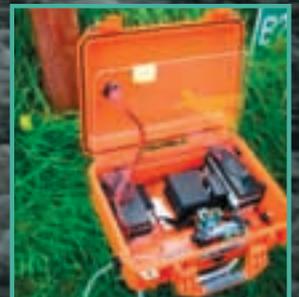


# STRIVE

## INNOVATION FOR A GREEN ECONOMY

Environment and Technology:  
A win-win story



# Environmental Protection Agency

The Environmental Protection Agency (EPA) is a statutory body responsible for protecting the environment in Ireland. We regulate and police activities that might otherwise cause pollution. We ensure there is solid information on environmental trends so that necessary actions are taken. Our priorities are protecting the Irish environment and ensuring that development is sustainable.

The EPA is an independent public body established in July 1993 under the Environmental Protection Agency Act, 1992. Its sponsor in Government is the Department of the Environment, Heritage and Local Government.

## OUR RESPONSIBILITIES

### LICENSING

We license the following to ensure that their emissions do not endanger human health or harm the environment:

- waste facilities (e.g., landfills, incinerators, waste transfer stations);
- large scale industrial activities (e.g., pharmaceutical manufacturing, cement manufacturing, power plants);
- intensive agriculture;
- the contained use and controlled release of Genetically Modified Organisms (GMOs);
- large petrol storage facilities.

### NATIONAL ENVIRONMENTAL ENFORCEMENT

- Conducting over 2,000 audits and inspections of EPA licensed facilities every year.
- Overseeing local authorities' environmental protection responsibilities in the areas of - air, noise, waste, waste-water and water quality.
- Working with local authorities and the Gardaí to stamp out illegal waste activity by co-ordinating a national enforcement network, targeting offenders, conducting investigations and overseeing remediation.
- Prosecuting those who flout environmental law and damage the environment as a result of their actions.

### MONITORING, ANALYSING AND REPORTING ON THE ENVIRONMENT

- Monitoring air quality and the quality of rivers, lakes, tidal waters and ground waters; measuring water levels and river flows.
- Independent reporting to inform decision making by national and local government.

### REGULATING IRELAND'S GREENHOUSE GAS EMISSIONS

- Quantifying Ireland's emissions of greenhouse gases in the context of our Kyoto commitments.
- Implementing the Emissions Trading Directive, involving over 100 companies who are major generators of carbon dioxide in Ireland.

### ENVIRONMENTAL RESEARCH AND DEVELOPMENT

- Co-ordinating research on environmental issues (including air and water quality, climate change, biodiversity, environmental technologies).

### STRATEGIC ENVIRONMENTAL ASSESSMENT

- Assessing the impact of plans and programmes on the Irish environment (such as waste management and development plans).

### ENVIRONMENTAL PLANNING, EDUCATION AND GUIDANCE

- Providing guidance to the public and to industry on various environmental topics (including licence applications, waste prevention and environmental regulations).
- Generating greater environmental awareness (through environmental television programmes and primary and secondary schools' resource packs).

### PROACTIVE WASTE MANAGEMENT

- Promoting waste prevention and minimisation projects through the co-ordination of the National Waste Prevention Programme, including input into the implementation of Producer Responsibility Initiatives.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE) and Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

### MANAGEMENT AND STRUCTURE OF THE EPA

The organisation is managed by a full time Board, consisting of a Director General and four Directors.

The work of the EPA is carried out across four offices:

- Office of Climate, Licensing and Resource Use
- Office of Environmental Enforcement
- Office of Environmental Assessment
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet several times a year to discuss issues of concern and offer advice to the Board.

Environmental Protection Agency

Science, Technology, Research and Innovation  
for the Environment

EPA STRIVE Programme 2007 – 2013

# INNOVATION FOR A GREEN ECONOMY

**Environment and Technology:  
A win-win story**

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The personnel involved in the production and preparation of this report were Brian Donlon, Shane Colgan and Lisa Sheils (EPA).

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Cover picture: Inniscarra Weir, Co. Cork, taken by John Doheny, EPA.

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## Environmental Technologies and Cleaner Production

The Environmental Technologies and Cleaner Production Section of the Environmental STRIVE Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in this area. The reports in this series are intended as contributions to the necessary debate on environmental technologies, eco-innovation, cleaner production and the environment, and in turn to foster innovation in this area.

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## Foreword

There is no doubt that Ireland is facing serious economic challenges, both domestically and internationally, and that it has entered a phase of economic transition and uncertainty. At the same time, the Environmental Protection Agency's most recent report on the state of Ireland's environment has identified a number of pressing environmental challenges that the country needs to address in the coming years.

I am convinced that economic growth is intrinsically linked to a clean and protected environment and that policy measures to address the current economic situation can lead to a more environmentally sustainable and resource-efficient economy into the future.

The most recent report from Forfás and InterTrade Ireland, *Environmental Goods and Services Sector on the Island of Ireland: Enterprise Opportunities and Policy Implications*, has identified significant potential to attract investment in the area of environmental goods and services. Some of the sub-sectors in this area have high export potential (clean technologies and processes and energy efficiency products and services) while others such as waste management, water supply, wastewater treatment and environmental consultancy have a strong domestic potential for development.

The Government's recent document, *Building Ireland's Smart Economy*, sets out a framework for economic renewal based on the principles of sustainable development. I believe that continued investment in developing environmental technologies is an appropriate fiscal stimulus in an Irish context, which would be spent domestically and provide a high rate of return in terms of future economic growth. The EPA is determined to play its part in the economic recovery of this country, and at the same time champion the cause of a clean and healthy environment as the basis for a strong economy in the future. I believe that the environmental technologies field provides a significant opportunity in this regard. Not only is this one of the fastest growing market areas internationally, but such technologies can also reduce pressure on the environment and improve resource efficiency, while supporting competitiveness and job creation.

It is vital that Ireland fosters an innovation-driven culture in the environmental technologies area and a critical step in this process is ensuring that the right people and resources are in place. The EPA, through its STRIVE programme, is among the main bodies fostering growth in this area through the provision of funding for research and innovation. Since 2005, it has funded 189 research and innovation projects in the technologies area, representing an investment of €30 million. This has directly led to the engagement of 200 new researchers in full-time roles.

Aside from the academic excellence of this work and its contribution to building Ireland's reputation as a centre for research and innovation, the investment is also yielding wider economic benefits such as patents, licence agreements and in one case a new spin-off company.

Environmental research is an important element underpinning the concept of a 'knowledge-based society' and the Smart Green Economy. This report presents some exciting results in terms of the quality of the research and innovation funded through the EPA STRIVE programme, the expertise and capability developed, and the wider economic and other impacts arising. It also outlines the EPA's future strategy in this vital area.

I hope that you find this report valuable and I look forward to informing you of further advances in this area in the coming years.

Dr Mary Kelly  
Director General





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## Executive Summary

The Government's *Strategy for Science, Technology and Innovation (SSTI)* has set out a vision to make Ireland internationally renowned for the excellence of its research and to be a leader in using new knowledge for economic and social progress. This is also reflected in the recent Government paper, *Building Ireland's Smart Economy*, which sets out a framework for economic renewal, based on the principles of sustainable development. The strategy addresses green-collar job creation and identifies 'enhancing the environment and securing energy supplies' as a priority action area.

The current economic circumstances facing Ireland and the wider global economy provide a challenging background for the development of new technologies. Reduced wealth will impact on funding both from public and business expenditure and from venture capital sources. There are, however, some opportunities presented by the current situation for the environmental goods and services sector including:

- A pressing drive for efficiency in resource and energy use;
- An urgent requirement to develop new business sectors and niches;
- The renewed importance of indigenous (environment-dependent) sectors such as food, and tourism, and of local-scale enterprise.

Environmental technologies represent a key part of delivering on the objectives of Ireland's Smart Economy. These are cleaner and resource-efficient technologies that can decrease material inputs, reduce energy consumption and emissions, recover valuable by-products, minimise waste disposal problems, or some combination of these. The EPA, via its STRIVE (Science, Technology, Research and Innovation for the Environment) programme, is among the main bodies fostering growth in this area through the provision of funding for research and innovation in environmental technologies and in the related area of cleaner production.

'*INNOVATION FOR A GREEN ECONOMY*' is a non-technical report giving a brief snapshot of the story so far with regard to EPA-funded Environmental Technologies and Cleaner Production research and innovation projects along with details of the next steps in the area.

The report highlights the type and variety of the environmental technologies research funded by the EPA, ranging from academic-based (scholarships and multi-institutional collaborative projects) to industrial-based and business-led cleaner production projects.

This report profiles a number of projects that typify the technology research supported by the EPA research programme. The profiles highlight the many successes and impacts of research and innovation supported by the EPA research programme and undertaken on the island of Ireland to date. Since the formal establishment of 'Environmental Technologies' as a theme in 2005, the EPA has made commitments of €30 million to academic researchers and industrial innovators and has funded in the region of 200 new researchers (Doctoral, Masters, Postdoctoral researchers) supervised by 150 Principal Investigators.

A recent EPA survey has shown that 18 large<sup>1</sup> projects, which received a combined total of €4.7 million EPA funding in 2005/06, have had a direct impact or cumulative effect that contributed significantly to environmental, social and economic benefits.

Highlights from the survey findings include:

- Training of many new researchers and innovators: 14 Postdocs, 11 Doctoral students, 9 Masters students, 45 others in part-time and full-time roles (technicians, research assistants, etc.) supervised by 25 leading researchers and industrial innovators;
- Publication of 28 peer-reviewed papers in high-impact scientific journals such as *Nature* and *New Scientist* with a further 17 papers in preparation;
- Presentation of research at 46 national and 87 international conferences;
- Laboratory trialling of novel technologies (nanotechnology, biotechnology, ICT<sup>2</sup>) with industrial effluents provided by EPA chemists;
- Pilot-scale demonstration and industry collaboration with companies such as Eli-Lilly, IBM, Western Proteins, Janssen Pharmaceuticals and Northern Ireland Water Limited (formerly the Northern Ireland Water Service);
- Full-scale demonstration of newly developed treatment and sensor technologies at sites identified by Local Authorities (Cork, Galway and Monaghan County Councils) and indigenous business, such as Bailieborough Co-op.

The wider economic impacts of the 18 large projects funded in 2005/06 include:

- Filing of five patents, seven patents in preparation, nine non-disclosure agreements, one licence agreement;
- Foundation of one spin-off company (Bioplastech Ltd);
- Leveraging of an additional €12.5 million funding to date from various national and international sources, which represents approximately 70 new researchers and industrial innovators;
- Building Ireland's reputation for research, which is vital in an increasingly competitive global market for R&D and technological innovation;
- Demonstrating that cleaner production methods can in many instances save money yielding win-win outcomes for business and the environment.

This report also provides a roadmap showing where Ireland, as a country, needs to progress further to meet the environmental and economic challenges ahead. Continuing to fund and strengthen Ireland's research and innovation capacity will enable Ireland to compete on international markets without compromising the quality of its environment.

The EPA's Environmental Technologies funding programme has contributed to enhancing Ireland's ability to rise to the main environmental challenges facing the country today and into the future. A strong innovation culture is now emerging in the growing environmental technologies arena. Researchers and businesses are developing technologies to deliver environmental benefits that compete successfully in home and international markets.

---

<sup>1</sup> EPA commitment of greater than €100,000.

<sup>2</sup> ICT – Information and Communication Technologies.

The recent announcement from the Higher Education Authority (HEA) on the proposed funding for the development of national shared facilities including the EPA-supported Environmental Technology Ireland Centre is crucially important at this time to provide infrastructure for the development of a more innovative, green and high-skilled economy.

Research and development funding is also made available directly to businesses and organisations. Since 2001, the EPA has provided almost €6 million (out of a total project cost of €17.5 million) to 75 participants under the Cleaner Greener Production Programme (CGPP). Analysis of the second phase of the programme (2005-2007) showed that based on EPA support of €1 million, the 22 organisations involved achieved cost savings of €1.6 million per annum.

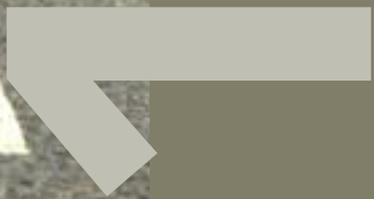
These savings were in addition to significant reductions in environmental impact, including 3,500 tonnes per annum of greenhouse gas emissions, 1,550 tonnes per annum of solid waste arisings and 120,000 m<sup>3</sup> per annum savings in water consumption. In 2007, the CGPP programme was highlighted as an Exemplar Programme in a European Commission review of Eco-Innovation Programmes.

It is envisaged that the EPA's research programmes will continue to develop significant research expertise and be recognised as a leading activity supporting the **Smart Green Economy**.





# Introduction



The most recent EPA State of the Environment report (*Ireland's Environment 2008*) identified four main environmental challenges facing Ireland in the coming years. As shown in Figure 1, these are:

1. Limiting and adapting to climate change;
2. Reversing environmental degradation – particularly in relation to water pollution and the conservation status of habitats;
3. Mainstreaming environmental considerations across all sectors of the economy; and
4. Complying with environmental legislation and agreements.

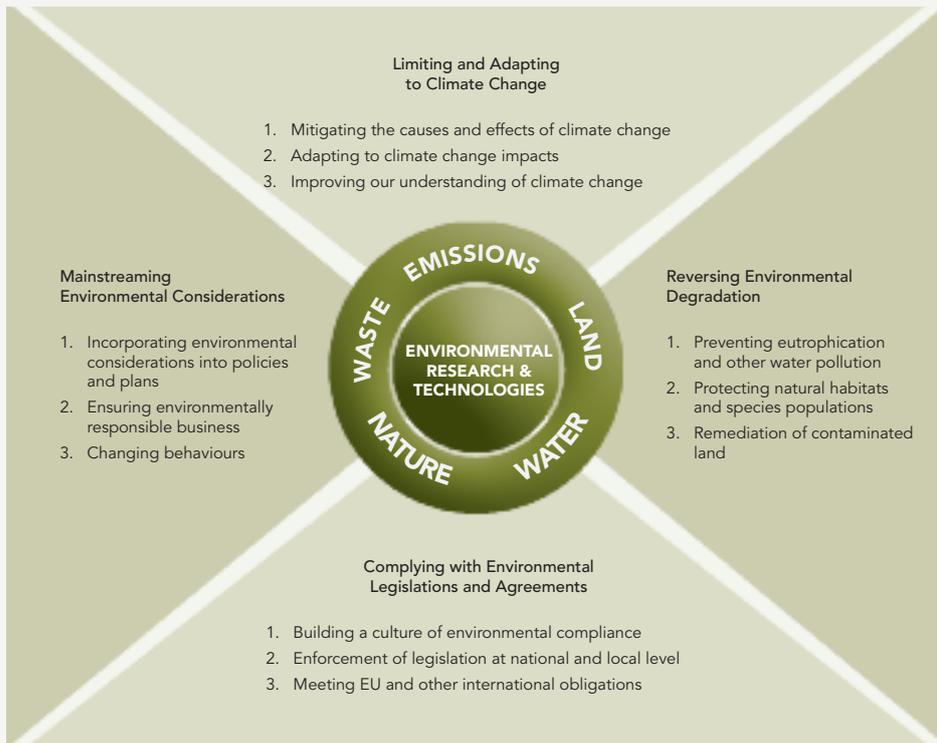


Figure 1: Environmental Technologies Research is central to meeting the main environmental challenges facing Ireland today.

The report also underlines the role that science, research and innovation play in responding to environmental protection challenges. In particular, it identifies that technology and innovation have a role to play in dealing with environmental challenges and priorities by delivering new processes to reduce environmental impact and developing new products to meet societal needs in an environmentally sound manner. In addition, there is further economic potential to be realised through enhancing competitiveness and improving efficiencies.

Environmental technologies are all around us: wind turbines and solar panels, biofuels, recycling systems for waste and water, etc. These are basically designed to prevent and reduce the environmental impacts at any stage in the life cycle of the products.

Eco-innovation refers to the creation of novel and competitively priced services, products, processes, etc., designed to provide a better quality of life for people without compromising

the environment. An EPA-funded research report highlighted that Ireland currently has the second-highest growth rate in eco-industries in the EU after Finland, with a growth of 55% noted between 1999 and 2004 (or 27% in constant euro terms).

In European terms, eco-innovation is a key development strategy and is regarded as a major opportunity for the EU economy. Europe is already a strong global player in eco-industries with around 30% of overall world turnover, and more than 50% in water and waste management. The worldwide environmental technology market is forecast to double to some €2,300 billion by 2020. The current EU turnover in this sector is €227 billion, accounting for 2.2% of GDP and generating 3.4 million jobs.

Given the increasing worldwide demand for and pressure on natural resources, existing technologies are not, in the longer term, adequate to safeguard sustainable development and therefore eco-innovation has to be the key component of Ireland's future economy. While many environmental impacts can be reduced using existing technologies, new technologies and more cost-effective solutions are always needed. Therefore, much greater levels of development and deployment/take-up of environmental technologies are crucial at both national and international levels if environmental degradation is to be mitigated and reversed and environmental protection achieved.

Promoting the take-up of environmental technologies is not only about technology and markets; it also involves raising awareness about opportunities, as well as developing the know-how to implement new solutions.

The importance of environmental technologies is mirrored at international level, such as the United Nations Environment Programme **Green New Deal** and, at EU level, the key driver in this area is the **Environmental Technology Action Plan (ETAP)** which was adopted by the European Commission in 2004 and covers a spectrum of actions to promote eco-innovation and the take-up of environmental technologies, alongside other programmes such as the Seventh Framework Programme for Research and Technological Development (FP7), the Competitiveness and Innovation Framework Programme (2007-2013) and LIFE+.

The renewed EU Sustainable Development Strategy (2006) reaffirms the strong political willingness from the EU to move into the sustainable path where environmental protection goes hand in hand with economic prosperity and social cohesion. The strategy defines Sustainable Consumption and Production (SCP), Climate Change and Clean Energy as being among the key challenges for Sustainable Development in Europe. The importance of SCP is reflected in global, EU and national policy priorities and plans and at business level in terms of efficiency in resource and waste management.

From a national perspective, the Government recently published its framework document *Building Ireland's Smart Economy* (2008) highlighting its aim to invest heavily in research and development, and implementing a 'new green deal'. A particular focus of this strategy will be the opportunities arising for research in the environmental technologies area. The National Competitiveness Council in its annual report (2008) noted that moving towards a lower carbon economy will require additional measures to reduce emissions, but also opens many avenues for new growth within the environmental goods and services area.

The ETAP initiative referred to is being strongly promoted at national level. In 2006, the Department of the Environment, Heritage and Local Government (DEHLG) prepared and published Ireland's National ETAP Roadmap to provide a high-level perspective on existing eco-innovation activities in Ireland and to outline future opportunities. The ETAP Roadmap is currently being updated and reviewed by the DEHLG/Department of Enterprise, Trade and Employment (DETE). The SSTI (2006) identifies environmental technologies as one of the key areas in which research and innovation are essential, both for economic competitiveness and to yield outcomes that make tangible improvements to the quality of life.

The mainstream industrial development programmes of the State Agencies such as Enterprise Ireland (EI), IDA Ireland, Science Foundation Ireland (SFI) and others such as the Marine Institute (MI) and Sustainable Energy Ireland (SEI) also actively support the development and production of environmental goods and services through a variety of schemes.

The Higher Education Authority (HEA) recently announced that it will fund the development of national shared facilities that focus on areas of strategic national importance including the EPA-supported Environmental Technology Ireland Centre and the MI-led Smart Bay initiative. These developments are vital at this particular time to develop a more innovative, greener, highly skilled economy and to allow Ireland to position itself as a leader in the environmental technologies field.



**Role of the EPA**

**2**

The EPA has a statutory role to co-ordinate environmental research in Ireland and since 1994 it has provided funding and support to environmental researchers through a series of research programmes. The current programme: Science, Technology, Research and Innovation for the Environment (STRIVE) is designed to underpin developments in the protection and enhancement of Ireland’s environment in the coming years.

The EPA STRIVE programme runs from 2007 to 2013 and is organised under three key measures together with two supporting measures. Figure 2 below is a schematic representation of the structure of the Programme.

|   |   |   |
|---|---|---|
| <b>Key Measure 1:<br/>Sustainable Development</b>                     | <b>Key Measure 2:<br/>Cleaner Production<br/>and Environmental<br/>Technologies</b> | <b>Key Measure 3:<br/>A Healthy Environment</b> |
| 1.1 Informing Environmental Policies                                  | 2.1 Innovation in Cleaner Production and Operations                                 | 3.1 Risks to Human Health                       |
| 1.2 Sectoral Integration of the Environment                           | 2.2 Environmental Technologies  | 3.2 Environment and Quality of Life             |
| <b>Support Measure 4:<br/>EPA Environmental Research Centre (ERC)</b> |   |   |
| 4.1 Pooling, Sharing and Advancing Knowledge                          |   |   |
| 4.2 Advanced Environmental Management and Assessment Methods          |   |   |
| <b>Support Measure 5:<br/>Capacity and Capability Building</b>        |   |   |
| 5.1 Developing Researcher Capability                                  |   |   |
| 5.2 Support for Instrumentation and Related Infrastructure            |   |   |

Figure 2: Structure of the EPA STRIVE programme.

The EPA STRIVE strategy has placed particular emphasis on new and improved technologies for the management of resources and to reduce the environmental impact of human activities. The key areas funded by the EPA that are directly relevant to the Green Economy are:

- Environmental Technologies;
- Innovation in Cleaner Production and Operations;
- Environmental Research Centre;
- Sustainable Development; and
- Developing Researcher Capability.

The EPA Climate Change Research Programme (CCRP) was established in 2007, and focuses on socio-economic analysis and long-term technology development to identify pathways in order to achieve a carbon/greenhouse gas (GHG)-neutral Ireland by 2050. Major projects have been advanced on model development and carbon capture and storage. Further projects on novel approaches to carbon capture and enhancement of carbon sequestration are in preparation.

In parallel, the EPA Waste Prevention Programme aims at delivering substantive results on waste prevention and minimisation and integrates a range of initiatives addressing awareness-raising, technical and financial assistance, training and incentive mechanisms.

These EPA programmes are co-ordinated with other key state agencies including the MI, SEI, Forfás, Teagasc, the Geological Survey of Ireland (GSI) and Enterprise Ireland along with the relevant government departments. In its role as a funding body, the EPA also liaises with other funders, including SFI, the Irish Research Council for Science, Engineering and Technology (IRCSET), the National Council for Forest Research and Development (COFORD) and the HEA to maximise the benefits and value from its research funding.

Overall, there has been considerable investment in research through the National Development Plan 2007-2013, with a strong focus on scientific, engineering and technical areas, including emerging sectors such as biotechnology, nanotechnology, green chemistry and ICT systems development. At this stage, national research capacity is well placed to provide solutions in support of sustainable development and to develop commercial opportunities for products and skills both within Ireland and internationally.





# Environmental Technologies Research and Innovation Funded by the EPA

3

Since the formal establishment of Environmental Technologies as a theme in 2005, the EPA has funded 189 projects representing an investment of €30 million. The most popular themes in the STRIVE Environmental Technologies programme are illustrated in Figure 3. For the purposes of this document, the funded projects are grouped under the following headings:

1. Basic/Fundamental Research;
2. Applied Environmental Technologies Research; and
3. Demonstration of Environmental Technologies.



Figure 3: Popular themes in the EPA STRIVE Environmental Technologies programme.

The EPA STRIVE involvement in the variety of research types funded in the field of Environmental Technologies is highlighted in Figure 4. This illustrates the emphasis of EPA funding and support throughout the chain of research, through to marketing and innovation. A full listing of EPA-funded projects is available in Appendix 2.

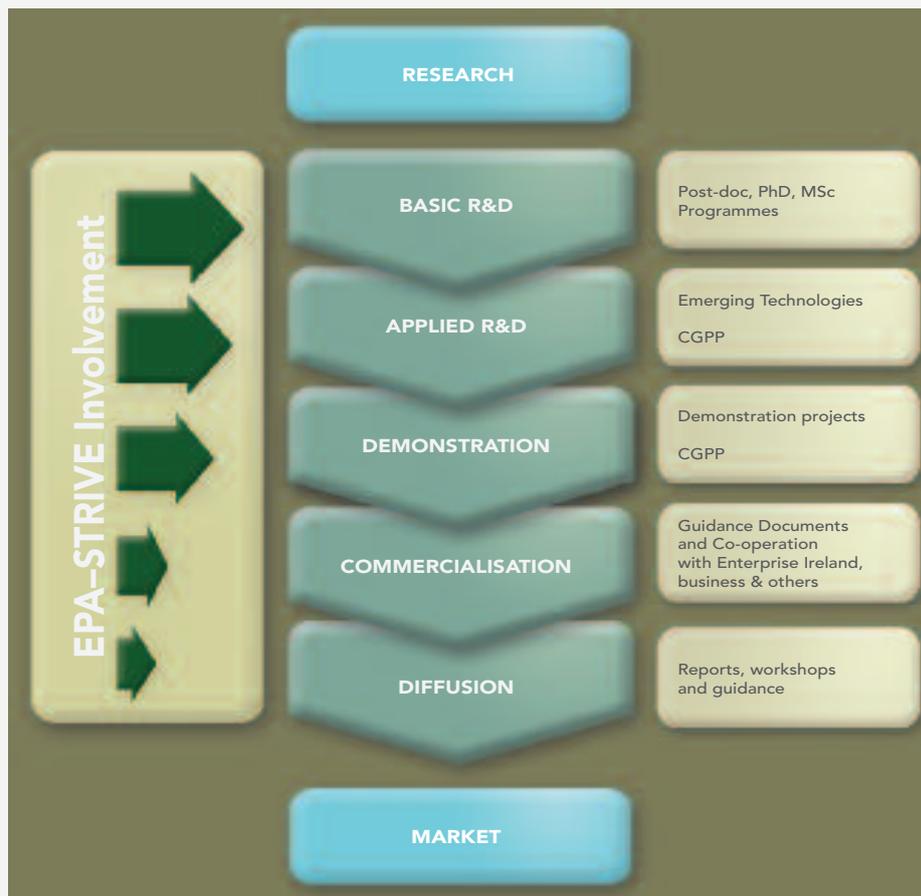


Figure 4: Structure of the EPA STRIVE Environmental Technologies programme.

Note: The dark green arrows indicate the scale of EPA involvement. CGPP refers to the EPA Cleaner Greener Production Programme.

## 3.1 Basic/Fundamental Research

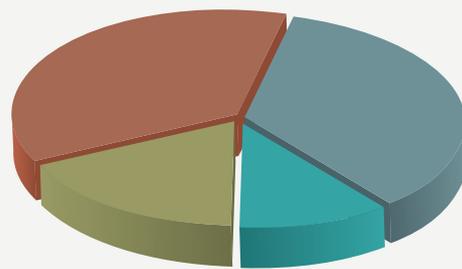
Successful development of environmental technologies depends strongly on a foundation of high-quality research into novel processes and materials. The government's *Strategy for Science Technology and Innovation* has set out a vision to make Ireland internationally renowned for the excellence of its research and to be a leader in using new knowledge for economic and social progress. To support this aim, Ireland must foster an innovation-driven culture in the environmental technologies area. A critical step in this process is ensuring that the right people and resources are in place.

The continued development of technological innovation in support of environmental protection is dependent on the availability of teams of high-quality motivated researchers and innovators. Through the provision of Doctoral and Masters scholarships and by supporting career progression through to postdoctoral level, the EPA is committed to building and developing Ireland's research capacity.

In addition to strong research teams, there is clearly a need to explore emerging research threads, so that the most promising can be identified and pursued at applied and demonstration levels. The scholarship programmes in the EPA STRIVE Programme facilitate exploration of topics at a more fundamental level and provide an opportunity for preliminary work on novel research topics.

Following the HEA/Forfás Research Infrastructure Review and consultation with the research community, a deficit was identified in some critical areas for the performance of world-class environmental research. Through the Environmental Research Infrastructure Scheme, the EPA provides funding to support capacity and infrastructure development for environmental research in Ireland. This scheme was launched in 2007 and provides 80% funding towards the purchase of large items of durable equipment where such equipment is absent or in deficit in Ireland.

In the Basic/Fundamental research area, the EPA has directly supported a total of 42 young researchers through its Doctoral Scholarship Schemes and 41 through its Masters Scholarship Schemes in the period from 2005 to 2008. In addition 20 postdoctoral-level positions have also been funded, and 13 infrastructure grants awarded, leading to a total investment of €12.5 million towards building a strong foundation for research in the environmental area. The breakdown of this investment is illustrated in Figure 5.



- Post-doctoral researchers
- PhD Scholarships
- MSc Scholarships
- Infrastructure awards

Figure 5: Breakdown of EPA STRIVE support to Basic and Fundamental Research in the period 2005-2008 (by number of awards).

The results of these capacity development activities can be seen by tracking publications and citations from Irish researchers over the years. Figures 6 and 7 illustrate the general trend for publications in the overall 'Environment and Ecology' field and, as an example of technology-focused work, those published under the topics of 'sludge' and 'wastewater'. Funding bodies other than the EPA may have been involved in supporting the work published but nevertheless the figures serve to illustrate that a strong growth in output has occurred in this target area of the EPA STRIVE Programme.

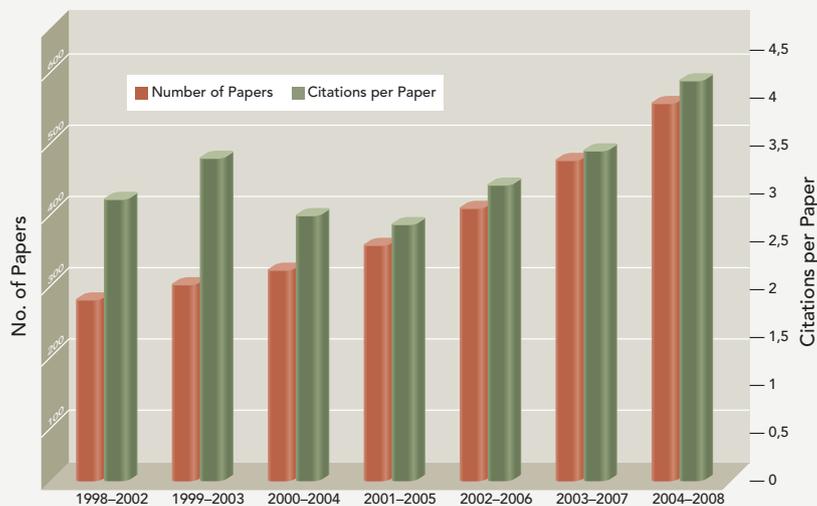


Figure 6: Number of papers published and citations per paper in the field of 'Environment and Ecology' from Ireland in five-year reporting periods. (Source: Thomson ISI, 2009).

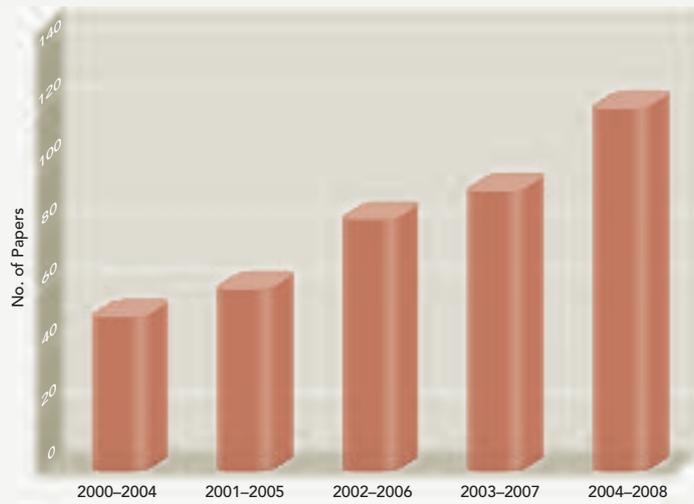


Figure 7: Number of papers published from Ireland with 'sludge' and 'wastewater' as keywords in five-year reporting periods. (Source: Thomson ISI, 2009).

Two examples of key *Basic/Fundamental Research* projects (Case Studies 1 and 2) funded by the EPA are provided below.

# Case Study 1

## Developing Better Pollution Sensors<sup>3</sup>

Dr Ber Alcock, National University of Ireland, Maynooth

Dr. Alcock is the principal investigator of the Environmental Technologies and Sensor Development research group at the National University of Ireland, Maynooth and was funded under the EPA's Developing Environmental Research Potential Scheme. This scheme supports outstanding early-career researchers for a five-year period to develop into team leaders of international standing.

The research is focused on new materials that can be used in (1) sensing and remediation of nitrates, (2) detection and removal of organic contaminants and (3) ultra-sensitive detection of heavy metal ions in water. These new materials are being synthesised and studied with the aim of developing new sensing and remediation technologies for the protection of water resources.

These novel materials offer an effective system comprising modified conducting polymer films which can be dispersed as films on a conducting substrate or as a stand-alone film within the solution environment. The process involves a reaction at the polymer solid phase and in many cases, entrapment of the offending species within the polymer matrix. These species



can then be removed simply by withdrawing the polymer from the environment, offering advantages over the traditional chemical treatment strategies.

Initial outcomes on her current environmental research work have been extremely promising and Dr. Alcock has recently filed two patent applications associated with this research.

<sup>3</sup> Full Project Title: *Protection of water resources - new materials for the sensing of nitrates & heavy metals and for the removal of organic contaminants.*

# Case Study 2

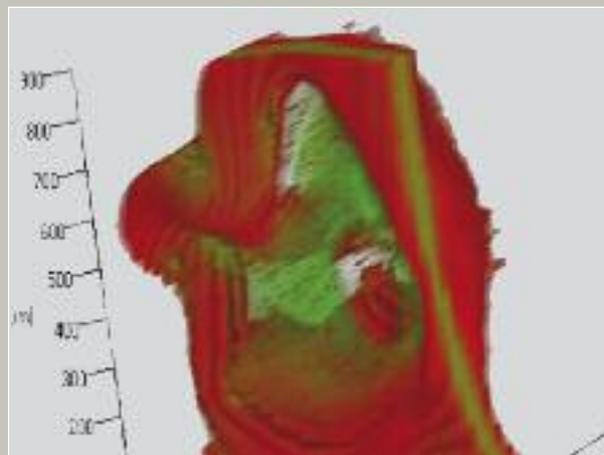
## Enzymes ensure a cleaner, greener dairy industry<sup>4</sup>

Dr Angela Boyce, University of Limerick

This research project focuses on minimising hazardous waste generation, during cleaning-in-place (CIP) operations in the dairy processing industry. The study is examining the potential of replacing currently used environmentally significant CIP agents (e.g. acid, alkali, phosphate-containing detergent and hypochlorite) either partially or entirely with enzymes (proteases and lipases), which are biodegradable and have minimal environmental impact.

Several recently developed commercialised enzymes as well as microbial enzymes produced in-house are being tested in terms of their suitability for this purpose, by quantitatively monitoring their cleaning efficiency when applied to stainless steel surfaces that are experimentally fouled with milk.

The image illustrates a milk-fouled stainless steel panel viewed under laser confocal scanning microscopy. The red colour represents binding affinity to hydrophobic domains of the lipids and proteins and the green colour represents binding affinity to the amino group of proteins.



<sup>4</sup> Full project title: *Minimisation of hazardous waste generated by CIP operations in the dairy processing industry.*

## 3.2 Applied Environmental Technologies Research

Moving on from the **Basic/Fundamental Research** programme, the EPA also funds two types of applied research: *Advanced Technologies for Environmental Protection* and *Analytical Monitoring and Forecasting*. These projects are directed primarily towards a specific practical application, aim or objective.

Four examples of key **Applied Environmental Technologies Research** projects funded by the EPA are provided below (Case Studies 3-6). These illustrate how new technologies can improve existing systems for environmental monitoring and deliver better solutions for management/treatment of wastes.

### 3.2.1. Advanced Technologies for Environmental Protection

This is aimed at exploring innovative research and development solutions that will address key issues to reduce the environmental impact of human activities, protect the environment and manage resources more efficiently. Research in this area focuses on developing the new/emerging or improved environmental technologies (e.g. nanotechnology, green chemistry, biotechnology, sustainable construction, environmental genomics, ICT systems, transport, etc.).

# Case Study 3

## 'Smart' filters to remove metal from water<sup>5</sup>

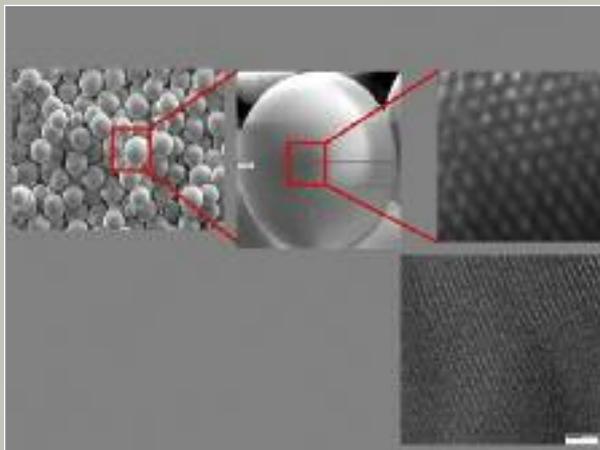
Professor Michael Morris and Dr Justin Holmes, University College Cork

The ability to remove metals from water can be greatly improved by technology developed at UCC that uses a 'smart' material as a key part of the filtration system.

This project is exploring the development of new nanostructured materials (silica) for effective treatment of various pollutants including nanoparticles. Recent work by the research team has demonstrated removal of 99.9% of metal ions (including chromium and lead) from polluted wastewaters and the team is now in the process of developing passive absorbents for removal of volatile organic pollutants.

The work builds on methods and techniques previously developed by the researchers. Highly porous structures that have very high surface areas, and may be chemically tailored to selectively absorb metal contaminants, are being fabricated. The design of novel nanomaterials and the field of nanotechnology are advancing rapidly and it is now clear that nanoparticles may have impacts on health. Part of the work at UCC will examine the effectiveness of these technologies in absorbing or filtering nanoparticles.

The system is currently on trial in both a domestic setting in West Cork, and at a dairy operation. The image is of a Scanning Electron Microscope (SEM) photograph of mesoporous silica.



<sup>5</sup> Full project title: *The use of mesoporous silicas to absorb and separate metals and nanoparticles from aqueous or organic solutions.*

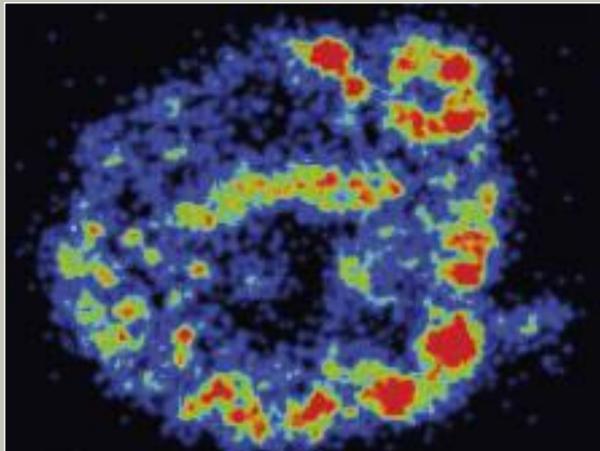
# Case Study 4

## Taking energy from sewage treatment<sup>6</sup>

Professor Vincent O'Flaherty, National University of Ireland, Galway

Anaerobic digestion (AD) is a biological process of waste treatment that converts organic matter to biogas, a useable fuel and a renewable energy source. The process occurs in bioreactors, where the microbes that carry out the process are retained as biofilms. AD is an established, sustainable waste treatment technology for residues from various sources, including industrial processes and agriculture. It has advantages over the conventional aerobic treatment approach, including lower capital and operating costs. To date, AD has not been applied to direct treatment of municipal wastewaters or domestic sewage, due mainly to concerns regarding the stability and efficiency of low-temperature AD. Recent advances in AD research and technology, by the applicants and others, have indicated that high-rate, low-temperature AD is a feasible and highly efficient approach.

This project will, using state-of-the-art methodologies, evaluate the applicability and underlying microbiology of low-temperature AD for municipal wastewater treatment under Irish conditions. If successful, this innovative approach, with AD as the core technology for municipal wastewater treatment will revolutionise the field of wastewater treatment, realise a major commercial and technological opportunity and facilitate future sustainable development.



The image illustrates the acetate uptake by cold-adapted granular sludge. Radiolabelled substrate uptake in a cross-section of a granule is shown in the red zones.

<sup>6</sup> Full project title: *High-rate anaerobic digestion as a core technology for sustainable treatment of municipal and low-strength industrial wastewaters.*

### 3.2.2. Analytical Monitoring and Forecasting

This is aimed at developing the technologies and systems required to measure and monitor the quality of Ireland's environment. Such monitoring and measurement allow for the collection, collation and analysis of data, which ensures that the changes and trends in the environment can be quantified and detected, in turn allowing for decisions to be made based on sound scientific knowledge.

Two examples of Analytical Monitoring and Forecasting projects funded by EPA are provided (Case Studies 5-6). These demonstrate the potential for use of new technologies to aid regulatory compliance while offering the opportunity for commercial development.

# Case Study 5

## Faster, cheaper, more ethical and comprehensive toxicity testing<sup>7</sup>

Professor Dmitri Papkovsky, University College Cork

In this project, the team of academic and industrial partners has developed a new system for toxicological monitoring of environmental samples, particularly wastewater, contaminated freshwater and sea-water samples. The system is based on a number of alternative biological models for toxicity testing and utilises optical oxygen respirometry as a method of detection.

Compared with existing tests and systems for toxicological assessment, this approach provides high sensitivity and specificity due to the measurement of sub-lethal changes in the metabolism of test organisms, along with the high sample throughput, miniaturisation, affordable cost and general convenience provided by the optical respirometry.

The system operates with dispensable O<sub>2</sub>-sensitive fluorescence-based probes, simple and robust assay procedures, standard microtitre plate assay platforms and widely available measurement instrumentation (fluorescence plate readers). This system for toxicological assessment has been developed using a panel of convenient and ethical biological models, including common prokaryotic and eukaryotic cell lines, small invertebrate and vertebrate aquatic organisms, which can be used individually or bundled together.

Corresponding toxicity assays were optimised and evaluated with toxicants and chemicals of different types, including heavy metal ions, pesticides, polyaromatic hydrocarbons, organic solvents, marine toxins, pharmaceuticals, drugs, and also mixtures of chemicals. The assays were subsequently validated with real environmental samples, including contaminated water and wastewater, and were benchmarked against the standard toxicity tests currently used by environmental laboratories. These pilot trials were conducted in collaboration with several environmental and toxicological monitoring laboratories in Ireland and Europe.

The project work has generated a large amount of new experimental and toxicological data. These results have provided the basis for one patent application and a significant number of scientific publications in leading international environmental and bioanalytical journals.



The image illustrates the experimental set-up.

<sup>7</sup> Full project title: *Marine monitoring system based on optical oxygen sensing and respirometry.*

# Case Study 6

## Sensors provide a more watchful eye on gases and odours<sup>8</sup>

Professor Dermot Diamond, Dublin City University

The main aim of this project is to provide a fully autonomous field-deployable device that is capable of measuring the main components of landfill gas (carbon dioxide and methane) in real time and communicating the data back to a base station or stakeholder. The current method of monitoring landfill gas at borehole wells uses a hand-held instrument with sampling being carried out once a month. By using the DCU-developed device (G2EMS), an operator will not need to physically carry out sampling but can communicate with the device and obtain measurements when needed on a daily/weekly/monthly basis.

The device uses tuned infrared sensors to detect and quantify the gas concentrations present. An integrated pump and valve system is used to extract the sample. Data are stored by the device and an average result for each data set is sent via GSM to the base station. This allows the operator to make the decision to increase the frequency of monitoring if an anomalous result is detected, or to continue the monitoring as per the predetermined schedule if nothing anomalous is found.

This device has been field-trialled at two landfill sites, leading to improvements in the design being carried out as part of the development phase from laboratory device to real-world deployable device. The final design has been built and will be field-trialled in 2009.

The images demonstrate the trial sensor deployment at landfills.

A related project (SmartPlant) monitors odorant gases (ammonia and hydrogen sulphide) passively using electrochemical sensors. This project was funded to provide a means of monitoring odorant gases at the perimeter of waste transfer stations and/or landfill sites, as a large proportion of the complaints received by the EPA every year pertain to odours.



(a) G2EMS on field trial

(b) G2EMS with reference instrument GA2000.

<sup>8</sup> Full project title: *Development and testing of autonomous environmental sensor systems for specific emissions to air from IPCC sites (SmartPlant) and landfills (SmartLandfill).*

### 3.3 Demonstration of Environmental Technologies

The EPA STRIVE Programme provides support for pilot and full-scale demonstration of environmental technologies that are capable of treating a particular and significant pollutant stream in Ireland and for which there has been little uptake to date. These may be led by an academic-based researcher or by an industrial-based innovator.

After previously working on an invention/product at laboratory-scale, academic-led research teams are then supported to demonstrate the innovation at pilot or full-scale. Examples of academic-led research being undertaken are given in Section 3.3.1 (see Case Studies 7-8).

The business-led programme is called the Cleaner Greener Production Programme (CGPP) and the objective is to encourage companies and organisations in Ireland, particularly Small and Medium Enterprises (SMEs), to adopt a high standard of environmental performance by adapting or improving business practices in order to minimise negative impact on the environment. Further details on the CGPP are outlined in Section 3.3.2 (see Case Studies 9-12).

### 3.3.1 Academic-Led Research Projects

## Case Study 7

### Blueprint for small wastewater plants<sup>9</sup>

Dr Michael Rodgers, National University of Ireland, Galway

There is an urgent need to develop sustainable wastewater treatment systems for small towns (500-1,000 person equivalent) that are simple, robust and cheap to construct and operate. These plants should efficiently remove organic carbon, nutrients, solids, odours, micro-organisms and fats/greases from the wastewater stream, treat sludges on-site (or locally), and be monitored and controlled remotely.

Using a new low-cost robust biofilm technology, which has been developed and tested by NUI Galway at laboratory and pilot-plant scale, a demonstration wastewater treatment system has been built in conjunction with Galway County Council at a location adjacent to the site of the Tuam Wastewater Treatment Plant. The performance of the treatment system will be controlled and monitored remotely using samplers, sensors, analysers and modems. This facility will also provide unique research opportunities to explore a wide range of technologies for the removal of cryptosporidia, and oestrogenic and recalcitrant compounds from the treated wastewater. It is the ultimate aim of the research team to eventually treat the wastewater to near drinking water quality. The demonstration system will provide a research facility for technical education, practice-based training, support to policy makers, and for development and testing of novel environmental technologies.

The image shows the Research Facility at Tuam Wastewater Treatment Plant.



<sup>9</sup> Full project title: *Treatment and monitoring of nutrients, odour and sludge at a small-town demonstration wastewater treatment system.*

# Case Study 8

## 'Shocked' bugs devour phosphorus<sup>10</sup>

Dr John McGrath, Dr John Quinn, QUESTOR Centre, Queen's University Belfast

The eutrophication of freshwater systems represents one of the biggest global water management issues. The Urban Wastewater Treatment Directive requires phosphorus to be removed from sewage, with a biological option regarded as preferable by industry. Implementation of this Directive, from a water companies' perspective, results in the production of a phosphorus-rich sludge by-product and elevated disposal costs. However, for those industries that utilise phosphorus as a raw material, these sludges could potentially constitute a valuable and abundant resource.

The options for phosphorus removal and recycling from wastewater are limited. This research project seeks to develop alternative phosphorus removal and recovery technologies for the marketplace. Of particular significance has been the group's discovery of acid-stimulated biological phosphorus removal (ASBPR), whereby certain micro-organisms show greatly enhanced levels of phosphorus removal, if the growth pH is adjusted to the range 5.0–6.5. Phosphorus is stored internally within micro-organisms as a biopolymer known as polyphosphate. The research group has trialled this process at both pilot (2000L) (see photo) and full-scale with 64% total phosphorus removed.

The image shows the 2000L pilot plant based at Hilden Sewage Treatment Works, Lisburn, Northern Ireland.

However, to achieve European compliance, an 80% reduction in phosphorus concentration is required. Recently this research has been given new momentum by the discovery of an additional physiological 'shock' which can be used either alone or in combination with the



acid process to greatly increase phosphorus removal (to under current EU compliance limits) and to produce a biomass with a phosphorus content in excess of the 6% threshold required for economic recycling. This represents a significant improvement on the original process and more importantly produces a high phosphorus biomass suitable for recycling.

<sup>10</sup> Full project title: *A novel biotechnological approach to phosphorus removal from wastewaters.*

### 3.3.2 Cleaner Greener Production Programme (CGPP)



The objective of the CGPP is to encourage companies and organisations in Ireland, particularly SMEs, to adopt a high standard of environmental performance by adapting or improving business practices in order to minimise negative impact on the environment. The philosophy of the programme is that prevention is better than cure.

Since 2001, the EPA has committed over €5.9 million (out of a total project cost of €17.5 million) to 75 organisations for demonstration projects. The long-term aim is to try to ensure that cleaner greener production and eco-efficiency become the established norm in Ireland. In 2007, the CGPP was highlighted as an *Exemplar Programme* in a European Commission review of Eco-Innovation Programmes.

Phase 2 of the CGPP took place between 2005 and 2007. It built on the success of CGPP Phase 1 (2001-2004), and the results have clearly demonstrated that Cleaner Greener Production brings both environmental and economic benefits. Significant improvements, both environmental and economic, have been made including:

- €1.6 million cost savings per annum to the 22 participating organisations from an EPA commitment of €1 million;
- 250,000 tonnes per annum reduction in water usage and wastewater arisings;
- 660 MWh per annum energy reduction.

Phase 3 of the CGPP was incorporated into the 2005 Environmental Technologies Research programme and five projects received EPA awards totalling €310,000. Patents and new eco-designed products have resulted from a number of the projects alongside improved environmental behaviour within companies.

Phase 4 of the CGPP commenced in 2009 with the award of approximately €2 million to 15 organisations.

Through the CGPP, the EPA will continue to encourage other businesses to learn from and build on past success stories and to work towards the CGPP's tag-line objective: **Better Business in a Better Ireland.**

The examples below (Case Studies 9-12) highlight only a fraction of the successful CGPP business-led projects undertaken over a number of years. They demonstrate the clear environmental and economic benefits that can be achieved and continue to be achieved across the various industrial sectors.

# Case Study 9

## Monitoring system for moisture-sensitive products<sup>11</sup>

Tim Cummins and Ray Speer, ChipSensors Ltd, Limerick

Recent studies have indicated that building Heating Ventilation and Air Conditioning (HVAC) systems are often operated inefficiently with energy wastage as high as 35%. A key factor in improving efficiency is the comprehensive deployment of indoor environment sensors monitoring temperature, humidity and, potentially, gases such as CO<sub>2</sub>. Today such deployment is greatly limited by installation/wiring and equipment costs.

In this project, funded under CGPP Phase 3, ChipSensors Ltd (formerly Cratlon Ltd) has developed a low-cost, silicon microchip sensor. The prototypes demonstrate humidity and temperature sensing for use in Building Energy Management (BEM) applications, but the technology is also applicable to other environmental and energy-sensitive applications, e.g. monitoring of perishable goods, white goods, etc. The commercial availability of such cheap, easily installed, wireless sensors will significantly cut energy wastage in buildings.



The image is an example of the Sensor Characterisation Board, invented by ChipSensors Ltd.

<sup>11</sup> Full project title: *A silicon single-chip humidity-temperature sensor.*

# Case Study 10

## Flexing some environmental mussels<sup>12</sup>

John Concannon, JFC Manufacturing Ltd, Tuam, Co. Galway

JFC Manufacturing Ltd has successfully designed and manufactured the JFC 400 litre mussel float for long-line rope mussel culture for national and international markets. The plastic float is rotationally moulded at the facility in Tuam, Co. Galway. The JFC 400 litre mussel float is designed so that it can support two horizontal rope lines, thus maximising the crop that can be grown in various conditions. JFC Manufacturing Ltd has designed the float which can withstand the pressures of high waves and which will sit steadily in the water even when loaded with a full crop of mussels. The introduction of the revolutionary new sub-aqua float system is increasing mussel crop yields by as much as 30%.

As part of the CGPP Phase 3 project, JFC Manufacturing Ltd has developed a closed-loop take-back of end-of-life mussel floats to be recycled and replaced with the new superior JFC mussel floats. The closed-loop return of old floats for the supply of new superior floats enabled Irish fishermen to dispose of 28 tonnes of plastic in an environmentally sustainable manner last year (2008). The product will have an increased lifespan compared with those of competitors and is 100% recyclable.

JFC has patented both the product and the stability ring that encompasses the product. JFC is in negotiation with two companies outside Europe to licence the design and moulds so that markets can be serviced by producing the product close to market to avoid logistics costs, etc.



The image illustrates the redesigned and recycled floats.

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<sup>12</sup> Full project title: *Sustainable design, manufacture, use and recycling of plastic mussel floats and fence posts.*

# Case Study 11

## **iameco: A sustainable, ecological, high-performance computer<sup>13</sup>**

Paul Maher and Anne Galligan, Multimedia Computer Systems Ltd, Dublin

MicroPro Computers (established in 1989) is an accredited ISO 14001 and ISO 9001 company carrying the Guaranteed Irish and Intel inside logos. The company has recently won the **Enviro 2008 award for the best small company**. MicroPro Computers is a wholly owned Irish company that has always been at the cutting edge of computer design coupled with a cleaner greener philosophy at the company's core. Its dynamic, innovative, highly trained engineers have designed iameco™ (pronounced I am eco) using techniques from environmental science with virtually no carbon footprint.

Under CGPP Phase 2, MicroPro designed and manufactured a zero-waste, high-specification PC (iameco). iameco is built to the new eco-label standards. The PC uses only reusable components, can be dismantled by a single worker in 11 minutes, is energy efficient, and free of hazardous materials such as brominated flame retardants, PVCs and heavy metals such as lead, cadmium and mercury that have been regularly used in computer manufacture for years. The PC housing is manufactured from recycled aluminium. No plastic is used in the computer housing. The parts and components have been carefully selected to meet EU requirements and to minimise electricity consumption, electromagnetic emissions and noise.

The support received through CGPP Phase 2 has elevated MicroPro from a small SME to a major player in eco-development. The company has recently been successful in the latest round of grant awards under CGPP Phase 4 and also under the European Commission's FP7 which will allow it to continue its R&D work in further greening iameco and bringing it to an international market.



The iameco on display at Green Week at the European Commission Headquarters in Brussels 2008.

<sup>13</sup> Full project title: *Prototype development of guaranteed Irish zero waste personal computer project.*

# Case Study 12

## Greening Irish hotels<sup>14</sup>

Adrian Cummins, Irish Hospitality Institute

Under CGPP Phase 2, the EPA provided funding to the Irish Hospitality Institute to identify the potential for environmental improvement and cost savings in the Irish hotels' sector. In total, 56 hotels were engaged in more than 20 counties. Hotels involved in the programme included 3, 4 and 5 star hotels, ranging in size from 30 to 255 bedrooms. These hotels represented c. 10% of the Irish hotel room stock. Environmental Management principles were introduced to in excess of 3,000 employees. Best practice standards were identified, and the Irish hotel industry was environmentally benchmarked for the first time. Quantifiable environmental achievements included 1,113 tonnes of waste diverted from landfill and 3,000+ tonnes of CO<sub>2</sub> output reduced by the end of 2006. It is estimated that Irish hotels could save over €100 million per annum by making environmental improvements, many at no or low cost. This illustrates that environmental best practice is a way to improve profitability.

Following the completion of the CGPP Phase 2 *Greening Irish Hotels* project, the EPA has provided a further €1.6 million under its National Waste Prevention Programme to promote and support environmental improvements in the Irish hotel/hospitality and related sectors over a four-year period. *The Hotel and Hospitality Project* is managed on behalf of the EPA by a consortium led by the Clean Technology Centre and includes Hospitality Solutions Consulting Ltd. This consortium is working with individual Irish hotels to significantly improve environmental management practices, prevent waste and encourage resource efficiency, while reducing operating costs for the sector. The image illustrates a hotel manager training staff on the principles of water conservation.

To date, over 140 hotels have already signed up and 78 of these were granted awards in recognition of the steps they have taken to improve their environmental practices. In addition to covering the hotel and hospitality sector, the project will be extended to other major food-producing sectors, including contract catering and nursing homes/private hospitals.



<sup>14</sup> Full project Title: *Development of a cleaner production programme for the Irish hotel industry – greening Irish hotels*



Analyzing the Results

4

In late 2008 the EPA surveyed 18 Principal Investigators who had received significant funding<sup>15</sup> for environmental technologies research in 2005/2006, representing an overall EPA commitment of €4.7 million. The details requested included the number and type of researchers working on the projects, figures on publications, the environmental benefits of the projects, patents and additional funding obtained since the commencement of the project. There was a full response to the survey, the findings of which are detailed in the following sections.

## 4.1 Knowledge Production and Capacity Development

Producing knowledge is usually the first output from any research. Results are traditionally published in peer-reviewed journal articles, but can also take the form of patent applications or research data deposited in public databases. Although many of the projects are not yet complete, there has been significant output in terms of publications and patent activity.

Top-line results show that the 18 projects have had a direct impact in terms of knowledge production on a national and international basis including:

- Training of many new researchers and innovators: 14 Postdocs, 11 PhD students, 9 Masters students, 45 others in part-time and full-time roles (technicians, research assistants, etc.) supervised by 25 leading researchers and industrial innovators;
- Publication of 28 peer-reviewed papers in high-impact journals such as *Nature* and *New Scientist*, with a further 17 papers in preparation;
- Presentation of work by awardees at 46 national and 87 international conferences.

## 4.2 Informing Policy and Environmental Benefits

A number of Principal Investigators working on these projects (many with the support and guidance of EPA staff) have demonstrated their newly developed technologies at laboratory scale and are well placed to exploit commercial opportunities for knowledge and products within Ireland and internationally (see case studies).

Several researchers supported by the EPA have also been able to demonstrate the application of environmental technologies at pilot scale with organisations such as Eli Lilly, Western Proteins, Severn Trent Water, Jansen Pharmaceuticals and Northern Ireland Water Ltd (formerly the Northern Ireland Water Service).

During a review of national eco-innovation schemes the EC identified the EPA's CGPP as an exemplar eco-innovation programme. In addition, the outputs from the EPA-funded Environmental Technologies projects formed part of the national response to the EC for the mid-term review of ETAP (February 2009).

A number of Principal Investigators have been invited to participate as experts on national and European expert committees in relation to Waste Prevention and Lead Market initiatives.

Many projects have established strong linkages with industry. One of these, led by Cork Institute of Technology (CIT), has established piloting services for potential applications, either in its own laboratory or at industrial sites. As this project concludes, further funding has been

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<sup>15</sup> EPA Project Commitment of greater than €100,000

received from Enterprise Ireland to procure a specialised, ATEX (from the French 'ATmosphères EXplosibles') and current good manufacturing practices (cGMP)-compliant pilot plant and to upgrade infrastructure facilities at CIT.

At full-scale, some of the researchers are demonstrating newly developed treatment and sensor technologies at relevant sites identified by Local Authorities (Cork, Galway and Monaghan County Councils) and indigenous business (Bailieborough Co-op.).

The EPA is also working closely with IBM and others with a view to further demonstrating innovative technologies for measuring, recording and predicting the quality of the environment.

### 4.3 Wider Economic Benefits

The economic benefits from the research programme are of pivotal importance and they can be identified in many ways such as commercialisation, leverage of additional funds, and realisation of cost savings.

The wider economic impacts of the 18 large projects funded in 2005/06 include:

- Filing of five patents, seven patents in preparation, nine non-disclosure agreements, one licence agreement;
- Foundation of one spin-off company (Bioplastech Ltd);
- Leverage of additional funding to date of €12.5 million (from various national and international sources), which represents approximately 70 new researchers and industrial innovators;
- Building Ireland's reputation for research, which is vital in an increasingly competitive global market for R&D and technological innovation; and
- Demonstrating that cleaner production methods also save money - yielding win-win outcomes for business and the environment.

Much of the work funded by the Environmental Technologies Programme has a clear commercial potential and in many cases the researchers have progressed towards realising this. Based on our survey results, it was found that the cost to produce one patent is less than €1 million of EPA research funds. A recent survey of US and European Technology Transfer Professionals reported that the US respondents require 4.1 million PPP\$<sup>16</sup> to produce one patent application, whereas the European respondents require 8.7 million PPP\$ per patent application.

One of the 18 projects funded indicated that the EPA investment in this group led to the establishment of a spin-off company, Bioplastech Ltd. The research expenditure to produce one start-up was reported as 66.7 PPP\$ and 55.5 PPP\$ in the US and European surveys, respectively. The national data analysed for 2007 in the *First Report on the Strategy for Science, Technology and Innovation* estimates 2.6 start-ups per €100 million spend.

Case Study 13 presents an example of one such project which has resulted in the establishment of a spin-off campus company:

<sup>16</sup> For comparison purposes for the report, financial data are given in US dollar purchasing power parities (PPP\$), using OECD data.

# Case Study 13

## Avoiding landfill, Bacteria key to plastic recycling<sup>17</sup>

Dr Kevin O'Connor, University College Dublin

Every year over 300 million kilograms of petrochemical plastic waste are managed in Ireland including some 70 million polyethylene terephthalate (PET) plastic bottles. The vast majority of PET and other plastics released onto the Irish market ends up in landfill placing a major burden on landfill management. The market for recycled PET is, however, small and saturated and the products are of low value. Consequently, the conversion of PET into new commodities is desirable. The aim of this project was to convert PET into a biodegradable plastic.

There are no known organisms that can biodegrade PET. However, the researchers believed that chemical pretreatment would give bacteria access to the building blocks that make up PET bottles. While the degradation of PET through the combination of chemical and biological treatments would be a world-first, the research team wished to bring the technology further and generate a value-added end-product rather than simply getting rid of PET. Thus, bacteria were selected from soil in Ireland that naturally make a biodegradable plastic within themselves, facilitating conversion of petrochemical plastic waste to a biodegradable raw material.

The research team have patented the technology for the conversion of PET into biodegradable plastic. The team is now working to enhance the efficiency of the conversion technology and developing the biodegradable polymer as a new market product. A spin-out company "Bioplastech Ltd" was founded in 2008 will further develop and commercialise this technology.



The image is an example of extracted bioplastic.

<sup>17</sup> Full project title: *Biotechnological conversion of PET plastic bottles into biodegradable plastics*. Image taken by Terence Union.

Increased success in national and, in particular, international funding programmes is not only advantageous to Ireland in terms of non-exchequer funding of research but also on the basis of its international competitiveness; it is ultimately an excellent indicator of the quality of Irish research because these awards are based on peer review and measure current rather than past performance.

In total, 14 of the 18 projects surveyed have secured significant other funding, based on an initial EPA investment of €4.7 million. The researchers have leveraged additional national (€9.3 million) and international (€3.2 million) funds from EI, SFI, MI and FP7, which equates to approximately 70 new researchers and jobs supported. This has wider economic benefits in terms of identifying Ireland as a Centre of Excellence, which is borne out by IBM's recent establishment of a water management research and development group in Dublin.

The CGPP has demonstrated that Cleaner Greener Production brings both environmental and economic benefits. Many of the participating organisations have discovered that there is a strong demand for environmentally sound products and services and, indeed, environmental performance is fast becoming a marketing tool. In addition, patents and new eco-designed products have resulted from a number of the projects, in tandem with improved environmental behaviour within companies.

#### 4.4 Value for Money

The EPA has developed an *Evaluation Framework/Value for Money Methodology* for research funded under STRIVE. This framework was partially applied to the 18 projects, pending a full analysis to be undertaken in 2010 when projects are completed. Based on these preliminary results, the analysis already demonstrates the importance of the programme to support research capacity and to promote world-class scientific and technological development. This, in turn, influences and impacts directly on both national and international policy (see above) and equates to economic value for money in terms of job creation, patent generation, etc. It is apparent that when benchmarked against European and US figures, the EPA Environmental Technologies programme demonstrates **excellent value for money**. Table 1 below summarises the major achievements resulting from the 18 projects surveyed.

**Table 1.** Results from the survey of 18 Principal Investigators funded under the Environmental Technologies and Cleaner Production Programme in 2005/2006, which represents an EPA investment of €4.7 million.

| <b>Payback Category</b>                     | <b>Outputs and Outcomes</b>  |
|---|--|
| Knowledge Production                        | <ul style="list-style-type: none"> <li>■ 28 Articles published in peer-reviewed journals (17 in preparation)</li> <li>■ Presentation by researchers at 87 International and 46 National Conferences</li> <li>■ Improved understanding of the application of emerging technologies to environmental protection</li> </ul>   |
| Capacity Development                        | <ul style="list-style-type: none"> <li>■ Training of new researchers: 14 Postdoctoral fellowships, 11 PhD students, 9 Masters students</li> <li>■ Career Development for 25 Principal Investigators and 45 study team researchers (technicians, research assistants)</li> <li>■ Development of a scientific and technological workforce in Ireland</li> <li>■ Support for the development of new science facilities (infrastructure)</li> </ul>  |
| Informing Policy and Environmental Benefits | <ul style="list-style-type: none"> <li>■ Development of new techniques, methods and systems for measuring, recording and predicting the quality of the environment</li> <li>■ Development of new technologies for the treatment of priority waste and wastewater streams</li> <li>■ Demonstration of new technologies at lab-, pilot- and full-scale operation at various locations in Ireland</li> <li>■ CGPP identified by the EC as an exemplar eco-innovation programme</li> <li>■ Support for National ETAP efforts</li> <li>■ Advisory roles played by some funded Principal Investigators to National and European Expert Groups</li> </ul> |
| Broad Social and Economic Benefits          | <ul style="list-style-type: none"> <li>■ One spin-off campus company established</li> <li>■ Five patents filed (seven in preparation)</li> <li>■ Economic benefit by leverage of additional national (€9.3 million) and international (€3.2 million) funding</li> <li>■ Benefit of identifying Ireland as a Centre of Excellence (e.g. IBM investment in Dublin)</li> <li>■ Environmental gains will contribute to improved quality of life</li> </ul>   |



5

# Future Strategy

Ireland has a high-quality research and technical base but this needs to be further strengthened if we are to meet the major economic and environmental challenges ahead. It is clear that technology and innovation have a significant role to play in rising to environmental challenges and can also deliver further economic benefits through enhancing competitiveness and improving efficiencies. In the coming years, the EPA will continue to prioritise research in this area with the aim of meeting a number of key strategic objectives as follows:

- Support for the development of the environmental goods and services sector and position Ireland to take advantage of this fast-growing international market;
- Contribute to environmental protection by delivering applicable and relevant solutions, information and knowledge;
- Develop and integrate the environmental component of the knowledge economy by promoting an innovation-driven culture in the environmental technologies sector; and
- Support the integration of eco-innovation into relevant international and national environmental policies and legislation.

To deliver on these objectives, the activities the EPA will undertake in the coming years will be targeted at:

- Maximising investment in research and innovation through collaboration with others;
- Stimulating and supporting commercialisation of research;
- Providing R&D support for business;
- Establishing a National Environmental Technologies Research Platform;
- Advancing climate change technologies;
- Enhancing international linkages; and
- Transferring the knowledge.

## 5.1 Maximising Investment in Research and Innovation through Collaboration with Others

The EPA will continue to develop national capacity in the environmental technologies area by funding research that supports both academia and industry. This increased expertise will be utilised to inform policy on a spectrum of national and international priorities, to mobilise this knowledge for use in environmental protection and to support economic recovery.

In order to achieve these aims, effective linkage between researchers and academia, funding agencies, government and business is essential. The active co-operation of both national and international stakeholders (including those actively seeking co-funding opportunities) is also required. The EPA will continue its participation in the Higher Education Research Group (HERG) linking directly with the *Strategy for Science, Technology and Innovation*.

Building on previous successful engagement with the MI, the EPA has agreed a follow-on collaboration to build a multidisciplinary industry-oriented research capability in the marine area. Further co-funding opportunities will also be identified with other relevant research funding partners across other sectors.

The EPA is also involved in Cycle 5 of the Programme for Research in Third-Level Institutions (PRTLII) launched in early 2009, with the aim of providing investment in priority research areas and associated facilities. This programme includes funding for a national research centre of excellence in the area of Environmental Technologies providing laboratory and pilot-plant space for development and demonstration of waste and wastewater conversion technologies. The initiative represents a very significant development for the Environmental Technologies sector and, to further support the facility, the EPA will publish a targeted call for proposals for groups who are part of the centre.

The EPA will:

- continue to develop national capacity in Environmental Technologies and innovation to underpin the smart green economy;
- work closely with other agencies to maximise the investment and synergy in environmental technologies; and
- support the establishment of the Environmental Technology Centre Ireland.

## 5.2 Stimulating and Supporting Commercialisation of Research

In line with government policy, it is the intention of the EPA that, where appropriate, researchers are encouraged to commercialise findings through licence agreements, patents and spin-off companies. In order to manage intellectual property (IP) generated through the research programme, the EPA has adopted the approach set out in the manual *Funding Agency Requirements & Guidelines For Managing Research-Generated Intellectual Property*.

The EPA will:

- work closely with technology transfer offices and public bodies (including EI) to support researchers, particularly in the critical early stages of commercialising their research;
- develop new and further co-funding and collaborative opportunities with industrial representative bodies.

## 5.3 Providing R&D Support for Business

The EPA will continue to support improved environmental performance in Irish businesses through the successful CGPP. In 2009, a further 15 new projects started, representing EPA support of €2 million towards total project costs of €5 million.

Linkages with industries (in particular SMEs) will be further reinforced through the STRIVE research programme with a greater focus on industrial-academic partnerships through arrangements such as co-funding and innovation vouchers.

Where possible, the EPA will facilitate requests from commercial organisations for advice and support on developing and trialling new systems and products for environmental protection.

**The EPA will:**

- provide funding through the CGPP to support cleaner greener business in Ireland;
- further develop links between industry and academia within the environmental and cleaner production arena; and
- further follow-up on successful CGPP projects via the Green Business Initiative.

## 5.4 Establishing a National Environmental Technologies Research Platform

There are a large number of researchers, industries, funding agencies and decision makers that have an interest in the field of Environmental Technologies research and innovation. The EPA intends, with the assistance of key stakeholders, to establish a National Environmental Technologies Research Platform/Secretariat. This group will co-ordinate activities and funding to support key research needs and future market development. The platform will also define a long-term vision for the greening of Ireland's economy.

**The EPA will:**

- work with others to establish a National Environmental Technologies Research Platform.

## 5.5 Advancing Climate Change Technologies

Technologies and socio-economic solutions are a key thematic element of the EPA's CCRP and of cross-cutting work on observations and analyses systems, e.g. in relation to issues of Measurement, Reporting and Verification (MRV). Advancing research on new technologies in co-operation with other research bodies and agencies is a major element of this activity.

The CCRP technologies programme will focus on the development and deployment of technologies in co-operation with key groups working in the areas of:

- Energy-related GHG emissions and their reduction;
- Land management and carbon release as well as sequestration in soils and biomass;
- Emissions from agriculture, particularly methane and nitrous oxide; and
- Other GHGs, e.g. from industrial processes, waste and resource use.

**The EPA will:**

- advance technologies and socio-economic solutions in relation to climate change mitigation and adaptation;
- advance observation and analytical systems in support of "MRVing" of the causes, consequences and responses to climate change; and
- develop technologies as an element of its vision of a carbon-neutral Ireland.

## 5.6 Enhancing International Linkages

Active participation by Irish researchers and innovators in international networks and programmes provides additional finance and, more importantly, access to world-class facilities and researchers. For companies it can provide access to research results of the whole consortium, contacts for further business relations and exposure to new markets.

The EPA will continue its support for Irish researchers through its role as a national contact point and national delegate for the EU FP7. It will also actively participate in relevant networks of research funders (ERA-Nets).

The EPA will maintain involvement in the higher-level working group for the European Commission ETAP and will participate in other actions such as the European Forum on Eco-Innovation in order to ensure good communication between Ireland and international partners on strategic environmental technology issues.

The EPA will:

- support increased participation and success in international funding competitions such as the EU FP7;
- continue to participate and support ETAP and further participate in ERA-Nets, in particular those related to eco-innovation.

## 5.7 Transferring the Knowledge

A significant suite of research projects is currently under way using classical and novel technologies to protect the environment. In addition, the CGPP has identified business opportunities and best practice to deliver both economic and environmental benefits.

It is essential to effectively transfer the knowledge gained and provide access to the findings of the research and development to all stakeholders. This will maximise synergies across the wider research agenda, accelerate the uptake of environmental technologies in the business sectors and environmental policy arena, and promote further innovation. The EPA will facilitate and encourage knowledge transfer through a variety of mechanisms including conferences, workshops, publications, short findings papers, online tools, demonstration projects, and through developing active linkages with business representative bodies.

The EPA will:

- communicate key research findings in such a manner as to ensure the earliest possible integration into the formulation of policy and decision making;
- leverage the research base to tackle key environmental problems and to inform industrial and other stakeholders of significant findings in a timely manner;
- continue to work with colleagues and others to inform the business sector and society in general of the potential for transfer of best environmental practice and to promote the uptake of environmental technologies.





# Conclusion



The EPA STRIVE Environmental Technologies and Cleaner Production Programme has been instrumental in establishing an emerging innovation culture to encourage and support researchers who are developing technologies to deliver environmental benefits that compete successfully in home and international markets and will continue to do so.

It is widely recognised that research and innovation play an important role in environmental protection and management. Compliance with national and international environmental obligations frequently requires the support of environmental research. The environmental technologies sector is well placed to provide this support through smart monitoring, novel treatment processes and advanced reporting systems.

Research and innovation has a critical role to play in developing a sustainable economy and in the creation of green-collar jobs. Through carefully targeted funding and networking, the EPA STRIVE programme will provide underpinnings for growth and innovation in the environmental sector, and support development of cleaner, more efficient business practices to boost competitiveness.

This report gives a brief snapshot of the story so far with regard to Irish Environmental Technologies research. It highlights the value of the research funded to date in terms of research capacity development, knowledge production, environmental benefits and wider social and economic benefits. It also sets out where Ireland needs to progress to ensure it meets the environmental and economic challenges that face it. By continuing to fund and strengthen environmental technologies research capacity, the EPA is enabling Ireland to compete internationally, without compromising the quality of the environment.

It is envisaged that the EPA programmes highlighted in this report will continue to develop significant research expertise in Ireland and be recognised as pivotal activities supporting the **Smart Green Economy**.



# Appendices

# 7

# Appendix 1

## Information Sources

Annual Competitiveness Report 2008. Available at:  
[http://www.forfas.ie/media/ncc090108\\_acr\\_2008.pdf](http://www.forfas.ie/media/ncc090108_acr_2008.pdf)

Arundel, A. & Bordoy, C. Summary Report for Respondents: The ASTP Survey for Fiscal Year 2006. Report produced by UNU-MERIT for the Association of European Science and Technology Transfer Professionals. Available at: <http://www.astp.net/>

Building Ireland's Smart Economy: A Framework for Sustainable Economic Renewal, Department of An Taoiseach, December 2008. Available at:  
[http://www.taoiseach.gov.ie/attached\\_files/BuildingIrelandsSmartEconomy.pdf](http://www.taoiseach.gov.ie/attached_files/BuildingIrelandsSmartEconomy.pdf)

Coakley, T. et al. 2007. Investigation into why existing environmental technologies are underused. ERTDI Report Series No. 62. EPA, Ireland.

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First Report on the Strategy for Science, Technology and Innovation 2006-2013. Available at: <http://www.entemp.ie/publications/science/2008/firstreportonSSTI.pdf>

Forfás and InterTrade Ireland *Enterprise Opportunities and Policy Implications for the All-Island Environmental Goods and Services Sector*. (2008). Available at:  
<http://www.intertradeireland.com/>

Fourth European Forum on Eco-Innovation, Vienna, 2008. Available at:  
[http://ec.europa.eu/environment/ecoinnovation2008/1st\\_forum/](http://ec.europa.eu/environment/ecoinnovation2008/1st_forum/)

Funding Agency Requirements & Guidelines For Managing Research-Generated Intellectual Property. Available at:  
[http://www.epa.ie/downloads/pubs/other/corporate/oea/research/researchtcandguides/ipguidelines-final\\_feb061.pdf](http://www.epa.ie/downloads/pubs/other/corporate/oea/research/researchtcandguides/ipguidelines-final_feb061.pdf)

O'Leary, G., Boyle, R., Donlon, B. and Sheils, L. Providing a framework for accountability and learning in environmental research. *Administration*. 55,4 (2008) pp. 159-170.

Research Infrastructure in Ireland - Building for Tomorrow. Available at:  
[http://www.forfas.ie/media/forfas061221\\_research\\_infrastructure.pdf](http://www.forfas.ie/media/forfas061221_research_infrastructure.pdf)

Strategy for Science, Technology and Innovation (2006). Available at:  
<http://www.entemp.ie/publications/science/2006/sciencestrategy.pdf>

## Appendix 2

### Full Listing of EPA STRIVE Environmental Technologies and Cleaner Production Projects

#### List of the 18 Large Environmental Technologies & Cleaner Production Projects Surveyed

| Title   | Investigator                | Lead Organisation            |
|---|-----------------------------|------------------------------|
| Marine monitoring system based on optical oxygen sensing and respirometry   | D. Papkovsky                | University College Cork      |
| Demonstration of a miniaturised multi-channel cytometry system and its suitability for autonomous deployment                      | J. Alderman                 | University College Cork      |
| Biotechnological conversion of PET plastic bottles into biodegradable plastics  | K. O' Connor                | University College Dublin    |
| A complete water and pollutant balance for a constructed wetland treating wastewater from a dairy processing plant                | M. Kelly-Quinn              | University College Dublin    |
| Trace radical absorption through cavity-enhanced spectroscopy   | A. Ruth                     | University College Cork      |
| High-rate anaerobic digestion as a core technology for sustainable treatment of municipal and low-strength industrial wastewaters | V. O'Flaherty               | NUI Galway                   |
| The use of mesoporous silicas to absorb and separate metals and nanoparticles from aqueous or organic solutions                   | J. Holmes/<br>M. Morris     | University College Cork      |
| Nitrogen removal from slaughterhouse wastewater by means of simultaneous nitrification and denitrification                        | X. Zhan                     | NUI Galway                   |
| Integrated research programme into membrane separation process technology   | N. Duffy                    | Cork Institute of Technology |
| Alum sludge based constructed wetland system for improving organic matter and nutrients removal in high strength wastewater       | Y. Zhao                     | University College Dublin    |
| Irish industrial road transport – current situation and potential software solutions for environmental compliance                 | P. Byrne<br>/C. Heavey      | University of Limerick       |
| i-Track: Irish transport using renewable and carbon-neutral fuels in support of the Kyoto agreement                               | J. Porter                   | Interactions Ltd             |
| Treatment and monitoring of nutrients, odour and sludge at a small-town demonstration wastewater treatment system.                | M. Rodgers                  | NUI Galway                   |
| Development and testing of autonomous environmental sensor systems for specific emissions to air from IPPC sites and landfills    | D. Diamond                  | Dublin City University       |
| A novel biotechnological approach to phosphorus removal from wastewaters.   | J. McGrath /<br>J. Quinn    | Queens University Belfast    |
| A silicon single-chip humidity-temperature sensor   | T. Cummins                  | Chip Sensors Ltd             |
| SMART COAST   | F. Regan                    | Dublin City University       |
| Sustainable design, manufacture, use and recycling of plastic mussel floats and fence posts                                       | J. Concannon /<br>S. Mooney | JFC Ltd                      |

**List of other EPA STRIVE Environmental Technologies  
Projects Funded since 2005/2006**

| Title   | Investigator      | Lead Organisation              |
|---|-------------------|--------------------------------|
| E-diesel: benefits and barriers   | F. Purcell        | Energy Solutions               |
| Study: investigation into why existing environmental technologies are underused   | T. Coakley        | Clean Technology Centre        |
| Energy efficiency improvement of wastewater treatment processes using process integration techniques  | T. Zhelev         | University of Limerick         |
| Guidelines on how to take a pilot project to market   | D. Kelly          | Circa Group Europe             |
| Evaluating microbial biosensors to detect PCB contamination and degradation in a range of water/soil environments and conditions  | P. Ryan           | Carlow Institute of Technology |
| Development of an Irish building environmental assessment method  | H. Lewis          | University College Dublin      |
| From a 'waste' into useful material: identifying adsorption capacity of dewatered alum sludge for phosphorus removal  | Y. Zhao           | University College Dublin      |
| Pharmaceutical residues within sewage sludges   | L. Barron         | Dublin City University         |
| Evaluation of models (PaSim, RothC, CENTURY, DNDC) for simulation of grassland carbon cycling at plot, field and regional scale   | K. Byrne          | University College Cork        |
| Global climate change observing system, hydrological, terrestrial and related activities  | N. Dwyer          | University College Cork        |
| Integrated GIS and neuro-fuzzy analysis for use in River Basin District management  | A. Nasr           | University College Dublin      |
| An investigation into the effective distribution of on-site wastewater effluent into percolation areas and the treatment performance of sandy subsoils and constructed wetlands                       | L. Gill           | Trinity College Dublin         |
| Digital soil information system for Ireland – scoping study   | K. Daly           | Teagasc                        |
| Enhanced pervaporation using a novel permeate recovery technology   | C. Ó'Súilleabháin | Cork Institute of Technology   |
| Anaerobic digestion in Ireland: decision support software   | J. Murphy         | Cork Institute of Technology   |
| Technical and economic feasibility of utilising construction and demolition waste and dredge material as landfill liner   | J. Murphy         | Cork Institute of Technology   |
| The development of nanoliquid chromatography-mass spectrometry (nanoLC-MS) methods for the determination of triazine herbicides and endocrine disruptors in wastewater, lake water and drinking water | A. Furey          | Cork Institute of Technology   |
| New generation contact economiser systems for flue gas energy recovery addressing the environmental impact of industrial boilers  | T. Zhelev         | University of Limerick         |
| Management system for dirty water on farms  | W. Magette        | University College Dublin      |
| Enhanced vacuum drying through improved solvent recovery, reduced process cycle times and prediction of drying duration   | C. Ó'Súilleabháin | Cork Institute of Technology   |
| Innovative data capture and presentation techniques in support of the EU environmental noise directive  | G. O'Riain        | Compass Informatics Ltd        |
| Marine ecological tools for reference, intercalibration and classification  | F. O'Beirn        | Marine Institute               |

| Title   | Investigator  | Lead Organisation                    |
|---|---------------|--------------------------------------|
| Organic waste management in multi-storey dwellings and the use of in-sink macerators  | W. Phelan     | RPS Consulting Engineers (RPS)       |
| Implementation of a community composting programme  | S. Miller     | Ballymun Regeneration Ltd            |
| MBT – has it an Irish role?   | B. Guinan     | Fehily Timoney and Company           |
| Early warning system for water treatment plants   | I. Dokas      | University College Cork              |
| GEO fellowship  | P. Tomkins    | Athlone Institute of Technology      |
| Modelling national emissions to air and water   | D. Styles     | Trinity College Dublin               |
| The effect of NOx traps on the combustion and size distribution of carbonaceous particulate matter emitted from diesel engines                      | M. Sullivan   | University College Dublin            |
| Environmental issues relating to the manufacture of antisense-based products of pharmaceutical biotechnology  | G. Walsh      | University of Limerick               |
| Sensing and remediation of nitrates using copper and bimetallic copper nanoparticles  | C. Breslin    | NUI Maynooth                         |
| Development of nanoengineered materials for mitigation of indoor VOC (carbonyls) pollutants   | M. Morris     | University College Cork              |
| Development of a novel process for the removal of selected organic compounds from waste streams   | T. O'Dwyer    | University of Limerick               |
| Environmental diagnostics: biomolecular interactions at nanostructured surfaces   | D. Leech      | NUI Galway                           |
| Novel anti-fouling strategies based on materials doped with nanoparticles for use in new monitoring technologies                                    | F. Regan      | Dublin City University               |
| Biomass to biofuel: generation of cellulose-based biomass degrading strains of brewery yeasts   | U. Bond       | Trinity College Dublin               |
| Photochemical alternatives to hazardous radical initiators for the synthesis of potent anti-tumour agents   | F. Aldabbagh  | NUI Galway                           |
| Biodegradable solvents for the pharmaceutical industry: toxicity, ecotoxicity and stereochemistry   | N. Gathergood | Dublin City University               |
| Novel alcohol dehydrogenases for the synthesis of chiral alcohols   | G. Paradisi   | University College Dublin            |
| A functional metagenomics approach to the identification of cyanide/nitrile metabolising enzymes  | C. O'Reilly   | Waterford Institute of Technology    |
| Communicating environmental risk: waste, incineration and dioxins   | A. Davies     | Trinity College Dublin               |
| Advanced systems for biological assessment of toxicity of industrial chemicals  | D. Papkovsky  | University College Cork              |
| Post-genomic approaches to assess the nanotoxicity risk of nanoparticles  | K. Dawson     | University College Dublin            |
| Development of a risk assessment methodology for evaluating ecological dispersion and human risks from nanoparticles through environmental pathways | E. Cummins    | University College Dublin            |
| Active microwave remote sensing of soil moisture  | P. Whelan     | University College Cork              |
| Sustainable development research model  | J. Fitzgerald | Economic & Social Research Institute |

| Title  | Investigator        | Lead Organisation                   |
|--|---------------------|-------------------------------------|
| Phosphate free conversion coating by nanoceramic technology for the engineering industry.  | S. O'Muircheartaigh | Galway Mayo Institute of Technology |
| A novel, green technology for environmental remediation of chloro-aromatic contaminants  | M. Jansen           | University College Cork             |
| The implementation of the European Pollution Emission Register to urban waste water treatment plants in Ireland  | J. Treacy           | Limerick Institute of Technology    |
| Transformation of food processing wastes into value added products   | B. McCarra          | Institute of Technology, Tralee     |
| An investigation of the effects of enzymatic additions on anaerobic sludge dewatering properties   | J. Bartlett         | Institute of Technology, Sligo      |
| Treatment of industrial waste water containing active pharmaceutical ingredients with a membrane bioreactor, with the aim of reducing resource consumption   | N. Duffy            | Cork Institute of Technology        |
| Nematode geno- and ecotoxicology for environmental monitoring of lead, cadmium and zinc pollution in Irish soils.  | T. Kakouli-Duarte   | Institute of Technology Carlow      |
| Photocatalytic surfaces for cleaning urban air using semi-conductor nanomaterials  | M. Seery            | Dublin Institute of Technology      |
| Passive samplers for water quality monitoring of persistent organic pollutants in the marine environment   | P. Behan            | Dublin Institute of Technology      |
| Pilot programme for establishing a regional eco-business recognition mark  | N. Duffy            | Clean Technology Centre             |
| To develop an industry led quality standard for composted materials produced in Ireland.   | P. Foster           | Cré                                 |
| The protection of water resources: new materials for the sensing of nitrates and heavy metals and for the removal of organic contaminants  | B. Alcock           | NUI Maynooth                        |
| Compressed biomethane generated from grass, utilised as a transport biofuel  | J. Murphy           | University College Cork             |
| Research specialist – theme 3 CCRP – socio-economic analysis and technologies.   | G. O'Reilly         | University College Dublin           |
| GMES/GEO Ireland   | B. Kelly            | Athlone Institute of Technology     |
| Nanotechnology: engaging with the public on health, environmental and social issues  | P. Murphy           | Dublin City University              |
| Establishment and validation of a human blood-brain barrier model for screening and risk assessment of nanoparticle access to the brain.   | M. Brown            | University College Dublin           |
| Emerging new nanotechnologies for separation of ethanol and water for bioethanol production  | D. Keane            | University College Cork             |
| Minimisation of hazardous waste generated by CIP operations in the dairy processing industry   | A. Boyce            | University of Limerick              |
| Zero carbon emission microfuel cell design   | L. Nagle            | University College Cork             |
| Recombinant DNA approaches to enhance activity of the pathway for degradation of the toxic pollutant styrene in the bioreactor isolate <i>P. putida</i> CA-3: a biotechnologically significant metabolic route | J. O'Mahony         | University College Cork             |
| Spent mushroom compost management and options for use  | P. Jordan           | Dundalk Institute of Technology     |
| Development of specific bacterial detoxification enzymes as bioindicators and biosensors of environmental pollution  | M. McGuinness       | Institute of Technology Carlow      |

| Title   | Investigator    | Lead Organisation              |
|---|-----------------|--------------------------------|
| Environmental scanning electron microscope  | M. Morris       | University College Cork        |
| Chemical ionisation mass spectrometer   | H. Berresheim   | NUI Galway                     |
| High content analysis and confocal spectroscopies platform  | K. Dawson       | University College Dublin      |
| Continuous-flow isotope ratio mass spectrometer   | N. Ogle         | Queen's University Belfast     |
| High frequency electrochemical impedance spectroscopy   | C. Breslin      | NUI Maynooth                   |
| Enhancement of sample introduction system for new multi-collector inductively coupled plasma mass spectrometer  | F. McDermott    | University College Dublin      |
| Temperature-controlled algal growth facility  | D. Stengel      | NUI Galway                     |
| Reference and field deployable instrument for thin sample and bulk (soil) analysis using XRF  | D. Diamond      | Dublin City University         |
| Beckman Coulter Avanti J26 XP centrifuge + rotors   | A. Dobson       | University College Cork        |
| Mobile research monitoring and control infrastructure for on-site wastewater treatment systems  | M. Rodgers      | NUI Galway                     |
| MIRA36 cloud radar for Mace Head atmospheric research supersite   | C. O'Dowd       | NUI Galway                     |
| Equipment to construct 4 respiration chambers to measure greenhouse and transboundary gas emissions from ruminants and maintenance energy requirements of ruminants                   | K. Pierce       | University College Dublin      |
| Instruments for the measurement of carbon and nitrogen in environmental substrates  | N. Allot        | Trinity College Dublin         |
| Role of engineered nanoparticles in protein fibrillation diseases   | K. Dawson       | University College Dublin      |
| Efficiency of Sligo secondary sewage treatment systems in the removal of cryptosporidium and other human enteric pathogens  | F. Lucy         | Institute of Technology, Sligo |
| Safe disposal of sewage effluent in coastal waters designated for the cultivation of oysters and for water-contact recreation   | P. O'Kane       | University College Cork        |
| Novel passive sampling devices for the monitoring of priority pollutants  | F. Regan        | Dublin City University         |
| Carbon nanocages as environmental adsorbents  | J. Holmes       | University College Cork        |
| Assessing and monitoring vegetation disturbance on Irish peatlands using satellite remote sensing   | N. Holden       | University College Dublin      |
| Legal issues relating to the admissibility in evidence of environmental data gathered by means of remote sampling and self-monitoring techniques – the case of water quality sampling | T. McIntyre     | University College Cork        |
| Cloud cover and radiation balance changes over Ireland due to aircraft induced contrails  | C. Cawkell      | University College Cork        |
| Green organocatalysis: a biodegradation and (eco)toxicity study   | N. Gathergood   | Dublin City University         |
| Investigation of biodegradable plastic production by an activated sludge microbial consortium treating dairy industry wastewater  | N. O'Leary      | University College Cork        |
| Synthesis of fine-chemicals through solar-chemical photooxygenations and environmental performance evaluations using the EATOS method   | M. Oelgemoeller | Dublin City University         |

| Title   | Investigator   | Lead Organisation                 |
|---|----------------|-----------------------------------|
| Elucidation of global regulatory signals controlling a biotechnologically significant pathway for the degradation of styrene, a toxic pollutant, by the bioreactor isolate <i>Pseudomonas putida</i> CA-3 | A. Dobson      | University College Cork           |
| Exploitation of sugar kinases in green chemistry  | O. Timson      | Queen's University Belfast        |
| Participatory governance: a best practice model for effective and inclusive decision making in wind energy development in Ireland   | M. O'Cinneide  | NUI Galway                        |
| The EU emission trading scheme and the greening of technology   | G. Di Maria    | University College Dublin         |
| Development of chemically engineered nanoporous absorbents for phosphate removal from wastewater streams  | J. Hanrahan    | University College Cork           |
| A cost-efficient method for enabling reuse of personal computers  | C. Fitzpatrick | University of Limerick            |
| Smart heating system for green homes  | T. O'Mahony    | Cork Institute of Technology      |
| Satellite remote sensing as a tool for monitoring vegetation seasonality  | N. Dwyer       | University College Cork           |
| Using recommendation technology to enhance waste exchange services  | D. Bridge      | University College Cork           |
| Implementing PassivHaus technologies to reduce environmental emissions in housing in Ireland  | V. Brophy      | University College Dublin         |
| The development of a quality management system for urban wastewater treatment plants in Ireland   | J. Treacy      | Limerick Institute of Technology  |
| Organic photovoltaic materials - identification simulation and characterisation for environmentally safe systems  | T. O'Mahony    | Waterford Institute of Technology |
| Capacity building for decentralized organic waste management and composting in Ireland  | M. Prasad      | CRÉ                               |
| Assessment of exposure to metallic nanoparticles on marine and freshwater model organisms at cellular and genetic level   | L. Joshi       | NUI Galway                        |
| A personal exposure, activity/location, GIS model for the greater Dublin area and its satellite towns   | B. Broderick   | Trinity College Dublin            |
| Visualisation and quantification of the interaction of fluorescent nanoparticles with ecotoxicologically relevant species   | K. Dawson      | University College Dublin         |
| Assessing the impact of wastewater treatment plant effluent on norovirus contamination in shellfisheries  | B. Dore        | Marine Institute                  |
| Demonstration of an adaptation to the activated sludge process; for reduced sludge generation   | C. Prunty      | Queen's University Belfast        |
| The upcycling of post-consumer polyethylene to a biodegradable plastic: waste to value-added product  | K. O'Connor    | University College Dublin         |
| Stress induced molecular and ecological changes in soil autotrophs: carbon capture and novel compound prospecting   | B. Kelleher    | Dublin City University            |
| Micro-photochemistry - a new resources-efficient R&D approach   | M. Macka       | Dublin City University            |
| The design of new photocatalytic systems for the generation of hydrogen from water using solar energy   | H. Vos         | Dublin City University            |

| Title  | Investigator   | Lead Organisation                 |
|--|----------------|-----------------------------------|
| Smart catchment demonstration: long-term deployment of sensor monitoring system  | F. Regan       | Dublin City University            |
| Flow-proportional passive sensor validation of phosphorus and nitrogen in Irish rivers   | P. Jordan      | University of Ulster              |
| Biodegradable catalytic asymmetric methods - a study of solvents, organocatalysts and magnetic-nanoparticle supported catalysts  | N. Gathergood  | Dublin City University            |
| Geoinformatics services for improved access to environmental data and information  | P. Mooney      | NUI Maynooth                      |
| Cavity-enhanced Fourier transform spectroscopy for the trace detection of atmospheric pollutants   | R. Varma       | University College Cork           |
| Development of remote sensing as a tool for detection, quantification and evaluation of submarine groundwater discharge to Irish coastal waters  | J. Wilson      | Trinity College Dublin            |
| An optical fibre sensor system for the detection of atmospheric gaseous pollutants in an urban environment   | A. Walsh       | Dublin Institute of Technology    |
| The 'cleaner, greener, leaner' study: combating climate change through planning for sustainable transport  | D. Woods       | Dublin City University            |
| Photoinduced advanced oxidative processes for the removal of pathogenic bacteria from drinking water   | M. Oelgemöller | Dublin City University            |
| Genetic methods to improve Cr(vi) bioremediation in groundwater  | C. Marsili     | Dublin City University            |
| A technical, environmental and economic analysis of dredge material recovery and reuse techniques for Ireland  | J. Harrington  | Cork Institute of Technology      |
| The development of a bioremediation product: a study of factors affecting biosorption of chromium by a variety of seaweed species  | P. McLoughlin  | Waterford Institute of Technology |
| Pulsed-UV light inactivation of <i>Cryptosporidium</i> spp. oocysts in drinking water supplies in Ireland  | N. Rowan       | Athlone Institute of Technology   |
| Development of a modified seaweed biofiltration system for the control of metals and other pollutants in an industry waste stream  | E. Fitzgerald  | Waterford Institute of Technology |
| Informing the design of bioremediation protocols for polycyclic aromatic hydrocarbon contaminated soil   | E. Doyle       | University College Dublin         |
| New delivery agents for nanosized zero-valent iron: Fe/C nanocomposites for in situ reductive remediation of pollutants  | M. Colavita    | Trinity College Dublin            |
| Investigation of the toughness of recycled polymer-clay nanocomposites for plastics recycling  | Y. Chen        | Trinity College Dublin            |
| Novel bioaugmentation product for fats, oils and grease degradation  | B. Quilty      | Dublin City University            |
| An environmental analysis of biopharmaceutical manufacturing in recombinant <i>E. coli</i> , with a view to waste minimization of phosphorus and nitrogen content in waste streams generated | G. Walsh       | University of Limerick            |
| The beneficial effects of using composted material on golf course fairways   | A. Hunter      | University College Dublin         |
| Investigation of energy efficiency in polymer processing - internal recycling of energy  | G. O'Donnell   | Trinity College Dublin            |
| Electrochemical based sensor for the determination of nitrate and nitrite in drinking water  | E. Dempsey     | Institute of Technology Tallaght  |

| Title  | Investigator   | Lead Organisation  |
|--|----------------|--|
| LED-micro-photochemistry - a new resources-efficient synthesis tool  | M. Macka       | Dublin City University                                     |
| Comparison of two biofilm technologies at an small town research and demonstration wastewater treatment facility                           | E. O'Reilly    | NUI Galway   |
| An investigation of the applicability of terrestrial laser scanning technology in biodiversity assessment of a range of forest types       | J. O'Halloran  | University College Cork                                    |
| Application of wireless sensor technology in wastewater treatment plant environmental monitoring systems                                   | J. Treacy      | Limerick Institute of Technology                           |
| Development of novel photocatalytic adsorbents for organics removal from water and wastewater  | J. Tobin       | Dublin City University                                     |
| Satellite remote sensing as a tool for habitat mapping and subsidence measurement in raised bogs   | N. Dwyer       | University College Cork                                    |
| A comparison of biogas to CHP and transport fuel technologies for small to medium scale projects   | N. Power       | Cork Institute of Technology                               |
| Design and testing of novel flat sheet membrane technologies for pervaporation; applications in biofuel production                         | M. Morris      | University College Cork & Environmental Research Institute |
| The laboratory analysis of Irish municipal and agricultural biomass wastes and evaluation of their utilisation in biorefining technologies | M. Hayes       | University of Limerick                                     |
| Waste augmentation and integrated shipment tracking  | G. O'Hare      | University College Dublin                                  |
| Development of an integrated waste management life cycle analysis and carbon footprinting tool for the major waste streams in Ireland      | R. Curry       | SRI  |
| The development of a waste prevention design tool for architects and designers   | M. Kelly       | Galway-Mayo Institute of Technology                        |
| RE-Evaluate – reuse of EEE – evaluation and mainstreaming  | C. Fitzpatrick | University of Limerick                                     |
| Innovative process for recycling of LCD displays   | L. O'Donoghue  | University of Limerick.                                    |
| Compost in crop production – availability disease suppressive properties   | M. Gaffney     | Teagasc  |

## List of EPA CGPP - Cleaner Production Projects Funded since 2001

### CGPP Phase 1 Project Listings

| Title   | Sector                        | Lead Organisation                                      |
|---|-------------------------------|--|
| Cleaning up our act   | Printing                      | Alert Packaging Ltd                                    |
| Treatment of shellfish wastewater by membrane filtration and recovery of proteins, salt and upgrading through product development | Food                          | Atlanfish Ltd  |
| Value green construction scheme   | Construction                  | Building Contractor Training Network                   |
| Process for extracting edible crab meat from bodies and legs often considered waste   | Food                          | CBL Services Ltd                                       |
| Investigation and implementation of environmental benefits and energy efficiency  | IT / Electronics              | Connaught Electronics Ltd                              |
| Macroom - towards a sustainable industrial environmental economy "a pilot project"  | Service                       | Cork County Council                                    |
| Recovery of nickel and iron from a waste stream and evaluation of electrochemical methods for cleaner production                  | Metals                        | Envirotech Ltd   |
| Pilot plant feasibility/case study on recovery and reuse of spent cleaning solutions  | Food                          | FDT Consulting Engineers And Project Managers          |
| Energy reduction using monitoring and targeting system  | Food                          | Glanbia Meats  |
| Development of water-based inks for printing of bread and confectionary wrapping  | Printing                      | Irish Flexible Packaging / Manders Coatings & Inks Irl |
| Cleaner beet production   | Food                          | Irish Sugar Ltd  |
| A programme of improvements at Lakeland Dairies aimed at reducing potential emissions and conserving natural resources            | Food                          | Lakeland Dairies Co-operative Society Ltd              |
| Reduction of atmospheric and sewer emissions incorporating reuse and conversion to product  | Chemicals / Pharma / Plastics | Micro-Bio (Ireland) Ltd                                |
| Cleaner production: eco-label feasibility study for "own-brand" products  | Food                          | Musgrave Supervalu-Centra                              |
| The reduction of wastewater generation and haul-off through reuse within the plant  | Metals                        | NN Euroball Ireland Ltd                                |
| Clean technology options - Sligo General Hospital   | Service                       | North Western Health Board                             |
| Greening the university campus  | Service                       | NUI & St Patrick's College Maynooth                    |
| On site waste reduction   | Construction                  | Oran Precast Ltd                                       |
| In depth review/analysis of waste management in RTE Éireann   | Service                       | Radio Telefis  |
| Environmental action leading to increased profitability at Renvyle House Hotel  | Service                       | Renvyle House Hotel                                    |
| The drive for a greener future  | Service                       | Ring-a-Link  |
| Reduce emissions from the production of smoked fish   | Food                          | Seaborn Ltd  |
| Upgrading of existing surface treatment plant by the elimination of waste paint and solvent emissions                             | Metals                        | SIAC Butlers Steel Ltd                                 |

| Title   | Investigator                  | Lead Organisation                                   |
|---|-------------------------------|---|
| Oil recovery, upcycling of by-product, waste disposal reduction plan, reduction in corrugated cardboard usage | Food                          | Tayto Ltd   |
| Minimisation of energy usage and waste production in a contract manufacturing company                         | Chemicals / Pharma / Plastics | Tech Group Ireland                                  |
| The Furniture College Letterfrack - moving towards environmental excellence                                   | Service                       | The Furniture College (GMIT and Connemara West Ltd) |
| The reduction of solvent usage in tennis ball manufacture from 30% to negligible quantities                   | Other                         | Tretorn Sport Ltd                                   |
| Reduction at source of fugitive emissions incorporating flux chemical recycling and heat recovery             | Metals                        | Waterford Metal Industries Ltd                      |
| Production of ethanol (96%) EP and approval for use in Tinzaparin manufacture                                 | Chemicals / Pharma / Plastics | Wexport Ltd   |

### CGPP Phase 2 Project Listings

| Title  | Sector                        | Lead Organisation   |
|--|-------------------------------|---|
| Environmental review of seaweed meal production at Arramara Teoranta and exploration of alternative cleaner seaweed drying technologies                | Food                          | Arramara Teoranta   |
| Moving towards a more sustainable fish industry  | Food                          | Atlanfish   |
| Resource savings in operations through lean green principles   | IT / Electronics              | Connaught Electronics Ltd                                 |
| Spent caustic recovery plant   | Food                          | Diageo Great Northern Brewery                             |
| Zero effluent stretch target   | Chemicals / Pharma / Plastics | FMC BioPolymer  |
| Recovery of hydrochloric acid and ferric chloride from spent pickle acid   | Metals                        | Galco Steel Ltd   |
| The optimisation of electroplating activities  | Metals                        | Irish Finishing Technologies                              |
| Development of a CP programme for the Irish hotel industry   | Service                       | Irish Hotel and Catering Federation                       |
| B2B green mentor programme   | Service                       | Limerick / Clare / Kerry Regional Waste Management Office |
| Closed loop regeneration and recycling of copper etchant used in printed circuit board manufacture   | IT / Electronics              | Micam Ltd   |
| Towards sustainable production - closing water and solvent cycles  | Chemicals / Pharma / Plastics | Millipore Ireland Ltd                                     |
| Prototype development of guaranteed Irish zero waste personal computer project   | IT / Electronics              | MircoPro Computers Ltd (Multimedia Computer System Ltd)   |
| Investigate the feasibility of using methanol, currently being sent off site for incineration to be reused in the low temperature cooling loop on site | Chemicals / Pharma / Plastics | Pfizer Ireland Pharmaceuticals                            |

| Title  | Investigator                  | Lead Organisation         |
|--|-------------------------------|---------------------------|
| Clean line and fluorescent penetrant inspection resource conservation project  | IT / Electronics              | PWA International         |
| Redesign of Schiedel chimney systems to reduce packaging waste   | Construction                  | Schiedel Chimney Systems  |
| Energy efficient system for zero waste transport and zero rinse water emission   | IT / Electronics              | Ship Company Ltd          |
| Clean lean manufacturing programme   | Service                       | South East Lean Forum     |
| Closed loop system for cleaner production in recovery of metal values from electronic scrap in support of WEEE directive | Metals                        | Specialised Metal Ltd/IET |
| More efficient and profitable production by the elimination of imported packaging material - heat conversion programme   | Chemicals / Pharma / Plastics | Sturdy Products Limited   |
| Manufacture of solid socket shovels and spades using boron steel   | Metals                        | True Temper               |
| The use of recycled/reusable materials in the construction of environmental infrastructure in the midlands               | Service                       | Westmeath County Council  |
| Reduction in milk solids content in wastewater to effluent plant   | Food                          | Wexford Creamery Ltd      |

### CGPP Phase 3 Project Listings

| Title   | Sector                        | Lead Organisation |
|---|-------------------------------|-------------------|
| Extended life cycle of GPS tracking system  | IT / Electronics              | CELtrak           |
| A silicon single-chip humidity-temperature sensor   | IT / Electronics              | Cratlon           |
| Sustainable design, manufacture, use and recycling of plastic mussel floats   | Chemicals / Pharma / Plastics | JFC Manufacturing |
| Vapour compression distillation combining innovative components for highly energy efficient water purification and recovery                             | IT / Electronics              | Ship Company Ltd  |
| Establish a pallet exchange matching service for wanted and unwanted pallets and be a source for industry best practice in packaging for transportation | Other                         | SNS               |

### CGPP Phase 4 Project Listings

| Title   | Sector                        | Lead Organisation                                      |
|---|-------------------------------|--|
| Reduce & reuse at Tech Group Europe                                       | Chemicals / Pharma / Plastics | Tech Group Europe                                      |
| Project LYSIS   | Food                          | Rosderra Irish Meats Ltd                               |
| Low cost, battery-powered, CO <sub>2</sub> and toxic-gas detector system  | IT / Electronics              | ChipSensors Limited                                    |
| Iameco 2- low carbon, resource efficiency and long life in PC design      | IT / Electronics              | Multimedia Computer Systems Ltd t/a MicroPro Computers |
| Achieving a zero-landfill waste facility at Tool and Plastic Ltd          | Chemicals / Pharma / Plastics | Tool and Plastic Industries Ltd                        |
| Applying eco-design and world class manufacturing at Larkin's Engineering | Other                         | Larkin Engineering Limited                             |

| Title   | Investigator | Lead Organisation                          |
|---|--------------|--|
| Greening Green-Isle manufacture and delivery  | Food         | Green Isle Foods Limited                   |
| CIT's sustainable campus programme  | Service      | Cork Institute of Technology               |
| Targeting water, energy and packaging - three environmental improvement projects at Dawn Meats  | Food         | Dawn Meats                                 |
| Implementation of an environmentally efficient continuous flux treatment system   | Metals       | Galco Steel Ltd                            |
| Waste reduction programme focused on process technologies at Shannonside  | Food         | Connaught Gold Shannonside Facility        |
| Coreless block mould – the development of process technology to remove polystyrene core from the manufacturing process                    | Other        | Honeywell Turbo Technologies Ireland       |
| Recycling of process water with heat recovery   | Other        | Organic Lens Manufacturing (OLM) / Essidev |
| Super-sustainable: biodegradable/compostable product packaging and overall improvement in environmental performance across all Supermac's | Food         | Supermac's                                 |
| Cleaner greener cleaning services   | Service      | Noonan Services Group                      |

# An Ghníomhaireacht um Chaomhnú Comhshaoil

Is í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) comhlachta reachtúil a chosnaíonn an comhshaoil do mhuintir na tíre go léir. Rialaímid agus déanaimid maoirsiú ar ghníomhaíochtaí a d'fhéadfadh truailliú a chruthú murach sin. Cinntímid go bhfuil eolas cruinn ann ar threochtaí comhshaoil ionas go nglactar aon chéim is gá. Is iad na príomh-nithe a bhfuilimid gníomhach leo ná comhshaoil na hÉireann a chosaint agus cinntiú go bhfuil forbairt inbhuanaithe.

Is comhlacht poiblí neamhspleách í an Ghníomhaireacht um Chaomhnú Comhshaoil (EPA) a bunaíodh i mí Iúil 1993 faoin Acht fán nGníomhaireacht um Chaomhnú Comhshaoil 1992. Ó thaobh an Rialtais, is í an Roinn Comhshaoil agus Rialtais Áitiúil a dhéanann urraíocht uirthi.

## ÁR bhFREAGRACHTAÍ

### CEADÚNÚ

Bíonn ceadúnais á n-eisiúint againn i gcomhair na nithe seo a leanas chun a chinntiú nach mbíonn astuithe uathu ag cur sláinte an phobail ná an comhshaoil i mbaol:

- áiseanna dramhaíola (m.sh., líonadh talún, loisceoirí, stáisiúin aistriúcháin dramhaíola);
- gníomhaíochtaí tionsclaíocha ar scála mór (m.sh., déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta);
- diantalmhaíocht;
- úsáid faoi shrian agus scaoileadh smachtaithe Orgánach Géinathraithe (GMO);
- mór-áiseanna stórais peitreal.

### FEIDHMIÚ COMHSHAOIL NÁISIÚNTA

- Stiúradh os cionn 2,000 iniúchadh agus cigireacht de áiseanna a fuair ceadúnas ón nGníomhaireacht gach bliain.
- Maoirsiú freagrachtaí cosanta comhshaoil údarás áitiúla thar sé earnáil - aer, fuaim, dramhaíl, dramhúisce agus caighdeán uisce.
- Obair le húdaráis áitiúla agus leis na Gardaí chun stop a chur le gníomhaíocht mhídhleathach dramhaíola trí comhordú a dhéanamh ar líonra forfheidhmithe náisiúnta, díriú isteach ar chiontóirí, stiúradh fiosrúcháin agus maoirsiú leigheas na bhfadhbanna.
- An dlí a chur orthu siúd a bhriseann dlí comhshaoil agus a dhéanann dochar don chomhshaoil mar thoradh ar a ngníomhaíochtaí.

### MONATÓIREACHT, ANAILÍS AGUS TUAIRISCIÚ AR AN GCOMHSHAOIL

- Monatóireacht ar chaighdeán aer agus caighdeán aibhneacha, locha, uiscí taoide agus uiscí talaimh; leibhéal agus sruth aibhneacha a thomhas.
- Tuairisciú neamhspleách chun cabhrú le rialtais náisiúnta agus áitiúla cinntiú a dhéanamh.

### RIALÚ ASTUITHE GÁIS CEAPTHA TEASA NA HÉIREANN

- Cainníochtú astuithe gáis ceaptha teasa na hÉireann i gcomhthéacs ár dtiomantas Kyoto.
- Cur i bhfeidhm na Treorach um Thrádáil Astuithe, a bhfuil baint aige le hos cionn 100 cuideachta atá ina mór-ghineadóirí dé-ocsaíd charbóin in Éirinn.

### TAIGHDE AGUS FORBAIRT COMHSHAOIL

- Taighde ar shaincheisteanna comhshaoil a chomhordú (cosúil le caighdeán aer agus uisce, athrú aeráide, bithéagsúlacht, teicneolaíochtaí comhshaoil).

### MEASÚNÚ STRAITÉISEACH COMHSHAOIL

- Ag déanamh measúnú ar thionchar phleananna agus chláracha ar chomhshaoil na hÉireann (cosúil le phleananna bainistíochta dramhaíola agus forbartha).

### PLEANÁIL, OIDEACHAS AGUS TREOIR CHOMHSHAOIL

- Treoir a thabhairt don phobal agus do thionscal ar cheisteanna comhshaoil éagsúla (m.sh., iarratais ar cheadúnais, seachaint dramhaíola agus rialacháin chomhshaoil).
- Eolas níos fearr ar an gcomhshaoil a scaipeadh (trí cláracha teilifíse comhshaoil agus pacáistí acmhainne do bhunscoileanna agus do mheánscoileanna).

### BAINISTÍOCHT DRAMHAÍOLA FHORGHNÍOMHACH

- Cur chun cinn seachaint agus laghdú dramhaíola trí chomhordú An Chláir Náisiúnta um Chosc Dramhaíola, lena n-áirítear cur i bhfeidhm na dTionscnamh Freagrachta Táirgeoirí.
- Cur i bhfeidhm Rialachán ar nós na treoracha maidir le Trealamh Leictreach agus Leictreonach Caite agus le Srianadh Substaintí Guaiseacha agus substaintí a dhéanann ídiú ar an gcrios ózóin.
- Plean Náisiúnta Bainistíochta um Dramhaíl Ghuaiseach a fhorbairt chun dramhaíl ghuaiseach a sheachaint agus a bhainistiú.

### STRUCTÚR NA GNÍOMHAIREACHTA

Bunaíodh an Ghníomhaireacht i 1993 chun comhshaoil na hÉireann a chosaint. Tá an eagraíocht á bhainistiú ag Bord lánaimseartha, ar a bhfuil Príomhstíúrthóir agus ceithre Stíúrthóir.

Tá obair na Ghníomhaireachta ar siúl trí ceithre Oifig:

- An Oifig Aeráide, Ceadúnaithe agus Úsáide Acmhainní
- An Oifig um Fhorfheidhmiúchán Comhshaoil
- An Oifig um Measúnacht Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáide

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag ball air agus tagann siad le chéile cúpla uair in aghaidh na bliana le plé a dhéanamh ar cheisteanna ar ábhar imní iad agus le comhairle a thabhairt don Bhord.



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Comhshaoil, Oidhreacht agus Rialtas Áitiúil  
Environment, Heritage and Local Government