outcomes should also be considered by those carrying out research on animals or on tissue samples taken from humans.

Research funding agencies are called on to promote research that links biomedical and social dimensions, including gender dimensions. The editorial boards of journals are encouraged to request that papers present data disaggregated by sex and explain sex and gender differences adequately.

Meanwhile, the GenderBasic researchers are still driving forward their aim of integrating sex and gender into research. They are particularly keen to turn their results into a training module, aimed at the research community, on the sex and gender aspects of biomedical and public health research.

‘I really think that for life sciences and health research, it is integral to view the sexes as different from the molecular to the social level,’ comments Dr Klinge. ‘Gender experts have a lot of expertise to offer concerning the influence of gender in biomedical and public health research and this was very well acknowledged in the project. I think one of our major strategies is to convince people to see that addressing sex and gender aspects is not necessarily feminist but a question of quality of research.’

The A to Zzzzzzzzz of sleep

Getting a good night's sleep is a key component of a healthy lifestyle, and a lack of sleep can reduce our quality of life, affect our health and place us at an increased risk of accidents. However, the rise of the 24 hour society means that few of us are getting as much sleep as we should.

Now the SLEEP RESTRICTION project is shedding new light on the factors keeping us awake, and highlighting the impacts this is having on our health and wellbeing. The six project partners come from four EU Member States plus Switzerland, and include medical doctors, zoologists, pharmacologists, engineers, psychologists and other social scientists.

Among other things, they are boosting our understanding of the effects of chronic sleep deprivation, sleeping problems among the elderly and the sociological aspects of sleep. Their results have important implications for the way we organise our work and our lives.

The project also has an important educational component, and the partners are training a number of students in the research and other skills needed for a successful career in the sleep studies field.

The links between sleep and health

Lack of sleep can be brought on by a number of factors, including sleep disorders, shift work and a busy lifestyle. Previous research has shown that sleep plays an important role in laying down our memories and ensuring that our metabolism, immune system and regenerative processes work properly. Furthermore, poor sleep is a known risk factor for weight gain, hypertension and type 2 diabetes.

The aim of the SLEEP RESTRICTION team is to identify the molecular, physiological, behavioural and sociological factors behind sleep loss and clarify its physiological and behavioural consequences. The project's members are particularly interested in how age, gender, genetics and social background influence sleeping patterns and how sleep loss

influences people's risk of developing obesity, cardiovascular diseases and diabetes.

The effects of partial sleep deprivation

One of the project's most important findings to date concerns the effect on health of partial sleep deprivation. In the study, young, healthy adults were restricted to just four hours' sleep a night for five nights. Over the course of the study, their ability to perform complex tasks declined, and the scientists detected problems in the subjects' energy metabolism and immune function. To the researchers' surprise, these effects could still be detected after two nights of normal sleep.

Partial sleep loss is experienced by a large part of the working population, and these results suggest that they could be at an increased risk of health problems.

The inability of those suffering from partial sleep loss to perform complex tasks also has implications for safety. With this in mind, the project partners call for greater attention to be paid to the safety aspects of sleep loss, particularly for jobs where it could lead to an accident, such as transportation and the medical profession.

Using blue light as a sleep aid

Our bodies rely on external signals such as light to regulate our internal body clocks. Many elderly people suffer from sleeping problems which are caused in part by an inability to set their body clocks correctly. The project partners discovered that the light information



Title | The biomedical and sociological effects of sleep restriction

Acronym | SLEEP RESTRICTION

EC Contract number | 512362

Website | www.sleep.fi/

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- Université Libre de Bruxelles (Belgium)
- Max-Planck-Gesellschaft zur Förderung der Wissenschaften EV (Germany)



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needed to regulate the body clock is transmitted less effectively in older people than in younger subjects. They also found that blue light is more effective than ordinary, full spectrum light at setting the body's internal clock.

The researchers are now investigating whether blue light could be effective in helping older people sleep better by improving the regulation of their internal body clocks. Their findings could have implications for the design of old people's homes.

The social side of sleep

The project has also revealed how social factors affect the quality of our sleep. For example, in Italy, the burden of care tends to fall on the shoulders of female family members. Interviews revealed that women caring for young children and adult children living at home slept poorly. However, the highest levels of sleep disturbance were found among women looking after elderly, frail relatives.

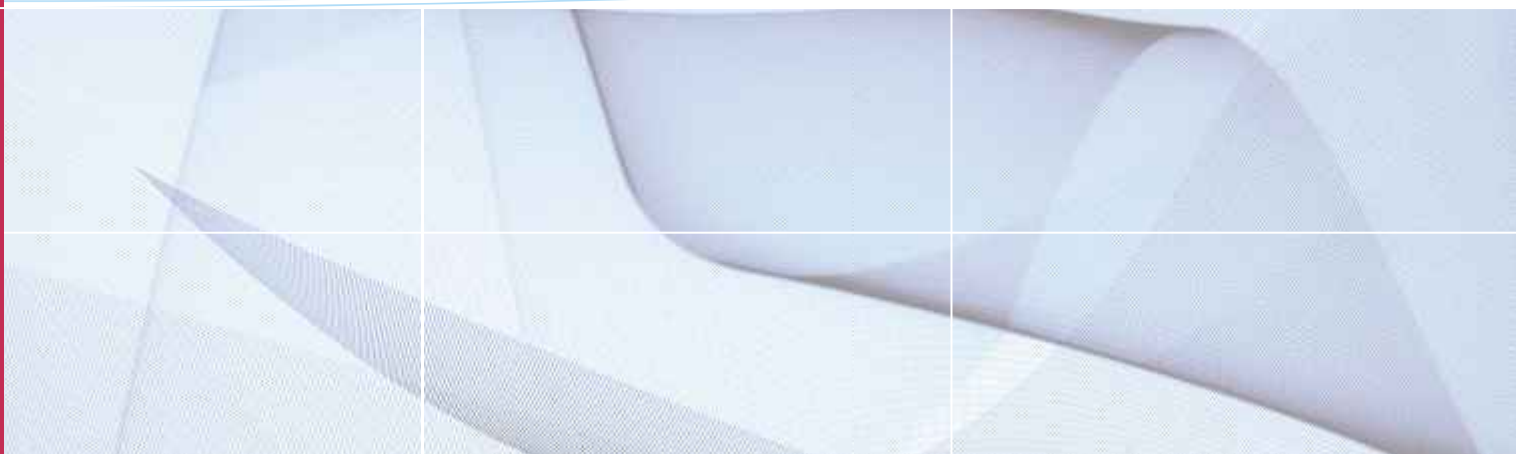
A survey of middle-aged British women also revealed that women with a lower socio-economic status, and particularly women with lower levels of education, are more likely to suffer from disturbed sleep.

This kind of information is essential if the project's other findings are to be successfully transformed into practical advice for stakeholders such as the medical community.

Training up the next generation of sleep researchers

At the heart of all this research activity is a training network of 16 research fellows from 12 countries who are being given a thorough grounding in the theory and practice of sleep research. The six laboratories involved in the project cover a range of disciplines in sleep research (basic biomedical research, basic human research, circadian research, clinical research and sociological research). The students therefore have the chance to learn more than they would if they were based in a single laboratory, working in just one area. The project places a particular emphasis on ensuring that the research fellows gain experience of both social and biomedical research. In addition to research skills, the students are also taught research management, research ethics and communication skills.

For project coordinator Tarja Porkka-Heiskanen of the University of Helsinki, the importance of this research for Europe's economy as well as its health is clear. 'The modern society needs workers who are alert, creative and motivated throughout the day. These qualities are most easily damaged by sleep loss,' she explains. The project partners are working hard to communicate their results to the public, so that we can all benefit from them and, hopefully, get a good night's sleep on a regular basis.



SUCCESS STORIES
**RESEARCH POLICY,
REGIONS AND SMEs**

BLUEBIONET

rides the **biotech** wave

Europe's coastal regions have been thrown a much needed lifeline by the BlueBioNet project, which has linked up four of the EU's maritime regions to help them share knowledge and boost innovation in the growing marine biotechnology sector.

The regions involved are geographically diverse, ranging from Germany's Lower Weser in the north to Andalusia in Spain in the south, and Scotland in the west to France's Provence-Alpes-Côte d'Azur in the east.

The EU has some 89 000 km of coastline, and almost half of all EU citizens live within 50 km of the sea. BlueBioNet's results are therefore of relevance to many Europeans. For many years, coastal towns and regions across Europe relied on fishing and shipbuilding as their main source of both money and jobs. In recent years, these industries have experienced a sharp decline, leaving coastal communities facing an economic slowdown and high levels of unemployment.

Thanks to the BlueBioNet project, several collaborative projects involving researchers and businesses are now up and running, allowing the communities involved to turn to blue biotechnology for their living.

A marine treasure trove

The sea covers around 70% of the Earth's surface and is home to 90% of all living things, yet it remains relatively untapped and underused. Marine biotechnology, also known as blue technology, is an attempt to explore this biosphere and make use of nature's own technology for the production of goods and services.

Research conducted to date has shown that the sea is rich in organisms with novel biological materials and unique metabolic mechanisms. These findings have already led to the development of commercially valuable bioactive compounds and substances for use in the food, cosmetics, pharmaceutical and environment sectors, among others.

In terms of the economic benefits it could generate, marine biotechnology was globally valued at EUR 2.2 billion by the Marine Industries

Global Market Analysis in 2005. This is most likely an under-estimate, since some industries that only partially involve marine biotechnology, including those working with aquaculture, seaweed and processing, were not factored into this calculation. By 2009, the global market is projected to surpass EUR 2.6 billion.

Putting Europe at the head of the field

The EU is keen to raise awareness of the potential of marine biotechnology and marine science for creating new knowledge, improving industrial competitiveness and spurring on economic growth. However, many maritime regions interested in re-directing their resources to this sector have come up against several large problems. Among other things, regions sometimes have difficulties finding out what other regions are doing to stimulate research. Other problems include poor collaboration between regions and an inadequate transfer of results.

The BlueBioNet project sought to address this fragmentation of knowledge by linking up four coastal regions from across Europe. Despite their diverse locations, the regions involved shared many of the same problems, and crucially, shared the belief that marine biotechnology could provide a much needed boost to their weakened economies. All the members of the consortium were well established regional players in the field of networking, innovation and technology support, such as regional technology and innovation platforms.

The project aimed to support the development of the blue biotechnology sector in the regions; boost collaboration between research organisations and industry; encourage regional companies to embark on research activities; and promote research cooperation and technology transfer between the regions involved.

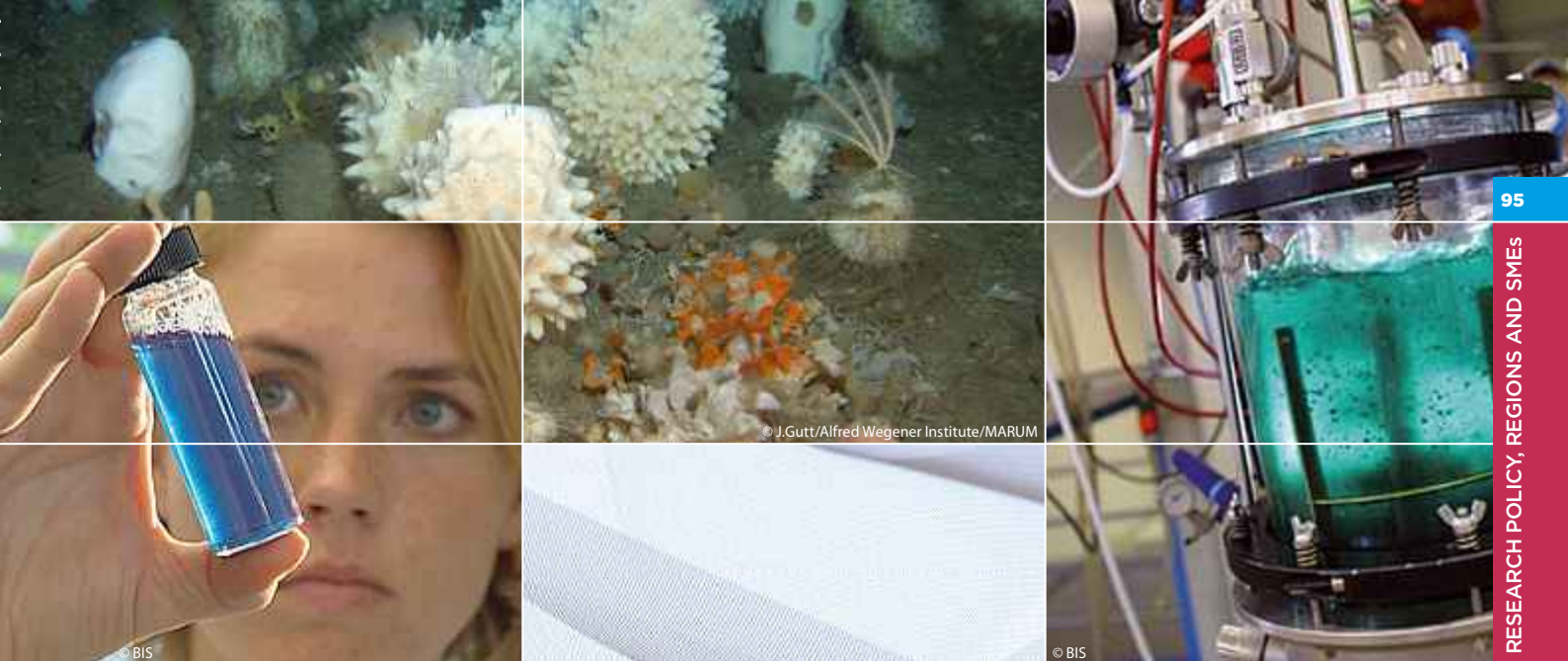
To achieve these goals, the partners created a search database where marine biotech partners were profiled, and organised regional and transnational brokerage events to raise awareness of the benefits of



Title | Conversion of Traditionally Structured Maritime Regions into European Knowledge regions for Applied Biotechnology
Acronym | BLUEBIONET
EC Contract number | KNRG-CT-2003-000040

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 • Toulon Var Technologies
 (TVT) (France)



working in marine biotechnology. These events brought together participants from universities, companies (including small and medium-sized enterprises), regional research agencies and other key regional science generators.

Breathing new life into coastal economies

Through its activities, the project successfully attracted both private investment and public research funds to the regions involved. The regions benefit from the increased business and investment resulting from these joint ventures and projects.

For Q-Bioanalytic, a German biotech company which produces analytical testkits for the rapid detection of pathogenic micro-organisms, the breakthrough came at a BlueBioNet event in Malaga, Spain. There they met a Spanish company which was interested in selling Q-Bioanalytic's products in Spain. Following further meetings in Spain and Germany, a contract was signed making the Spanish company Q-Bioanalytic's official distributor in Spain.

The project has been instrumental in setting up research and development projects between scientific organisations and companies.

BlueBioNet also encouraged companies to apply for European research funds for their activities.

For example, the SPIINES ('Sea urchin production in European Species') project received funding from the EU's Sixth Framework Programme for research to investigate how to improve integration, economics and market compliance for this commercially important species. The preparation of the proposal was made possible with support from the Scottish Proposal Assistance Fund.

Other consortia brought together through BlueBioNet include INFINITE ('Information Networks for Industries in Technological Environments'), and HATCHBAC, which involves the development of a bacterial pathogen detection bio-strip as an early warning system in aquaculture hatcheries.

Although the BlueBioNet project has come to an end, the links and contacts established through its activities live on. Most importantly, the research and trade links established as a result are helping to set the regions involved on the path to a brighter economic future.

EUROTRANS-BIO – a leg up for Europe's biotech SMEs

Europe's biotechnology sector has an important role to play in developing new products and services for fields as diverse as health, food, the environment and energy. Furthermore, with over 2 100 small and medium-sized enterprises (SMEs) employing over 100 000 people, the biotechnology sector also has a high socio-economic value. A lot is at stake; the European biotech industry is already lagging behind its American counterpart and many emerging economies are catching up fast.

The sector's success depends on its ability to fund and carry out the research needed to develop new products; this could be rendered more effective by boosting cooperation within the sector right across Europe. This would promote the exchange of information and ideas and reduce a possible duplication of research effort.

One major problem in Europe is that there is currently little coordination between the national agencies responsible for funding research, and this is where the EUROTRANS-BIO ERA-NET Action comes in. ERA-NET Actions are designed to help national funding agencies coordinate their activities.

Under the EUROTRANS-BIO banner, nine European regions and countries (Austria, the Belgian region of Flanders, Finland, France, Germany, Italy, the Netherlands, the Spanish Basque Country and Spain as a whole) joined forces to promote transnational biotechnology research

cooperation, particularly among SMEs. Between them, the project partners cover some 55 to 60 per cent of the EU's biotech industry.

The partners include policy makers, agencies and their respective funding programmes, and they are united by their common goal to boost the competitiveness of Europe's biotech industry. Together, they have succeeded in creating a single, transnational research initiative which funds joint calls from a 'virtual' common pot of money.

United we stand

'EUROTRANS-BIO has created a network of ministries and agencies that efficiently managed to dedicate national or regional funds to international cooperations through creating commitments to increase the rate of cross-border R&D partnerships of SMEs in their respective



Title | EUROpean network of TRANS-national collaborative RTD for SMEs projects in the field of BIOtechnology

Acronym | EUROTRANS-BIO
EC Contract number | 11718

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- Finnish Funding Agency for Technology and Innovation (TEKES) (Finland)
- Ministry of Economy, Finance and Industry (MinEFI) (France)
- Ministry for Research and New Technologies – Technology Directorate (MR) (France)
- OSEO innovation (France)
- Agence nationale de la recherche (ANR) (France)

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- Istituto per la Promozione Industriale (IPI) (Italy)
- Ministerie van Economische Zaken (The Netherlands)
- SenterNovem (The Netherlands)
- Centro para el Desarrollo Tecnológico Industrial (CDTI) (Spain)
- Departamento de Industria, Comercio y Turismo (Spain – Basque Country)
- The Sociedad para la Promoción y Reconversión Industrial (Spain – Basque Country)



countries,' says Project Coordinator, Edith Petitet of the French SME support organisation, OSEO innovation.

The network is not virtual but concrete, as managers from agencies in different regions and countries now contact each other as they would their own colleagues.

At the heart of the project is a virtual common funding pot from which money is allocated to the selected projects. Within the projects, each region and country funds its own participants. Under the rules of the project, each consortium must include at least two SMEs from two EUROTRANS-BIO member regions or countries. A unique proposal submission system was set up, in which all the proposals are evaluated by at least two evaluators of different nationalities helped by external experts. The recommendations for funding are made at a final Evaluator Meeting. From the submission to the decision, all the national funding programmes work hand in hand.

The EUROTRANS-BIO initiative launched its first call for proposals within 15 months of starting. Three calls for proposals have already been launched; new calls are announced on the project's website as well as on the partners' own websites, the FP6 website and in the press. In the two first calls EUROTRANS-BIO received 125 proposals for innovative industrial research and development projects, signifying a high level of interest from the SME community. From these calls, 41 projects with a total cost of EUR 77 million were recommended for funding. The SMEs appreciated the bottom-up approach, the high levels of interaction between the agencies and the proximity of their financiers.

Small projects with big ambitions

Projects funded through EUROTRANS-BIO include COLOGENETICS. This project aims to develop innovative diagnostic tools to improve the clinical management of colorectal cancer patients by the better prediction of their clinical outcome and the personalised selection of the most suitable treatment for them. The project brings together an SME, a research centre and a research foundation in the Spanish Basque Country, as well as a German SME, plus three hospitals in the Spanish Basque Country which will recruit and follow up on the patients who will participate in the study.

Meanwhile the ETB-DV project, also funded under EUROTRANS-BIO, brings together Finnish and French partners and is working on third generation DNA vaccines for pandemic and seasonal flu. The project covers the whole phase of vaccine development from fundamental research to preclinical studies.

Though the health sector dominates the EUROTRANS-BIO projects, other sectors are also represented. For example, the SHORTWHEAT project is working to develop a semi-dwarf variety of wheat with improved resistance to Fusarium Head Blight, a fungal disease which reduces both grain quality and yield in wheat crops. The project partners include wheat breeders and biotech labs.

Everyone's a winner

EUROTRANS-BIO fulfils an important role in providing SMEs with a transnational funding instrument which is designed specifically for small consortia and understands the needs of SMEs. A further advantage of collaborative projects such as those funded by the EUROTRANS-BIO initiative is the fact that risks are shared between the partners, a factor which is especially important in the high-risk biotechnology field.

Participating in EUROTRANS-BIO has also had a major impact on the regional or national agencies and ministries involved. The EUROTRANS-BIO team was delighted that the initiative led to improved coordination at the regional, national as well as the European level.

Transnational activities coordinating national and regional research programmes such as EUROTRANS-BIO can lead to reduced risks and costs, fewer cases of research duplication and stronger international SME cooperation all over the European Union.

A warm welcome for the **knowledge economy**

Four of Europe's outermost island regions are on the way to becoming true knowledge economies, thanks to the IN.TRACK project.

A 'knowledge economy' means using knowledge, particularly technological and innovation knowledge, for economic benefit. In the rush to develop the knowledge economy it is important that smaller, less developed or remote regions are not left behind due to lack of expert help and resources. However, encouraging a knowledge economy can be a two-edged sword, with bigger and wealthier regions forging ahead while smaller ones flounder, widening the gap between stagnation and growth.

To avoid this and help all EU regions reap the maximum benefits from the growing knowledge economy, the 'Regions of Knowledge' initiative was created. Regions of Knowledge is an EU pilot action which consists of 14 projects that are developing strategies to implement the knowledge-based economy through cooperation and technological development between regions.

IN.TRACK is one of these 14 projects and is working with 4 regions – Madeira, Crete, Sicily and the Canary Islands – to support new measures to promote technological development and inter-regional cooperation between peripheral EU regions.

Four regions, four action plans

These islands are all major tourist destinations whose beautiful landscapes attract thousands of visitors every year. Before tourism soared in the 1970s they were almost solely agriculture based, producing fruit, vegetables, wine and olives.

The regions all have very specific qualities. In spite of the rapid expansion of tourism, Crete still has a thriving agricultural economy and supplies much of Greece with fruit and vegetables. The Canary Islands traditionally produce bananas, tomatoes, potatoes and tropical fruit, while Sicily exports lemons and oranges and Madeira produces handicrafts, wine and tobacco. What characterises all four regions, however, is their geographic isolation.

IN.TRACK had four main objectives. The first of these was an evaluation of the current innovation and technology knowledge and an assessment of the possible value of knowledge in the islands. The second was to launch a professional awareness raising process to publicise the Regions of Knowledge idea. The third was to ensure that key people in the area (such as scientists, technologists, regional authorities and investors) were involved. The fourth was to develop an inter-regional network to enhance the exchange of learning and experiences through shared plans of action.

Creating a knowledge economy blueprint

The project set out to develop integrated strategies to create knowledge-based policies tailored to each region. In order to achieve this, three methods of analysing the regions' present circumstances and future needs were carried out: First came a SWOT analysis (Strengths, Weaknesses, Opportunities and Threats), a well established method of business analysis which detailed the present situation in each region. The results of this exercise provided a clear picture of how knowledge-based development should be carried out in each region.



Title | Insular Regions Knowledge TRACKer
Acronym | IN.TRACK
EC Contract number | KNRG-CT-2003 000036
Website | www.intrack.org/

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Secondly, another business tool called a Strategic Gap Analysis showed where the 'gaps' were in the knowledge economy of each region and helped to pinpoint the actions needed. Thirdly, a European Awareness Scenario Workshop, which is a business workshop using a technique called the Regional Foresight Methodology, was held. Usually the foresight methodology tool consists of brainstorming sessions and filling in questionnaires, but IN.TRACK took this a stage further and introduced a well-structured and consensus building methodology with dialogue and collaboration between representatives of the regions including investors, technology experts, administrators and representatives from regional business.

These discussions focused on many issues concerning the islands' attitudes to the knowledge-based economy and covered economic, political, technological, cultural and social values. At the end of the workshop, one of the main results of the project was formulated – a set of four blueprints listing what needs to be achieved in each region.

Towards a better quality of life

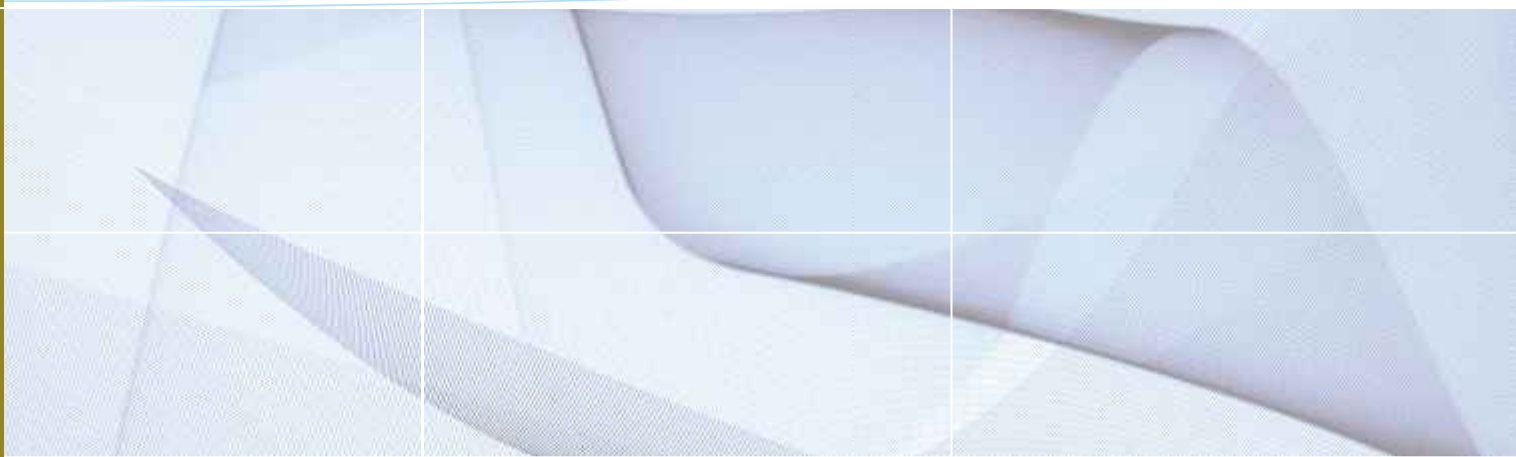
Out of the blueprints came four regional action plans in which the islands focused on particular areas. For example, the Cretan partners made a list of actions to be carried out with the help of regional authorities. These involved infrastructure, the modernisation of the agricultural sector, the development of the tourism sector, integrating research and education into the island's economy, and raising society's awareness of the importance of a knowledge economy.

As a result of the blueprints the IN.TRACK partners formulated the following collective statement on their intentions for their regions:

'The regions of the Canary Islands, Crete, Sicily and Madeira strive to accomplish the goals of a diversified economy based on the information society and the converging technologies, while strengthening an innovation culture based on private-public partnerships aimed at enhancing the society's orientation towards education, research and continuous training. Additionally, they share the vision that a cohesive society will be developed by the growth of the societal capital of the four regions sustaining high quality of life standards, desirable to any European citizen.'

For these four regions the opening up of the knowledge economy is a way to a better quality of life, better job prospects and improved regional competitiveness.

One of the best things about the IN.TRACK model is that it is very flexible. A strong focus on workshops and discussions at a local level gives enough flexibility to allow many different opinions to be heard and a region's own strengths, culture and identity to play a part in creating its knowledge economy. The IN.TRACK model is now going to be carried out in other very culturally distinctive regions such as the Balearic Islands, the Azores, Sardinia, Corsica and Scotland's highlands and islands.





SUCCESS STORIES **INTERNATIONAL COOPERATION**

United to save Europe's longest river

The Volga is Europe's longest river and home to one of the world's best conserved delta wetlands. But threats from dams, reservoirs and hydropower stations mean that the survival of 'Mother Volga', as it is known in Russia, is increasingly in peril. Now, thanks to the CABRI-Volga project, this majestic river's future is looking cleaner and brighter. What's more, the project results could also be applied to other rivers facing similar problems.

Eight huge complexes comprising dams, reservoirs and hydroelectric facilities operate on the Volga. The result: what was once flowing water has become a chain of lakes. Unable to flush themselves out, these lakes are seriously polluted by industrial waste, sewage and agricultural run-off.

While polluted water discharge into the Volga Basin declined by a third during the last 15 years, water quality, and especially drinking water quality, remains high on the environmental agenda. None of the major cities in the Volga Basin is supplied with drinking water that complies with national and World Health Organization (WHO) standards.

If the Volga is to be rescued from this predicament, those seeking to bring about change must combine their efforts, resources and ideas and present a united front. While previous attempts to address individual problems had taken place, they were impeded by low levels of cooperation between academics and policy-makers, a dearth of cross-sectoral cooperation and a lack of civil society involvement.

It is here that the CABRI-Volga project comes in. Bringing together 17 partners from the public and private sector in Russia and seven EU

Member States, the project facilitated cooperation and coordinated research on environmental risk management in the context of large river basins in the EU, Russia and the New Independent States (NIS).

'We tried something that was rather unique'

The project was initiated when researchers from Russia contacted Rupprecht Consult Forschung und Beratung in Germany, which eventually took on the role of CABRI-Volga coordinator. The Russian team had become interested in the Volga through their involvement in an earlier project, 'Volga Vision', which was funded by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and was keen to embark on new initiatives involving the river.

CABRI-Volga's impressive results include policy recommendations, a research agenda for the future, a presentation to politicians, major international conferences and an exchange of researchers. 'Our project didn't carry out research as such; we coordinated researchers. The success really was that we tried something that was rather unique. We provided an opportunity for a dialogue between eastern and western researchers,' says project coordinator Frank Wefering.

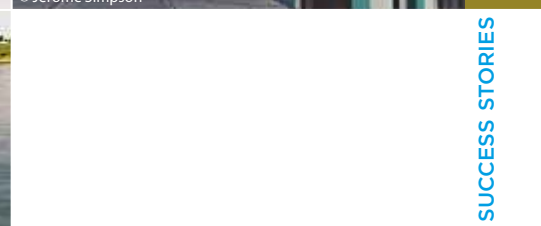


Title | Cooperation Along a Big River: Institutional Coordination Among Stakeholders for Environmental Risk Management in the Volga Basin
Acronym | CABRI-Volga
EC Contract number | 13424
Website | www.cabri-volga.org

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- Saratov State Socio-Economic University (Russia)
- Caspian Marine Scientific and Research Centre (Russia)
- Autonomous Non-Commercial Organisation (ANO) Institute of Environmental Economics and Natural Resources Accounting 'Cadastre' (Russia)
- Ecological Projects Consulting Institute (Russia)
- Open Joint-Stock Company 'Ammophos' (Russia)
- United Nations University – Institute for Environment and Human Security (Germany)
- Wageningen University (The Netherlands)
- Aristotle University of Thessaloniki – UNESCO Chair/ INWEB (Greece)
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- University of Karlsruhe Institute for Water Resource Management, Hydrologic and Rural Engineering (Germany)
- Compagnie Nationale du Rhône (France)
- The Regional Environmental Center for Central and Eastern Europe (Hungary)
- International Ocean Institute (Malta)



The policy recommendations are directed primarily at decision-makers in Russia and the Volga Basin. But they could equally be applied to other river basins and other stakeholders. They illustrate the broad diversity of factors that must be considered in order to protect the Volga, and how they are interlinked. Some of these may not have been immediately obvious to actors approaching the problems with a limited overview of the threats. The creation of one over-arching list makes very evident the advantages of gathering so many stakeholders from different disciplines who ultimately share the same objective.

Recommendations include, for example: establishing an inventory of hydro-facilities and the risks they pose; enhancing institutional capacities in water governance; building an integrative transport strategy; enhancing the system of protected areas and nature reserves; building drinking water and wastewater plants; reforming licence and tax regulations to promote environmental performance; improving information-sharing; enhancing partnerships between stakeholders; and raising awareness and promoting EU-Russian cooperation.

The project also led to a research agenda for the future, addressing current gaps in knowledge. For example, research into the processing and supply of drinking water is inadequate, and is coupled with a shortage of scientific advice about good water governance. There is also a lack of multidisciplinary assessment of the risks of water-related disasters such as floods and droughts and loopholes in understanding of the risks from hydro-technical facilities for human health and ecology.

Changing perceptions...

The recommendations were not the only results to arise from 27 months of close cooperation and exchanges between some 150 experts from various stakeholder groups and scientific disciplines. Other achievements included three major conferences and researcher exchanges. Researchers from both the EU and Russia took part in the exchanges. Those from the West who spent time in Russia often reported back that their preconceived ideas about Russia being behind in some areas were challenged. According to the project coordinator, it gave them the opportunity to observe that in some cases, such as energy production in dams, they are just as far ahead as western Europe, if not more.

The CABRI-Volga team also succeeded in reaching Russian politicians through a political round table in Moscow and a small-scale information session in the Duma. These are the people that need to be most aware of the extent of the threats to the river basin, as well as how to deal with them.

... to work together

Some stakeholders did not believe initially that EU participation was necessary in order to save the Volga, and involving them was a major coup for the project team. The project partners placed great emphasis on the value of working with their opponents rather than around them.

One of objectives before work on the CABRI-Volga project got underway was to ensure that it left a legacy. There can be no doubt that this has been achieved. The network is in place and there is an eagerness among the partners to continue what the project started.

In the eye of the dust storm

Dust storms often sweep across Central Asia, causing problems for both human health and agriculture. Now scientists from the CALTER ('Long-term ecological research programme for monitoring Aeolian soil erosion in central Asia') project are shedding new light on this devastating phenomenon.

They have already set up a ground monitoring system, braving harsh desert environments to do so, and gathered extensive data on dust storms from archives going back several decades.

The project brings together nine partners from seven countries (Germany, Portugal, Israel, Kazakhstan, Russia, Turkmenistan and Uzbekistan). Their expertise covers a range of disciplines including climatology, geography, meteorology, soil science, botany, physics, mathematics and remote sensing.

Dust storms

Central Asia is naturally prone to dust storms, as the wind regularly whips up the sands of its vast Karakum and Kyzylkum deserts. The resulting high levels of dust in the atmosphere cause respiratory problems in people and animals, and affect crops by damaging the structure of the plants and stripping away the topsoil. Communications activities infrastructures can also be affected by dust storms.

Over the past four to five decades, human activities in Central Asia have caused the frequency of dust storms to increase significantly. In the 1950s, large areas of the Kazakhstan steppes were given over to agricultural production, creating a period of severe dust storms known as the 'Soviet Dust Bowl'. Today, excessive grazing, transport and oil and gas exploitation activities are having a similar effect, placing the light, sandy soils of the Karakum and Kyzylkum deserts at increased risk of erosion.

More recently, irrigation activities have caused the Aral Sea to shrink and the exposed seabed is now a major source of dust in the region. Worryingly, this dust is heavily contaminated with salts and herbicides, pesticides and other agricultural chemicals.

Looking to the future, some climate change models predict that Central Asia will become even drier, causing vegetation to die back and water bodies to dry up, and exacerbating the problem further.

The region's attempts to deal with these storms are hampered by a lack of information about the factors influencing the storms. Unsolved mysteries include the location of the main dust-producing areas, how far the dust is transported, where it is deposited, what it is made of and to what extent human activities affect the frequency of dust storms.

Delving into the details of dust

The aim of the CALTER project is to answer these questions and develop recommendations to reduce the severity of dust storms, with a particular focus on Kazakhstan, Turkmenistan and Uzbekistan. Some 80% of the area of these countries is classified as arid or semi-arid.

The first priority of the project is to set up a comprehensive monitoring system on emission sites, dust storm frequency and dust composition, which will provide the information needed to mitigate the effects of dust storms.



Title | Long-term ecological research program for monitoring Aeolian Soil Erosion in Central Asia

Acronym | CALTER

EC Contract number | 516721

Website | www.epif.bgu.ac.il/CALTER/index.html

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- Water Problems Institute of Russian Academy of Sciences (Russian Federation)
- Philipps-Universität Marburg (Germany)

- Universidade do Algarve (Portugal)
- Hydrometeorological Research Institute (Uzbekistan)
- Institute of Bioecology of Karakalpak Division, Uzbek Academy of Sciences (Uzbekistan)
- Space Research Institute (Kazakhstan)



The project team is turning to a wide range of techniques and information sources to study the storms. One part of the project involves collecting and analysing data on dust storms from more than 300 Central Asian meteorological stations which have been operating since 1936.

Satellite images are also being used, both to monitor dust storms and study the changes taking place in the most active dust-emitting sites. The partners are also developing computer simulations of dust storms, and using wind tunnels to determine wind speed thresholds.

They are also testing materials which could be used to stabilise soils, and developing phytorehabilitation measures using local drought and salt-tolerant plant species, which could be used for the most hostile environments such as the dried bottom of the Aral Sea.

Another important goal of the project is the establishment of long-lasting links between European and Central Asian researchers, and boosting research cooperation among the Central Asian states.

Setting up a network in the desert

According to the project partners, CALTER's main achievement to date is the establishment of a ground monitoring system on dust deposits in Kazakhstan, Turkmenistan and Uzbekistan. This is no mean feat – simply reaching the sites in the middle of the desert is a challenge. The monitoring system is already helping the countries involved to identify the major sources of dust in the region. Armed with this information, the countries can plan more effective strategies to mitigate the problem.

The project has also succeeded in drawing the attention of local authorities in the region to the problem of wind erosion and air quality. The heads of Kazakhstan's provincial meteorological services were so impressed by CALTER's methodology that they have decided to extend the monitoring network to cover the whole country.

Extending the project's reach

CALTER is focusing its efforts on just three countries: Kazakhstan, Turkmenistan and Uzbekistan. However, the project partners are keen to build on the work carried out within CALTER and expand the monitoring network to other Central Asian countries such as Mongolia and China, and possibly even Afghanistan and Iran.

They are also eager to explore the socioeconomic and natural causes of land-cover change in greater depth, and analyse in detail the way landscapes change over time.

Although CALTER focused its efforts on Central Asia, the knowledge generated by the project in terms of our understanding of the conditions which lead to the development of dust storms, as well as the methodologies created to monitor and observe these phenomena, could also be applied elsewhere.

The project's reach therefore has the potential to extend far beyond the windswept Karakum and Kyzylkum deserts to the other regions of the world where bare, arid soils and high winds conspire to whip up sand storms on a regular basis.

INCOFISH – international cooperation to keep plenty more fish in the sea

Environmentally aware seafood fans can now use their mobile phones to find out which fish have been caught sustainably, and which deserve to be struck firmly off the menu, thanks to a service developed by the INCOFISH ('Integrating multiple demands on coastal zones with emphasis on aquatic ecosystems and fisheries') project. It is just one of many tools created by the project with the aim of helping consumers pick fish which have been ethically sourced.

INCOFISH brings together 36 partners from 23 countries on 4 continents (Europe, Africa, America and Asia). Their goal is to study the pressures faced by coastal waters around the world, with a focus on fishing, and develop tools that can be easily used by consumers, fishermen and policy makers to reduce these pressures.

Plenty more fish in the sea?

According to the saying, there are plenty more fish in the sea. Unfortunately, research shows that this is no longer the case. In Europe, many once-common species are now overfished. In the North Sea, cod stocks are on the verge of collapse, while the growing popularity of sushi around the world is pushing the Atlantic bluefin tuna to the brink of extinction.

Fishing affects the environment in other ways too. For example, bottom trawling for Norwegian lobster devastates the sea floor and its

inhabitants, such as starfish, shellfish and other crustaceans. Many fishing methods also catch large numbers of unwanted fish along with the target species; this 'bycatch' is usually discarded. Endangered species such as turtles and dolphins can also become entangled in nets, where they drown.

One important INCOFISH result is the discovery that fisheries could maintain current catch levels while drastically reducing the damage they cause to both fish populations and the wider environment. In an article in the journal *Fisheries Research* in August 2008, the scientists show that wild stocks could be up to seven times larger if the fish were caught at a size where they have reached their full growth potential and have spawned several times.

Alternatively, the larger catch per effort could be used to introduce slightly less efficient fishing methods that are less harmful to the environment.

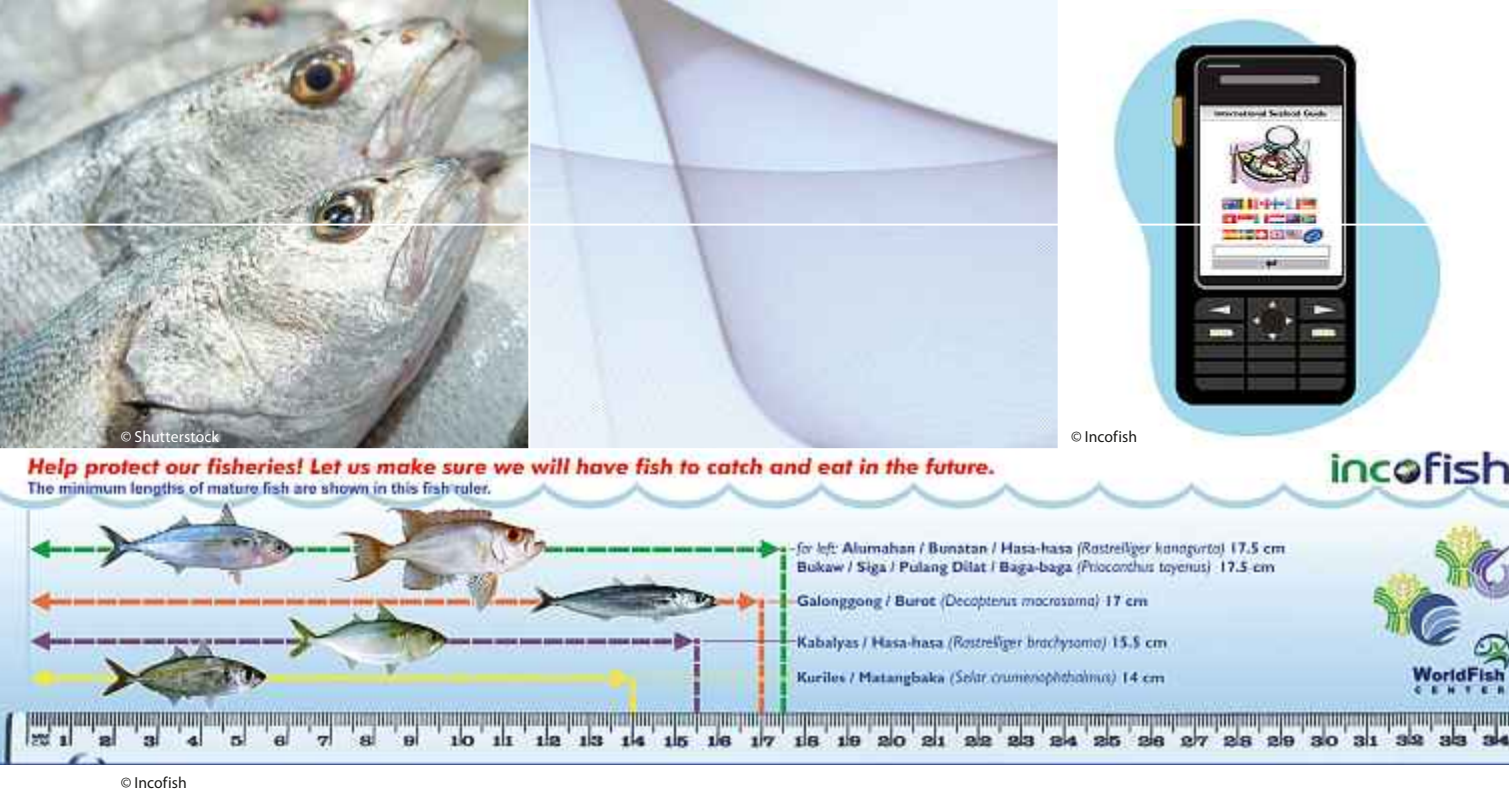


Title | Integrating Multiple Demands on Coastal Zones with Emphasis on Aquatic Ecosystems and Fisheries
Acronym | INCOFISH
EC Contract number | 509087
Website | www.incofish.org

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- Empresa de Consultoria e Inversiones (CABAL, SA) (Nicaragua)
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- Charles Darwin Foundation for the Galapagos Islands (CDF) (Ecuador)
- The Secretary of State for Environment, Food & Rural Affairs acting through the Centre for Environment, Fisheries & Aquaculture Science (CEFAS) (UK)
- Centro Interdisciplinario de Ciencias Marinas del Instituto Politécnico Nacional (CICIMAR) (Mexico)
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- University of Namibia (Namibia)
- Universidad de Concepción (Chile)
- University of Newcastle upon Tyne (UK)
- Universitetet i Tromsø (Norway)
- University of the Western Cape (South Africa)
- The University Court of the University of Aberdeen (UK)
- Universidad San Francisco de Quito (Ecuador)
- Kenya Sea Turtle Conservation Committee (KESCOM) (Kenya)



Good fish, bad fish

Consumers also have a role to play in preserving marine life. They can avoid eating endangered species, opting instead for fish from sustainably managed stocks that are caught or farmed in ways that cause minimum damage to the marine environment.

However, many consumers struggle to differentiate between the fish that have been sourced ethically and those that have not, and this is where the INCOFISH project comes in.

They have developed an International Seafood Guide which contains ethical information on over 4 000 varieties of seafood from around the world. The guide pulls together data from 27 existing seafood guides and uses a simple traffic light system to inform users of a species' status. Green means the fish was caught sustainably and can be enjoyed with a clean conscience; amber means the fish was caught in a questionable manner and if possible an alternative should be found; and red means the fish should definitely be avoided.

By clicking on a link users can find out more about the fish and the way it was caught. Among other things, the guide tells users whether a species is vulnerable to over-fishing or is fished using methods which harm other species or are damaging to the environment.

The guide also helps users avoid eating juvenile fish. In many fisheries, a lot of fish are caught when they are very young, before they have been able to reproduce. This practice is placing the future of many fish stocks in peril. Young fish are also small, and so by choosing bigger fish, consumers can ensure they are eating mature fish that have already reproduced.

But how big should a fish be? Again, the INCOFISH seafood guide has the answer – by clicking on a ruler icon, the user can find out the smallest acceptable size for the whole fish, the headless fish or a fillet for the fish in question.

The guide can be accessed by any internet-enabled mobile phone at www.seafoodguide.mobi, making the information it contains immediately available for restaurant diners hesitating over the menu and shoppers lingering over the fish counter. It is now available in 17 countries worldwide, including 9 in the EU.

'Don't catch the babies'

The project partners are also working closely with fishing communities, to encourage them to preserve the resources they rely on for their livelihoods. The project has developed a fish ruler to help fishermen avoid catching juvenile fish that have not yet reproduced.

Made out of flexible but sturdy plastic that can be rolled up to fit in a pocket, the ruler is very easy to use. Pictures of the most common commercial species are printed on the ruler indicating the minimum length of mature fish. In this way the fishermen can easily check to see if they are catching juvenile or mature fish and, if necessary, change the size of their nets' mesh accordingly.

Different versions of the ruler have been created for different regions of the world including the North Sea (this version is available in German and English), the west coast of the US, the Philippines, Senegal and Peru; each one shows popular local species.

Tools to save the seas

While the mobile fish guide and fishing ruler are two of the project's main products, other important INCOFISH outputs include data on the history of key fish stocks, maps showing current and predicted biodiversity in our seas, and an inventory of the plants favoured by herbivorous fish.

The project's products and findings are freely available on the INCOFISH website at www.incofish.org. The hope is that this toolbox will help all of us – consumers, fishermen and policy makers – protect our marine environment and ensure that it continues to provide us with food long into the future.

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