SUCCESS STORIES

of Irish Participants in the European Union
Framework Programme for Research & Technological Development

Aughinish Alumina Ltd

€1.7 million total project funding

Project: Reacon

Reaction Control

As far as metals go, aluminium is one of the most successful of our age, appearing not just in consumer items like drinks cans, but throughout the construction and aerospace industries. For raw material suppliers like Limerick-based refinery Aughinish Alumina, commercial opportunities are expanding, inspiring the company to work more efficiently to exploit market growth. Thanks to FP6 funding, secured under the programme's Marie Curie Actions, and assisted in a hands-on way by the Conference of Heads of Irish Universities (CHIU), Aughinish now has an unprecedented opportunity to build for the future – by gaining a better understanding of the chemistry behind its business, and by developing process control systems to put its new knowledge to work. This is the largest amount won by any Irish organisation in FP6 to date.

Formerly a part of the Canadian company Alcan, Aughinish Alumina has long appreciated the important role R&D plays in the future of the company. However, with the sale of Aughinish in 1999 to Swiss company Glencore, Aughinish lost its R&D function, which had traditionally been carried out by laboratories in Canada and the UK. In forming its new business strategy, Aughinish made R&D one of its main priorities and was asked by Glencore to establish R&D for the group's alumina refineries as a whole.

The refinery's reasons for embracing R&D are clear. Located far from the major hubs of the alumina industry – Australia, for example, is one such centre – Aughinish needed to find other ways of excelling among the competition, and developing its own leading-edge technologies offered an obvious route forward. The Irish refinery, like many traditional industries, also faces competition from lower-cost economies; and even while uses of aluminium continue to grow, the cost of raw alumina has decreased in real terms, forcing Aughinish to cut costs, increase production and use R&D to provide innovative solutions. REACON, the FP6 funded Marie Curie project at Aughinish, gives the refinery a way to make progress on all these fronts, for the long-term stability of the company.

In-house researchers to provide a lasting competitive advantage

REACON gives Aughinish a unique opportunity to welcome various expert researchers to work in the company. The researchers will also have access to the facilities at University of Limerick, where Aughinish has strong ties and currently helps fund 17 researchers to perform work related to its industry. The aims of the four-year REACON project are to give Aughinish a more fundamental

understanding of the chemistry behind its processes: it's hoping for insights that can be incorporated into its industrial processes, and into the sophisticated control systems used to manage its processes.

The chemistry behind the refinery's processes is complex and difficult to investigate because of the elevated temperatures and pressures needed to extract the alumina. To make alumina, Aughinish crushes raw bauxite ore and mixes this with caustic soda inside large pressure vessels. At 255 degrees Centigrade the ore dissolves and the impurities can be removed. Then, an intermediate form of alumina is produced in a series of large crystallisers; this substance is heated to 1,050 degrees Centigrade to create the final alumina, which is sold to aluminium smelters.

"We understand what is happening [during these processes] through sampling after the event, but we're developing technologies now to let us study the process in real time," explains REACON Coordinator Martin Fennell, a process consultant at Aughinish. He says the fundamental knowledge gained here – perhaps on how it could improve operating efficiencies, or raise the quality of the final alumina – could then be incorporated into its business. For instance it might modify or commission the development of equipment, and the company would also be able to modify the hardware and software systems that control its plant.

Researchers collaborating for the future of the company

Martin says there is tremendous value for Aughinish in being able to draw on trained researchers from industry as well as industrial research institutes, making use of their expertise for as little as two months or as long as two years. Aughinish will also have the chance to send its own technical people to industry-leading institutions, enabling them to return with important knowledge for the company. Martin said the first researchers who've come to work at Aughinish have already benefited the company, since they've brought up-to-date knowledge about control and automation technology, and about how to customise the technology for use.

"REACON is a tremendous opportunity for us," he says. "It's going to allow us to accelerate our development of technology, and it's also going to establish us within the multinational environment that we work in as a technology player and a technology leader." The more intellectual property Aughinish is able to develop, he adds, the more its value should increase among its group of companies – and the better able Aughinish will be to compete on the world stage.

"Our view til now would have been reasonably narrow in terms of what can be achieved [with technology]," he said. "But now that people are coming in with a fresh view of things, it's going to offer new perspectives on what's possible."

Did you know?
The Marie Curie programme's many advantages for companies include the fact that the schemes are open to all research areas; a single company can apply and can also avail of proposal writing services, contract negotiation and assistance overcoming issues such as work permits through the National Contact Point Office in C.H.I.U.

Trinity College Dublin

Research consortium: 40 partners

Project: Hilas

Human Integration into the Lifecycle of Aviation Systems

Some 80 percent of accidents concerning commercial aircraft involve a contribution of human error. But a consortium of research institutes, businesses and universities – all led by Trinity College Dublin – are aiming to reduce this figure as part of the FP6-funded project HILAS, a four-year examination into the way workers interact with the complex systems that constitute the aviation industry. Making flying safer is an ambitious aim, one that will require experts from not only the realm of aerospace engineering and mechanics, but also human psychology.

"As everyone knows, air travel is mushrooming," says Dr. Nick McDonald of the Department of Psychology at Trinity College Dublin (TCD), coordinator of the HILAS project, now in the final stages of receiving FP6 approval. "The system is going to be put under enormous strain if people are to be able to travel in the volumes anticipated. Every airline is trying to reorganise to cope; the human aspect is part of this whole process."

"If the system is going to be able to deal with increased capacity, while maintaining or increasing safety levels, there are going to have to be some radical changes," he says.

The questions posed by Dr. McDonald and those involved in the HILAS project are seemingly simple ones. How can we design systems that better meet the needs of those operating them? When systems (aircraft, operational processes and procedures) are not designed with this in mind, then the users have to find ways of compensating for this. This can lead those who operate and maintain aircraft to deviate from the protocols put in place by those who design aircraft equipment, and those who draft operational and maintenance procedures. Thus, how can we reduce the disconnect between designers and crews/technicians?

"If you look at the way in which people do their job, any job, you will find that people don't always follow the plans that designers have laid down – and sometimes what they are doing is illegal," Dr. McDonald explains. "Often designers are horrified by this. But ask the technicians and they will often say they've found a way that is better and quicker, and even safer."

Knowledge Management

In theory, if the paths that crews and technicians follow could be tracked – if that knowledge could be managed – then crucial "real world" data could be brought to designers, who in turn could design better procedures, such as new maintenance or safety protocols, or even new measures for pilots and crews facing a crisis. What's more, the process could work in reverse: armed with a deeper understanding of how crews and technicians carry out their work, those who make the rules and regulations within the complex system that is the aerospace industry could devise improved training regimens to keep workers better apprised of new innovations.

The project will involve not only a knowledge management objective, it will also see researchers propose changes in the system, with the impact of these changes carefully tracked to determine if this closer exchange of knowledge can result in both increased safety for passengers and air crews, as well as increased efficiency for the airlines and maintenance organisations themselves.

HILAS will also examine technological means to improve aircraft safety including synthetic vision, head-mounted displays and multi-modal dialogue systems. Here too, scientists will look closely at the way pilots interface with equipment and whether that interaction is as efficient as possible.

Systems within systems

On the surface, the research seems simple. But in fact the almost never-ending "systems within systems" that characterise the aviation industry turn HILAS into a mammoth project. After all, an almost countless number of complicated processes are part of the daily routine of ground crews and air crews, with each operation carried out under strict regulations, from tyre pressure checks to coping with a sudden loss of altitude. Throw into the mix extensive record keeping, not to mention the thousands of aircraft and hundreds of thousands of workers, and the whole affair of capturing and analysing knowledge about how individuals interact with this complex system becomes extraordinary.

Dr. McDonald notes that such a job, involving 40 partners ranging from other research institutions to businesses – such as FLS Aerospace, AMT Technologies and Shevlin Technologies in Ireland – could not be carried out without the support of FP6. "We have been doing this kind of work for some time," he says, noting that HILAS is a more extensive project than previous EU-supported efforts such as AMPOS and the ADAMS 1 and 2 projects, which Dr. McDonald and the team at Trinity's Aerospace Psychology Research Group also co-ordinated.

"For a research group here in Ireland to gain the level of credibility and expertise we have...it just could not have been done without European support," Dr. McDonald commented. "...The European Framework programme has been our main avenue to develop the close collaboration with industry and other researchers necessary to achieve these large-scale research goals."

He also says that the involvement of firms like FLS Aerospace, AMT Technologies and Shevlin Technologies, as well as other researchers throughout Ireland, will allow the country to develop as a regional pocket of aeronautics expertise within Europe. "I think that this kind of regional development represents a very good example of results of investment into applied industrial research."

Engineering Solutions International Ltd

€2.14 million total project funding

Project: Effises

Energy Efficient Safe Innovative Fast Ships and Vessels

For engineering on a truly massive scale – such as creating an entirely new type of vehicle – companies cannot afford to make expensive mistakes at the prototyping stage. That is where Irish company Engineering Solutions International Ltd. (ESIL) has shone, providing computer modelling tools that can actually predict the behaviour and performance of products at the design stage. A regular participant in research projects, ESIL says one of its most successful to date was the FP5-funded EFFISES initiative, a project that gave ESIL important recognition for its valuable simulation engineering services.

EFFISES, led by the Norwegian company SES Europe AS, had a clear goal: create an entirely new type of passenger ferry, using an innovative catamaran configuration – a double-hulled design – along with unique airlift technology. Together, these technologies would combine to lift the vessel above the waves and drive it forward with powerful motors. The aim was speed, creating a ferry that was able to travel at more than 50 knots (around 100 kilometres per hour), while still being energy-efficient and environmentally friendly.

"We met the Norwegian team at an EU-sponsored research exhibition," recalls Barry O'Reilly, Managing Director of ESIL in Dublin. "We started talking, and when we understood what they wanted to accomplish, we were sure we could help with their design thanks to our involvement in computational fluid dynamics."

Barry explains that while his company had established tools for CFD – which is the application of mathematical techniques to problems of fluid flows and aerodynamics – the company was seeking a project that would showcase what it could do, as well as allowing ESIL to further refine its techniques. The EFFISES project was ideal. Not only would it allow the Irish company to become involved in a stimulating consortium of research partners, all with unique strengths in areas like maritime consulting and catamaran construction, but the technical challenges were exactly within ESIL's area of expertise.

Better ferries for a smoother ride: simulation technology makes the difference

By any measure, the EFFISES project was an exciting new departure in ferry design. The combination of a catamaran hull with an airlift system – where a tremendous amount of air would be pumped below the hulls, using giant fans – was known to be possible. EFFISES, however, marked the first time that the concept would be implemented on this scale. Such a vessel would be unique, since its propulsion technology would give it extremely low resistance and create low wash waves.

Low wash waves are highly desirable from a safety and environmental point of view. High wash waves may not only endanger other vessels and even threaten human life on beaches, but they are also known to cause damage in the form of bank erosion. Fast ferries moving at high speeds typically create high wash waves; if EFFISES could lead to a vessel with increased speeds but no danger of high wash, the breakthrough would be substantial, with promising commercial opportunities.

As it turned out, the participation of the Irish company was crucial to the success of EFFISES. ESIL was able to show how the giant fans would make the ferry behave in the water, including the amount of air required and whether the resulting ride would be smooth. "One thing we found is that the location of the fans could be improved," Barry recalls. "We were able to show by computer simulation how to move the fans to the optimal position."

Collaboration for real research success

Barry stresses that the success of EFFISES would not have been possible without the collaboration of research partners across Europe. He says that projects like FP5 create an exciting synergy of experts, each with different talents, which make the project intellectually stimulating as well as rewarding in terms of new commercial opportunities. "This partnership approach of the European Commission works because it means that everybody is bringing something to the table, and if the research is successful, everybody walks away with something better," he says. "You get access to other people's ideas, you find out what other people do, and you see where the technology is going and where it's coming from. In two days of meetings with these partners, it was amazing the amount of information that was shared."

Today the technology pioneered in EFFISES is ready for commercialisation by the Norwegian firm SES Europe AS, while the research partners themselves have also gone on to new opportunities. "We know that certain projects we've become involved in have come because of our involvement in EFFISES," says Barry. "We made a reputation for ourselves based on the work done in EFFISES, and new opportunities are still arising for us."

Biotrin International

€1.5 million total project funding

Project: Euparvo

Human Parvovirus Infection: Towards Improved Understanding, Diagnosis and Therapy

For most of us, the common infection of human parvovirus (parvovirus B19) is a normal disease of childhood. Although highly contagious, the virus causes nothing but temporary soreness and perhaps a rash, after which we develop a lifelong immunity to the disease. But for groups at risk – like pregnant women and patients with weak immunity – parvovirus B19 poses a graver threat. Irish diagnostics company Biotrin International, already a world leader in parvovirus testing products, has made impressive strides in reducing the threat thanks to EUPARVO, an FP5 funded project to improve doctors' ability to detect and treat the disease.

For Biotrin International, bringing research advances from the lab to the marketplace has always been central to its business. Formed in 1992, Dublin-based Biotrin has made its name by developing a range of diagnostic tools, most notably antibody testing kits for human parvovirus which are now the market leaders. With 64 staff in total employed (27 in R&D and manufacturing), Biotrin is living proof of how an Irish company can turn laboratory research into a successful international business.

With EUPARVO, Biotrin has had the opportunity to participate in one of the most important initiatives in the history of parvovirus research. For the first time, the FP5 funded project unites Europe's leading parvovirus specialists in areas like detection, strain differentiation and therapeutic treatments – including scientists from Germany, Finland, Sweden and France, as well as a dedicated research team from the National University Of Ireland, Maynooth led by Biotrin's own former head of R&D, Dr. Sean Doyle. If EUPARVO is successful, not only will detection be vastly improved, but novel therapies will also become available to doctors.

Harmless to most, lethal to some

To date, although tools like Biotrin's can be used to find parvovirus antibodies in a patient, there are still no standard systems for diagnosing or treating the virus itself.

For pregnant woman, too, the risk is real. If a woman without prior immunity contracts human parvovirus during her pregnancy, she could miscarry due to severe anaemia in the foetus. Biotrin, the only commercial organisation in the consortium, is already helping the cause of pregnant women through its antibody test kits, but it was aiming for even greater improvements with EUPARVO.

Des O'Leary, Chief Operations Officer of Biotrin, says the company's aims were twofold. First, it wanted to develop a rapid blood test for antibody detection: its current tests can be done in three hours by a lab technician, but it wanted a blood test that doctors themselves could perform in around 15 minutes. Second, Biotrin wanted to be able to detect the virus itself, both in patients and in the blood supply.

For Biotrin, the blood supply market is a crucial one. "Currently there is little or no screening of blood components for human parvovirus, and we see this as one major market opportunity," he says. "From a public health point of a view, this would be very important."

Cooperation for better advances

Des says that the collaboration opportunity EUPARVO provides is invaluable to Biotrin, providing unprecedented access to the leading scientists in the field. "The Framework Programme provides a basis for public health researchers to interact with a commercial enterprise without feeling in any way compromised. As part of the cooperation [of FP5], they are sharing knowledge and expertise that normally they might not share with a commercial enterprise."

Vicky McGrath, Business Development Manager for Biotrin, adds that the research skills of the EUPARVO team have created a synergy that makes major progress possible. "It means that you have the top scientists in Europe all working together on the same disease, trying to advance the knowledge on that disease," she says. "It's so advantageous to us to know who the experts are in each area, and it opens lots of avenues to cutting-edge technology for us."

Although EUPARVO doesn't wind down until later this year, already it looks certain to create market opportunities for Biotrin. Des says the company is very confident that the rapid testing device developed under FP5 will end up as a commercial product for Biotrin. The attempts to detect the virus itself have also shown impressive progress, and Biotrin now has a fully functioning virus test. All that remains now is for the test's sensitivity to be perfected, and doctors may soon have another important weapon in the fight to minimise the risks of human parvovirus across the population.

NTERA Ltd

Project: Nanochromics

Expanding the Nanotechnology Knowledge Base

NTERA, an Irish nanotechnology company, has made a commitment to develop cutting edge, "paper-quality" electronic displays for devices like laptops and e-readers. To fulfil this commitment, the company, already a leader in next-generation displays, will need additional expertise from specialists who have proven their ability to innovate. Thanks to FP6, NTERA is about to bring the necessary talent on board, having secured funding under the FP6 Marie Curie Actions with key assistance from the Conference of Heads of Irish Universities (CHIU).

The world has come to be reliant on displays, such as the small liquid crystal displays found in digital clocks, automobile dashboards or other instruments, typically used for numerical information or a few words or symbols. It is in this area that NTERA has come to be a leader, despite that fact that its proprietary NanoChromics displays (NCDs) are yet to be seen by most people. That is because NTERA is not in the business of designing ordinary displays; its business is designing what are known as "paper-quality" displays, or screens that resemble paper, the medium widely preferred for reading due to its clarity and contrast.

"I think it's fair to say we are leaders," says David Corr, Chief Technology Officer of NTERA, which expects to see displays it designed – among the first of their kind to become commercially available – to start shipping by the end of 2004. "But we are now looking beyond...the more basic kinds of displays. We are looking at growing into new areas; into products that offer even higher resolutions, products that could be used as e-readers or laptop screens."

Nano-alphabet soup

Developing the company's NanoChromics technology has required tremendous research into nanomaterials, materials that are carefully constructed, almost one atom at a time using highly-sophisticated techniques. The actual displays are a kind of nanomaterial "soup" sandwiched between conductors and two thin layers of glass. The magic of NanoChromics happens in the soup, where a nanostructured film sits beneath a layer of specially designed molecules that act as a kind of electronic ink. When an electric charge is sent through the mix, the molecules assemble themselves into patterns, forming letters, numbers and shapes that can be read by users.

In layman's terms, NTERA's products are screens that appear white or crystal clear and offer high definition text -- like ink on paper. Other benefits over traditional displays include low power consumption, as well as switching times (the speed at which the text can be changed) in the millisecond range.

New knowledge, new products

Work to date on this technology required a level of know-how that can't be found just anywhere and for its move into far more sophisticated displays for laptops and similar devices, NTERA will need highly-trained individuals who come from a research background in an academic institution. "We need to replenish our fundamental research base. We can't provide new products without new knowledge," David says. "That is what the Marie Curie programme is about, and we are taking advantage of it."

Full support to companies, from identifying the appropriate action to proposal writing assistance, is provided by the National Contact Point office in CHIU. "The success of our application is in no small way related to their assistance and to the clarity of information provided; we are grateful for the help received during the application process," David says.

NTERA, like any firm involved in an FP6 Marie Curie action, will take on several researchers from academic institutions anywhere in the world for varying lengths of time, ranging from two to three years. These individuals – already classified as experts – will help the firm to build up its knowledge base to achieve a commercial result: more advanced and higher quality displays. The only restriction is that the researcher must hail from outside of Ireland.

"Essentially, what we are talking about is bridging the gap between universities and industry," David notes. "The philosophy is to stop the brain drain from Europe and to transfer knowledge from researchers to companies. I also believe that many of the researchers in Europe, and in the US and Asia, want to move to companies as a viable alternative to University research. They want that opportunity and that is what the programme enables."

David also notes that the funding programme allows small to medium enterprises in high-tech fields to lure specialists who, without FP funding, might be forced to hold out for a position with a large global enterprise with vast R&D resources. "Considering that more than 70 percent of all employment in the EU is in SME's...and that these individuals have highly specialised skills, their options are limited unless they can look toward smaller companies."

NTERA has already been through several successful venture capital rounds to support its development. With a product coming to market, it should be able to begin generating new revenue, but according to its Chief Technology Officer NTERA would need additional venture investment to bring in high-calibre talent were it not for FP6. "I think the Framework Programme is critical for a company at NTERA's stage. It is very difficult to raise additional venture capital and this means we won't be forced to do that." David said. "On top of that, it's a very, very good use of taxpayer money."

GEM Plastics Ltd

€540,000 total project funding

Project: Nanoadd-Craft

Nanoadditive Reinforcement of Plastic Resins

The commercial plastics industry has gone from strength to strength over the past 20 years, with plastics now being used in a range of applications unthinkable a generation ago. But for GEM Plastics of Cavan, even its strongest plastic drums, cans and other containers are still not rugged enough to hold the most volatile or corrosive materials used by industry. In such applications, stainless steel reigns supreme, leaving this valuable market closed to plastics companies. But with the help of nanotechnology, GEM Plastics was determined to change all this, through the FP5-funded NANOADD-CRAFT project.

For GEM Plastics, a 17 year old company without a dedicated internal R&D function, getting involved in a major pan-European research initiative didn't come as second nature. The company knew it wanted to widen its product line and enter new markets by improving its plastics. But without significant research experience, getting involved in R&D was a giant step to make.

Things began to change for GEM Plastics thanks to a Trinity College Dublin lecture attended by one of its senior executives. The presentation covered nanotechnology, and the GEM Plastics representative approached the researchers after the talk to discuss how nanotech might be usable to improve the quality of GEM's products.

"They knew that they wanted more resilient plastics, and that nanotech had potential," recalls Jennifer Melia, a senior chemist at Trinity's Polymer Research Centre. The talks between Trinity and GEM Plastics continued, and Trinity and GEM decided to work together to seek funding from FP5 to bring these plans to reality. Using the CRAFT funding instrument, GEM and Trinity joined the NANOADD consortium, a group of four small European companies in different areas of the plastics industry, and with their research partners the work began in earnest to build a better plastic.

NANOADD-CRAFT: reinforcing plastic for new applications

Research on NANOADD began in 2001, with a total project cost of over €1 million, funded by €540,000 from FP5. Working with small companies and their research partners from Spain, the UK and Belgium, GEM Plastics and its research partners from Trinity began exploring how to reinforce plastic using nanocomposites instead of conventional materials.

Traditionally, plastics are reinforced with conventional, micron-sized materials at a loading level of 15 to 40%. The hope of researchers was that, by using much smaller loading levels (just 3 to 5%) of nano-sized particles, a plastic could be created that had enhanced desirable properties -- mechanical, thermal, barrier and flame retardance -- without any problems such as a decrease in impact strength. Among university researchers, it was already known that nanocomposites could successfully achieve these goals; but the question was, could this technology be successfully transferred to industrial production lines?

For GEM Plastics, the challenge was how to incorporate the nanomaterials into its existing processes in a way that was safe and economically viable, and that created goods even more rugged than its existing products. GEM Plastics Managing Director Maura Burke explains that while NANOADD-CRAFT was the company's first foray into serious research, her team was hopeful of developing technology that would help GEM crack new markets.

"Over the years we had done process R&D – where we improved our own machines, enhancing them, getting them to work better – but in terms of materials research, this was our first move into the wider world," she recalls.

Positive results lead GEM forward to further research

As it turned out, NANOADD-CRAFT did help GEM Plastics incorporate nanomaterials into its production process: by the end of the research project, using methods developed in the lab, full-scale production trials were conducted in Cavan, and plastics were created that did indeed have improved properties.

"We're very much at the beginning of this process, but we found that some basic qualities like physical strength and impact rigidity of the materials were improved," Maura says. "This means that in time, plastic containers may well be usable in areas where they're not used now. There is still a lot of steel used in the industry and we believe that we could start nibbling at that market – and it's a very big market."

Maura says that the findings of NANOADD-CRAFT have inspired GEM Plastics to explore further research, and the company has applied to FP6 for Marie Curie funding to support the work of a new, in-house researcher at the company.

One area GEM Plastics is particularly keen to break into is containers for solvents and other chemicals that have a static charge – only steel drums are used in such applications currently, since they can be earthed. "If we could work on the barrier properties of the plastics, and the antistatic properties, using nanocomposites, this would be a remarkable change."

Maura says the best outcome of the research is the exposure it's given GEM to Irish and European research resources, and the relationships GEM has formed that could be helpful for future networking. Most importantly, NANOADD has changed GEM's perception of the technologies that are within its reach as a small company.

"This project has really built our confidence in our ability to lead major research," Maura says. "Now that we've got to the other side of this research project, we think there's nothing we can't do."

Trinity College Dublin, University College Cork & University College Dublin

€17.1 million total project funding

Project: CarboEurope-IP

Assessment of the European Terrestrial Carbon Balance

Few research areas capture the public's attention as much as global warming, a phenomenon understood to be driven by higher concentrations of greenhouse gasses produced by human activities. Around the world, researchers are scrambling to work out the impact of gasses like carbon dioxide (CO_2) on the Earth's atmosphere, and more importantly, what can be done to reduce the threat. In the front lines of this fight to understand the so-called terrestrial carbon balance are Trinity College Dublin, University College Cork and University College Dublin, which are part of CarboEurope-IP, an FP6-funded project involving more than 60 EU institutions in 17 countries.

Many scientists have concluded that global warming is being exacerbated by higher atmospheric concentrations of greenhouse gasses – primarily carbon dioxide but also methane (CH_4) and nitrous oxide (N_2O). Atmospheric levels of these gasses have been on the rise since the mid 1700s, hitting levels not seen for more than 400,000 years. Given the wide-ranging impact that global warming will have upon all life on Earth, there is a clear imperative to study the mechanisms that may be contributing to greenhouse gas build-up.

Researchers already know that plants and soil can help reduce greenhouse gasses in the air by "fixing" or "trapping" CO_2 and keeping it out of the atmosphere. CarboEurope-IP researchers intend to study these "carbon sinks" – including soils, forests, grasslands, wetlands and other areas of significant vegetation – to develop a clearer sense of how they work and how much carbon they keep locked away.

Regulating the carbon cycle

CarboEurope researchers believe that the key to reducing the rate of carbon increase in the air is to understand the way in which the gas cycles between the atmosphere, vegetation and soil, explains Professor Mike Jones of Trinity College Dublin's Department of Botany. Professor Jones is coordinator of

one of CarboEurope-IP's research clusters, incorporating Trinity College Dublin, University College Cork, University College Dublin and the Centre for Ecology and Hydrology (CEH) in Wallingford, England. These groups also received key funding from the Environmental Protection Agency's Climate Change research programme which allowed them to develop advanced greenhouse gas measurement sites.

The work in the project, which is led by Germany's Max Planck Institute for Biogeochemistry, involves the collection, analysis and modelling of data from about 100 sites. Irish research sites have been set up at a wetland near Cork and at a grassland and barley field site at the TEAGASC Oak Park Research Centre in Co. Carlow, as well as grassland sites at Dripsey, Co Cork and Johnstown Castle, Wexford.

As data is collected and analysed, the scientists in the five year project can begin to draw conclusions about the types of plants which are the most effective at fixing CO_2. They will also learn about conditions in which plants tend to fix greater volumes of the gas, and the amount of CO_2 trapped in soil by plants.

"What we are hoping to do is learn about whether forests fix more carbon than grasslands for example," Professor Jones says. "We are also asking questions like, 'Can you increase the amount of carbon in certain sinks? What are the factors which affect the way carbon is trapped in soils? Do high temperatures cause more carbon to be released from soils?'"

This type of research, involving a large number of partners and expert researchers from various disciplines, is typical of FP6 projects, particularly those classified as Integrated Projects. Moreover, CarboEurope-IP has practical implications beyond a greater understanding of the carbon cycle, which is another common feature of FP6 Integrated Projects. "The eventual aim is to...show where the gasses are and how they are cycling. Ultimately, we may be able to regulate the process," says Professor Jones.

"Currently, governments under the Kyoto Protocol have commitments to meet certain carbon targets. Something they will be able to do is receive 'credit' for the forests they have. With this data countries will be able to say, for example, 'We've got X area of forest which is fixing Y amount of carbon per unit area, so this is the amount of credit we are due," he explains, noting that credits will also be applied for grasslands, wetland and other vegetation.

Working together for a clearer understanding

Professor Jones acknowledges that far-reaching projects like CarboEurope-IP could not be done without FP6 funding. But it is more than just money that the Framework Programme offers. "A project of this magnitude needs coordination," he says. "That's what FP6 provides. You might envisage groups around Europe trying to work together without this kind of framework, but it would be quite difficult to manage and I don't really see how it could be done."

He also says that not being involved would isolate him and his team from scientists conducting essential research in this area. Furthermore, those involved in projects like CarboEurope-IP – or its predecessors under FP5 such as CarboInvent and Greengrass which involved UCD and TCD respectively – are better able to become members of consortia in later projects. "Currently there is a call for a project on the nitrogen cycle and we plan to be involved in one of these bids," Professor Jones said. "We have become part of the network, and that is just as important as the funding itself."

SIFCO Turbine Components Ltd

€2.21 million total project funding

Project: Ordico

Oxidation Resistant Al and PtAl Diffusion Coatings with Improved Oxidation and Thermomechanical Fatigue Life

In the competitive aircraft maintenance business, the future belongs to companies who can create technologies to prolong the lives of the hard-working gas turbine engines which power the aircraft. Almost a decade ago, Cork-based SIFCO recognised the increasing competition in its marketplace, and resolved then to make research and development central to its strategy. That policy has paid dividends, most recently with SIFCO's successful involvement in ORDICO, a pan-European FP5-funded research project that has opened exciting possibilities for products with real commercial potential.

SIFCO is not new to the business of gas turbine engine maintenance and repair. Over 20 years it has built a reputation for expertise in the products of the four leading manufacturers of large commercial aircraft engines - CFMI, Pratt & Whitney, GE and Rolls-Royce. But as the manufacturers themselves began to move into the maintenance and repair business in the mid 1990's, SIFCO knew changes were at hand.

SIFCO found itself facing a strategic dilemma. As new engines are developed, repair and maintenance companies must earn the manufacturers' official approval to be allowed to conduct repairs. But as the manufacturers saw the profit potential of repair and maintenance and moved into this sector themselves, they were naturally slower to grant official approval and to license their own repair technologies to outside firms.

It all added up to one option for SIFCO: develop its own repair and maintenance technologies from scratch, or face a decline in business.

"The reasons for getting involved with research vary from company to company, but in our industry, there was simply no alternative," explains Aidan Kennedy, SIFCO's R&D Manager. "Until 10 years ago, we didn't have to develop our own technologies. But our industry changed, and if we hadn't acted, it is difficult to see how we could have held on to our market share, or developed new market niches."

ORDICO – a route to more durable engine components

SIFCO enthusiastically embraced the new realities of its industry, and over the past eight years has been involved in various research projects designed to enhance its technology base and competitive position. Around 2000 the company heard from one of its suppliers about a project called ORDICO – an initiative to develop advanced protective coating technologies for engine components.

"At that time ORDICO was in an embryonic stage," explains Aidan. "It fitted with our strategy to become industry leaders in advanced coatings, so we joined the emerging research consortium."

The aim of ORDICO was quite simple: through collaboration with research partners around Europe, the goal was to develop significant improvements in the coatings that protect turbine blades of aero engines. The importance of coatings in the industry can't be overstated. That's because the coatings – which are usually either of the simple aluminide or the duplex platinum-aluminide variety – perform two invaluable tasks: protect the blades from oxidation, and guard them from the thermomechanical fatigue that results from the repeated heating-cooling cycle that engines endure. Coatings that extend the serviceable life of engines are worth their weight in gold: repairing components costs around 20 percent of the price of replacing them.

The research challenge with ORDICO was to develop a coating with precisely the right mix of materials so that oxidation protection was maximised, and fatigue protection was optimised. The problems with striking this balance were well known in the industry: while aluminide offers great protection against oxidation, it tends to be brittle, meaning that fatigue protection is poor. Adding elements like platinum helps, but the sky-high cost of this material means that its use must be minimised.

Better than expected improvements in coating properties

Collaborating closely with its consortium of companies and research institutions across five countries, SIFCO developed and tested a coating process that has improved the desired fatigue properties of the coatings by a factor of three. The results far exceeded SIFCO's own goals, and SIFCO is confident of eventually being able to commercialise the results.

SIFCO says that while ORDICO brought out occasional tensions between commercial partners over information sharing and usage, the project still offered a valuable chance to work closely with researchers, especially those at Germany's Technical University of Braunschweig. "Where there was a full and free exchange of the information generated by the research, the collaboration was very beneficial to us," he says.

For companies considering getting involved in FP initiatives, Aidan advises patience, since while consortia can produce remarkable results, their nature means that they move slowly. He also advises companies to ensure they have an R&D champion at the highest level.

"The FP programme can be complex administratively, but it's useful if companies are prepared to get involved," he said. "Projects may not produce results for three to five years, so the project management and general management of the company have to be patient, make an act of faith and allow their R&D champion to persist until results begin to emerge. For any kind of serious technology development – we're not talking about minor modifications to product design – this is the investment that is going to be required."

LAKE Communications and the Waterford Institute of Technology

€14.7 million total project funding

Project: Daidalos

Designing Advanced Network Interfaces for the Delivery and Administration of Location Independent, Optimised Personal Services

The days of telecoms companies merely building mobile phone base stations are long gone. Now operators are racing to build powerful Third generation (3G) networks that transmit not just voice but also data, while also installing so-called Wi-Fi wireless internet hotspots in areas like hotels and cafes. As standalone technologies, both 3G and Wi-Fi work well, with service delivery and long-established billing mechanisms in place. But the trick, according to researchers, is to create an architecture that will allow users to connect wirelessly using the "best" standard for a given job. Taking up this challenge are LAKE Communications, the Waterford Institute of Technology and 45 other research institutions and businesses, through the FP6 funded project DAIDALOS

It's easiest to think of different wireless technologies like different modes of travel. A trip from Paris to Moscow is best made on a jetliner, while a car or train is more efficient for travelling from Dublin to Kilkenny. Technology such as 3G – which moves voice and data at high speed over a mobile phone network – is ideal for people on the move who need to use e-mail, the web or even teleconference. Meanwhile, a wireless technology like Wi-Fi provides even faster connectivity at lower prices, but is limited to smaller areas, such as a single building. Depending on the task, the user's location, and the cost, one service may be superior to another.

Those working in the industry, as well as the researchers involved in DAIDALOS, have long known that most users don't want to manually switch from one technology to another – it's just too complicated. And in the future, wireless connectivity will become even more convoluted when newer technologies such as satellite become more available, bringing their unique advantages and shortcomings.

But what if just one system could be put in place that would tie all these technologies together in a seamless way, allowing users to always use the best standard for a particular task? What if that could be done automatically, with security, privacy, cost, quality of service and efficiency all factored into the process? Turning these "what if's" into reality is the goal of DAIDALOS.

"That is the aim of the project in the simplest terms," says Mícheál Ó Foghlú, Research Director at the Waterford Institute of Technology's Telecommunications Software & Systems Group (TSSG). "In fact, this work is very complicated. It involves many layers of infrastructure and some aspects of it are basic research, while the underlying goals are applied research."

Despite its complexity, for all participants in the 30-month project the work couldn't be more exhilarating. "Absolutely, this is very forward looking and exciting for us... This kind of work allows us to see into the future," explains LAKE Communications' DAIDALOS Project Manager Jim Clarke. "And we have already used the knowledge gained in the work for our existing customers."

Irish and global partners working together

One of LAKE's roles in the project will be to ensure that all of the architecture layers of the DAIDALOS architecture meet accepted security and privacy guidelines, an area in which the firm has tremendous experience already. The company will work with researchers at the TSSG, who have a similar security-focused remit as part of DAIDALOS, and a wider task group.

Both LAKE and the TSSG will also carry out important integration and testing functions to ensure that DAIDALOS components delivered by the broad group of partners are interoperable and meet specifications. "We are seen as neutral, which is important," says WIT's Mícheál Ó Foghlú. "Since there are a lot of large companies involved in this project, the consortium needs partners that are seen to be completely independent when it comes down to testing. That is how we are seen."

Jim Clarke of LAKE says that DAIDALOS marks one of the biggest research initiatives in the company's history. "R&D has always been an aspect of what we have done," he says. "But it is fair to say that FP6 funding allows us to do more than would be possible otherwise." He also notes that a project of this magnitude – an Integrated Project (IP) with a longer timeframe and a large list of collaborators – is particularly important since it exposes the company to a wide swathe of partners, including DAIDALOS co-ordinator Deutsche Telekom AG of Germany, Telenor of Norway, Lucent Technologies in The Netherlands and BMW, amongst many other telecom operators, corporations, universities, research institutes and SME's.

Jim adds that the firm has already forged strong partnerships in earlier FP projects such as AlbatrOSS, which was coordinated by the TSSG in Waterford. All these projects have helped LAKE keep abreast of developments on the leading edge of wired and wireless technologies, and knowledge gleaned from the information has been incorporated into work undertaken for existing customers. "We wouldn't have the same access to this knowledge, and these partnerships wouldn't necessarily have been formed if we weren't engaged in this research programme – and they have become invaluable to us."

Trinity College Dublin

€12.5 million total project funding

Project: Lipgene

Diet, Genomics and the Metabolic Syndrome: an Integrated Nutrition, Agro-food, Social and Economic Analysis

Even a casual glance at the news makes it clear that Europe's problem of obesity and related illnesses – including high blood pressure and diabetes – is deteriorating. In just 10 years obesity has doubled in the UK and Ireland, with a huge impact not only on citizens' quality of life, but also on stretched health budgets. Through the wide-ranging FP6 funded LIPGENE project, a groundbreaking consortium led by Trinity College Dublin is now examining the true cost of obesity, and investigating whether new types of food, instead of drugs, can help keep symptoms under control.

For researchers involved in the food and nutrition areas, obesity is one of the single greatest challenges. As obesity rates rise, so too does the incidence of what researchers call the 'metabolic syndrome': a definable set of interrelated health problem that includes non-insulin dependent diabetes, high blood pressure and abnormal blood lipid patterns (including increased levels of 'bad' cholesterol, LDL).

The prominence of the metabolic syndrome is already at worrying levels in Europe: by 2010, it's estimated that 31 million Europeans will suffer from the syndrome and related complications, including heart disease. Professor Michael Gibney, who is jointly coordinating the pan-European Integrated Project LIPGENE with Dr. Helen Roche, explains that caring for these ailing citizens is a major issue. His team believes that the answer doesn't rest with drugs alone, but with the fats people consume.

"What do you do with these people? You can't wave them away with a magic wand," Professor Gibney says. "You can treat them with drugs, or you can try changing the composition of the fat they eat, and partly reduce the problems there... and save a fortune on drugs. Currently, the pharmacological cost of treating the metabolic syndrome is very high."

Changing the fats we eat could make all the difference

As an Integrated Project, one of the new funding instruments under FP6, LIPGENE is by definition vast, encompassing 25 research institutions in more than 10 countries and lasting five years. The project is being coordinated by the Institute of Molecular Medicine and the Department of Clinical Medicine at Trinity College Dublin. As Professor Gibney explains, researchers are not aiming to cure obesity; instead, they'll focus on the people who live with the condition and explore how to better treat their symptoms.

One unusual aspect of the research will involve trying to create vegetable oil that's more like fish oil. Scientists know that certain fish oils carry beneficial fatty acids (long chain n-3 polyunsaturated fatty acids), but Europeans don't eat enough fish to gain the right amount of these oils. Even if we wanted to eat our fill, however, the oceans couldn't produce enough fish for all of us. For a solution, researchers are turning to the algae that fish feed on, extracting the genes responsible for making the good fatty acids, and putting these into linseed and other vegetable oils.

Comparable oils will then be used in spreads, sauces, mayonnaise, biscuits and other foods that will be tested on volunteers across Europe. Lasting one year and including 480 volunteers in eight centres, the trial will be the largest of its kind, and will provide illuminating insights into whether diet – rather than drugs – can be used to tackle problems like insulin resistance. Researchers will specifically examine whether genes have a say in how diet affects the body. Would everyone benefit from a diet change, or do some people carry genes that make them prone to the metabolic syndrome, no matter what they eat?

Beyond human studies

Although the human feeding intervention study is one of the most crucial aspects of LIPGENE, researchers will also be examining a wide range of other areas. A major study will be carried out, for example, to see if the fat composition of pigs and poultry is altered when they are given feed that's been modified with the experimental vegetable oils. Scientists will also work with cows, in an endeavour to create milk and butter that offers more monounsaturated fats and fewer 'bad' fats (such as saturated fats and so-called trans fats).

Researchers will determine the true financial cost of the metabolic syndrome, and calculate how the proposed food technologies would affect end prices. Intensive consumer research will also be undertaken, exploring attitudes to obesity, the dangers it presents, and the benefits and risks of the proposed food technologies.

Professor Gibney says that LIPGENE – which is closely related to and will share data with a number of other Integrated Projects – would not be possible without the collaboration of his partners across Europe, and he praises the vision of FP6 for supporting such in-depth and ambitious projects.

"You can fund a small project here and there and that's great for the scientists, but if you really want to solve societal problems, you have to be multidisciplinary," Professor Gibney says. "There's no future in biologists working alone -- they must work with physicists and engineers and computation people. You couldn't undertake a project like LIPGENE in Ireland or in any other single country. We have to work together."

National University of Ireland, Galway and University College Cork

€14.9 million total project funding

Project: Hermes

Hotspot Ecosystem Research on the Margins of European Seas

Deep within the sea, beyond Europe's continental shelf, live ancient ecosystems that are also hotbeds of economic activity, including fishing, bioactive compounds useful to biotechnology and fossil fuel exploration. But these biological communities are under threat and may be impossible to replace if destroyed, resulting in environmental and economic loss. Thanks to FP6, 34 partner academic institutions and companies – including the National Universities of Ireland, Galway and Cork – are working to gain a better understanding of these eco-hotspots, with a long term aim of ensuring sustainable development of deep-sea resources while also protecting deep-ocean forests.

The four-year HERMES project is massive in scope, spanning an area from the North Atlantic to the Mediterranean Sea, and on to the Black Sea. The object is to gain a better understanding of life at depths of between 200 and 2,000 metres, and in some cases deeper.

Through HERMES, scientists plan to study deep-sea biological hotspots, including life in canyons; in areas where oxygen is almost non-existent; and in cold seeps, where poisonous natural gases and noxious waters create a sulphur-rich environment that should kill all life – but instead life thrives. However, it's the vast underwater coral communities dotting the deep-ocean margin that will attract the greatest focus, which will come from a group of experts ranging from marine biologists, sedimentologists and biogeochemists, to economists and lawyers.

Deep ocean coral communities are facing serious threats from newer fishing techniques, including nets that rake the ocean floor, with devastating consequences. As industry seeks new fossil fuel reserves, oil and gas drilling has become more common in the deep ocean, destroying fragile ecosystems. Since the life at these depths exists in frigid conditions, with little light, it grows slowly, making destruction of these hotspots effectively permanent.

"Ireland has a number of outstanding examples of deep-ocean coral. That's one of the reasons why we are involved," says Dr. Anthony Grehan, of the National University of Ireland Galway, who is heading up the Irish contribution to the HERMES-IP project, which also involves University College Cork. Dr. Grehan also notes that the project complements initiatives backed by the Irish Government, such as the National Seabed Survey and the recent provision of a state-of-the-art 65 metre ship the R.V. Celtic Explorer, giving both a European-wide dimension.

Labour of life

The HERMES-related work required in Irish waters and elsewhere will include intensive mapping, much of which will be done through acoustic techniques, as well as visual examination using remotely operated vehicles and other submersibles, which FP6 funding has helped fund. One of the project's ultimate goals is to create the first comprehensive pan-European margin Geographic Information System (GIS).

"The GIS will be an extremely valuable tool which will be used to examine different management regimes at hotspots particularly in a spatial context. While similar tools are used in coast zone management nothing like it has been developed for the European offshore," Dr. Grehan said.

Researchers will also take water samples and readings from instrumented platforms left on the seafloor for months at a time as well as from ships, while also examining the life in the bio-hotspots to determine what makes them tick. HERMES researchers will also uncover what positive contributions eco-hotspots make to the global environment – such as how they help reduce greenhouse gasses. Meanwhile sediment samples will help scientists understand ancient deep-sea cataclysms like volcanic eruptions, possibly providing evidence on how bio-hotspots recovered.

From research to policy

The overall aim is to develop a comprehensive "European Ocean and Seas Integrated Governance Policy" that can be presented to policymakers to enable sustainable economic development in the deep-sea while ensuring that environmental integrity is maintained.

This cross-disciplinary aspect of the research – a common theme in FP6 Integrated Projects – will involve maritime lawyers from academic institutions such as NUI Galway's Dr. Ronan Long. Socio-economists will also play a part by placing monetary value on deep-ocean ecosystems, and forecasting monetary losses that would result from their destruction as well as developing strategies for conflict resolution between competing end-users.

Collaboration is key

It's this kind of collaboration that makes Framework Programmes projects so necessary at the European scale. "It would be very difficult for one country to supply researchers in all of the study areas. But under projects like this, it's not necessary. For example, if Ireland were missing a biochemist,

it might be a UK biochemist that would support research being carried out in Irish waters," Dr. Grehan explains. "It also means that our scientists are able to stay up to date with the best in Europe. As most of the Irish participants are quite young, it is important that we are able to work closely with other institutions throughout Europe."

NUI Galway, UCC and UCD have been part of related projects under FP5, including ACES (Atlantic Coral Ecosystem Study) and ECOMOUND (Environmental Controls on Mound Formations along the European Margin). Dr. Grehan says the Irish scientists' ability to deliver results in earlier projects has given them the credibility necessary to take on larger roles in newer endeavours, like HERMES.

"What I think this reflects is Ireland's evolving position in European marine research," Dr. Grehan says. "It's one that has grown tremendously, and one that I think will continue to grow."

Did you know?
Irish marine researchers are participating in 15 co-operative projects with grant aid of over €4 million. Topics covered range from marine ecosystem dynamics to maritime safety and marine biotoxins.