focus




Getting more from less

LIFE and sustainable production in the EU

EUROPEAN COMMISSION

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Environmental concerns, growing public pressure and regulatory measures are changing the way people do business. Increasingly, companies are required to demonstrate that when it comes to their environmental performance, not only can they "talk the talk", but more importantly, that their daily operations and investment strategies are rooted in sound principles of sustainable development. However, far from being seen as a burden, a growing number of businesses are embracing sustainable production as an opportunity to cut costs, exploit new markets and achieve competitive advantages. Sustainable production and consumption gives businesses the chance to transform environmental challenges into economic opportunities whilst also providing a better deal for consumers.

Despite these business and economic opportunities, unsustainable production methods and business activities continue to exert considerable pressure on the environment, thereby threatening long-term economic and social welfare. A key challenge, therefore, is to gradually change current unsustainable production and consumption patterns, such as by continuously improving environmental performance throughout the product life-cycle, encouraging more and more businesses to adopt innovative technologies and approaches and stimulating demand for more sustainable goods and production technologies.

The European Union is aware that sustainable production patterns, based on new innovations, are needed to address the considerable pressure that industrial processes and business activities place on the environment. With the adoption of the action plans on Sustainable Consumption and Production (SCP) and Sustainable Industrial Policy (SIP) in 2008, the EU put forward a package of measures on sustainable production and consumption that complements and integrates a vast range of existing policies at EU and national level.

The European Commission's LIFE (Financial Instrument for the Environment) programme has played an important role in demonstrating innovative approaches to sustainable production in European businesses and industries. To date more than 480 projects co-financed by LIFE have dealt with manufacturing industries and businesses, addressing a variety of sectors and environmental challenges. Support under LIFE is now also complemented by the new Competitiveness and Innovation Framework Programme (CIP), which aims to enhance the competitiveness of European enterprises, for example by promoting the market uptake of eco-innovative products and services.

Building on the recent LIFE Focus brochure, "Breathing LIFE into greener businesses", this latest publication presents a range of innovative approaches, developed within the framework of the LIFE programme, to promote sustainable production in Europe. This brochure presents 10 more exemplary LIFE projects targeting Europe's main industrial sectors and highlights the potential for Europe's businesses to take the lead in the shift towards more sustainable patterns of production and consumption. I hope this latest brochure will inspire and encourage other businesses to follow suit and grasp the opportunities presented by sustainable production to improve business and environmental performance.

Joaquim Capitão

Europe's roadmap to **sustainable production**

Ever-scarcer resources, expensive raw materials, and political, social and economic challenges are increasingly focusing international attention on the importance of sustainable production patterns.

All products cause environmental degradation, whether from their production, use or disposal. The way products are produced contributes to a vast range of environmental problems including natural resource depletion, global warming and pollution. A key challenge is to reduce the environmental footprint of production and consumption patterns by promoting the transition to a more energy and resource efficient economy. This requires profound changes in the way we produce and use goods, as well as in existing economic and social structures.

Despite challenges, the efficient use of resources is attractive not only because it reduces negative environmental impacts, but also because it can increase economic competitiveness. In addition to the significant cost savings and the positive marketing message, there is also a rapidly growing market for "green" products and services. In 2005, the global market for environmental industries was estimated at €1 000 billion and this is expected to grow to €2 200 billion by 2020.

EU LEGISLATION AND POLICY

The EU has sought ways to reduce the environmental impact of industrial activities and consumption patterns. In July 2008, it launched action plans on **sustainable consumption and production and on sustainable industrial policy**. These plans propose a dynamic framework to improve the energy and environmental performance of products and to help consumers make better choices.

Building on existing EU policies, the action plans specifically **propose to:**

- extend the ecodesign Directive to include not only energy-using products (such as computers, televisions, boilers, and industrial fans) but all energy-related products (such as adding products that do not consume energy during use but have an indirect impact on energy consumption);
- extend **voluntary labelling on energy** and environmental performance under the Energy Labelling Directive and the EU Ecolabel to include a wider range of products;
- promote voluntary measures to increase the potential benefits of Green Public Procurement by enhancing green spending by public authorities; and
- significantly revise the voluntary EU eco-management and audit scheme, EMAS, to increase user-friendliness, thereby making it more attractive to participating organisations.

EU FUNDING FOR SUSTAINABLE PRODUCTION

European Union efforts to drive progress towards more sustainable industrial practices include several funding programmes. In 2007 the European Union introduced **LIFE+**, which provides support for the development and demonstration of innovative green technologies and efforts to take environmental considerations into account in the workplace, especially in the public sector.

Private sector businesses now can also receive dedicated support for environmental improvements via an eco-innovation strand of the European Commission's **Competitiveness and Innovation Framework Programme (CIP)** (http://ec.europa.eu/cip/index_en.htm). The CIP channels its assistance towards commercial and private sector businesses and is especially focused on market-oriented activities, such as the market uptake and demonstration of some of the Europe's best eco-innovative products and services.

Sustainable production in industrial and business activities relies not only on legislative requirements, but also on positive

LIFE has played an important role in supporting sustainable production to businesses and industries across Europe

Photo: LIFE00 ENV/IT/000034

stimuli to encourage a rethinking of business and investment strategies. It takes a long time to recover the costs of large-scale investments geared towards making manufacturing sustainable. Besides a stable regulatory framework, companies need financial support to invest in resource and energy efficient and eco-friendly processes.

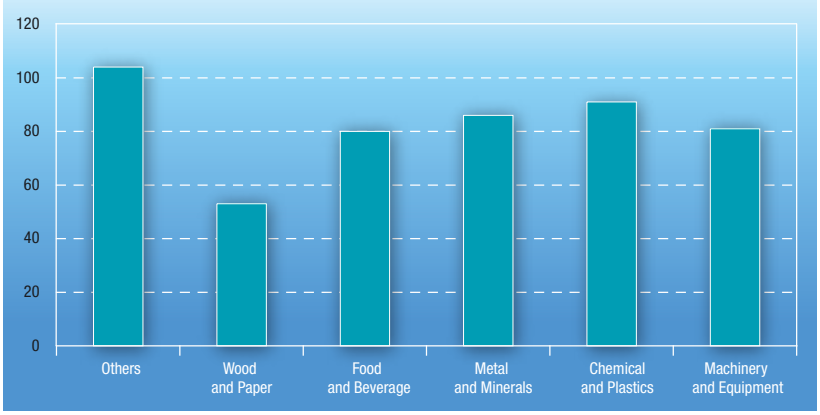
LIFE: A FAST TRACK TO SUSTAINABLE PRODUCTION

Since 1992, the EU's LIFE programme has played an important role in providing financial support to businesses and industries across Europe. Over the past 17 years, the LIFE programme has supported more than 480 projects related to sustainable production, roughly one-third of all LIFE Environment projects.

This LIFE Focus publication highlights the willingness of a wide range of industrial sectors to move towards cleaner production processes. Complementing the earlier publication, "Breathing LIFE into greener businesses", this brochure focuses on LIFE's contributions to promoting sustainable production in Europe's five main industrial sectors: machinery and equipment; chemicals and plastics; metal and non-metallic minerals; food and beverage; and wood, pulp, paper and printing industries.

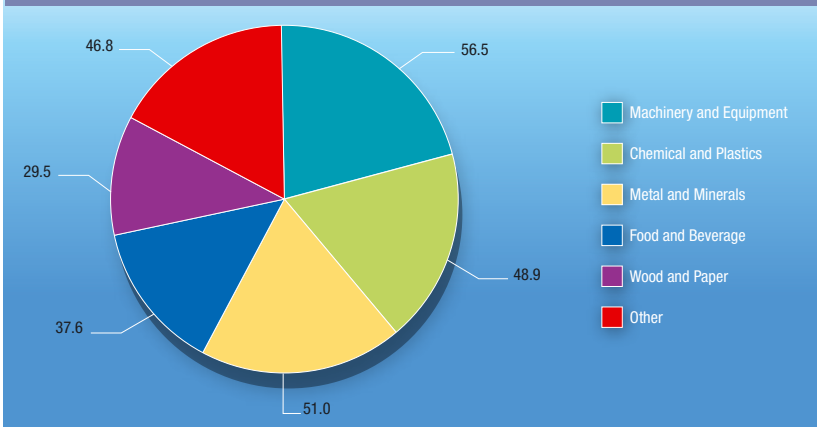
LIFE Environment has financed a variety of innovative approaches to sustainable production in these industrial sectors. As indicated in Figure 1, all five sectors have been represented by numerous LIFE Environment projects dealing with sustainable production, accounting for in total more than 390 projects. While all sectors have received substantial co-financing by LIFE the machinery and equipment, metal and minerals, and chemical and plastics indutries have been most heavily funded, accounting for almost 58% of total LIFE environmental funding in sustainable production, followed by funding in the food and beverage and wood and paper sectors that represents 25% of funding (other sectors – such as clothing and leather industries that are not covered by this brochure – account for the remaining 17% of funding). In total the LIFE environment programme has since 1992 spent an estimated €270 million to co-finance initiatives dealing with sustainable production (see Figure 2).

Figure 1: **Number of LIFE Environment projects dealing with sustainable production by sector**



Since 1992, LIFE Environment has funded more than 390 projects dealing with sustainable production in Europe's five main industrial sectors

Figure 2: **LIFE Environment funding support to sustainable production by sector (in millions of Euros)**



Over the past 17 years the LIFE Environment programme has provided some 270 million to co-finance projects addressing sustainable production in Europe's key industrial sectors

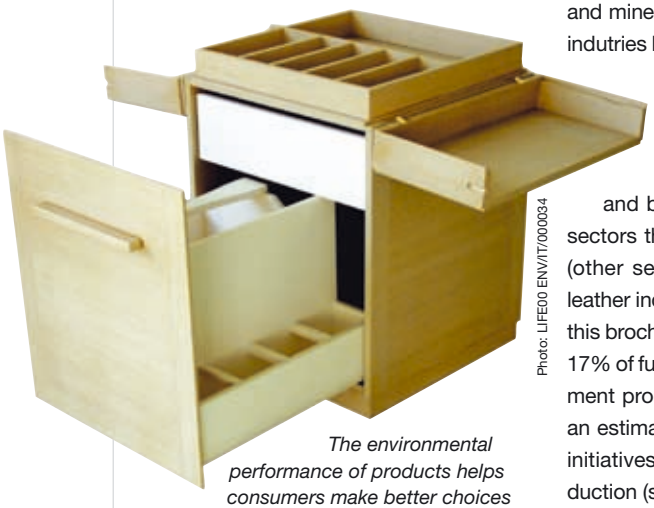


Photo: LIFE00 ENV/IT/000034

The environmental performance of products helps consumers make better choices

The following chapters focus in more detail on the achievements of the LIFE Environment programme in each of Europe's five main industrial sectors. Each chapter includes two case studies illustrating how LIFE has played a role in the implementation of sustainable production practices. These projects clearly underline the potential of the LIFE programme to foster environmentally and economically beneficial results at the same time. For a list of other interesting projects on sustainable production see pages 35-36 of this publication, as well as the LIFE website's project database at: http://ec.europa.eu/life.

MACHINERY & EQUIPMENT MANUFACTURING: AEROSPACE & ELECTRIC INDUSTRY

Sustainable manufacturing of machines and equipment

LIFE projects have helped address the environmental challenges facing Europe's large and diverse manufacturing sector.

European firms produce a vast range of machinery and equipment. Goods are manufactured for domestic use, for example refrigerators or home computers, or for business and industry, such as office equipment or heavy machinery that is in turn used to manufacture other goods. EU manufacturers are world leaders in complex, high-technology machine systems, such as cars and aircraft. Production of large civil aircraft alone generates €20 billion annually for the EU, though even this is dwarfed by Europe's automotive industries, which generated €80 billion in export earnings in 2007. The importance of such goods is shown by their sales figures: every year, 13.5 million washing machines, 15 million personal computers, and 26 million televisions are sold in Europe.

ENVIRONMENTAL CHALLENGES

The life cycles of these goods, however, are associated with numerous environmental problems. The production stage may be energy inefficient, and can involve excessive water use, generation of greenhouse gases, and use of hazardous materials. Machinery and electrical and electronic goods continue to consume energy after production, not always efficiently.

Ultimately, waste electrical and electronic equipment (WEEE), and other machine systems, also must be safely disposed of. The waste challenge is illustrated by figures showing that Germany produces 750 000 tonnes/yr of WEEE, or 8 kg per citizen. This waste can include hazardous and toxic materials, such as lead, mercury and polycholorinated biphenyls (PCBs).

Waste streams can damage the climate. Refrigerators, for example, use hydrofluorocarbons (HFCs), greenhouse gases that trap 9 000 to 10 000 times more heat than carbon dioxide. HFCs, and other man-made greenhouse gases, such as perfluorocarbons (PFCs) and sulphur hexafluoride (SF6), are more powerful than many of the naturally occurring greenhouse gases since they last longer in the atmosphere and can trap more heat per molecule.

LIFE INNOVATIONS

Many LIFE projects have taken up the challenges of reducing energy use and cutting down on waste from the production and use of machinery and equipment. Projects have sought to use technological approaches that address the entire product life cycle from design and assembly, to repair, reuse and recycling. Many LIFE projects have shown that process improvements can be both environmentally-beneficial and money-saving, especially if energy and water consumption are reduced, or waste volumes (and thus disposal costs) are cut.

A number of innovative approaches to reducing waste have been demonstrated by LIFE projects. The LIFE GAP project (**LIFE05 ENV/F/000062**) demonstrated how manufacturing processes could be modified to minimise not just waste but also energy and water use. The beneficiary, Dufieux, a company based near Grenoble, France, replaced current chemical processes used to manufacture complex panels for the aerospace industry with an eco-friendly mechanical process. The modification not only

Photo: LIFE00 ENV/IRL/000764

MACHINERY & EQUIPMENT MANUFACTURING: AEROSPACE & ELECTRIC INDUSTRY

significantly cut waste volumes and water use by respectively 16 000 tonnes and 225 000 m^3, and reduced energy consumption by 57%, it also succeeded in cutting costs by as much as half.

Hazardous waste from finished products can be reduced if hazardous materials are not used during production. The AMELIE project **(LIFE05 ENV/F/000053)** showed that electronic boards could be made on a lead-free assembly line, effectively eliminating at source this hazardous substance from the waste stream.

Reuse and recycling are important goals for many industries. The LIFE project RESOLVED **(LIFE04 ENV/DE/000047)** demonstrated that the materials used in thin film photovoltaic panels could be recycled back into the industry, thus preserving scarce natural resources. Another German project, TRAFODECON **(LIFE04 ENV/DE/000041)**, was able to decontaminate, recondition and reuse transformers containing PCBs, more than halving the replacement cost of transformers.

Environmental management and correct implementation of legislation is also targeted at reducing waste. The ACADEMY project **(LIFE04 ENV/FR/000353)** piloted integration of environmental management in aircraft manufacturing, while the 'Sustainable Management of E-waste in Greece' project **(LIFE00 ENV/GR/000688)** focused on local and regional policies for dealing with WEEE, as a complement to Greece's implementation of the EU's WEEE Directive (2002/95/EC).

LIFE projects are an important source of knowledge on improving energy efficiency and reducing emissions. Lower energy consumption not only reduces pressure on natural resources, but also lowers the carbon-intensity of production.
A number of LIFE projects have targeted refrigeration, both to improve energy efficiency through design and production, and to remove HFCs from manufacturing processes.

The PROCOOL project **(LIFE03 ENV/A/000002)**, for example, promoted an award scheme rewarding energy-efficient and HFC-free cooling appliances. The best products achieved energy savings of more than 50%. The Danish CO2REF project **(LIFE05 ENV/DK/000156)** showed that carbon dioxide could replace harmful HFCs as a refrigerant. The NOTRE project (**LIFE005 ENV/IT/000876**) used air drying technology in refrigerators to reduce ice formation, which has been associated with energy loss from traditional fridges. For cold stores, the HEIGHT project **(LIFE05 ENV/NL/000020)** is demonstrating that better design of refrigerated areas, including improved air distribution, can cut greenhouse gas emissions.

Correctly implemented policies can also foster energy efficiency and help tackle global warming. The ETRES project **(LIFE03 ENV/GR/000219)** assessed the integration of emissions trading and alternative renewable energy support mechanisms in Greece's electricity sector, as the basis for a more climate-friendly strategy for the country's power producers.

This chapter includes two case studies showing how LIFE has promoted sustainable production in the aerospace and electric industries.

The sustainable management of used electronic equipment has been a focus of various LIFE projects

PAMELA: finding **a new use for old aircraft**

With the support of LIFE, Airbus in Toulouse has developed a system for recycling materials from aircraft at the end-of-life. This has proved so successful that the aviation giant is now investing in a new business to park and dismantle planes reaching the end of service.

She came from Toulouse in the south of France but became a globetrotter, heading first to Brazil, and then to Japan. This was followed by a spell in Turkey and extensive travels in the Middle East, including the Hadj pilgrimage to Mecca in Saudi Arabia. Finally, at the end of an international career lasting 24 years, she returned home, retiring to Tarbes, at the foot of the Pyrenees, two hours from Toulouse.

'She' was a 266-seat Airbus A300B4-200, one of 46 A300 aircraft delivered in 1982, the peak year for A300 deliveries. On her retirement, she performed one more service to the aviation industry: she was the first aircraft to be dismantled and recycled by a unique LIFE Environment project known as PAMELA (Process for Advanced Management of End of Life of Aircraft).

PAMELA, which ran from 2005-2007, investigated what could be done with end-of-life aircraft. Planes have a useful working life of 20-30 years, during which time they may go through several changes of ownership. As they reach the end of their careers, owners might decide to sell them on one last time, often to developing countries. Alternatively, depending on issues such as current demand for air travel and fuel costs, aircraft might be parked up. They may be used for spare parts, or temporarily brought back into service if demand increases or fuel prices drop. Ultimately, old aircraft may simply be dumped. Deserts, such as the Mojave in the United States, are popular for this, as their dry air minimises corrosion.

Some end-of-life aircraft are broken up, and waste material is re-used. But this is normally a haphazard scrap metal opera-

Photo: Stephen Gardner

The PAMELA project demonstrated that the environmental impact of aircraft dismantling can be reduced

tion, says Olivier Malavallon of the Airbus environmental affairs department, and manager of the PAMELA project. Malavallon estimates that current breaking operations result in some 45% of the weight of an aircraft going to landfill. He adds that aircraft scrapping may also be a poorly-controlled process, with insufficient attention paid to the handling of potentially hazardous wastes, and second hand parts re-entering the supply chain, sometimes without proper monitoring.

PAMELA's objective was to demonstrate that an aircraft's final days need not follow this pattern. The project set out to show that the components and materials that make up an aircraft could mostly be reused or recycled, or if not, at least processed into useful material and resold as secondary raw material. "An aircraft is not a unique form of waste material. What is important is what you do with the material and most of all how you treat it," says Malavallon. "This means that we aim to use as much as possible the existing regulatory recovery channel promoted by the EU."

RAISING STANDARDS

Although aeroplanes are made of materials that can be recycled or reused in a number of ways, there are currently no standard procedures for end-of-life aircraft. Malavallon emphasises that all other stages in an aircraft's life are subject to an ever-more rigorous framework of standards and good practices, including environmental standards. These apply to aircraft design, manufacture and use. However, before PAMELA, a serious investigation into waste management standards for end-of-life aircraft had not been attempted.

The timing of PAMELA was also important. At present, according to Airbus figures, 14 500 aircraft with 100 seats or more are in service worldwide. Around 6 000 of these can be expected to be removed from service over the next 20 years, with peaks expected in 2011/12 and from 2017-19. Airbus says that aircraft by weight make up a relatively small proportion of the end-of-life transport stream. Tens of aircraft are scrapped each year, compared to millions of private cars, for example. Nevertheless, a more environmentally-sensitive approach for aircraft will reduce risks such as soil contamination from abandoned planes, or unnecessary landfilling of scrap materials.

Malavallon says that PAMELA took as its benchmark the European Union's End-of-Life Vehicles Directive (2002/53/EC), which states that "for all end-of life vehicles, the reuse and recovery shall be increased to a minimum of 85% by an average weight per vehicle and year." A similar target can be adopted for aircraft, Malavallon argues.

A SYSTEMATIC APPROACH

PAMELA followed a systematic approach, dividing the aircraft end-of-life process into three stages: decommissioning (D1), disassembling (D2), and smart and selective dismantling (D3).

The first stage, D1, involved the cleaning and decontaminating of the aircraft, with the removal of hazardous substances, and flammable or explosive materials. During this stage – which, Malavallon says, generally does not happen in current aircraft scrapping operations – the plane was also thoroughly assessed, with parts listed, and equipment identified as being salvageable or not. At the end of the D1 phase, PAMELA had reduced the weight of the demonstration aircraft by 17%, largely because of the removal of liquids such as fuel and water.

During the D2 stage, PAMELA removed the reusable parts from the A300B4-200, and was able to put them back into the supply chain with appropriate certification to enable tracking. The parts removed included two engines, three landing gears, and a host of other components: the weight of the demonstration aircraft dropped by another 13% during this stage.

In principle, after D1 and D2, an aircraft could still be put back into service. But a decision to move to the third stage, D3, is irrevocable, as at this point the aircraft officially becomes waste. By the beginning of the D3 stage, the PAMELA project aircraft weighed 74 500 kg, compared with 106 000 kg prior to D1.

Although PAMELA applied a more systematic and thorough approach to D1 and D2 than has been employed before, it was during the D3 stage that the project really came into its own. The project systematically dismantled the aircraft shell, testing a variety of cutting techniques in the process (a diamond saw was found to be most efficient). By volume, aluminium made up the largest portion of the waste. Other recovered materials were titanium alloys, steel, copper, plastics, foams and textiles.

PAMELA carefully sorted these waste streams, even separating the aluminium into alloys of different types. This was a particular success of the project: the aluminium was sent for "re-fusion", and the process selected by PAMELA generated aluminium of a high enough quality for reuse in aerospace manufacturing. This was a "breakthrough," Malavallon says. Previously it was not thought that aluminium extracted from old aircraft could be used for this purpose.

In total, during the D3 stage, PAMELA extracted 61 000 kg of reusable material from the retired A300B4-200, meaning that, in total, only 13% of the original weight of the aircraft had to be classified as non-recoverable waste and sent to landfill.

POST-PAMELA DEVELOPMENTS

PAMELA was successful in demonstrating that the environmental impact of aircraft dismantling can be significantly reduced; that the weight of waste sent to landfill can be reduced from around 45% of an aircraft to 15% or less; and that recycling and reuse processes can be carried out to high environmental standards. But the project has also had a concrete commercial result.

Photo: Stephen Gardner

The PAMELA project developed waste management standards for end-of-life aircraft

Based on the results of PAMELA, in 2007 Airbus, along with other investors, decided to set up TARMAC (Tarbes Advanced Recycling & Maintenance Aircraft Company). TARMAC will provide parking and dismantling services for some of the 6 000 aircraft that will retire during the next 15 to 20 years.

TARMAC is based at a state-of-the-art site alongside Tarbes airport in the south of France, with space to host 20 large passenger aircraft. TARMAC general manager Philippe Fournadet says that in the beginning, 70% of planes coming to Tarbes will be kept at D1 or D2 stage and may fly again, with the remaining 30% to be dismantled according to the PAMELA guidelines. However, by 2018 as more aircraft reach the end of their lives, these proportions will be reversed.

TARMAC has already started work on dismantling aircraft, and has made agreements to receive a number of planes. The site has a permit under French legislation relating to industrial pollution prevention and control (IPPC) covering 18 industrial activities, meaning it operates to environmental standards far superior to scrap metal operations where aircraft are usually broken up.

Airbus's Olivier Malavallon sees the TARMAC site at Tarbes as the first in a network, all of which will apply the lessons learned from PAMELA. He says that Tarbes can be a "centre of reference" that will continue to improve the environmental performance of aircraft end-of-life processes, and that will promote its standards worldwide.

The innovative decontamination phase aims to remove all hazardous substances and flammable or explosive materials from the aircraft

FRANCE

Project number: LIFE05 ENV/F/000059

Title: Process for Advanced Management of End of Life of Aircraft

Beneficiary: Airbus

Total budget: €3 243 000

LIFE contribution: €1 160 000

Period: Mar-2005 to Nov-2007

Website: http://www.pamelalife.com

Contact: Olivier Malavallon

Email: olivier.malavallon@airbus.com

LEADFREE: Building **sustainable production capacities** in electronic companies

A popular and successful industry-led initiative in Germany has used LIFE funds to raise awareness about lead-free manufacturing techniques for electronic components.

For decades Europe's electronic industry had used tin-lead alloys as a main solder element in its many millions of different products. This manufacturing practice changed in 2006 following the introduction of new legal requirements set out in the Directive 2002/96/EC, on "Waste of Electrical and Electronic Equipment (WEEE)" and the Directive 2002/95, "Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)". These Directives established new and higher standards regarding the use of lead, cadmium, mercury and other potentially toxic elements in electrical and electronic equipment.

The introduction of these new European standards encouraged manufacturers of electronic components to seek more sustainable production processes and a German LIFE project has been successful in helping to facilitate this shift to more environmentally-friendly production methods.

LEAD-FREE LIFE

LIFE's LEADFREE project was led by the Fraunhofer Institute of Silicon Technology (ISIT), from Itzehoe in northern Germany, which specialises in the development and manufacturing of technology for microelectronics and microsystems. Staff at the Institute recognised the need to raise awareness about the alternatives to tin-lead soldering and also the importance of building know-how within electronics companies to compete in this new greener operating environment that had been created by the EU Directives.

A three-year LIFE project was developed to address the technology and awareness gap and support was made available to establish a dedicated training centre for electronics manufacturing SMEs. A range of different training programmes were then designed and delivered to companies from across the EU.

The training programmes were based on a demonstration production line that covered the whole life cycle for industrial scale soldering of components on printed circuit boards. This was considered as good practice in terms of Integrated Production Policy (IPP), and the production line was equipped with innovative technologies capable of demonstrating LEADFREE soldering for electronic assemblies 50-300 mm wide and up to 400 mm long.

INDUSTRY TRAINING

Some 750 trainees from 400 different companies and 12 Member States have completed LEADFREE training courses in a variety of topics associated with soldering and quality analysis. A total of 43 seminars have now successfully built sustainable production cognition in techniques such as: selection, handling and evaluation of components and laminates; paste printing; component placement; and automated optical inspection (AOI). Additional courses have been delivered on design and logistics measures linked with life cycle analysis (LCA) and the EU Eco-Management and Audit Scheme (EMAS).

The training was particularly popular with businesses that produce electronics, as well as Original Equipment Manufacturers (OEMs) and contract manufacturers. Other clients included companies from plant engineering sectors with in-house production, prototypes or other trials. Clients had the option of bringing their own products and designs and testing them on the LEADFREE demonstration line before investing in new lead-free soldering equipment "at home".

Trainers from the Fraunhofer Institute are pleased with the strong level of industry support that their LIFE project has received and they attribute this to its relevance in demonstrating viable sustainable production techniques.

Training sessions took place to raise awareness about lead-free manufacturing techniques for electrical components

GERMANY

Project Number: LIFE05 ENV/D/000197

Title: Demonstration and Training Lead-Free Soldering for European Industry in Order to Promote Environment-Friendly Electronic Production

Beneficiary: Fraunhofer Institut für Siliziumtechnologie

Total Budget: €4 249 000

LIFE Contribution: €1 662 000

Period: Apr-2005 to Apr-2008

Website: www.life-leadfree.de

Contact: Dr. Thomas Ahrens

Email: thomas.ahrens@isit.fraunhofer.de

CHEMICALS & PLASTIC MANUFACTURING

LIFE addressing environmental concerns

The chemicals, plastic and rubber sectors are central to the European Union's economy, with 60 000 firms and 3.2 million people working across these industries. The LIFE programme is helping these traditionally polluting sectors to address the need to develop sustainable production methods.

The chemical industry in particular is crucially important. The EU as a region is responsible for 16% of world chemical sales, double the share of USA, and four times greater than the share of Japan. Of the world's top 30 chemicals firms, 14 are European, including the world's largest, BASF, headquartered in Ludwigshafen, Germany.

ENVIRONMENTAL CHALLENGES

Chemical and plastic manufacturing are clearly vital to Europe, but the development and expansion of these sectors has had a cost in terms of substantial environmental degradation. Hazardous chemicals have polluted the air, soil and water, and pose risks to human health. Industrial chemicals, including organic compounds such as polychlorinated biphenyls (PCBs), pesticides, solvents, and heavy metals (e.g., mercury), have been linked to diseases such as cancer and diabetes and to reduced fertility. Such chemicals have been found in the food chain, not only in processed foods, but also, for example, in fish or vegetables that have just been caught or harvested.

As well as the risks related to manufactured chemicals entering natural ecosystems or human bodies, the chemical industry affects the environment in other ways. Chemical processes are invariably associated with the extraction and use of natural resources such as fossil fuels and metals, the consumption of high levels of energy, and the production of greenhouse gas emissions. The chemicals sector also generates waste, such as chemical sludge and other toxic by-products.

Environmental concerns also relate to what happens to the products of the chemical and plastic industries once they have been used and are discarded. Europe produces more than 21 million tonnes/yr of post-consumer plastic waste, of which only 16.5% is recycled. Promoting reuse and recycling of the products and by-products of plastics and chemicals manufacturing is a key challenge for the industry.

The industry is, however, increasingly aware of its environmental impact, and is taking steps to meet the challenges it faces. The chemical sector in Europe is already heavily regulated, and this has been further strengthened with the introduction of the new REACH (Registration, Authorization, and Evaluation of Chemicals) Regulation, which entered into force on 01 June 2007. REACH, the most extensive legislation of its type in the world, requires chemical firms for the first time to carry out a thorough

CHEMICALS & PLASTIC MANUFACTURING

examination of their inventories, with a view to assembling data and understanding the intrinsic properties of tens of thousands of substances. The most dangerous chemicals will be phased out and replaced with safer alternatives.

LIFE INNOVATIONS

The LIFE programme demonstrates new approaches to improving environmental performance and meeting regulatory requirements, through a series of innovative projects dealing with issues such as reducing emissions of pollutants into air, soil or water; waste reduction, reuse and recycling; management of hazardous waste; and energy efficiency. LIFE projects that have addressed environmental challenges associated with the chemical and plastics industries are highlighted below.

The LIFE programme demonstrates new approaches to improving environmental performance and meeting regulatory requirements

Photo: LIFE06 ENV/IT/000241

Pollutant and waste reduction projects have been targeted at managing hazardous effluents and emissions. The FORMOSE project (**LIFE05 ENV/UK/000126**), for example, used a chemical reaction that breaks formaldehyde into harmless sugars to reduce the toxicity of wastewater from a chemical plant in Newport, UK. The Spanish PERCUS project (**LIFE02 ENV/E/000237**), developed a method of separating copper and hydrochloride solution from a toxic by-product produced during the manufacture of printed circuit-boards. In this way, the need for treatment of this hazardous waste was completely eliminated.

Through the introduction of a filtration method the on-going LIFE project PVClean (**LIFE06 ENV/D/000470**) seeks to reduce water contamination and freshwater use in suspension-polymerisation polyvinyl chloride (S-PVC) production. Current "suspension techniques" that produce S-PVC result in substantial contamination of water with a high amount of PVC residual (50-300g/m^3); such highly contaminated water cannot be re-used in the production process. PVClean's innovative filtration method is expected to result in a significant reduction of unused PVC and freshwater use by separating at least 80% PVC and recycling of up to 40% of the process water in turn.

LIFE assistance also represents a cluster of expertise in waste reduction. Plastic waste recycling was, for example, the goal of the RECIPLAS project (**LIFE03 ENV/E/000106**), carried out in Zaragoza, Spain. This project piloted a new process that allowed auto-industry plastic waste to be reformed into durable, reusable pallets for the transportation of goods. The project beneficiary, specialist automotive manufacturer Ribawood, estimated that the pallet production facility it put in place would mean that 38 000 fewer trees annually would have to be cut down to produce wooden pallets. Another Spanish project, GENPLAST (**LIFE03 ENV/E/000076**), set out to reduce plastic waste from the agricultural sector by constructing a pilot plant that recycled material such as plastic sheeting and irrigation pipes into new agricultural products. The plant reduced volumes of landfilled plastic waste by 7 000 tonnes/yr, though there is still a long way to go: in Spain alone around 200 000 tonnes of plastic raw material is used annually for agricultural tools and equipment.

Manufacturing processes that combine waste reduction with greater energy- and cost-efficiency are urgently needed in all industrial sectors, including the chemical and plastics industries. LIFE has contributed towards the use of cleaner and more energy efficient technologies, as demonstrated by the Swedish ART project (**LIFE05 ENV/SE/000401**). This pilot project applied a new technology to chemical reactions such as synthesis. Trials show reductions in toxic by-products of up to 95%, and energy savings of as much as 70%, thus potentially offering a considerable reduction in operating costs.

In the following pages, two detailed case studies of LIFE projects are presented that demonstrate the wide variety of innovative ways of addressing environmental challenges linked to the manufacturing of chemicals and plastics.

The Swedish Eurocrate LIFE project led to the establishment of a reusable packaging system for food and other goods, bringing about energy savings and reductions in waste volumes.

Eurocrate: Crate expectations

Wooden packaging, such as boxes, crates and pallets, plays a fundamental role in the transportation of goods around Europe, but at the same time extracts a heavy environmental price. Each year, 280 million wooden pallets are loaded with eight billion crates of merchandise, which is moved across the continent. In principle, this packaging is recyclable, repairable and reusable. But in practice, much wooden packaging ends up as landfill, or is incinerated. The environmental impact is thus felt at both ends of the pallet lifecycle – consumption of natural materials to make them in the first place, and production of large waste volumes.

Two Swedish organisations launched an initiative to reduce the environmental impact of wooden packaging in the mid-1990s. The Grocery Manufacturers of Sweden (Dagligvaruleverantörers Förbund – DLF) and the Swedish Food and Drink Retailers' Federation (Svensk Dagligvaruhandel – SDH) joined forces and formed Svenska Retursystem AB, a joint venture to put in place a scheme to replace wooden packaging with 'reusable transportation items' (RTIs), or pallets and crates made from polythene and polypropylene. A primary objective was to make food distribution much less wasteful and in this way to contribute to the objectives of EU's Packaging & Packaging Waste Directive (94/62/EC).

But the RTI system created its own problems. The plastic pallets and crates have to be collected, washed and repaired, and by their nature are less environmentally-friendly than wood if they do get into the waste stream. To generate real environmental benefits, such as reduction in transportation distances and energy consumption, a well-organised RTI exchange system involving the whole supply chain was needed.

EFFICIENT EXCHANGE

Consequently, in 2001, Svenska Retursystem AB started a two-year LIFE Environment project to set up a full-scale demonstration of the RTI exchange system. The trial ran in two areas of Sweden: Skåne, Sweden's southern-most county, and in the region around Stockholm. In each region, a washing plant for returned crates and pallets was established. The plants were built at Helsingborg on Sweden's western coast, just four kilometres from Denmark, and at Örebro, to the west of Stockholm.

Svenska Retursystem provides its customers with five types of crate designed to be stacked on 800x600 mm or 1200x800 mm black polythene pallets. These have a 15-year lifespan, and are tagged with radio-frequency identification (RFID) tags so that they can be tracked as they move through the exchange system. They are resistant to moisture and cold, and do not pick up odours from the goods they transport.

The EUROCRATE project cut down on waste production and increased energy savings by creating a reusable packaging system

Svenska Retursystem delivers the reusable pallets and crates from the washing plant to the customer

The Eurocrate exchange system is a circular one. The pallets and crates remain the property of Svenska Retursystem, and customers, such as food producers, order them online. Svenska Retursystem delivers the required number of pallets and crates from the washing plant to the customer, who pays a small usage fee, and a deposit for the period that the pallets are under the customer's control. This provides an incentive to ensure that all pallets and crates are ultimately returned to the washing plant, at which point the deposit is credited back to the customer.

The producer uses the crates and pallets to package goods, and sends them onto the wholesaler, who in turn uses them for deliveries to retailers. The job of collecting the pallets and returning them to the washing plant falls to the wholesaler. As soon as the pallets are back at the washing plant, they are ready to start another journey, once an online order from a producer has been received.

BENEFITS OF REUSABILITY

The Eurocrate project showed that the RTI exchange system has a number of advantages over the use of traditional wooden packaging. Importantly, the scheme has proved cost effective. The RTIs are durable and need little repair; producers and wholesalers do not have to buy their own pallets; the system is run on a non-profit basis; and use of standardised pallet and crate sizes has made life easier throughout the supply chain. The cost effectiveness of the scheme is a major factor in encouraging firms to join the exchange system.

In environmental terms, one of the main benefits is simply that fewer pallets are needed. The RTIs circulate efficiently through the system and are reused constantly. Once pallets are worn out, they are ground down, and the recovered material is used to make new RTIs.

A further benefit is that delivery trucks make fewer journeys while empty, because they are either delivering pallets full of goods to retailers, or are returning empty RTIs to wholesale depots.

RTIs also cut down the amount of packaging needed because far fewer cardboard boxes are required for transporting goods. During the two-year project period, use of the crates and pallets rather than boxes reduced waste volumes by 12 000 tonnes compared with business-as-usual.

Svenska Retursystem calculates the energy consumption per crate per journey through the exchange system, including washing, as 0.2 kilowatt hours (KWh) relative to a system that sends cardboard boxes in one direction and does not collect or re-use them.

The efficient system established during the Eurocrate project was clearly transferable beyond Swedish borders, and indeed, soon after the close of the project, Svenska Retursystem began exporting its RTIs to other European markets.

The design of the system is such that its efficiency improves in more densely populated areas. The pan-European environmental pay-off could be considerable, as could the reduction in distribution costs for goods: some €700 million could be saved annually if the system was to be replicated across the continent.

Actual environmental benefits are difficult to measure, but the beneficiary estimates that if 1.7 million crates were in the system it would reduce packaging waste by 28 000 tonnes/yr; reduce lorry transports by 260 000 km/yr (equal to 180 tonnes of carbon dioxide); energy consumption by 52 million KWh/yr; the volume of damaged goods by at least 20%; and transportation costs by 25%.

Since the project finished, the beneficiary has actively expanded the system in Sweden and beyond, so that as of 2008 some 10 million crates were in the system. Although no detailed study has been carried out, the environmental benefits are therefore likely to be higher.

SWEDEN

Project Number: LIFE00 ENV/S/000867

Title: Integrated reusable plastic crates and pallets, eliminating package waste, for sustainable distribution of everyday commodities in Europe

Beneficiary: Svenska Retursystem AB

Total Budget: €7 821 000

LIFE Contribution: €1 843 000

Period: Jan-2001 to Dec-2002

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Cognis: **Solvent solutions**

The "Environmental sustainability through solvent and energy recovery techniques" project, which took place at the Cognis chemical plant in County Cork, Ireland, introduced a new process for recycling a reagent, leading to significant environmental improvements and cost savings.

Toluene is a solvent, originally isolated from tolu balsam, an aromatic extract from a tropical tree. The substance is used by a multinational chemical company, Cognis, in the production of reagents that are used for extracting from their ores non-ferrous metals at very high purity levels. This final extraction process offers a number of environmental benefits compared with traditional, energy-intensive, smelting of ores.

But the process involved in the production of the reagents themselves presented its own environmental problems. At its plant in County Cork, Ireland, Cognis was using 16 000 tonnes of toluene annually as a reaction solvent, but recovery of the toluene for re-use proved difficult because, during the production process, methanol and methyl formate were generated as impurities and remained in the toluene. There was a way around this: the toluene could be washed at high temperatures, thus rendering it fit for re-use. But the cleaning process generated large volumes of biological sludge. In 1999, for example, Cognis sent 2 331 tonnes of this to landfill.

Cognis thus launched a LIFE project, entitled "Environmental sustainability through solvent and energy recovery techniques". The aim of the project was to substantially reduce the waste generated by the reagent production process. This would be done by using evaporation technologies, rather than washing, to 'clean' the toluene.

PURIFICATION THROUGH EVAPORATION

LIFE supported Cognis in constructing a new distillation column into which used toluene could be pumped. Within the column, evaporation was used to separate the waste elements from the toluene, rendering it re-usable. The evaporated impurities from the toluene could then be converted back into a liquid with a fuel value similar to gasoline. This liquid was injected into a combined heat and power (CHP) system, and burned as fuel to heat water and generate steam. The steam was used to provide heat energy to various parts of the Cognis plant, thus completing a virtuous circle in which waste material was converted into energy.

This final part of the process was unique to the LIFE project. Use of evaporation techniques to distil solvents was already proven, but use of the resulting distillate to meet the production site's energy needs was an innovative step.

CLEANER AIR, LESS WASTEWATER

The project led to significant environmental benefits. Previously, the cleaning of toluene had used large quantities of water, had generated odours and reduced the air quality in site buildings where the

LIFE supported the Cognis project in developing a process for solvent and energy recovery

processing took place. It was also energy-intensive as water heated to 45-50°C had been required for the cleaning process.

With the new process, water usage was reduced from nearly 30 m^3/tonne of product in 1999 before the project's start, to 24.3 m^3/tonne in 2002 – a reduction of 19%. Energy use per tonne of product was also reduced over the same period from 0.78 MW to 0.75 MW. Third, the volume of biological sludge sent to landfill fell from 2 331 tonnes in 1999 to 1 662 tonnes in 2002 – a decrease of nearly 30%.

There were a number of further benefits leading to improvements overall at the Cognis plant. Odours and emissions from the wastewater treatment plant previously used to re-process toluene both fell – emissions, for example, were cut by more than 40 000 kg annually. The evaporation process resulted in a superior quality of toluene compared with the washing process.

A major benefit, meanwhile, was derived from the use of the waste product as fuel. Cognis calculated that the reduced fuel cost for powering the CHP plant amounted to €70 000/yr. The reduction in the amount of biological sludge sent for landfill also led to considerable cost savings. The sludge disposal cost saving in 2003 was in excess of €430 000, according to Cognis. Less landfilled sludge also meant a lesser impact on air and water quality around the landfill site.

SOLVENT STEWARDSHIP AWARD

The project was considered highly successful, and in 2004 was the winner of a Solvent Stewardship Award, in the environmental improvement category. This award scheme is promoted by the European Solvents Industry Group, and is designed to encourage good practice and continuous improvements in the use of solvents. The award jury was impressed by the effectiveness of the design of the system put in place by Cognis; by the different environmental benefits targeted (water, energy, air); and by the impressive return on investment achieved by the company.

The award is one factor in spreading information about the project. Cognis also promoted the results at conferences, and encouraged site tours. As the toluene washing process is widely used throughout the chemical industry, and is also applied in other sectors such as the food and beverage industry, the potential for transferability of Cognis's approach is significant. The results of the project, and the demonstration of the cost/benefit advantages of cleaner technologies, will only make transfer of the technology more likely.

The Cognis project received the prestigious Solvent Stewardship Award

LIFE AFTER LIFE

The 65% reduction in chemical waste sent to the Cognis wastewater plant was maintained after the project ended. Such was the reduction in the amount of waste produced that in June 2006 Cognis was able to close its old and inefficient water treatment facility and discharge its effluent to the municipal sewage works with only primary treatment. This has helped Cognis reduce its operating costs still further as, without the need for secondary/tertiary water treatment, its electrical energy consumption has fallen as a result of the success of the project.

The distilled waste product was used to meet the production site's energy needs

IRELAND

Project Number: LIFE99 ENV/IRL/000605

Title: Environmental sustainability through solvent and energy recovery technologies

Beneficiary: Cognis Ireland Limited

Total Budget: €1 884 000

LIFE Contribution: €468 000

Period: Nov-1999 to Nov-2002

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→ METAL & NON-METALLIC MINERALS MANUFACTURING: FABRICATED METALS & CERAMICS

LIFE throughout the life-cycle

The metals and non-metallic minerals manufacturing sector makes important direct and indirect contributions to Europe's economy. It is a major employer and wealth generator. It is also a crucial sector in the value-chain of many other European manufacturing industries, including automotive and construction.

In 2005, the metal industries accounted for around 5% of turnover and 3.3% of employment in the EU-27. Steel was the most important metal, production of which generated an annual turnover in the EU-25 of €220 billion, giving jobs to 412 000 people. Also in 2005, some 345 000 people were involved in the production of non-ferrous metals – such as aluminium, copper, zinc, lead, and nickel – and the sector had an annual turnover of €96 billion.

In addition to metals, Europe is also a major global producer of non-metallic minerals such as cement, ceramics, glass, and lime. Production in these four industries was worth approximately €83 billion in 2005, representing some 1.5% of the total value of manufacturing industry output in EU-25. These sectors employed just under 500 000 people, over 1.5% of total employment in EU manufacturing.

ENVIRONMENTAL CHALLENGES

Since metal manufacturing is highly energy intensive, a main environmental challenge posed by the steel and non-ferrous metal sectors relates to energy consumption and the associated emission of greenhouse gases and air pollutants, such as carbon dioxide (CO_2), nitrogen oxides (NOx), sulphur oxide gases (SOx), and volatile organic compounds (VOCs).

Further challenges surround the consumption of water in the production chain and environmental costs related to the extraction and transportation of mineral resources. Some treatment processes used in the production of metal and of non-metallic materials can generate toxic waste capable of polluting soil and water.

Consideration of the full life-cycle of metal and non-metallic materials reveals issues around waste at end-of-life, particularly of metal parts. In Europe, an estimated 10-11 million end-of-life vehicles are disposed of each year, resulting in 9 million tonnes of waste.

LIFE INNOVATIONS

LIFE projects have delivered extensive expertise in "greening" the manufacture of metals and non-metallic minerals, including fabricated metals and ceramics. Projects have tackled a wide range of issues at various stages of the production processes. Innovations have included improving energy efficiency in the production of steel-rod wire, reducing pollution from the treatment of steel and enabling the reuse of previously toxic sludge in the ceramics industry. A number of LIFE projects that have addressed these environmental challenges are highlighted below. For a comprehensive list of LIFE projects addressing energy efficiency, pollution reduction, and water treatment in the metal and non-metallic minerals sectors see pp. 35-36.

→ METAL & NON-METALLIC MINERALS MANUFACTURING: FABRICATED METALS & CERAMICS

Energy efficiency projects have been targeted at reducing energy use in metal manufacturing. The Italian ESD project **(LIFE04 ENV/IT/000598)** for example developed and implemented a new cold-drawing system for steel-rod wire production that reduced energy consumption. By pulling the wire through polycrystalline diamond dies in a mechanical process, the LIFE project demonstrated improvements in energy efficiency of 35.3%-59.4%. The Dutch Green Bearings project **(LIFE06 ENV/NL/000176)** is developing seal technologies, lightweight elements and lubrication technologies to reduce energy consumption in ball-bearing manufacture and use.

Various LIFE projects have also addressed emissions and waste reduction in the metal and non-metallic mineral industries. The Swedish Picked project **(LIFE00 ENV/S/000853)**, for example, demonstrated and implemented a new clean technology – electrodialysis – to recycle nitric acid from the process of pickling steel to remove oxides. It led to a 55% reduction in the discharge of nitrates from the production of stainless steel. Another clean technology in metal manufacturing was tested by the CLEAN DECO project (**LIFE00 ENV/IT/000213**). It demonstrated the environmental advantages of replacing the process of galvanizing metals with Physical Vapour Deposition (PVD) technology. PVD has led to the elimination of chromium wastes and a substantial reduction in the use of dangerous chemicals: chromium trioxide (CrO_3) by 100%; hydrogen chloride (HCl) by 30%; and sulphuric acid (H_2SO_4) by 90%.

Metal and ceramic products have been made greener by LIFE funded projects

In the non-metallic minerals industry, the on-going ReLiStop Spanish project **(LIFE06 ENV/E/000001)** is demonstrating the development of an alternative "cold-casting" process and new composition in the production of 'artificial stone' decoration that completely avoids the use of polyester resins, volatile solvents and hazardous pigments. This should substantially reduce the generation of polluting emissions.

In the ceramics sector, the EWG project **(LIFE04 ENV/IT/000589)** demonstrated a new technology to decorate ceramics on flat and textured surfaces using a soft roll able to adapt itself to the surface's shape. A pilot plant reduced wasted glazes by 98% and waste caused by printing faults by 8%. Its implementation generated a reduction in energy consumption of up to 76%.

Waste treatment, recycling and reuse has been another focus of the LIFE programme. The Swedish project CoolTech **(LIFE00 ENV/S/000864)** developed two new methods to lubricate and cool metals and tools without using hazardous lubricants. The German LIFE project RECARC **(LIFE03 ENV/D/000043)**, highlighted the possibilities of recycling by-products of steel production. It successfully demonstrated the complete recycling of slag containing high amounts of chromium that is a by-product of stainless steel manufacturing. The project used a thermochemical treatment in an arc furnace to recover completely the heavy metal fraction of the residue.

The Italian P.S.V. project **(LIFE05 ENV/IT/000875)** is reducing waste associated with the production of ceramic, marble, granite, and other similar material by examining the re-use of sludge created during polishing and/or smoothing. The aim is to create a 'waste' product that may be used as insulation in the construction industry.

The following pages feature two detailed case studies of LIFE projects that are showing the way to sustainable production in Europe's metal and non-metallic minerals sector.

This Dutch LIFE project developed a new technology that significantly reduces toxic sludge waste produced in the metal industry. It enables the reuse of contaminated electro-chemical liquid from the passivation of galvanised steel and iron for two years, rather than six weeks, which is the industry standard.

Empereur: **The perfect finish for iron and steel**

The metal industry uses a technique of galvanising to coat steel or iron with zinc, thereby providing a physical barrier against corrosion and thus avoiding rust. Passivation is the final treatment of the surface of the metal objects to further lower the reactivity of the surface. However, this process has been both inefficient and environmentally unfriendly, producing large quantities of toxic metal sludge waste in Europe each year.

The whole process of protecting iron or steel from rust involves the metal parts being cleaned, coated in zinc and then passed through a passivating bath. The bath holds a solution containing tri-valent chromium, which adds a protective layer over the zinc. The extent to which the metal resists corrosion depends on the quality of the coating applied.

The technical problem with this process was that, after several uses, the quantities of iron and zinc ions in the bath liquid became too high due to slight dissolving of the steel and zinc coating. This was reducing the quality of the anti-corrosive coating.

The director of Ondeo Industrial Solutions demonstrates the emulsion pertraction process and how it reduces amounts of toxic metal sludge

One of the LIFE project partners, Galvano Techniek Veenendaal B.V (GTV) – a small metal-plating company of around 20 employees in the Netherlands – found that the quality of the passivating liquid in its blue bath deteriorated so quickly that the quality of the product was lost after little more than a month. To maintain high product standards, the company had to replace the bath liquid every six weeks.

BEST OF THE BEST 2006-2007

The whole EU metal-plating industry – some 10 000 companies, mainly SMEs – discards some 420 million litres of contaminated passivating bath liquid every year, resulting in the production of 40 000 tonnes /yr of toxic sludge. The estimated annual cost of chemical replacement in the EU metal-plating sector is €168 million and the treatment and disposal costs are €76 million.

In May 2002, the European Committee for Surface Treatment (CETS) reported that there were no available technologies to extend the lifetime of the passivating baths. This was a challenge the LIFE project Empereur sought to overcome. It brought together scientists and industrialists to develop a technology to remove tramp ions from the passivating liquid on an industrial scale. The project built on initial research that had already indicated that selective removal of these ions would maintain a constant quality of the baths.

The project's solution was emulsion pertraction, which is a new process evolved from a combination of

The Empereur project produced outstanding results by improving the quality of the final product at a considerably lower cost

permeation through membranes and solvent extraction.

In the emulsion pertraction process, the liquid from the passivation bath is pumped into a tank. An emulsion containing an organic solvent is placed in another tank, separated from the liquid by a porous membrane. Through the pores in the membrane, the extractant binds the tramp ions, allowing the 'clean' passivating liquid to be redirected back into the bath for re-use. The extractant is regenerated.

The project carried out the first full-scale demonstration of the emulsion pertraction technology, which had previously only been demonstrated in principle. It introduced a light installation, which fitted easily into the industrial process.

EMPEREUR PROVIDED DRAMATIC IMPROVEMENTS

The results achieved were highly impressive. At one of the participating metal platers, the lifespan of a blue passivating bath liquid was extended from six weeks to two years. The project beneficiary, Loko Gramsbergen BV, treated a black passivating bath – a different oxidation state of chromium to the blue bath – with emulsion pertraction; the lifespan was extended from one to three years.

Project director Ron Keulen is proud of these achievements. "Extending the duration of a blue passivation bath from six weeks to two years means that it is both an ecological solution and it reduces expenditure for galvanising companies." Furthermore, the reliability of the emulsion pertraction units was excellent. During the long-term tests, the lowest reliability score was 98%.

The considerable savings in chemicals, energy and water from the new technology mean that the initial investment is paid off in just over a year. For blue passivating, without the use of emulsion pertraction technology, the cost estimate for the normal operation over the course of a year is €47 920. With the application of the technology, the cost is reduced to €2 182. The new process also reduces waste transport costs.

The project demonstrated not only that emulsion pertraction technology reduces the production of toxic metal sludge, but also that the final product is of a higher, more consistent quality and at lower cost. Whereas previously the quality of the protective coating would drop with use of the bath, this process maintains the high standards independent of the lifetime of the passivating bath. This avoids poor-quality or unacceptable products, loss of production and the need to re-treat metal parts.

These performance improvements ensure customer trust, which is crucial to the success of the metal-plating business sector in Europe. As one of the project leaders, Rob Klaason, points out: "Improved quality of the final product goes a long way towards increasing the competitiveness of companies that do thermal glazing within an increasingly global marketplace." The technology even enabled GTV to win back a customer that had previously switched to a Chinese competitor.

The environmental benefits of the project are clear, with a dramatic reduction in the production of toxic metal sludge containing high levels of chromium and iron and zinc ions. Furthermore, with superior, cheaper products that meet European regulations, there is no longer any rationale for using the ChromiumVI+ (CrVI+)-based passivating liquids. This suspected carcinogen can be eliminated from the metal-plating environment entirely thanks to the quality improvement achieved with emulsion pertraction.

There is significant scope to introduce this technology across the thousands of small-business metal platers in Europe who are all facing fierce competition from low-wage countries, especially China. The introduction of this technology, which reduces costs, improves the consistency of the final product quality and reduces environmental impacts, could mark the future of the industry.

The technology demonstrated by Empereur may qualify as a Best Available Technique (BAT). There will also be complementary studies to see if the technology can be used in other types of passivation.

This project was awarded the title of "Best of the Best" from a shortlist of 22 "Best" LIFE Environment projects in 2006-2007.

NETHERLANDS

Project Number: LIFE03 ENV/NL/000476

Title: Empereur - Emulsion Pertraction for Europe

Beneficiary: Loko Gramsbergen BV

Total Budget: €1 070 000

LIFE Contribution: €321 000

Period: Nov-2003 to Jun-2006

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Microfinishing: **Cleaning up ceramic tiles**

The Italian LIFE project Microfinishing was able to develop a new process for finishing ceramic tiles that brought tremendous environmental and performance benefits. It eliminated the consumption of water and the production of toxic ceramic waste, which had long been the norm in the ceramic industry. Instead, it enabled the reuse of all waste materials in the production system.

Ceramic materials are inorganic, non-metallic materials that are processed at high temperatures. They are highly resistant to corrosive compounds and heat, which has made them excellent materials in a range of domestic and industrial settings. Although ceramics is not commonly thought of as an environmentally damaging industry, the finishing of ceramic materials has been a highly polluting process.

The finishing process involves coating and polishing the ceramic materials. This was typically done with grinding wheels made of silicon carbide, which must be run wet. Highly polluting enamels and soluble compounds were applied to the ceramic surfaces. Not only did this consume a lot of water and power, it also produced highly toxic ceramic mud as a waste product.

This finishing process produced sludge totalling 1.95 kg/m^2 of end product. This sludge was made of ceramic material, abrasive material from the grinding wheel, (around 25%) water and chemical additives from the process. This sludge would be stored temporarily in open-topped systems before being disposed of.

The physical, chemical, mineralogical and thermal incompatibility of the mix of materials in the sludge means that the components cannot be recycled or reused and the sludge itself cannot be used even after filter-pressing or drying. In 2001, over 110 000 tonnes of such

BEST OF THE BEST 2006-2007

The innovative Microfinishing process for the ceramic industry reduced the consumption of valuable resources and the production of waste

waste ceramic sludge was created in Italy alone.

A NEW PROCESS: 'MICROFINISHING'

Ceramica Fondovalle, an Italian ceramics firm founded 50 years ago in the village of Torre Maina in the region of Emilia-Romagna, wanted to see if it could develop a successful new dry process for finishing tile surfaces. Their idea was to replace the abrasive materials used traditionally with the very same ceramic material used to make the tiles.

The company was convinced it could eliminate both water consumption and the creation of ceramic sludge from the finishing process using this technique. The ceramic dust created would not be contaminated with other components and would therefore be much easier to recycle. Ceramica Fondovalle was given LIFE funding for the 'Microfinishing' project to design, realise and test a pilot plant for this process.

Through the project, the beneficiary was able to develop a process that eliminated the grinding and polishing stages from ceramic tile production. These two stages were replaced by blasting ceramic particles of varying grain sizes against the ceramic surface, using a pneumo-mechanical method. Compressed air is only used during the spraying stage; all other abrasive handling actions are performed by means of a bucket elevator or through the force of gravity.

Via this process, the ceramic particles perform the same role as the abrasive materials used previously. Using preset pressure, incidence angle and composition modes, the process enables the treatment of flat, planar or indented surfaces, such as those typical of marble, breccias and split stones. Stress is applied to the surface to be treated, which can be moulded as required to create any desired features, such as a matt or glossy finish or a translucent effect.

The pilot plant provided greater precision in the finishing process.

The microfinishing spraying technique replaced highly polluting grinding and polishing stages in the ceramic tile production process

MAJOR ENVIRONMENTAL ADVANTAGES

The microfinishing technique has slashed both consumption of valuable resources and the production of toxic waste. The fact that the finishing waste is now made up exclusively of ceramic particles – from the treated surface and the sprayed particles – means that these can be easily collected and reused in the same process. They are re-entered as abrasive material until the grains become too fine, at which point they are used as raw material for the production of new tiles.

The process has eliminated the need to use water, which is already an important environmental achievement. Furthermore, it means that the production of toxic ceramic sludge is reduced to zero.

In addition, the process does not generate waste from deteriorating parts. It avoids abrasive action on the conveying system parts that previously required the regular replacement of components. It also prevents the accumulation of exhausted grinding wheels.

The use of mechanical processes and gravity to transport materials, limiting the use of compressed air to the moment of spraying particles, means that electricity consumption is kept permanently low. The only obstacle to achieving full industrial performance levels in the process was the lack of an automated loading process.

For the beneficiary alone, the use of the microfinishing process has meant savings of 20 000 litres of water/day, 20 000 grinding wheels/yr and 4 300 tonnes/yr of ceramic mud. Energy consumption has been halved in the plant and the use of special pollutant enamels reduced by 10%.

Finally, it is important to note that the benefits are not only environmental. The pilot plant provided greater precision in the finishing process, with a high stereoscopic definition of the product and a reduction of the fault rate. It allowed the beneficiary to obtain more resistant surfaces, more efficiently. The reduced production costs will help the competiveness of the products on the world market.

Following the success of the project, the beneficiary installed the pilot plant in another factory where it achieved close to industrial performance levels with the introduction of an automated loading process.

The successes of the project were recognised when it was awarded the title of "Best of the Best" project from a shortlist of 22 "Best" LIFE Environment projects in 2006-2007.

ITALY

Project Number: LIFE02 ENV/IT/000052
Title: Microfinishing
Beneficiary: Ceramica Fondovalle
Total Budget: €2 670 000
LIFE Contribution: €734 000
Period: Oct-2002 to Dec-2005
Website: www.fondovalle.it
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FOOD & BEVERAGE INDUSTRIES: WINEMAKING & OLIVE OIL

Reducing waste in wine and olive oil production

The food and beverage industry is one of the European Union's most important and dynamic, employing four million people and generating annual sales of €800 billion. The expansion and development of different food and drink sectors has been accompanied by several negative environmental impacts, which LIFE has been helping to address.

Within the food and drink sector, winemaking alone has an economic value of €15.6 billion /yr, with annual production averaging 185 hectolitres. The importance of winemaking varies from country to country of course, but for some Member States (France and Portugal) represents more than 12% of their total agricultural production. Olive oil is similarly important for the Mediterranean region: Italy, Greece and Spain together have around 2.4 million farmers growing olives for olive oil production, and the EU provides 80% of the world's supply.

ENVIRONMENTAL CHALLENGES

The expansion and development of different food and drink sectors has been accompanied by several negative environmental impacts, ranging from waste generation (resulting from production, processing and packaging), depletion of water resources and pollution of the air, soil and water to soil erosion. Waste including hazardous waste such as toxic organic substances, for example, is a problem for wine producers. Winemaking generates solid waste equal to 17% of total grape weight. The activities of Mediterranean olive oil producers, meanwhile, result in 30 million m^3/yr of wastewater. This is often disposed of directly into streams, rivers and the sea, contaminating water, negatively affecting plant growth, and resulting in damage to fragile aquatic species.

In the Communication, "Towards a sustainable European wine sector" [COM(2006) 319], the European Commission made a number of proposals concerning winemaking practices, including the proposal that producers ensure a minimum level of environmental protection in the winemaking process.

LIFE INNOVATIONS

LIFE assistance has worked to support the greening of food and drink production in the EU. For the wine and olive oil sectors, LIFE assistance has helped build expertise in techniques to reduce waste. Some of these techniques allow by-products to be used as raw materials for a number of industries, such as cosmetics, fertilizers, food additives, animal feed, packaging and even tannins, which can be used for tanning leather and for some medical applications.

Numerous projects carried out under the LIFE programme by wine and olive oil producers have, for example, shown that waste by-products can be used in a number of creative ways. The DIONYSOS project **(LIFE03 ENV/GR/000223)** showed

→ FOOD & BEVERAGE INDUSTRIES: WINEMAKING & OLIVE OIL

that polyphenols, or organic chemicals, from wine-making could be recovered and used in nutritional supplements or as active ingredients in wine-making. The MINOS project (**LIFE00 ENV/GR/000671** – see p. 28) demonstrated that polyphenols from olive oil production could be used in similar ways.

Use of waste products for agriculture is also a promising area, as illustrated by several LIFE projects. Both the DIONYSOS and MINOS projects were also able to produce fertilizer from organic waste. The TIRSAV project **(LIFE00 ENV/IT/000223)** demonstrated similar results using olive oil waste water, fresh olive pomace, and other natural organic olive production by-products.

The BIOVID project in Spain **(LIFE 03 ENV/E/000114)** used wine industry waste, specifically vine shoots, which are normally incinerated, to produce good quality cellulose pulp for cardboard production. This project had a double benefit because not only was the waste by-product reused, but burning of waste, and the attendant air pollution, was greatly reduced.

For the leather industry, the GRAPE TANNINS project **(LIFE04 ENV/ES/000237)** showed how grape seeds could be used to produce tannin, which is used to tan leather – in other words, to darken and protect it. This was a potentially significant breakthrough, because tannin agents are typically produced from high value deciduous trees. The project calculated that 2 625 tonnes of tannin from grape extracts could be produced each year by recycling 22 830 tonnes of grape seed waste. These figures were converted to show that substituting timber tannins in this way could save the felling of more than 500 000 trees.

Under the LIFE programme, olive oil producers have proved that waste by-products can be used as raw materials in other industries

Addressing waste treatment through life cycle approaches has been a central aspect of many LIFE projects.The ECOIL project **(LIFE04 ENV/GR/000110)** analysed the olive oil production cycle in detail, including study of olive tree varieties, olive cultivation practices, irrigation demands, use of pesticides and herbicides, production volumes, olive milling processes, and olive mill waste management practices. The objective was to better understand the impact of olive oil production, and to redesign the production process if necessary to make it more efficient. The project carried out assessments in Lythrodontas in Cyprus, Voukolies in Crete and Navarra in northern Spain, and as a result produced detailed recommendations on issues ranging from planting processes to electricity use and even packaging of the final product.

The following pages include two detailed case studies looking at the impact of LIFE on the wine and olive oil industries.

This LIFE project from the world-famous wine-growing region of La Rioja in Spain compiled the first-ever guide to best practice in sustainable wine production. It also developed specific technological innovations that improved the environmental performance of the life-cycle of wine.

SINERGIA: **Raising a glass to sustainable production**

La Rioja wines are famous amongst wine drinkers across the world. Based on specific climatic and soil conditions, the territory has long been recognised as a producer of excellent wines. Indeed, wine accounts for 46% of the region's agricultural output with a total business volume of €200 million/yr.

The production of wine is not obviously the most environmentally damaging of economic activities. Nevertheless, it has a number of important effects at various stages of production that impact negatively on the environment. These include the use of fertilizers and pesticides, which can contaminate soil; the use of sulphites in preventing the spoiling of wines; water consumption; and energy use from machinery and transport.

The Directorate-General of Environmental Quality (DGCA) of the Regional Authority of La Rioja has long been keen to reduce the environmental impact of wine production in the region. The Director General of DGCA, Jesus Ruiz Tutor, explains, "When people think of Rioja wine, we want them to think of a quality product that also respects the environment. We realised that we needed to take an approach that integrated all aspects of the wine's life cycle to reduce its overall environmental impact."

DGCA had its first experience of using funding offered by LIFE to support its activities around wine production through the project "From the Vine" to the Bottle (**LIFE99 ENV/E/000349**). It also participated in other organisations' projects, for example around the rationalisation of water use through the LIFE project Optimizagua **(LIFE03 ENV/E/000164)**.

This ongoing desire to develop more sustainable production of wine led DGCA to successfully apply for LIFE funding for SINERGIA. This project aimed to bring together the full spread of practitioners involved in the production of wine – from

SINERGIA developed a prototype that strips grapes from the vine ***enabling the branches to re-enter the natural life cycle***

the growing of the grapes to the selling of the wine – to look at how they could reduce their environmental impact while maintaining or even improving quality.

IDENTIFYING WINEMAKING BEST PRACTICE

A technical working group was created with participants from the different sectors involved in wine production, including farmers' associations and wineries. This group met at least once a month over two years. Its primary objective was to establish what constituted best practice in wine production. This did not mean looking at new technology, but as Jesus Ruiz Tutor explains, "bringing existing knowledge to the surface."

The members of the group contributed their experience and expertise and initial submissions were refined, improved and added to. The draft best practices were also circulated and contributions accepted from outside the working group meetings.

The result of this work was the publication of two guides of best practice: one on the growing of the grapes and another on the production of the wine from the grapes. These explain not only "what to do", but also "how" and "when to do it", and include practices that the experts considered obligatory; others they recommended; and practices they classified as unacceptable.

Different types of vegetative cover were used to protect the soil from erosion

The first guide covered all aspects of vine growing, including preparation of the ground, use of fertilizer, planting of vines, watering, pruning, use of machines, protection of the vines, and harvesting. The second dealt with the stages of wine production, including transporting and transferring the grapes to the wineries, separating them from the stems, soaking, fermentation, adding sulphur dioxide, pressing, decanting, ageing in barrels, removing impurities, refrigerating, bottling and labelling.

The guides are so comprehensive that the good practices even extend to the use and storage of equipment in the winemaking process, the traceability of a wine, quality control systems, the energy efficiency of buildings and use of sustainable energy, care of machinery, cleaning and hygiene, use of water, and management of residues.

As the DGCA's Juan Francisco Alarcia explains, "This was the first time that this knowledge had been collated. Some of the practices are very simple, but setting them down on paper makes sure that practitioners do not forget the basics of good practice and provides a check that their current practices are up-to-date and effective."

The project results have been disseminated through a total of 30 publications. The winemaking guides in particular have been much sought-after: "We have already distributed all the copies of the guides that we printed. Farmers are asking for two copies: one to read at home; and one to have out in the fields," notes Mr. Alarcia. The DGCA is currently looking at possible funding sources to print further examples.

INNOVATIONS AND EXPERIMENTATION

One of the major debates around the environmental and health aspects of wine production surrounds the use of sulphur dioxide (SO_2) to control fermentation and prevent spoilage and oxidation. Sulphur has been used for centuries in wine production and even organic wines are not necessarily sulphite free. Nevertheless, sulphur is a potential contaminant and is even corrosive if left in contact with pipes.

Since SO_2 does not automatically distribute evenly throughout the wine, relatively large doses have traditionally been needed to ensure effective protection against spoilage throughout the liquid. In conjunction with the private company Carburos Metalicos, the project developed new technology to use nitrogen to support this distribution and enable the minimum possible amount of SO_2 to be added.

Traditionally the technology added nitrogen after the SO_2 – this both cleaned the pipes and, by bubbling through the liquid, helped to homogenise the distribution of sulphur in the wine. This worked well in thinner liquids, but was not enough in more solid grape mass.

The project team developed a new technology, using nitrogen to reduce the amount of SO_2 added to the wine

The prototype protects the grapes in a storage drum ready for transportation to the wineries

The project developed a new technology that measures the density of the grape mass as it enters into a container and injects regular small amounts of SO_2.

Through experimentation with this process, the project team was able to reduce the amount of SO_2 added while protecting the wine from spoilage. Whereas before, up to 50 mg of SO_2 was commonly added to each litre of wine, the new technology requires less than 35 mg.

The head of Agricultural Management in the regional government of La Rioja, Juan Chavarri, is clearly excited about this LIFE co-funded technology: "This is now used by all new wineries in the region. It is a brilliant development that enables a reduction in the use of sulphur without any reduction in quality of the wine. The machinery is totally automatic and requires almost no looking after; so it brings only benefits."

SINERGIA also developed a prototype piece of machinery that strips grapes from the vine directly in the field after hand picking. This enables the stripped branches to be deposited immediately back onto the ground where they re-enter the natural life cycle without further transportation. The grapes are protected in a storage drum ready for transportation to the wineries. This is a much more efficient process, although the beneficiary admits that storage in drums is limited in usefulness to small vineyards where harvesting by hand is still common practice.

The project further addressed erosion issues by experimenting with the use of different types of vegetative cover in vineyards. While it has long been thought that vegetation on the ground subtracts nutrients from the soil, the evidence of the project's experiments is that this is only a short-term effect. "In the long-run, having an effectively watered vegetative cover can protect the soil from erosion and maintain a symbiosis of nutrient exchange between the vines and the other vegetation," explains Mr. Chavarri.

It also experimented successfully with the use of pheromones to tackle the threat to crops posed by moth larvae. Pheromone-laden capsules placed around the vineyards attract the male moths and make it almost impossible for them to find a mate. This in turn prevents the laying of larvae which would feed on the fruit. All this is done in a way that avoids the need for pesticides and has no impact on other species.

SUPPORTING ACTIVITIES

To support these activities, the specialist LIFE project partner ECCYSA developed a certification system for the implementation of the best practices. The team also developed a specific record-keeping system for farmers to chart their own activities and measures used. Although these tools have not yet been effectively implemented, they do provide promising channels of work for the future to ensure best practices are followed effectively.

The SINERGIA project ran training and awareness-raising activities to support its publications and technological innovations. Perhaps the highlight of these was a detailed on-line course on good practice in wine production. During the project 240 people finished this course, for which they earned a formal certificate.

Six technical events were organised to bring together relevant practitioners to examine and discuss particular stages of the winemaking process. These worked both to raise awareness of the good practice and provide a forum for new ideas. The team produced a video on the project which is available, along with all supporting documents, on the project website. They also attended numerous events to present the project's work.

SINERGIA has provided detailed information that can be invaluable to wine producers across Europe in improving their environmental performance. It has also demonstrated an effective approach to developing understanding of good practice in the life-cycle of a particular product that could be followed in other areas of production.

SPAIN

Project number: LIFE03 ENV/E/000085

Title: SINERGIA (SYNERGY), Quality and respect for environment

Beneficiary: Dirección General de Calidad Ambiental. Gobierno de La Rioja

Period: Sept-2003 to Jun-2006

Total budget: €875 000

LIFE contribution: €424 000

Website: http://www.lifesinergia.org/ingles/sinergia.htm

Contact: Juan Francisco Alarcia

Email: programaseuropeos.ma@larioja.org

MINOS: **Making new products from olive oil wastewater**

The MINOS LIFE Environment project established a process for turning wastewater from olive oil production into nutritional supplements and fertilizer.

Olive oil is found in most kitchens in Europe. Olive cultivation has a long history in the Mediterranean region, where Greece, Italy, and Spain lead the world in olive oil production. Italy alone has more than one million farmers cultivating olive groves, and the EU in total produces four-fifths of the world's olive oil.

But modern olive oil production processes have an environmental impact. In particular, for each litre of olive oil produced, five litres of wastewater containing polyphenols, or organic chemicals, are generated. Across the EU, this adds up to 30 million tonnes of wastewater annually, much of which is discharged into rivers, lakes and the sea. This is especially the case because many olive oil producers are micro-businesses that cannot or do not invest in wastewater treatment facilities.

A Greek LIFE Environment project, known as MINOS and led by Athens University, realised that while polyphenols in olive oil wastewater have negative impacts – they degrade water resources and cause phytotoxic phenomena – they also have anti-oxidant and antimicrobial properties, and thus a nutritional value. The project set out to demonstrate a process for separating natural anti-oxidants from olive oil mill wastewater and using them as a raw material for production of goods such as cosmetics and food supplements. In addition, the project wanted to show that cleaned-up wastewater could be recycled, and that organic solid waste from olive oil production, such as olive leaves, could be processed into fertilizer.

The project put in place an integrated multi-stage process for treating olive oil wastewater. First, it was put through successive filtration phases. Then, the polyphenols were removed from the water using an absorbent resin. This stage produced two outputs: water, which was further cleaned through filtration; and the resin loaded with polyphenols. Organic solvents were used to separate the polyphenols from the resin, with the solvent itself being recycled through thermal recovery. Finally, the polyphenol mixture was purified through further separation processes.

The process as a whole produced three outputs. The first was a purified polyphenol mixture, which was suitable in terms of chemical form and quality for use in food supplements and other products. The second was water, which, as a result of the filtration processes, was clean enough for discharge into water courses, for use in irrigation, or even for reuse in the olive oil plant. Finally, the filtration processes produced sludge. The project partners combined this with olive leaves, composted it, and produced an organic fertilizer.

The polyphenol extraction process leads to the recovery of nutritional supplements and fertilizers from olive oil wastewater

TRANSFERABLE POTENTIAL

MINOS thus demonstrated a very effective wastewater treatment process, which in principle would be highly transferable throughout Greece's 2 500-3 000 olive oil mills, and beyond to countries such as Italy and Spain. Installation of such a treatment process does involve upfront costs that could be a barrier for smaller operators. Nevertheless, the project partners calculated that, depending on market prices for the polyphenol extract, an initial investment in a treatment facility could be repaid comfortably after two years.

GREECE

Project Number: LIFE00 ENV/GR/000671

Title: MINOS - Process development for an integrated olive oil mill waste management recovering natural antioxidants and producing organic fertilizer

Beneficiary: National and Kapodistrian University of Athens

Total Budget: €1 239 000

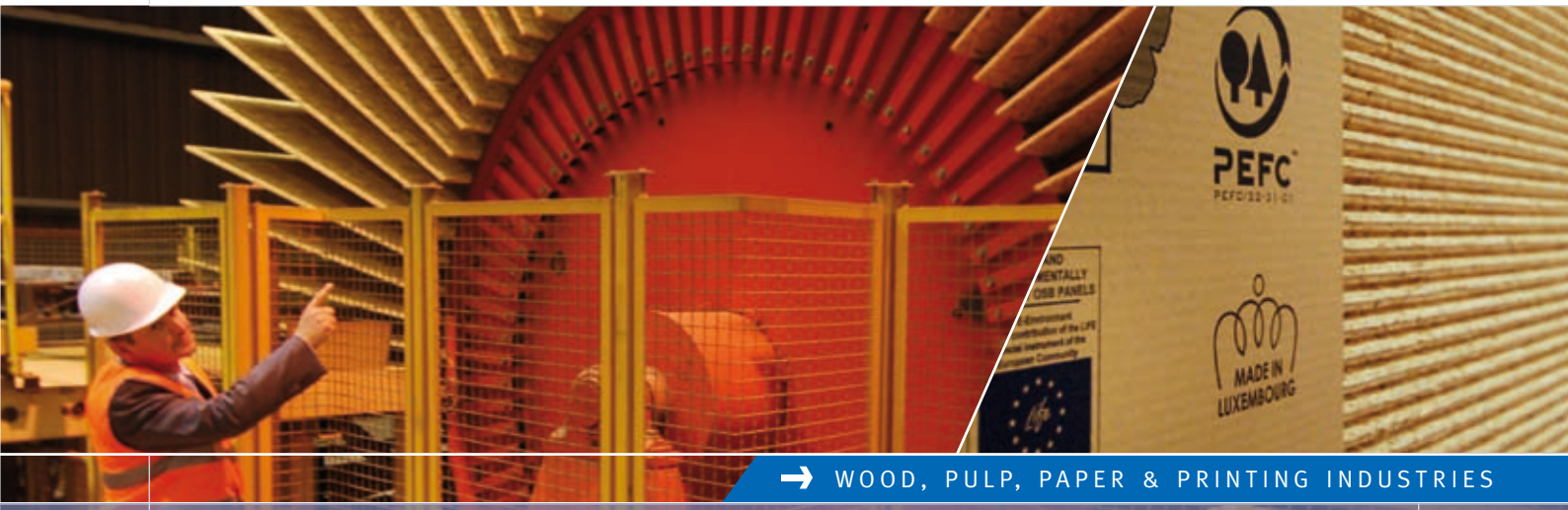
LIFE Contribution: €609 000

Period: Sep-2001 to Apr-2002

Website: http://www.pharm.uoa.gr/minos

Contact: Leandros Skaltsounis

Email: Skaltsounis@pharm.uoa.gr



→ WOOD, PULP, PAPER & PRINTING INDUSTRIES

Greening the forest-based industries

With the support of LIFE, Europe's wood, pulp, paper and other forest-based industries are shaking off their 'smokestack' image to reduce emissions, recycle and reuse the by-products of manufacturing.

The forest-based and related industries (forestry, woodworking, furniture, pulp and paper and printing) are among the most important in the European Union, accounting for some 8% of all EU manufacturing. The pulp and paper sector alone is responsible for 6.5% of all EU manufacturing turnover, some €375 billion annually. It employs approximately 260 000 people directly and a further 1.8 million indirectly, with 63% of the jobs in rural areas. The forest-based industries as a whole employed in 2001 some 3.35 million people.

ENVIRONMENTAL CHALLENGES

Despite the significant contribution of the forest-based industries to the European economy, obstacles still lie ahead on the path to sustainable production. The pulp and paper industry has long been associated with instances of air and water pollution (atmospheric emissions of NOx and SOx, high BOD and COD in aquatic emissions). Furthermore, the EU printing industry emits large amounts of Volatile Organic Compounds (VOCs) in gaseous form into the atmosphere, where they combine with exhaust emissions to form photochemical smog. Although the industry has taken significant strides to reduce emissions in the last two decades, further improvements are possible and desirable.

Reuse of raw materials, whether wood, water, chemicals or, indeed, paper, is a key challenge for the sector. The pulp and paper industry has responded well to the challenge of using more recovered fibre (recycled paper) as a raw material in manufacturing. According to the Confederation of European Paper Industries (CEPI), recovered fibre makes up 42% of the raw materials used by the sector, while many everyday paper products (e.g. newspapers, cardboard boxes) are typically made from 100% recovered fibre.

Europe's forests are also a potential source of biomass for energy. The pulp and paper sector has invested widely in combined heat and power (CHP) plants using biomass as a raw material. CEPI estimates that some 50% of on-site heat and power generation in Europe's pulp and paper mills comes from biomass-based energy.

In instances where virgin fibre wood pulp is used in paper manufacturing, the industry faces the challenge of ensuring it is sourced from sustainably managed and certified forests. The EU Eco-label scheme was set up in 1992 to help European consumers distinguish greener, more environmentally-friendly products and services. Among the 23 product groups covered by the scheme are furniture, tissue paper, and copying and graphic paper. Uptake by producers in the forest-based industries has been significant: for instance, more than 275 brands of copying and graphic paper currently are allowed to carry the distinctive EU Eco-label 'flower' logo.

LIFE INNOVATIONS

The LIFE programme is tackling the challenges facing the forest-based

→ WOOD, PULP, PAPER & PRINTING INDUSTRIES

industries in Europe by co-funding the development and demonstration of numerous projects dealing with sustainable pulp and paper production. Specifically, these have been geared towards reducing emissions to air and water; developing systems for the reuse of manufacturing by-products, such as heat (from biomass-boilers) and sludge; and developing tools for improving environmental performance, such as EMAS (for instance, the PIONEER project in Italy – **LIFE03 ENV/IT/000421** – see p. 34).

LIFE assistance has supported a number of projects aimed at reducing emissions in forest-based manufacturing. The project (**LIFE99 ENV/UK/000172**), for example, focused on lowering VOC emissions in the printing industry. A prototype bioreactor plant ('Biovox') at the CPC Stroud Flexibles factory was installed in South West England to safely destroy more than 90% of the VOCs emitted. Excellent VOC removal efficiencies were consistently and reliably achieved at the treatment plant. The project also produced best practice guidelines for the operation of printing machines to minimise solvent waste and maximise recycling, as well as guidelines for the of use water-based alternatives in order to minimise the cost of printing and to reduce VOC emissions.

LIFE projects have furthermore sought innovative ways to address wastewater treatment associated with the manufacturing of forest-based products For example, in the Dutch "High quality water recycling" project (**LIFE03 ENV/NL/000464**), the beneficiary, Fuji, successfully demonstrated (at its facility in Tilburg) large-scale high-quality wastewater recycling – including thermal energy recovery – in photo film and photo paper production. The application of a membrane bio-reactor (MBR) had previously been limited to low-quality re-use and end-of-pipe applications. Based on the results of the pilot research, Fuji expects to have recovered its investment in 4-5 years, while with further optimisation of the process this period could be reduced to 2.5-3.5 years. Reductions of CO_2 and thermal pollution were in line with targets. Fuji is now looking to use the installation to treat other wastewater streams of the plant and more MBR installations are planned for the Netherlands.

LIFE has enabled the reuse of by-products from the forest-based industries

LIFE Environment support has also enabled the reuse of by-products of the forest-based industries. The Spanish 'Reintegra' project (**LIFE00 ENV/E/000452**) for example, focused on reusing all wood waste generated in the wood cycle with the aim of reducing the production of inert waste and reintegrating all wood waste generated back into the industrial production process. After honing the suggestions emerging from pilot tests involving more than 100 companies, the project delivered a Reintegra Manual to provide guidance on practical, affordable measures to be taken to improve wood companies' environmental performance. A sign of the success of the project is the fact that many companies who took part in the pilot experiments decided to continue using the implemented changes afterwards.

The Integrated Logistics for Use of Biomass (ILUBE) project (**LIFE03 ENV/SK/000577**) was similarly focused on the re-use of by-products and aimed to develop an internal market for biofuels in Slovakia through the creation of an innovative logistics system of wood waste (sawdust) collection, transport, processing to wood pellets and delivery to end users. The project has helped grow the internal market for biomass in Slovakia to some 40 000 tonnes/yr. A further benefit has been the work done by the project to improve energy efficiency, as well as the installation of biomass boilers in schools and other buildings. These improvements have helped to decrease overall heating costs.

The following pages include two case studies from LIFE projects targeting the forest-based industries.

BIORED: **Reducing the environmental footprint of pulp and paper production**

An innovative Swedish LIFE project has successfully demonstrated the potential for a new integrated treatment technology that reduces pollution risks from bleaching processes and improves the environmental sustainability of pulp and paper production.

Europe's pulp and paper industry has been improving the environmental sustainability of its manufacturing processes over the last two decades. The 1990s saw a trend to replace chlorine-based bleaching technology and many companies adapted well to this challenge by adopting new systems that used less toxic substances as an alternative to chlorine.

Nordic Paper, which operates pulp and paper mills in Sweden as well as its home country, Norway, was one of the pioneers of this new and more environmentally sustainable approach. In 1994, the firm adapted the pulp bleaching processes at Nordic Paper Seffle, which is located in the town of Säffle on the western shores of Vänern, Sweden's largest lake. The change saw chlorine replaced by hydrogen peroxide (H_2O_2), which is less toxic and less detrimental to the environment.

Further environmental gains were achieved by pre-washing the pulp with ethylene diamine tetracetic acid (EDTA), which is a 'chelating agent' that helps to prevent the hydrogen peroxide from degrading during bleaching. Less degradation meant that the hydrogen peroxide lasted longer and so the bleaching agents did not need to be replenished as often. Reduced consumption of bleaching chemicals translated to reduced environmental risks and so EDTA was welcomed as an effective eco-innovation for Europe's pulp and paper industry.

As Nordic Paper's Environmental Engineer, Anne Persson, explains, "Metal ions that are present in the pulp mix can neutralise the hydrogen peroxide and so reduce the overall efficiency of bleaching processes. We introduced EDTA to counter this problem because we knew that the EDTA could combine with the metal ions to form complexes that can then be washed out of the pulp mix prior to bleaching." She continues, "Our use of EDTA in the pulping process can increase the efficiency of every kg of hydrogen peroxide by 50% and EDTA

also has a shorter degradation time than other chelating agents, which tend to require higher volumes of bleaching chemicals."

These environmental advantages led to an increased application of EDTA in pulp bleaching systems across Europe, and some 3 800 tonnes of EDTA are now estimated to be used by pulp manufacturers in Western Europe alone.

Despite its advantages, EDTA can however have negative impacts on the environment. It is not a natural compound and it takes a long time to degrade on its own, meaning that the metal complexes that it produces can be transported far from the source of emission, potentially leading to pollution in lakes and watercourses. Furthermore, EDTA is still a relatively new manufactured substance, so the long-term effects of its presence in the environment remain unknown.

These environmental concerns were acknowledged by Nordic Paper, which was required to comply with Swedish environmental standards and implement procedures to reduce potential risks from EDTA pollution.

REDUCING EDTA IMPACTS

Encouraged by this legal impetus, the research and development department at Nordic Paper set about exploring ways to limit any environmental impacts associated with EDTA. Conventional approaches to EDTA treatment relied on using very sensitive bacteria, which took a long time to grow and required a lot of oxygen to break down the chelating agent. Accordingly, the treatments needed large processing plants and involved large volumes of active sludge.

Micro organisms grow on the plastic Biofilm carriers and eat the EDTA

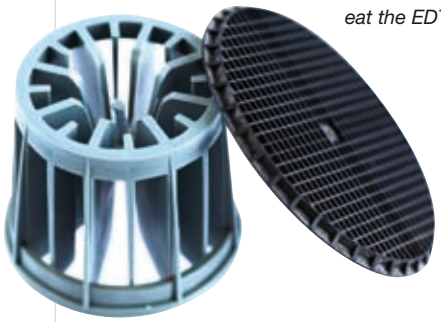


Photo: Tim Hudson

Nordic Paper's Anna Persson, Eva Pettersson and Curt Dersjö check one of the innovative BIORED biofilms - Photo Tim Hudson.jpg

Investments in such pollution control technology were expensive and acted as a disincentive to industry. However, Nordic Paper became aware of a new biological treatment process called 'BIORED' that had been developed by the wastewater technology company AnoxKaldnes AB. BIORED used innovative bioreactor technology and scientists from both companies joined forces to investigate its potential for safely degrading EDTA.

A development agreement was entered into by the two companies and LIFE funds were awarded to help test the potential of using BIORED as a viable technology for speeding up the biological degradation of EDTA, using a controlled treatment facility.

BIORED IN ACTION

Key objectives for the LIFE project involved: reducing EDTA emissions by 90%; producing a treatment plant that did not require a significant amount of new space; determining optimum BIORED operational parameters; quantifying the BIORED plant's ability to degrade EDTA; and demonstrating the technology's potential for the pulp and paper industry and other EDTA users.

Pilot work on the LIFE project began in 2003 and laboratory-scale trials soon confirmed that EDTA was biologically degradable under specific conditions. A full-scale demonstration plant was then constructed to apply these conditions in a commercial pulp mill environment.

The BIORED demonstration plant was established at Nordic Paper's sulphite pulp mill in Säffle, central Sweden, which employs 240 people and produces 28 000 tonnes/yr of greaseproof paper and 50 000 tonnes/yr of pulp (some of which is used to manufacture the greaseproof paper, while the rest is shipped to the company's other paper production facilities). While the Säffle mill is relatively small, it has large niche international markets, supplying much of the world's greaseproof paper.

Mill Manager, Eva Pettersson, is keen to highlight the environmental benefits that have been created by the different elements of the LIFE project. "Our plant at Säffle combines two integrated approaches to reduce EDTA emissions," she explains. "The first part of the process involves mechanical innovations that help us to reduce the amount of water that is used in the debarking and screening process. It also allows us to increase the amount of time that the EDTA is retained within the pulp mix. This means that more metal ions can be fixed by the same amount of EDTA and so we reduce the overall need for EDTA inputs."

Ms. Pettersson continues, "EDTA outputs, in the pulp mill's wastewater, are then reduced during the second part of the LIFE project process, in the new biological treatment facility. Here, we have applied the BIORED technology which uses special micro-organisms that eat the pollutants and break them down into safe sludge".

The open air bioreactors contain thousands of plastic Biofilm carriers

This biological treatment of the pulp effluent takes place in several Moving Bed Biofilm Reactors (MBBR™). Inside each bioreactor, the micro-organisms that degrade the pollutants grow on the surface of small plastic elements called biofilms. BIORED biofilms were highly innovative because they provided an extremely large surface area for microbial growth. They also protect the micro-organisms from disturbances, such as variations in load and toxic compounds. It was these factors that made the stable degradation of EDTA possible in a relatively small reactor.

The end product of the BIORED treatment process is a non-toxic solid sludge that Nordic Paper sells for use as a high quality soil substrate.

SUSTAINABLE BENEFITS

Results from the LIFE project show important improvements to the environmental sustainability of the grease-proof paper production process. The mechanical alterations to the debarking and screening process have allowed EDTA inputs and costs to be reduced by 30%. Installation of the biological treatment plant, and assessment of the optimum operational parameters, shows that degradation of about 40% of the EDTA in the pulp effluent is possible using the BIORED wastewater treatment process.

Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the wastewater have been reduced by 92% and 40-50%, respectively. In total, the overall discharges of EDTA into the environment have been decreased by some 60%. These achievements are expected to be built on as more work is undertaken to fully optimise the biological treatment process and further reduce the amount of EDTA used during the pre-bleaching process.

"The LIFE funds helped us to develop a highly effective new production process that has considerably improved our environmental footprint," says Nordic Paper's Project Manager, Curt Dersjö. "The new debarking and screening technology was developed specifically for the project and we are very pleased with the results. The increased efficiency of these new mechanical treatments has helped us to increase the efficiency of the biological treatment, and we are also glad that we were able to introduce both new treatment processes without stopping the paper production line."

RELEVANT TECHNOLOGY

Nordic Paper is aware that its new EDTA treatment methodology offers potential benefits both for other pulp and paper mills and other enterprises that use EDTA, such as those in the agriculture, photo chemicals and industrial detergents sectors.

"The technology that we have developed here with the help of AnoxKaldnes should be relevant to many other companies around Europe," believes Ms. Pettersson. "We would recommend that companies who are interested in reducing EDTA by using biological treatment methods should spend as much time as possible testing the different operating parameters before moving to a full-scale plant."

The Mill Manager expands on this by explaining that, "We have found that the biological treatment is very variable. It is not like a machine that you can easily control. It constantly changes and, because it relies on micro-organisms, it can sometimes act less like a piece of predictable equipment and more like an animal with a mind of its own. Our experience shows us that the main variable is the content of the wastewater and we are still learning how to understand the way that the micro-organisms react to different loads, different nutrient additives and different treatment conditions."

FUTURE POTENTIAL

Nordic Paper will continue to work on optimising its EDTA reduction process and the company still hopes to reach its original goals. "Our LIFE target of reducing EDTA emissions by 90% was based on laboratory modelling, but we have learnt that scaling up the technology does not provide the same results as in the pilot tests," notes Ms. Persson. However, she adds, "We have come a long way and we are still working towards our goals. We are very proud of the fact that our production processes are now more environmentally sustainable and we know that our achievements help contribute to the EU's Water Framework Directive, as well as the environmental objectives of the forthcoming EU Swedish Presidency."

In conclusion, says Ms. Pettersson, "Our LIFE project technologies have not only created environmental benefits but have helped us to reduce our consumption of energy, water and chemicals, all of which have a big effect on the competitiveness of our business. Good environmental sense makes good commercial sense to us and I think that this is a crucial message from our LIFE project."

SWEDEN

Project number: LIFE04 ENV/SE/000765

Title: Multi-Stage Biological Reduction of EDTA in Pulp Industries

Beneficiary: Nordic Paper Seffle AB

Period: Dec-2003 to Aug-2006

Total budget: €6 519 000

LIFE contribution: €1 489 000

Website: www.biored.se

Contact: Anne Persson

Email: Anne.Persson@nordic-paper.com

PIONEER: a new approach to EMAS in the paper industry

This LIFE Environment project in Lucca, Italy pioneered a new, public-private partnership approach to EMAS implementation across an industrial cluster.

The EU Eco-Management and Audit Scheme (EMAS) is a management tool for companies and other organisations to evaluate, report and improve their environmental performance. The scheme has been available for participation by companies since 1995 , although it was originally restricted to companies in industrial sectors.

In 2001, the scheme was revised to cover all economic sectors, both public and private. The revisions introduced by EMAS Regulation 761/2001 ("allowing voluntary participation by organisations in a Community eco-management and audit scheme") identify EMAS as a key strategic instrument for implementing local policies intended to improve the environmental performance of territorial areas.

PAPER INDUSTRY PIONEERS

The PIONEER LIFE project set out to apply the new EMAS regulation across an industrial cluster, in this case the paper industry territorial cluster located in Lucca, in Tuscany, Italy. The beneficiary, Amministrazione Provinciale di Lucca, planned to coordinate the project in partnership with the local paper industry, universities, associations and the municipality of Pescia, with the aim of implementing environmental management systems in compliance with EMAS across at least half of the 35 industrial facilities, local authorities and service providers selected to take part. This would be achieved through the setting up of common procedures, shared resources and collaborative training initiatives.

PIONEER developed a new approach to EMAS implementation

SUSTAINABLE RESULTS

The cooperative and integrated approach of the LIFE project proved successful, fostering an atmosphere of collaboration among enterprises and local bodies, improving the exchange of information and expertise and facilitating the EMAS registration process. PIONEER succeeded in helping 18 organisations achieve EMAS registration. These included paper manufacturers such as Delicarta and SCA Packaging Italia, service companies such as Aquapur Multiservizi and Enel Produzione - Asta del Serchio, and public bodies such as the Comune di Fabbriche di Vallico.

The successful demonstration of the applied methodology led the project to propose a revision of the EMAS Regulation. PIONEER suggests awarding some form of environmental recognition to bodies represented by a homogeneous production area.

A representative body, the Promotion Committee, was set up to coordinate and create synergies between the different actors in the territory. Members of the committee were chosen from within each participating organisation and represent the principal public and private actors in the area. The Promotion Committee oversaw activities aimed at applying EMAS. It also ensured integrated management and promoted the use of processes and available resources within the district.

The project conducted an initial territorial review of the cluster area, enabling the creation of a cluster environmental policy and programme, as well as a cluster environmental management system. A cluster environmental audit was carried out, which enabled the beneficiary to produce a Cluster Environmental Statement that both serves as a point of reference and acts as a support tool for organisations within the Province of Lucca that wish to join EMAS.

A questionnaire concerning the transferability of the PIONEER methodology was sent out to 181 districts across Europe, and replies were elicited from Spain, Portugal, France, Germany and Slovenia.

ITALY

Project Number: LIFE03 ENV/IT/000421

Title: Paper Industry Operating in Network: an Experiment for EMAS Revision (PIONEER)

Beneficiary: Amministrazione Provinciale di Lucca

Total Budget: €1 224 000

LIFE Contribution: €612 000

Period: Nov-2003 to Feb-2006

Website: www.life-pioneer.info

Contact: Roberto Pagni; Giovanni Coco

Email: agenda21@provincia.lucca.it

List of successful and promising projects

The table below presents a selection of LIFE projects that have focused on sustainable production in Europe's five main industrial sectors. For more information on other LIFE projects dealing with greening businesses, see the previous LIFE Focus edition on "Breathing LIFE into greener businesses" available at http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/env.htm#greening. For additional information on individual projects, visit the online LIFE database at: http://ec.europa.eu/environment/life/project/Projects/index.cfm or the section 'LIFE by theme: Industry & production' at http://ec.europa.eu/environment/life/themes/industry/index.htm.

Year	Country	Number	Acronym	Title
Metal & non-metallic minerals				
2006	Italy	LIFE06 ENV/IT/000254	UME	Ultrasound micro-cut ecosustainable
2006	Spain	LIFE06 ENV/E/000001	ReLiStoP	Resin-free Liquid-Stone Process elimination of synthetic polluting resins and toxic solvents used in the production of decorative elements in bass-relief with high artistic contents, substituted by eco sustainable and natural row materials imparting similar effect
2005	Germany	LIFE05 ENV/D/000185	INOCAST ✪	Demonstration of environmentally friendly aluminium engine block Core Package casting (CPS) using an inorganic binder
2005	Germany	LIFE05 ENV/D/000207	HVD	Hydro-Mechanical Descaling Process based on High-Pressure Vacuum Technology Using Scales as Abrasive Blast Medium
2005	Italy	LIFE05 ENV/IT/000875	PSV	Polishing Sludge Valorisation
2005	Spain	LIFE05 ENV/E/000301	ECO-CERAMICS	Ecological ceramics optimization. Alternative to sludge disposal
2004	Italy	LIFE04 ENV/IT/000598	ESD	New ESD (eco-sustainable drawing) system, environment-friendly to process steel wire rods/by-products, eliminating the current pickling practice and the related chemical fumes possessing a high environmental impact substituting the ...
2003	Sweden	LIFE03 ENV/S/000596	Reuseoil ✪	Recovery of Used Oil filters generating recyclable metal and oil fractions
2000	Italy	LIFE00 ENV/IT/000213	CLEAN DECO ✪	Development of a clean coating technology pvd for decorative applications on metal components in place of the traditional (galvanic) coating technologies
2000	The Netherlands	LIFE00 ENV/NL/000794	Zero Emission Lacquer	Zero Emission Lacquer
Machinery & equipment				
2004	France	LIFE04 ENV/FR/000353	ACADEMY	Airbus Corporate Answer to Disseminate integrated Environmental Management System
2005	France	LIFE05 ENV/F/000053	AMELIE	Reliability and industrialisation of processes and equipment in electronic assembly. Compliance with "WEEE" & "ROHS" european directives
2005	Denmark	LIFE05 ENV/DK/000156	CO2REF	Development and demonstration of a prototype transcritical CO_2 refrigeration system
2005	Italy	LIFE05 ENV/IT/000876	NOTRE	Novel Technology to Reduce Greenhouse Gas Emissions
2005	The Netherlands	LIFE05 ENV/NL/000020	HEIGHT	HM de Jong -Engery- efficient by Innovative Geometry and HFC-replacing Technology
2004	Germany	LIFE04 ENV/DE/000041	TRAFODECON	PCB Transformer Decontamination for Re-Use, and Decontamination of other PCB waste, with small-scale semi-mobile facilities, applied in pilot countries Poland and Greece (TrafoDecon)
2003	Austria	LIFE03 ENV/A/000002	PROCOOL ✪	Development and successful market penetration of HFC-free and eco-efficient cold appliances for the commercial use
2000	Greece	LIFE00 ENV/GR/000688	SUMANEWAG	Sustainable Management of E-waste in Greece
Chemicals & plastic				
2006	Germany	LIFE06 ENV/D/000470	PVClean	Optimising process Water Handling in S-PVC Production

✪ 'Best Projects' award 2005-2006

Year	Country	Number	Acronym	Title
2005	Sweden	LIFE05 ENV/S/000401	ART ✪	Advanced Reactor Technology for Sustainable Production in the Chemical Industry
2005	Spain	LIFE05 ENV/E/000328	PREVOC PLAN	Pilot Demonstration Plant for Reduction of VOC Air Emissions
2005	UK	LIFE05 ENV/UK/000126	FORMOSE	The demonstration of the environmental benefits of a new chemical process (Formose), capable of 100% reduction of formaldehyde from industrial effluent waste streams.
2003	Spain	LIFE03 ENV/E/000106	RECIPLAS ✪	Recycling plastic from vehicle factory waste to produce packaging and pallets
2003	Spain	LIFE03 ENV/E/000076	LIFE GENPLAST ✪	Integrated recycling plant for agricultural plastic
2002	Spain	LIFE02 ENV/E/000237	PERCUS ✪	Modular Electrochemical Process for the Recovery of Copper in metal form, contained in SPENT-PERCUS
		Food & beverage		
2005	Spain	LIFE05 ENV/E/000292	OLIWASTE	Processing plant for the integral treatment and valorisation of the wasted generated during the olive oil production process
2005	Spain	LIFE05 ENV/E/000330	PRIORAT	Making compatible mountain viticulture development with European Landscape Convention objectives
2004	Spain	LIFE04 ENV/ES/000237	GRAPE TANNINS	Saving of forest exploitation for obtaining of tanning extracts through valorisation of wine waste
2003	Greece	LIFE03 ENV/GR/000223	DIONYSOS ✪	Development of an economically viable process for the integrated management via utilization of winemaking industry waste; production of high added value natural products and organic fertilizer
2004	Italy	LIFE04 ENV/IT/000478	Vento II	Voluntary Environmental Tools for the continuous improvement of a district
2003	The Netherlands	LIFE03 ENV/NL/000488	Dairy, no water! ✪	A dairy industry which is self-supporting in water
2004	Spain	LIFE04 ENV/ES/000224	JELLY ✪	Demonstration project for gelatine production with use of innovative technology achieving an important washing wastewater reduction
		Wood, pulp, paper & printing		
2005	Luxemburg	LIFE05 ENV/L/000047	ECOSB	New and environmentally friendly OSB panels
2003	Slovakia	LIFE03 ENV/SK/000577	ILUBE	Integrated Logistics for Use of Biomass Energy
2000	Spain	LIFE00 ENV/E/000452	Reintegra	ReIntegrate System. Model for the reduction of environmental impact on a sectorial basis
2000	Germany	LIFE00 ENV/D/000348	WPCRecycle	Pilot-plant for the material utilization of plastic waste in the production of products based on new, polimere-bound wood materials
1999	UK	LIFE99 ENV/UK/000172		Development and evaluation of innovative solutions to reduce VOC emissions from the printing industry

✪ 'Best Projects' award 2005-2006 ✪ 'Best of the Best Projects' award 2005-2006

Competitiveness and Innovation Framework Program (2007-2013): Supporting innovative green technologies

The Competitiveness and Innovation Framework Programme (CIP) is a new Community instrument which aims to promote the competitiveness of European enterprises. With small and medium-sized enterprises (SMEs) as its main target group, the programme includes support for innovation activities, including eco-innovation, and for the promotion of renewable energies and energy efficiency. The eco-innovation strand within CIP has a budget of €430 million and specifically aims to support products, processes and services that help to reduce environmental impacts and promote the sustainable use of natural resources. It also supports the implementation of the Environmental Technologies Action Plan (ETAP), focusing primarily on market-oriented activities related to the take-up of environmental technologies, and also eco-innovation activities by enterprises and entrepreneurs oriented towards commercialisation.

Programme website: http://ec.europa.eu/cip/index_en.htm

Environmental Technologies Action Plan

The Environmental Technologies Action Plan (ETAP) was launched in 2004 to stimulate the development and use of environmental technologies. ETAP covers a spectrum of actions to promote eco-innovation and the take-up of environmental technologies. It includes priority actions along several lines, such as promoting research and development, mobilising funds, and helping to drive demand and improving market conditions.

Plan website: http://ec.europa.eu/environment/etap/index_en.htm

Available LIFE publications

LIFE-Focus brochures

A number of LIFE publications are available on the LIFE website:

Breathing LIFE into greener businesses: Demonstrating innovative approaches to improving the environmental performance of European businesses (2008 - 60 pp. - ISBN 978-92-79-10656-9)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/greening.pdf

LIFE and Europe's grasslands: Restoring a forgotten habitat ((2008 - 54 pp. - ISBN 978-92-79-10159-5)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/grassland.pdf

LIFE and endangered plants: Conserving Europe's threatened flora (2008 - 52p - ISBN 978-92-79-08815-5)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/plants.pdf

LIFE and Europe's wetlands: Restoring a vital ecosystem (2007 - 68 pp. - ISBN 978-92-79-07617-6)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/wetlands.pdf

LIFE and waste recycling: Innovative waste management options in Europe (2007 - 60 pp. - ISBN 978-92-79-07397-7)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/recycling.pdf

LIFE and Europe's rivers: Protecting and improving our water resources (2007 – 52pp. ISBN 978-92-79-05543-0 - ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/rivers.pdf

LIFE and Energy: Innovative solutions for sustainable and efficient energy in Europe (2007 – 64pp. ISBN 978 92-79-04969-9 - ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/energy_lr.pdf

LIFE and the marine environment (2006 – 54pp. ISBN 92-79-03447-2- ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/marine_lr.pdf

LIFE and European forests (2006 - 68pp. ISBN 92-79-02255-5 - ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/forest_lr.pdf

LIFE in the City: Innovative solutions for Europe's urban environment (2006, 64pp. - ISBN 92-79-02254-7 – ISSN 1725-5619) *http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/urban_lr.pdf*

Integrated management of Natura 2000 sites (2005 - 48 pp. – ISBN 92-79-00388-7)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/managingnatura_lr.pdf

LIFE, Natura 2000 and the military (2005 - 86 pp. – ISBN 92-894-9213-9 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/military_en.pdf

LIFE for birds: 25 years of the Birds Directive: the contribution of LIFE-Nature projects (2004 - 48 pp. – ISBN 92-894-7452-1 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/birds_en.pdf

LIFE-Nature: communicating with stakeholders and the general public – Best practice examples for Natura 2000 (2004 - 72 pp. – ISBN 92-894-7898-5 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/natcommunicat_lr.pdf

A cleaner, greener Europe: LIFE and the European Union waste policy (2004 - 28 pp. – ISBN 92-894-6018-0 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/waste_en.pdf

LIFE and agri-environment supporting Natura 2000: Experience from the LIFE programme (2003 - 72 pp. – ISBN 92-894-6023-7 – ISSN N° 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/agrienvironment_en.pdf

Other publications

Best LIFE-Environment Projects 2007-2008 (2008, 44 pp.-ISBN 978-92-79-09325-8 ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/bestprojects/documents/bestenv08.pdf

Best LIFE-Environment Projects 2006-2007 (2007, 44 pp.-ISBN 978-92-79-06699-3 ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/bestprojects documents/bestenv07.pdf

LIFE-Third Countries 1992-2006 (2007, 64 pp. – ISBN 978-92-79-05694-9 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/TCY_lr.pdf

Best LIFE-Environment Projects 2005-2006 (2006, 40 pp. ISBN 92-79-02123-0)
http://ec.europa.eu/environment/life/publications/lifepublications/bestprojects/documents/bestenv06_lr.pdf

LIFE-Environment 1992-2004 "Demonstrating excellence in environmental innovation" (2005, 124 pp. – ISBN 92-894-7699-3 – ISSN 1725-5619)
http://ec.europa.eu/environment/life/publications/lifepublications/lifefocus/documents/lifeenv92_04.pdf

LIFE-Environment Projects 2006 compilation (2006, 56 pp.-ISBN 92-79-02786-7)
http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/envcompilation06.pdf

LIFE-Nature Projects 2006 compilation (2006, 67 pp. – ISBN 92-79-02788-3)
http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/natcompilation06.pdf

LIFE-Third Countries Projects 2006 compilation (2006, 20 pp. – ISBN 92-79-02787-5)
http://ec.europa.eu/environment/life/publications/lifepublications/compilations/documents/tcycompilation06.pdf

A number of printed copies of certain LIFE publications are available and can be ordered free-of-charge at: *http://ec.europa.eu/environment/life/publications/order.htm*

The programme

LIFE "**L**'**I**nstrument **F**inancier pour l'**E**nvironnement" / The financial instrument for the environment

Period covered (LIFE III) 2000-2006.

EU funding available approximately EUR 945 million.

Type of intervention co-financing actions in favour of the environment (LIFE projects) in the Member States of the European Union, in associated candidate countries and in certain third countries bordering the Mediterranean and the Baltic Sea.

LIFE projects

> **LIFE Nature projects** improve the conservation status of endangered species and natural habitats. They support the implementation of the Birds and Habitats Directives and the Natura 2000 network.
> **LIFE Environment projects** contribute to the development of innovative and integrated techniques or methods to support environmental progress.
> **LIFE Third Countries projects** support environmental capacity building and initiatives in non-EU countries bordering the Mediterranean and the Baltic Sea.

LIFE+ "**L**'**I**nstrument **F**inancier pour l'**E**nvironnement" / The financial instrument for the environment

Period covered (LIFE+) 2007-2013.

EU funding available approximately EUR 2,143 million

Type of intervention at least 78% of the budget is for co-financing actions in favour of the environment (LIFE+ projects) in the Member States of the European Union and in certain non-EU countries.

LIFE+ projects

> **LIFE Nature projects** improve the conservation status of endangered species and natural habitats. They support the implementation of the Birds and Habitats Directives and the Natura 2000 network.
> **LIFE+ Biodiversity projects** improve biodiversity in the EU. They contribute to the implementation of the objectives of the Commission Communication, "*Halting the loss of Biodiversity by 2010 – and beyond*" (COM (2006) 216 final).
> **LIFE+ Environment Policy and Governance projects** contribute to the development and demonstration of innovative policy approaches, technologies, methods and instruments in support of European environmental policy and legislation.
> **LIFE+ Information and Communication projects** are communication and awareness raising campaigns related to the implementation, updating and development of European environmental policy and legislation, including the prevention of forest fires and training for forest fire agents.

Further information further information on LIFE and LIFE+ is available at http://ec.europa/life.

How to apply for LIFE+ funding The European Commission organises annual calls for proposals. Full details are available at http://ec.europa.eu/environment/life/funding/lifeplus.htm

Contact

European Commission – Directorate-General for the Environment
LIFE Unit – BU-9 02/1 – B-1049 Brussels
Internet: http://ec.europa.eu/life

LIFE Focus / Getting more from less: LIFE and sustainable production in the EU
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