



European  
Commission



BEST LIFE ENVIRONMENT  
PROJECTS



# Best LIFE Environment projects 2015

LIFE Environment

Environment



## EUROPEAN COMMISSION ENVIRONMENT DIRECTORATE-GENERAL

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# Foreword



Photo: European Commission

**Pekka Harju-Autti**  
*LIFE Environment Best of the Best coordinator 2015*  
 Finnish Ministry of the Environment, Physical Planning and Public Works

The 13<sup>th</sup> edition of the LIFE Environment Awards took place in Brussels in May 2016 during EU Green Week. This annual event is a means of acknowledging the work of the most outstanding LIFE Environment projects and LIFE Information & Communication projects with an environmental focus completed by the end of the previous calendar year.

As the LIFE Programme's national contact point for Finland I had the privilege of coordinating the process by which the national contact points of the Member States selected the Best of the Best LIFE Environment projects. I would like to thank my colleagues for their input as we chose 5 Best of the Best projects, with a further 19 projects awarded LIFE Environment Best project status. These 24 projects were joined by one Information & Communication project with an environmental theme, in a process coordinated by Markéta Konecna (see below). All 25 award-winning projects were also entered in a public vote to choose the LIFE Citizens' Award for Environment. This honour went to POLYMIX, a Spanish circular economy project that successfully tested polymer waste in asphalt mixtures on a section of road in Madrid. If replicated, this could reduce landfilling of polyethylene, polypropylene and polystyrene, as well as end-of-life tyres.

POLYMIX was one of a number of projects this year that implemented practical measures to support the EU's goal of transitioning to a low carbon, resource efficient economy. The LIFE programme continues to deliver the goals of EU environmental policy through practical projects that demonstrate best practice and deliver replicable and marketable solutions.



Photo: European Commission

**Markéta Konecna**  
*LIFE Information & Communication Best of the Best coordinator 2015*  
 Department of Economic and Voluntary Instruments,  
 Ministry of the Environment  
 of the Czech Republic

This is the third year that LIFE Information & Communication (LIFE INF) projects have been recognised at the LIFE Best Awards. LIFE INF projects with an environmental theme were presented at the LIFE Environment Awards; those with a Nature theme were presented at the LIFE Nature Awards. I was very pleased to be invited to lead the selection process for both ceremonies. Projects were judged according to a range of criteria, including their ability to solve an environmental problem through communication, innovativeness, replicability and widespread applicability. The one LIFE INF project with an environmental theme in this year's selection - the REBIRTH project - helped reduce construction and demolition waste by 10% in Slovenia: a great example of the power of effective communication.



Photo: LIFE09/ENV/PI/00579

Photo: LIFE11/ENV/PI/000447

Photo: LIFE10/ENV/GR/000606

BEST LIFE ENVIRONMENT PROJECTS

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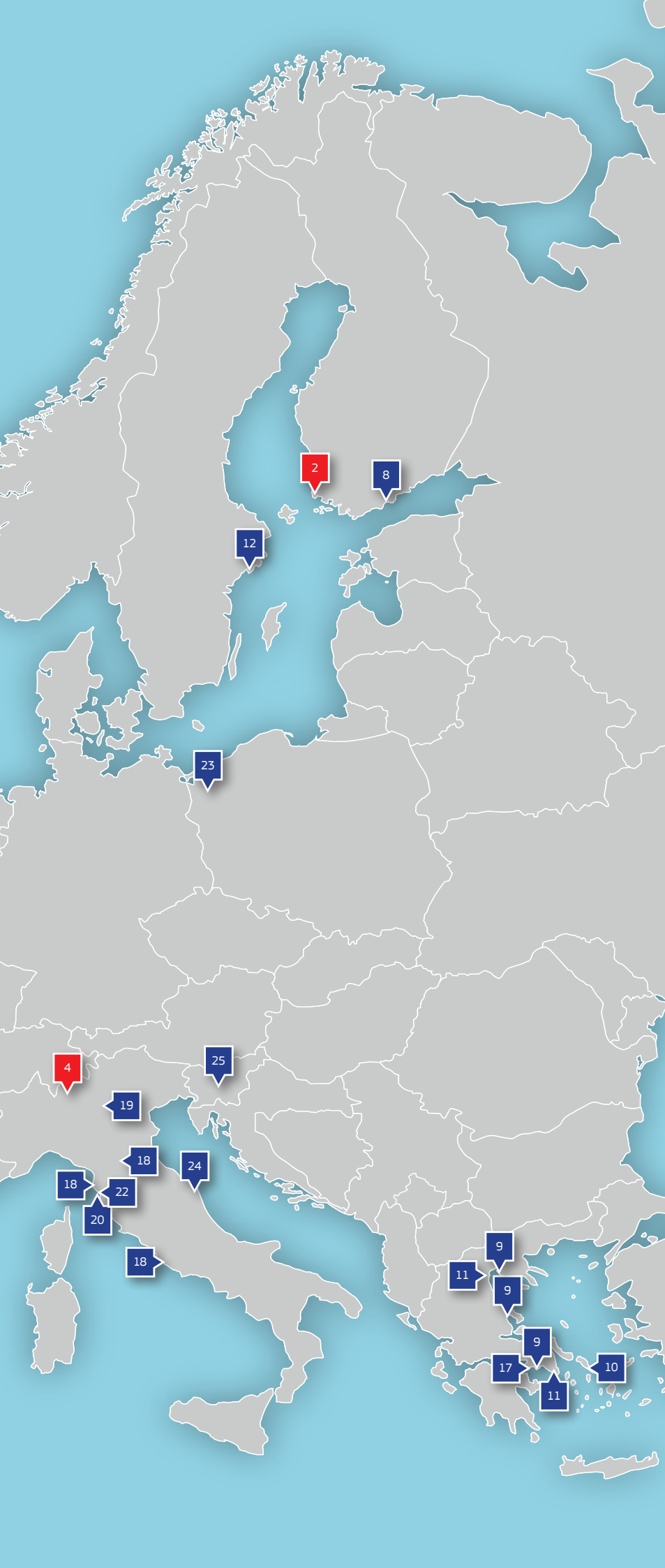
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LIFE ENVIRONMENT BEST AWARD WINNERS 2015





## BEST OF THE BEST PROJECTS

- 1** LIFE09 ENV/ES/000466  
**EDEA-RENOV**  
Development of Energy Efficiency in Architecture: Energy Renovation, Innovation and ICTs
- 2** LIFE10 ENV/FI/000059  
**Odourless casting**  
Odour and hazardous emission abatement of foundries
- 3** LIFE10 ENV/UK/000182  
**SEWeb**  
Scotland's environmental web

- 4** LIFE11 ENV/IT/000103  
**HEO**  
Highly Efficient Ovens through eco-friendly, energy efficient sol-gel enamelling process
- 5** LIFE11 ENV/UK/000402  
**ACUMEN**  
Assessing, Capturing & Utilising Methane from Expired and Non-operational landfill
- 6** LIFE10 ENV/ES/000516  
**POLYMIK**  
Polymer Wastes in Asphalt Mixes: a Way to Increase Sustainability of Roads Infrastructures



## BEST PROJECTS

- 7** LIFE09 ENV/ES/000493  
**DOMOTIC**  
Demonstration Of Models for Optimisation of Technologies for Intelligent Construction
- 8** LIFE09 ENV/FI/000579  
**REDUST**  
Best winter maintenance practices to reduce respirable street dust in urban areas - demonstration of best practices, strategy development and implementation
- 9** LIFE09 ENV/GR/000289  
**ACCEPT-AIR**  
Development of A Cost Efficient Policy Tool for reduction of Particulate Matter in AIR
- 10** LIFE09 ENV/GR/000299  
**SOL-BRINE**  
Development of an advanced innovative energy autonomous system for the treatment of brine from seawater desalination plants
- 11** LIFE09 ENV/GR/000307  
**ENERGY-WASTE**  
Energy exploitation of non-recyclable urban waste in a sustainable waste-to-energy market
- 12** LIFE09 ENV/SE/000355  
**DYEMOND SOLAR**  
Innovative Technology for Low Cost Production of Energy Efficient Dye-Sensitized Solar Cells
- 13** LIFE09 ENV/UK/000023  
**EDOC**  
Electronic Duty of Care
- 14** LIFE10 ENV/ES/000479  
**BREAD4PLA**  
Demonstration-plant project to produce poly-lactic acid (PLA) biopolymer from waste products of bakery industry
- 15** LIFE10 ENV/ES/000520  
**AQUAENVEC**  
Assessment and improvement of the urban water cycle eco-efficiency using LCA and LCC
- 16** LIFE10 ENV/FR/000211  
**HARMONICA**  
HARMONised Noise Information for Citizens and Authorities

- 17** LIFE10 ENV/GR/000606  
**ELINA**  
Integrated green life-cycle management of waste oils and petroleum residues
- 18** LIFE10 ENV/IT/000365  
**PODEBA**  
Use of poultry dejection for the bating phase in the tanning cycle
- 19** LIFE10 ENV/IT/000404  
**NOW**  
No more organic waste. A new integrated system to eliminate organic waste in the organised large scale distribution
- 20** LIFE10 ENV/IT/000423  
**B.R.A.V.E.**  
Better Regulation Aimed at Valorising Emas
- 21** LIFE11 ENV/FR/000742  
**BIOTTOPE**  
Biological tools to Optimize Treatment Technologies to remove micro Pollutants and Endocrine disrupters
- 22** LIFE11 ENV/IT/000277  
**PRISCA**  
Pilot project for scale re-use starting from bulky waste stream
- 23** LIFE11 ENV/PL/000447  
**GeoPyrz**  
Demonstration of the innovative technology of the improvement of absorption of the geothermal deposit layer
- 24** LIFE12 ENV/IT/000736  
**LIFE GREEN SINKS**  
Realization of green composite sinks substituting organic and mineral primary materials by recovered waste
- 25** LIFE10 INF/SI/000138  
**REBIRTH**  
Promotion of the Recycling of Industrial Waste and Building Rubble for the Construction Industry

# BEST LIFE PROJECTS



The winners of the Best LIFE Environment awards for 2015



**BREAD4PLA:** “ Thanks to this project, a new fully biodegradable and compostable packaging made of polylactic acid (PLA) for bakery products has been successfully developed, using as raw material the bakery and pastry wastes generated by the industry. ”

**Raquel Giner Borrul**



**DYEMOND SOLAR:** “ The LIFE programme was] pivotal in helping this technology reach a commercial phase. Funding from the EU has greatly accelerated the development of the production method and has laid the groundwork for future global expansion. We now hope to build a gigafactory in the EU and expect that funding from the European Investment Bank and European Fund for Strategic Investments is the natural next step in the globalisation of a solar technology which grew from two employees in Stockholm, Sweden. ”

**Giovanni Fili**

# AWARD CEREMONY ★

2015



**HEO:** “Without a doubt, it was the support and encouragement offered by the LIFE programme that enabled us to build the team and focus the resources that could take this bright idea and make it a reality.”

**Gianpiero Santacatterina**



**SOL-BRINE** not only protected the marine environment but also provided critical insight on understanding the circular value of seawater desalination brine. It was the stepping stone for the continuation of our path towards next generation desalination, circular desalination.”

**Dimitris Xevgenos**



**ACCEPT-AIR:** “The development and application of the ACCEPT-AIR Policy Tool, achieved with LIFE programme funding, has linked scientific knowledge and specialised modelling tools with active policymaking.”

**Lila Diapouli**



**EDEA-RENOV:** “We have so many social houses that need to be renovated that these pilot tests were extremely useful to determine which measures worked best and can easily be replicated elsewhere.”

**Esther Gamero Ceballos-Zúñiga**



**PRISCA:** “Centres for reuse can provide local job opportunities for disadvantaged groups.”

**Marco Frey**



# The LIFE Best Awards

The LIFE Environment Best Awards recognise those projects whose results, if widely applied, could have the most positive impact on the environment. The 12<sup>th</sup> edition of the awards took place during EU Green Week in Brussels in May 2016.

Green investment needs to play a key role in the transition to a circular, resource-efficient economy. While speaking at the LIFE Environment Best Awards, the European Commission’s Director-General for Environment, Daniel Calleja Crespo, highlighted the importance of the LIFE programme in achieving this investment goal: “since 1992, LIFE-funded projects have created profitable green businesses, sustainable jobs and new approaches to meet our environmental challenges.”

In fact, the programme has helped finance over 2 400 environmental and information projects since its inception, with €1.7 billion in co-funding mobilising investments totalling almost €5 billion for the environment.

In recognition of the importance of LIFE’s work, every year the European Commission presents awards to the most outstanding projects. All newly-completed LIFE projects are evaluated according to a number of criteria: their contribution to immediate and long-term environmental, economic and social improvement; their degree of innovation and transferability; their relevance to EU policy; and their cost-effectiveness.

This year a total of 25 ‘Best’ LIFE Environment projects and LIFE Information & Communication projects with an environ-

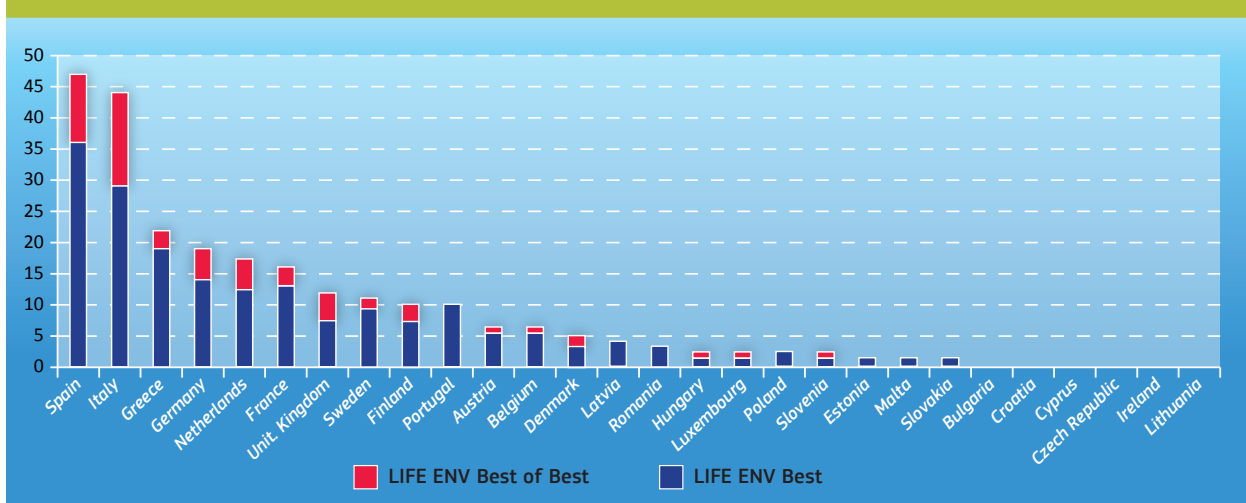
mental theme were invited to attend the awards as ‘Best’ LIFE projects for 2015. These projects were drawn from a total of nine EU Member States and tackled environmental challenges as diverse as improving air quality, enhancing environmental reporting and governance, and supporting the development of technologies and processes that turn waste into a resource.

The most outstanding five projects from this list subsequently received the ultimate accolade: ‘Best of the Best’ LIFE project (see pp. 8-22).

The public was also given the chance to vote for its favourite project from the longlist of 25. The second LIFE Citizens’ Award for environment went to POLYMIX, a project that trialled the use of waste tyres as a raw material in road-building (see pp. 23-25).

Karmenu Vella, EU Commissioner for the Environment, Maritime Affairs and Fisheries said: “Sincere congratulations to the winners and the finalists in this year’s edition of the LIFE Best Awards! These innovative projects show how effective small-scale actions, with the help of LIFE funding, can lead to big results, replicable across national borders, with benefits for all. That’s the real EU added value of the LIFE programme – being a catalyst for private and public investments helping to build a greener future.”

Fig. 1: LIFE Environment Best Project winners 2005-2015 by Member State



N.B. Data includes INF projects with an environment theme since 2013





Photo: LIFE09 ENV/ES/000466



Photo: LIFE10 ENV/IT/000059



Photo: LIFE10 ENV/ES/000051@POLIMIX Consortium



Photo: LIFE11 ENV/UK/000402



Photo: LIFE11 ENV/IT/000103@NEEMO EEG@Stephen Jones



Photo: LIFE10 ENV/UK/000182



# BEST OF THE BEST PROJECTS

# Spain: Energy saving solutions for social housing

EDEA-RENOV looked at reducing the carbon footprint of social housing by testing innovative solutions to reduce day-to-day energy losses and carbon dioxide (CO<sub>2</sub>) emissions produced by buildings and to increase their energy efficiency.



The region of Extremadura owns and manages more than 14 000 social dwellings

Homes and commercial buildings accounted for almost 40% of EU energy consumption in 2010, equating to 36% of greenhouse gas emissions. Therefore, improving the energy efficiency of buildings represents a key contribution to meeting EU 2020 Climate and Energy Package targets. In policy terms, this is driven primarily by the Energy Performance of Buildings Directive; but further efforts are required, in light of the Energy Roadmap 2050 and given the relatively low rate of increase (about 1.4% per year) in building energy efficiency. This will involve high energy-efficiency standards in new buildings and the renovation of existing buildings to reduce demand for heat, cooling and power.

Energy poverty is a major issue for Spain's financially-disadvantaged households. The regional government of Extremadura, which manages a housing stock of some 14 000 properties across the region, decided to tackle the issue by improving the energy efficiency of the dwellings for which it is responsible.

The idea was that improving the quality and environmental performance of social housing would provide a long-term solution to the residents' high energy bills, while also improving their quality of life, increasing the value of the properties, stimulating business activities and reducing pollution and greenhouse gas emissions.

The EDEA-RENOV project (**LIFE09 ENV/ES/000466**) was launched in 2011 to identify the best solutions and develop ICT tools able to increase the energy-efficiency potential of social housing in a cost-effective way (see box p.10). The project carried out some 500 simulation exercises before introducing a series of active and passive energy saving measures in 10 pilot social dwellings. It then studied the costs of the works carried out and the real improvements they brought to the day-to-day life of the residents and compared the results with the non-rehabilitated social housing in the same area.

"When you are faced with social housing neighbourhoods presenting a wide range of issues that need to be addressed,

such as high unemployment, low levels of education, violence and crime or poor access to facilities the question is: where do you start?," says EDEA-RENOV project coordinator, Esther Gamero Ceballos-Zúñiga. "We decided to start by renovating houses because this is where people spend most of their time and because it represents a good return on investment."

### Pilot renovations

EDEA-RENOV picked two neighbourhoods for the pilot projects: one in Badajoz (the Santa Engracia neighbourhood) and the other in Merida (the San Lazaro neighbourhood).

The Santa Engracia neighbourhood is the oldest social housing complex managed by the government of Extremadura. It was built in 1955 and was supposed to be a temporary solution. However, it soon turned out to be too big to be demolished. "There are 800 houses all built on the same model and of the same size. Santa Engracia also houses a nursery, a primary school, a church and a social club. It's a social housing estate but it presents none of the problems that are often associated with those areas, probably because most of the people living there are old and have lived in the neighbourhood from the beginning," explains Ms Gamero. These factors meant that the neighbourhood was recognised having, "a great potential for developing renovation strategies and practices that incorporate energy sustainability principles," she adds.

The project chose four houses that needed urgent renovations and carried out the same type of renovation work in each of them. It installed solar panels on the roof and a

heat pump for hot water, air conditioning and central heating in the backyard. New insulation techniques were used on the outside walls. "The idea behind this was two-fold: by insulating the walls on the outside rather than on the inside, the surface of the house remained unchanged. It also meant that residents did not have to move out during the renovation work. This made the work more difficult but it was an essential condition for the success of the project," says Ms Gamero.

Many of the solutions were found by the residents themselves, something that the project team had hoped would happen: "We wanted to empower people and involve them in the process. Our reasoning was that if residents were involved in improving their surroundings they would appreciate it more," explains Ms Gamero.

The project took a different approach in the San Lazaro neighbourhood of Merida, a more challenging social housing estate consisting of 500 apartments. There it was decided to opt for "minor interventions for faster improvement" (€3 500 per renovation compared to €12 000 in Santa Engracia). Two apartments were chosen. One was insulated from the inside, equipped with new double-glazing and installed with EFICIEEX, a low cost open-source sensor kit with a mobile app and a web database, while the other was also equipped with EFICIEEX but otherwise left intact.

Using wireless sensors, EFICIEEX measured the temperature, humidity, butane consumption and indoor air quality of the apartment and sent notifications to the user's phone, with suggestions on how to reduce energy consumption and improve home comfort. The sensor system enables users to

*The project actively involved the sector's stakeholders - including residents - via training courses, technical workshops and awareness-raising activities*



## The role of ICT

Information and Communication Technologies (ICT) tools played a significant role in the success of the project by offering opportunities for improving energy use and energy efficiency in the housing sector.

In addition to the EFICIEX tool, the project also developed ClimEX, an Extremadura climate database that provides climate files for 66 towns in the region as well as a geographical information system covering all existing buildings in Extremadura; and EDEAsim, software that allows users with no technical knowledge to create their own modelling scenarios for their home, identify areas for energy improvement and evaluate the cost and benefits of renovation works.

The three tools provide end users with ideas on how to reduce their energy bills and open up new opportunities for defining energy rehabilitation strategies.



identity when their energy use is greatest and what behavioural changes are needed to reduce their energy bill. It is also able to spot leaks and wastage and inform residents in real time.

### Training builders and technicians

To complement the tests carried out in the pilot renovation projects, EDEA-RENOV organised 16 technical courses for builders and technicians on energy certifications and related energy renovation techniques. The project team also ran workshops for residents to help them identify how to change their habits in order to reduce their energy consumption and energy bills.

Using the data captured during the project the team was able to draw some interesting conclusions. It found that those residents “that did their homework” and adapted their behaviour successfully reduced their energy bills by approximately 50% through simple steps such as closing windows and not leaving electronic appliances in stand-by mode. The team also realised that energy consumption habits are at least as important as construction and installation improvements in terms of achieving energy efficiency.

“The impact of the change depends on the user’s willingness to adapt consumption patterns and habits,” notes Ms Gamero. “Sometimes we reached better energy-efficiency results in dwellings where no work had been done. At the end of the day it all boils down to the user.”

She added that social housing residents were “suspicious” of smart installations often reverting to using out-dated installations out of fear of increasing their energy consumption.

“How to make people change? This is the issue,” says Ms Gamero. “It is a question of education,” she believes.

Despite these concerns that will need to be addressed in future, the project established that the energy savings resulting from the renovation work brings a rapid return on investment - within two to three years in a worst case scenario and in six to seven months in the best case scenario.

The beneficiary is very pleased with the outcome of the project. “We have so many social houses that need to be renovated that these pilot tests were extremely useful to determine which measures worked best and can easily be replicated elsewhere,” says Ms Gamero.

The regional government of Extremadura is now planning to use the methodologies and tools developed during the project to renovate not only other social housing estates across the region but also school buildings, hospitals and administrative buildings.

**Project number:** LIFE09 ENV/ES/000466

**Title:** EDEA-RENOV - Development of Energy Efficiency in Architecture: Energy Renovation, Innovation and ICTs

**Beneficiary:** Junta de Extremadura

**Contact:** Esther Gamero Ceballos-Zúñiga

**Email:** esther.gamero@salud-juntaex.es

**Website:** www.renov.proyectoedeade.com/

**Period:** 01-Jan-2011 to 31-Dec-2014

**Total budget:** €2 282 000

**LIFE contribution:** €1 455 000



# Finland: Reducing odour emissions from foundries

The Odourless casting project measured odorous and hazardous emissions at several foundries, and tested some innovative cleaning techniques for abating such emissions. The results provide crucial information for iron, steel and aluminium foundries looking to tackle odour problems.



*Foundries emit odorous and noxious gaseous compounds from processes such as melting, core making, die casting and sand reclamation*

**F**oundries make metal castings from ferrous and non-ferrous alloys. The casting process typically generates emissions of odorous and hazardous gases, including some greenhouse gases. Europe is home to around 4 000 foundries, many of which are located in densely-populated areas. Odorous emissions are not regulated at EU level or by most Member States. But an estimated 10%-20% of foundries have severe emissions of odours and hazardous air pollutants, thus potentially causing conflicts with the public and

authorities, as well as affecting the health and wellbeing of foundry staff.

The Odourless casting project (**LIFE10 ENV/FI/000059**) aimed to address this problem through a two-pronged approach: by defining the emissions in typical aluminium, steel and iron foundries, establishing which were the most harmful compounds and odorous concentrations; and by demonstrating technically and economically feasible abatement



techniques for wide-scale implementation. The goal was to pilot the best exhaust air cleaning systems at a number of foundries, reducing the hazardous and odorous emissions from different parts of the casting process by 80%-90% compared to the industry baseline.

### Identifying the problem

Foundries emit a number of odorous substances. The most common nuisance-causing, noxious compounds are organic decomposition products (e.g. tetramethyl, propylbenzenes, naphthalenes, benzene, mesitylenes, ethyl, styrene and cresolene). To apply suitable abatement measures, it is important to identify and quantify the substances emitted at the various stages of the casting process in different types of foundry. Thus the first key action of the project was to study and measure the odorous and hazardous emissions in iron, steel and aluminium foundries.

“We had many meetings and discussions about what exactly should be measured, as the measurements themselves are rather expensive and there are millions of compounds of odorous substances,” says project manager Sara Tapola from the coordinating beneficiary, Meehanite Technology. After deciding what to measure and how the measurements were to be carried out, the project team collected emissions samples from different parts of the casting process at the eight participating sites - in Finland, Germany, the Netherlands and Sweden - during 2012-2014. Samples were taken from seven foundries and one cupola furnace. This involved sucking emissions from different stages of the casting process into plastic bags, which can hold around 30 litres of gas, for testing by an ‘odour panel’. Those samples that were destined for laboratory analysis were collected using adsorption materials (activated charcoal or resins).

*The project carried out odour emission measurements in iron, steel and aluminium foundries*



### Testing emissions and technologies

The samples were subjected to several tests to determine whether odours were present and, if so, which substances were responsible and their concentrations. An olfactometer delivered diluted samples to a group of people (the odour panel) who sniffed them to check for odours and attempted to define the smell threshold of any samples detected; clean specimens were used during the testing process to separate the different odorous samples. “Four people must be present to use the machine. Usually, we run the test three times and with two batches of staff, so with eight people,” explains project coordinator, Markku Tapola. “An experienced panel will give reasonable results,” he adds.

To determine the concentrations of hazardous and odorous substances present, the samples were laboratory analysed using standardised identification methods for chemical compounds. These ‘odour emission balance measurements’ enabled the project to establish what were the most common compounds creating the odours. It found that benzene, amines and creosols were particularly odorous. Odours typically originate from several phases of the casting process, namely the melting, core-making, pouring, mould cooling, die-casting, shake-out and sand reclamation stages.

The LIFE project’s other key action was to test six innovative cleaning techniques to abate large amounts of odour emissions. Small-scale prototypes were developed by some project partners and owners of participating foundries (CTP, Reinluft, IfG and Nederman). The technologies tested included regenerative catalytic oxidation (RCO), regenerative thermal oxidation (RTO), a concentrator and RTO system, biofiltration, ignition and adsorption. These were trialled at six foundries in Finland, Germany and Austria during 2012-2013.

The project found that RTO, RCO, biofiltration and a two-stage adsorption process are all suitable abatement technologies for foundries, with oxidation having the greatest cleaning efficiency. Biofilters proved to be the most cost effective system when low concentrations of odours are present in emissions. “Adsorption has potential but needs further development,” says Mr Tapola. This method is cost effective as the adsorption material used to remove odorous particles from the air can be reused a number of times before the cleaning efficiency decreases and new material is required.

### Major odour reductions possible

The results provide vital information for foundries looking to tackle odour problems. As well as pinpointing the most odorous parts of the casting process, thus enabling foundries to target particularly problematic areas. The project



The six abatement techniques tested proved effective, some reaching 99.5% cleaning efficiency in certain processes

has established which abatement techniques are suitable for different circumstances. Based on the results of the pilot tests, the project calculated the total annual estimated costs for implementing the technologies at full scale.

“There is space in the market for all the technologies tested,” says Mr Tapola. Foundries could choose whichever is most suited to their needs, depending on the level of abatement required and the associated cost. If European foundries were to apply the best feasible exhaust air cleaning systems, hazardous and odorous emissions would be cut by 80%-90%, or some 11 million kg of noxious compounds per year. This would create a healthier environment both for foundry employees and for nearby residents, as odours can cause sensitisation and long-term health effects.

Although odours are not regulated at EU level or by most Member States at present, some environmental authorities require foundries to abide by limit values to secure operating permits, especially in cities. The results of Odourless casting may prove to be useful for these authorities in the permit process, since the project showed that total odorous emissions and the reduction of such emissions can be accurately defined by olfactometric measurements supported by chemical analysis.

The project’s results are also useful from a policy perspective. The findings on reducing and eliminating emissions

contribute to the EU’s Volatile Organic Compounds (VOC) Solvents Emissions Directive (1999/13/EC) as well as national, regional and local requirements on air quality. The painting of metal castings and the coating of mould surfaces are processes covered by the VOC directive. On top of that, the results of the project can be used to develop further the best available technology (BAT) and BAT reference (BREF) documents for the foundry industry.

The project beneficiary expects more foundries to invest in the equipment tested by the project as demand for odourless production increases. “It will take more legislation and limit values at both national and EU level to increase the use of these cleaning techniques,” concludes Ms Tapola.

**Project number:** LIFE10 ENV/FI/000059

**Title:** Odourless casting - Odour and hazardous emission abatement of foundries

**Beneficiary:** Meehanite Technology

**Contact:** Markku Tapola

**Email:** markku.tapola@meehanite.org

**Website:** odorlesscasting.com/

**Period:** 01-Oct-2011 to 30-Sept-2014

**Total budget:** €1 568 000

**LIFE contribution:** €768 000



# UK: Linking Scotland's environmental data

**Scotland's Environment Web (SEWeb) developed a Shared Environmental Information System for Scotland, providing a comprehensive view of the nation's environment and helping to identify priorities. The project also developed mapping and data visualisation applications that increase public understanding of environmental issues and participation in citizen science.**

In most EU Member States, environmental protection is the responsibility of a number of different agencies and organisations. While this has undoubted benefits in terms of channeling expertise to where it is most useful, it has drawbacks in terms of limiting close interaction on ideas and data provision, leading to fragmented information and difficulty in comparing datasets. This can ultimately make it hard to identify common environmental management challenges, hard to fully and accurately determine the state of the environment and hard to report what is happening to the public and ultimately to the European Environment Agency (EEA).

In Scotland, LIFE has helped to deliver a project called SEWeb (**LIFE10 ENV/UK/000182**) that demonstrates a replicable path to overcoming these challenges. Scot Mathieson, principal policy officer for conservation at the Scottish Environment Protection Agency (SEPA), the coordinating beneficiary, explains the genesis of the project: "Since the late 1990s, SEPA has published a State of the Environment report every few

years. In 2009, we started discussing the idea of a report that was more web-based, that wouldn't date as quickly as a book dates, and one that was written across government, rather than just by SEPA."

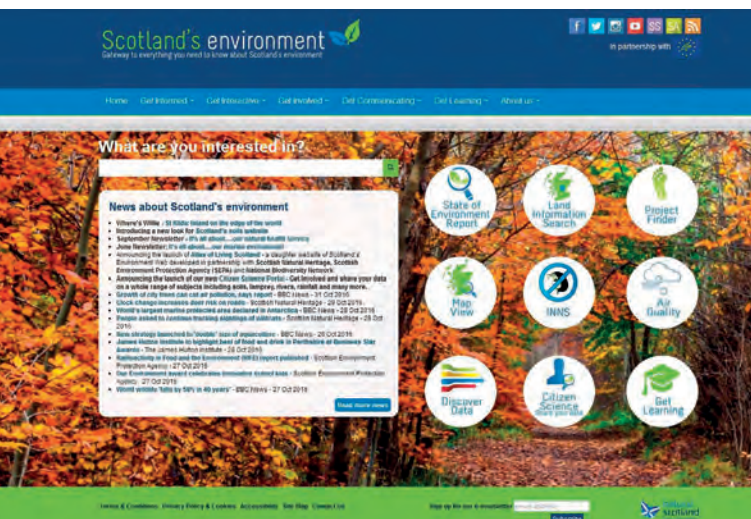
From this initial idea, SEPA pursued the concept of creating an online resource that not only gave a snapshot of Scotland's environment, but which also gave a single point of access to the underpinning environmental data from many different sources. After a trial, it was agreed to apply for LIFE co-funding "around the idea of creating a Shared Environmental Information System (SEIS) for Scotland that would become a one-stop-shop for environmental information and expertise from a number of organisations and also allow us to improve our reporting to Europe," says Dr Mathieson. This single centralised 'gateway to everything you want to know about Scotland's environment' became Scotland's Environment Web (<http://www.environment.scotland.gov.uk/>).

*The SEWeb portal offers the most relevant and up-to-date information about Scotland's environment in a user-friendly way*

## Inspiring a multi-agency approach

With LIFE's support in place, the first objective was to develop an inclusive programme bringing together key data providers and data users. "We had partnerships established already, but this gave us a real impetus to go forward," explains senior project manager, Paula Brown.

"It was very much a multi-agency approach to the project, built on strong partnership," confirms Jo Muse, SEPA's principal policy officer. SEPA worked with 12 environmental organisations to develop the online version of the State of the Environment report. "It was a very consultative process. Our methodology was commended by the EEA: they are interested in doing something similar for their next report," says SEPA's Nathan Critchlow Watton, who led the process. SEPA is also using the methodology to identify key environmental priorities for the future.





“One of the unique selling points of SEWeb is that it is viewed by users as a trusted gateway to evidence and information, which is very important at a time when the web is increasingly overwhelmed with information and data,” says Ms Muse. The project delivered a number of initiatives involving open data, including a linked data repository and the use of linked data to present Scottish indicators of environmental quality. “The fact that we don’t hold any data, we harvest data direct from the source, means it is always the most up-to-date data that is available,” she explains.

In its role as regional SEIS, SEWeb provides access to more than 300 datasets from 15 data providers, including key project partners Scottish Natural Heritage (SNH) and Forestry Commission Scotland (FCS).

“The INSPIRE Directive had us all moving in the same technology direction. We were lucky we were coincident with the development of the Scottish government digital and open data strategies as well,” says Dave Watson, SEPA’s lead systems analyst. “INSPIRE came along just at the right time - it has encouraged agencies to provide spatial layers as web services (and with a common format),” adds Howard Davies from FCS, who was one of the people in the team that built SEWeb’s Land Information Search (LIS), a map-based tool that takes advantage of these principles. LIS lets users search for data relating to an area of land to highlight the presence of a range of environmental features and designations such as Scheduled Monuments, Sites of Special Scientific Interest and Native Woodland. “We delivered this in about 12 months - LIFE funding paid for the developers’ time,” notes Mr Davies. “LIS is an essential business tool for us. Knowing it is continuing is really important. In terms of the benefits, we are getting better quality grant applications; it is saving our staff time and stakeholders time,” he adds.

Replicability was built into the project from the outset: “We wanted to develop through the LIFE funding the basic infrastructure that we can then iterate for different users and different datasets,” says Jo Muse. SEWeb also links to a family of interconnected daughter websites that provide more specialist audiences with a detailed view of topics such as soils, aquaculture, air quality, invasive non-native species, as well as the NBN Atlas of Living Scotland, a platform for the millions of Scottish species records and biodiversity data.

Other SEWeb visualisation tools include Map View, which lets users look at any combination of environmental data map layers for anywhere in Scotland. Such tools help engage the public and increase understanding of the local environment. “SEWeb transforms scientific data and aims to make it more accessible to a wider user base,” believes Ms Muse.

## EcoHack 2015

SEWeb held the EcoHack 2015 ‘hackathon’ at the Edinburgh Centre for Carbon Innovation in May 2015. The event brought computer programmers, graphic designers and product developers together with biologists and ecologists to collaborate on software development and build prototypes of the next generation of environmental data applications. “We really wanted to get students along from different disciplines to engage with data,” explains Jo Muse. “We had mentors from private companies - Skyscanner, GeoGeo - mobile app lecturers at Edinburgh University, Abertay University: they all gave up their time for free for the weekend. It was brilliant.”

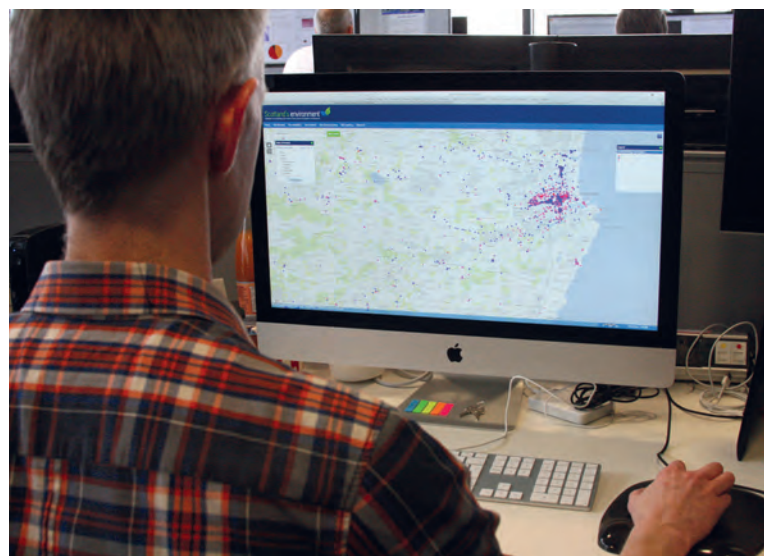
“I was absolutely blown away by these students who spent the whole weekend researching and coding. We almost couldn’t get rid of them when we had to close the building at 8 o’clock at night as they wanted to carry on! The ideas they came up with were brilliant,” she adds. “One was a scanned barcode on food products - they were data mining information in barcodes to calculate the food miles of the product. Another idea involved working with land data from Historic Environment Scotland to create an augmented reality app with information about what you were seeing.”

Another way in which the project opened up environmental data was by engaging with younger audiences, including students (see EcoHack 2015 box) and schoolchildren.

## Citizen science in schools

“Teachers are increasingly being asked to include environment in their lessons, but they are not environmentalists, so for them a quick source of information and learning outcomes is really useful,” says Ms Muse. The LIFE project enabled SEPA

*The portal enables users to access datasets that support policy-making, grant applications and environmental work*





The project also engaged with the educational community, bringing environmental science into a school setting

and Education Scotland to jointly fund a post to develop and promote SEWeb's Get Learning pages. A former primary school teacher, – Stuart McGrath, took on the role. "He had a really good idea about the types of content and functionality that SEWeb had that would be of most interest to schools," says Ian Menzies from Education Scotland. Launched at the start of the 2015 school year, the Get Learning pages encourage active participation in citizen science. "It's great for supporting outdoor learning, which is a key approach to learning within Curriculum for Excellence," explains Mr Menzies. "A lot of teachers said that it really brought science to life in the school, particularly in primary schools," he adds.

"Another thing we are trying to do within the *Curriculum for Excellence* is to develop scientific literacy and skills for learning, life and work," says Mr Menzies. "Some of the functionalities that SEWeb was offering were really important... Developing skills for young people in terms of taking accurate measurements, recording, using different equipment, using IT skills to share that information with the scientific community," he says. Specific actions included bird and earthworm surveys, taking air quality measurements and developing travel action plans and "a big focus on flooding: we got schools to go down to local rivers to visit flood protection schemes," explains Mr Menzies.

### A hub for change

Ingrid Baber from SEPA's data unit believes the air quality and flooding work with schools would never have happened without SEWeb. "It provided a really good platform to get everyone together. On their own none of the agencies would have done it because it's not their remit."

The LIFE project "became kind of a hub for people who had interest in doing things differently that were cross-organisational, that needed the integration and the partnership," explains Paula Brown. "It gave us the space to try new things," confirms Jo Muse. "While we tried to explore better partnership working with a variety of groups, it gave us the flexibility to work with whoever was ready to come on board at the time," says Ms Baber. "It's probably one of the most positive projects I've ever worked on," adds Ed Mackey, unit manager, knowledge and information management at SNH.

The project leaves a strong and transferable legacy. "Without the galvanising effect of LIFE funding, we would be many years behind where we are now," believes Scot Mathieson. "Scotland's key agencies and government involved in rural affairs, food and environment (RAFE) have agreed that SEWeb will become Scotland's digital hub for environmental information and data. This gives SEWeb a clear mandate to take forward and a great example of the legacy that LIFE funding has provided," says Jo Muse.

**Project number:** LIFE10 ENV/UK/000182

**Title:** SEWeb - Scotland's environmental web

**Beneficiary:** Scottish Environment Protection Agency

**Contact:** Paula Brown

**Email:** paula.brown@sepa.org.uk

**Website:** [www.environment.scotland.gov.uk/about-us/lifeplus-project/](http://www.environment.scotland.gov.uk/about-us/lifeplus-project/)

**Period:** 01-Sept-2011 to 31-Aug-2015

**Total budget:** €4 781 000

**LIFE contribution:** €2 352 000



# Italy: Pioneering new techniques to make ovens more energy efficient

The HEO project successfully developed and tested a new coating compound for use in oven manufacturing which halves energy use in the production process and is 30% more energy efficient in the kitchen.



The project team with the new HEO oven

The popularity of cookery shows on television and the increasingly sophisticated food tastes of European consumers has ensured that ovens remain among the most popular items in the major home appliances market, a market worth an estimated €163 billion worldwide in 2015 according to GfK, a market research company. Around 11.5 million electric ovens are sold annually in the European Union.

Ovens are ubiquitous in Europe's domestic kitchens, a reflection of their pivotal place in the culture and cuisines of European countries. However, despite their popularity, ovens are one of the most energy-intensive appliances in our homes. Electric ovens, in particular, are notoriously wasteful, with an efficiency of around 20% relative to the input power.

Ovens account for up to 5% of household energy use, and the European Commission estimates that using more efficient cooking appliances could save 1% of Europe's annual household energy bill by 2030 – a saving that represents 2.7 million tonnes less carbon dioxide (CO<sub>2</sub>) released into the atmosphere, equivalent to the annual output of four medium-sized power stations.

In its drive to promote energy efficiency, address climate change and encourage eco-innovation, the Commission drafted regulations dealing respectively with the eco-design of domestic ovens and energy efficiency labelling. These directives, which entered into force in 2015, created a new framework for manufacturers and consumers.

However, even before this framework was finalised, Whirlpool Europe, a producer of home appliances, was already working towards becoming a standard-setter with regard to energy efficiency. Whirlpool Europe has 24 000 employees, a sales presence in about 35 countries and manufacturing sites in eight countries in the EMEA region (Europe, Middle East and Africa). The EMEA headquarters is in Comerio (Varese), Italy, and Whirlpool Europe also has a Centre of Excellence for Research in nearby Cassinetta.

It was there that the company conceived the HEO - Highly Efficient Ovens - project (**LIFE11 ENV/IT/000103**) designed to contribute to the EU's goals of energy efficiency, using less fossil fuel, limiting greenhouse gas emissions, minimising waste and restricting the use of harmful chemicals. The pro-



ject was designed not only to make the ovens it manufactures more energy efficient, but also to save energy in the manufacturing process.

### Contributing to common climate and energy goals

The cavities of most of today's ovens, even the most state-of-the-art versions, are made of enamelling-grade steel. Not only is the enamelling process the most energy-intensive stage of the appliance's manufacture, but the enamel typically used contains potentially harmful chemicals such as nickel and cobalt. The process of enamelling oven cavities is also highly precise because heat differentials within the oven when it is in use can cause the enamel to shift away from the underlying steel surface and crack.

The project set out to demonstrate the feasibility of moving beyond the traditional enamelling process, towards an innovative coating for the manufacture of ovens. Through many months of research, Whirlpool Europe had identified a new proprietary technology that it hoped would both cut the amount of energy used on the production line to enamel the cavity and bring savings in energy consumption when in domestic use. Moreover, the project team set out to achieve this alongside a commitment to avoid the use of compounds identified as of toxicological concern.

Whirlpool Europe, as the main beneficiary, brought in partners to help guide the project forward. Scamm, a company specialising in the manufacture of metal products, had responsibility for casting the moulds for, and assembling, the cavities.

*The new enamelling technique greens the entire life-cycle of the oven*

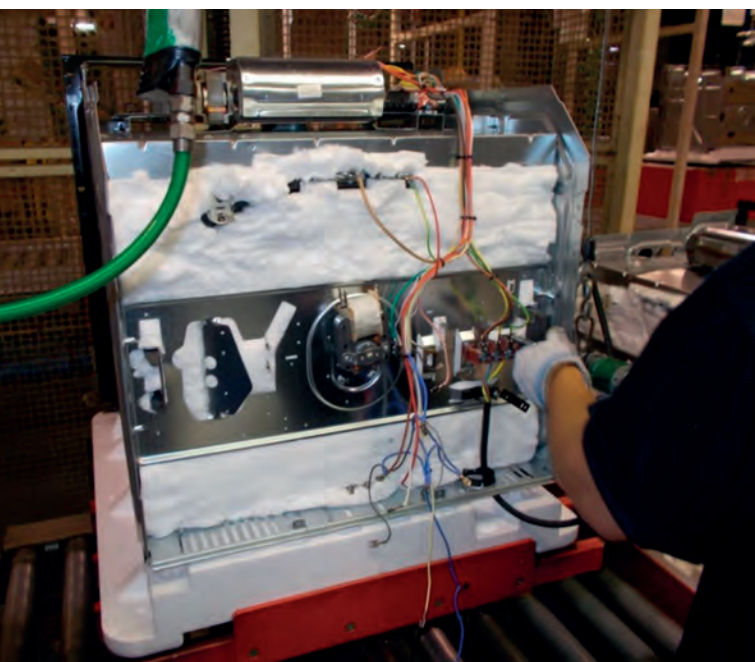


Photo: Whirlpool Corporation

Whirlpool Europe's own research and development arm was brought in to handle management of the project's communication and dissemination activities. Meanwhile, the University of Manchester in England was tasked with conducting a life-cycle assessment of the technology, especially with regard to energy efficiency and cost.

"We are always thinking up new ideas and concepts at Whirlpool but we don't always have the time or the resources to take a concept from the drawing board to the factory," explains Gianpiero Santacatterina, the project's coordinator. "When the opportunity to engage with the LIFE programme came along we did not hesitate. Without a doubt, it was the support and encouragement offered by the LIFE programme that enabled us to build the team and focus the resources that could take this bright idea and make it a reality."

### Science in the kitchen

The alternative coating developed for Whirlpool's project was an inorganic compound created from so-called 'sol-gel' chemistry. The compound was manipulated so that it could be applied in two transparent nanometric layers around the oven cavity, with a thickness of approximately one micron. The compound was also completely devoid of nickel and cobalt, enhancing the environmental sustainability and safety of the project.

The engineers working on the project decided against low-carbon steel for the prototype cavity, choosing instead stainless steel for its reflective characteristics. They were hoping that the higher energy usage in stainless steel production over low-carbon steel would be more than offset by its capacity to save energy consumption by spreading heat more evenly around the oven interior.

In the typical coating process for ovens, the low-carbon steel used is cured at 830°C to apply the traditional enamel. However, on the pre-industrial production line established by the project team, stainless steel was used for the cavity, and instead of being heated once to a very high temperature it was cured twice, for 30 minutes each time, at 230°C, to apply the new coating.

### Encouraging results

Rigorous testing and quality control proved the project team right: not only was the new coating 30% more energy-efficient during oven usage but the energy consumption during the production phase was half as much as for traditional enamelled ovens.

"The new coating has proved to be very effective at reflecting heat within the oven," says Massimiliano Daniele, one of the technical experts who took the project to fruition. "It has the advantage of being visually attractive, and it has extremely



Photo: Whirlpool Corporation

*The new oven is technically and financially viable and can help the sector to reach the targets of the Energy Efficiency Directive*

high resistance to the gradual surface degradation in an oven interior that quickly becomes apparent in an oven coated with enamel. Even after intensive use the new compound keeps the surface looking bright and shiny, which means that the oven requires less maintenance and should have a much longer life," he explains.

By avoiding the use of potentially hazardous substances in manufacturing, the ovens produced should also be easier to recycle at the end of their working life, in line with the goals of the EU action plan on the circular economy.

The project's success has opened new possibilities for Whirlpool Europe but has also shown how an investment by the LIFE programme can help to develop processes and technologies with significant replicability potential in different sectors.

"We have found that the new coating has different properties that are useful not only in our sector of household appliances but potentially for other sectors too," says Mr Daniele. "Our work has shown that the coating can be applied to outer surfaces as well as oven cavities, and we are considering how best to integrate our proprietary technology into other areas of the business."

For now, the processes developed by the HEO project are not used on the commercial production line, but Whirlpool Europe staff are convinced that the coating could be viable commercially, especially at a time when consumers are ever more

aware of the importance of saving energy and limiting the impact of energy consumption on the environment.

"We know that our customers want maximum efficiency at a competitive cost, and we believe that this technology can offer both expectations, so we anticipate working with our marketing and communications teams to make the technology an integral part of our range," says Mr Santacatterina.

"The transparent, hydrophilic and ultra-thin properties of the compound suggest a range of applications in other industries. We are proud to have made our contribution to building a more energy-efficient Europe, and to have demonstrated the upscaling potential of this technology," adds Mr Daniele.

**Project number:** LIFE11 ENV/IT/000103

**Title:** HEO - Highly Efficient Ovens through eco-friendly, energy efficient sol-gel enamelling process

**Beneficiary:** Whirlpool Europe s.r.l.

**Contact:** Gianpiero Santacatterina

**Email:** gianpiero\_santacatterina@whirlpool.com

**Website:** www.highefficientoven.eu/

**Period:** 01-Jun-2012 to 31-May-2015

**Total budget:** €1 821 000

**LIFE contribution:** €855 000



# UK: Assessing, capturing and utilising methane from closed landfill sites

The ACUMEN project demonstrated how methane from closed landfill sites can be managed to produce less harmful gases or captured and used in the generation of electricity.

Landfill sites are a significant producer of methane (CH<sub>4</sub>), a potent greenhouse gas that has 28 times the global warming potential of carbon dioxide (CO<sub>2</sub>). The many landfill sites across the EU represent a major environmental challenge for regulating authorities tasked with ensuring compliance with the aims of the Landfill Directive. Around 20 000 non-operational or closed landfill sites are located in the UK alone. While many of these precede the need for regulation, they nevertheless produce an estimated 12.9 million tonnes of CO<sub>2</sub> equivalent every year.

At the majority of these sites, landfill gases are simply released through a funnel and dispersed into the atmosphere or they are piped to a flare, which through combustion breaks down the harmful methane into CO<sub>2</sub>. There was therefore a definite need to show that these gases can be

used or treated to mitigate their impact without adding to the burden of those responsible for managing the sites.

The ACUMEN project (**LIFE11 ENV/UK/000402**) was set up to build on previous research into the treatment of methane and demonstrate feasible and financially-viable alternatives to today's common practices. To do so, it brought together a wide range of partners: the regulator, the Environment Agency (which was the project's coordinating beneficiary); a local authority, Norfolk County Council; two governmental departments (the Department of Energy and Climate Change and the Department of Environment Food and Rural Affairs); and two technology companies, Biogas Technology Limited and Ground Gas Solutions. The Warsaw University of Technology was also a project partner.

## Assessment and conversion tools

The first step was to determine the best five demonstration sites for the project. The project team devised rigorous selection criteria and the process served as a useful assessment exercise, says Charles Wright, landfill strategy manager, Norfolk County Council. "We had to pick sites that were typical but were also possible in a short period of time." The demonstration sites selected were located in Docking and Strumpshaw in Norfolk, as well as Sugden End in Yorkshire, Otterspool in Liverpool and Maesbury Road in Shropshire.

Each closed site has its own set of changing characteristics and its own challenges as a result. But the selection process helped clarify the common problems to be tackled. These range from the method of construction of the landfill, topography, sensitive receptors and climate through to available infrastructure, ownership and legal status. The differences mean that each site has to be managed on an individual basis, and maintaining the resources for such management can be difficult.

Estimating methane levels at one of the project sites



Photo: Ground Gas Solutions Ltd



Photo: Ground Gas Solutions Ltd.

*The project developed tools for identifying and harnessing the energy-generation potential of closed landfills*

For those closed sites that are the responsibility of municipal authorities, the problem of stretched resources is particularly acute, and the project thus focused on developing simple tools for assessing whether a site would benefit from the type of improved landfill gas management that the project aimed to demonstrate. The focus was on making the best use of existing landfill gas infrastructure.

Norfolk County Council is currently benefitting from the Stirling engines that were used in the energy conversion aspect of the project at the Docking site. These engines have now been relocated to the nearby closed landfill site at Strumpshaw, also one of the selected sites. The engine, the Cleanergy C9G, is an external combustion Stirling engine that burns the landfill gases to convert heat energy via helium expansion and compression to mechanical power. At Strumpshaw it is possible to feed this energy into the national grid (as well as use it locally at the adjacent recycling plant) – an option that is economically beneficial thanks to green energy subsidies.

As part of the LIFE project, the two engines were installed on the small landfill site of Docking that closed in 2000. These engines were shown to be able to generate 15 kW of electricity from 25 m<sup>3</sup> per hour of landfill gas that was between 18% to 32% methane. This was sufficient to power the landfill

site and around 8-10 local homes. The process represents an annual saving of some 1 000 tonnes of CO<sub>2</sub> emissions. Furthermore, the project estimated through cost-benefit analysis that these micro-scale engines can generate around €11 000 annually.

The project additionally demonstrated how waste heat produced during the process could be harnessed. This heat energy was used to heat water that was transported through an insulated pipe to a point where it was converted into hot air. This air was then blown into a modified biomass drying unit.

Across the five project sites, ACUMEN used a total of 1 339 tonnes of methane that would have been flared to produce energy: 594.8 MWh of electricity and 230 MWh of useable heat. Moreover, by showing that small legacy landfill sites can be net energy producers, the project led to the avoidance of around 340 tonnes of CO<sub>2</sub> emissions during its lifespan. A further 38 tonnes of emissions were avoided by using generated heat (and not other fuel sources) to dry biomass.

### Bio-filtering

Strumpshaw is an unlined landfill site near Norwich that ceased operation in 1988. Nevertheless, it still requires



## Spreading the word

The project formed strong links with Polish landfill managers, resulting in widespread dissemination of the project methods throughout the country. Two Polish companies contacted the project to seek assistance for developing treatments for methane. Closer to home, the project's legacy is already visible. Joel Hull, who is head of waste at Norfolk County Council, says that the other sites will shortly be "going down the route of the micro-scale engines". Cleanergy, a Swedish startup funded by the Nobel Foundation and the Swedish Energy Agency, has commissioned a market survey in the UK to test the potential roll-out of Stirling engines at closed landfills. Another company, Beetle Capital, has expressed interest in developing the sale of energy generated at closed landfills as an investment opportunity.

regular management and is the liability of Norfolk County Council. Before the project the site used a standard gas flare to control emissions but ACUMEN's assessment tools showed that it was a good candidate for trying out active bio-oxidation based gas treatment.

This process entailed creating a lined biofilter in the surface cover layer of the site consisting of a mixture of expanded clay, coir (coconut fibre), well-matured compost and wood fibres. These elements create a porous mix that retains moisture and organic matter to feed the methanophilic bacteria required for the bio-oxidation process. The filter at Strumpshaw was designed specifically to manage migration landfill gases. "It's a question of safety; if you don't treat the gas from a landfill site, it will only escape laterally. So it's about proving that you can do it. It works! It treats methane and it's safe," says Daniel Rankin, the landfill gas officer at Norfolk County Council.

*The new low-calorific flare works under lower methane concentrations than current technologies*



Photo: Environment Agency

The biofilter works by using the existing perimeter migration control line to pipe through landfill gas consisting of around 10% methane at 30 m<sup>3</sup> per hour. The bacteria then residing in the filter consume the methane to create a self-sustaining biological community. Its effectiveness was regularly monitored by assessing the weekly gas concentration data from different locations and depths within the unit. The filter was shown here and elsewhere to reduce methane and increase CO<sub>2</sub> concentrations between the base and the surface. In fact, the bio-oxidation process was shown to result in methane removal rates of 90% at the biofilter surface.

But this process is only suitable when landfill gas flow and methane concentrations are relatively low – commonly when a site is in its last and long-lasting stages. Overall, the measures demonstrated by the project are not suitable for all sites but they can be tailored to individual needs. "The challenge was to make a standalone business case. We are at the cusp of the hill and with a bit of support we can get over it," says Charles Wright of Norfolk County Council. Such support might depend on government priorities, but ACUMEN's main achievement was to show that treating landfill gases can be profitable or at least not a financial burden.

At the Strumpshaw site, for example, emissions would have continued to be managed (though with a greater environmental impact) without the project. So the transportation costs of someone to monitor the site's treatment processes are already budgeted. It is now just a case of the extra hours required to take the additional measurements, a cost that is compensated for by the energy now produced on the site. In short, such an outcome is the real success of the project, emphasises Mr Wright: "The regulator has now got something [the ACUMEN results] that it can point to when people say, 'there's nothing we can do'...Before it was engine, flare and finally vent. ACUMEN has shown that there's a green way and that it's technically possible."

**Project number:** LIFE11 ENV/UK/000402

**Title:** ACUMEN - Assessing, Capturing & Utilising Methane from Expired and Non-operational landfill

**Beneficiary:** The Environment Agency

**Contact:** Matt Askin

**Email:** matt.askin@environment-agency.gov.uk

**Website:** [www.gov.uk/government/groups/acumen-assessing-capturing-and-utilising-methane-from-expired-and-non-operational-landfills](http://www.gov.uk/government/groups/acumen-assessing-capturing-and-utilising-methane-from-expired-and-non-operational-landfills)

**Period:** 03-Sept-2012 to 28-Aug-2015

**Total budget:** €2 935 000

**LIFE contribution:** €1 437 000





# Spain: Plastic and rubber wastes increase the sustainability of road construction

The POLYMIX project demonstrated the reuse of household plastic polymer wastes and rubber from end-of-life tyres as raw materials in the production of asphalt mixes. This helps divert waste from landfill and results in more durable roads.

Plastic waste can take hundreds of years to biodegrade in landfill, where it is accumulating in and potentially contaminating soil and groundwater. With an increasing number of ephemeral products on the market, there is an urgent need for economically-viable uses for plastic waste. One promising idea is to add it to road asphalt. This has been done in India, where shredded plastic from household waste has been added to more than 5 000 km of roads, with fewer potholes being reported. However, it is not known if these roads would comply with EU regulations and standards. The POLYMIX project (**LIFE10 ENV/ES/000516**) was the first demonstration of the use of polymer waste in asphalt mixtures made using a dry mix method under real road conditions in Europe.

At the University of Cantabria (UNICAN) in Santander, Irune Indacoechea of GITECO (Construction Technology Applied Research Group) explains the origins of the LIFE project: "The initial laboratory work of ACCIONA Infraestructuras (Madrid) and AIMPLAS (Valencia) on polymer asphalt mixes had shown promising results. The mixes were found to have important properties that would allow them to perform well in roads." To progress this work and move it beyond the laboratory a consortium was established, which also included VIA-M, the directorate of roads for the community of Madrid.

"The project tested 18 different polymers in trials and four were selected to make the asphalt mixes," says Ms

*In Spain alone, about 45 million tonnes of asphalt mixes are produced annually. In Europe, the figure is about 300 million tonnes/yr*

Photo: POLYMIX Consortium





Indacoechea. "After testing different concentrations of these polymers, we selected 1% polymer in each asphalt mix. All the mixes met Spanish technical requirements for use in roads with heavy traffic loads." The project's four asphalt mixes incorporated powdered rubber from end-of-life tyres (ELT), and the most commonly used plastic polymers, namely, polyethylene (PE) from containers, polypropylene (PP) from bottle caps, and polystyrene (PS) from clothes hangers. In addition, a fifth mixture was made as a reference (control).

## The Roads Laboratory

In the basement of the School of Civil Engineering at UNICAN are machines for making asphalt mixes and determining their material and mechanical properties. These include a compacter "that works like the passing of a roller, so that realistic asphalt cores can be tested in the other machines," explains project manager, Daniel Castro-Fresno. The lab also has a wheel tracking test machine, in which a wheel continually moves to create a rut in the asphalt. "We do the tests at 60°C, to simulate hotter road conditions," says Mr Castro-Fresno. The addition of polymer wastes increased resistance to rutting (also called plastic deformation). In situations with high temperature and high traffic volume, reducing rutting is an important factor in increasing road durability.

In the basement room with the loudest noise, another machine simulates the effects of hundreds of wheels passing to measure asphalt stiffness and load. "We observed that the polymer wastes increased asphalt stiffness without

*The POLYMIX mixtures proved more resistant than conventional asphalts*



Photo: POLYMIX Consortium

compromising fatigue resistance," says Ms Indacoechea. "Increased stiffness means the asphalt is able to resist higher stress, so it transfers a lower load through the asphalt layers. This enables a decrease in the thickness of the asphalt mixture. When stiffness is higher the asphalt usually has a lower fatigue resistance, so this result is very good," explains her colleague Pedro Lastra from GITECO.

Asphalt is made when aggregate is mixed with bitumen (the binder). The polymer wastes were added to replace 1% of the aggregate by volume. However, the addition of polystyrene was found to have an unexpected benefit. "Around 80% of the PS used in this project is thought to have melted and blended with the bitumen, so there is a possibility of reducing the amount of binder," notes Ms Indacoechea. Bitumen is the most expensive component, so GITECO is planning further work with this promising asphalt mix.

## Upscaling: the asphalt plant

The project modified an existing asphalt plant to produce the asphalt mixtures in sufficient quantities to construct a demonstration road. It conducted tests to compare these samples with those made in the laboratory (e.g. rutting, water sensitivity and other properties), and similar results were obtained for the asphalt plant and laboratory mixes. The team also carried out work to determine the best order in which to add the aggregate, bitumen and reused waste materials to the mixing drum. All the mixes complied with Spanish and European regulations concerning road-building materials.

The project found that little modification was needed at the asphalt plant, so the technique is easy to replicate and transfer. The main advantage is that the polymer can be directly added into the mixer drum, as a direct replacement for aggregate, in a simplified and easily exportable dry process; whereas previously, polymers have usually been added to bituminous mixes using a more specialist wet process. "I think this is one of the best points of the project," says Mr Lastra, "because using the dry method you can manufacture this type of mixture in practically any asphalt plant."

## The demonstration road

The four asphalt mixes and the control were incorporated into a new access road onto a motorway. The stretch, which has heavy traffic loads, was monitored over an 18-month period. "We were responsible for the construction of the test section of the M-300 near Madrid, and its monitoring and the quality control," says Raquel Casado of ACCIONA, speaking over the telephone from a road construction site. "The LIFE funding enabled us to work with different groups, which was really important for ACCIONA as it is not always possible to

test new technology in a realistic scenario. I think it is a technology that works well, particularly with some types of polymer, so we are offering this kind of technology in our bidding processes," she explains. "We will tell clients that we have the technology ready to apply, and I think it is something that can benefit construction."

Monitoring work was subcontracted to CEDEX (the national research centre for public works), and included taking core samples for testing. Its analysis of stiffness, water sensitivity, rutting resistance, micro-texture and other parameters confirmed the results obtained in the UNICAN laboratory. CEDEX also monitored traffic volumes for an economic feasibility study. This found that the asphalt mixes made with polymer wastes were more expensive, but that their life-cycle costs were favourable because the improved durability of roads lowers maintenance costs. It also showed that the better mechanical performance of these mixes could be used to reduce the total asphalt pavement thickness, which could save on raw material costs (natural aggregates and bitumen), reduce the amount of asphalt produced, and therefore reduce energy use and greenhouse gas emissions during the manufacturing process.

The construction of the stretch of demonstration road (375-425 m for each asphalt treatment) required 20 tonnes of recycled polymer waste and saved on the use of 60 tonnes of aggregate. Environmental benefits also arose from reduced amounts of waste going to landfill. The best results were obtained with the PS and PP asphalt mixes. However, the project team believes it can further improve the performance of all the asphalt mixes, for example, to reduce clustering in the PE mix and the adhesion of the ELT mix to roller wheels.

## LIFE Citizens' Award

POLYMIX won the LIFE Citizens' Award for environment at the Best LIFE Projects 2015 ceremony in Brussels, during EU Green Week in May 2016. This award was voted by the public, so what made it such a popular project? "It was a big surprise for us," says Prof Castro-Fresno. "Maybe because it is a project that is easy to understand; I think roads are used by people every day and everybody knows the large amounts of plastic waste they produce in their own houses." Mr Lastra agrees: "I think people now are very aware of the problem with plastic waste."

The solution offered by the project is relevant to EU directives concerning waste management, landfills, product packaging, end-of-life vehicles and, most recently, the EU Action Plan for the Circular Economy, which stresses the need to divert plastics away from landfill and incineration to reuse and recycling. "The life-cycle analysis showed



Photo: POLYMIX Consortium

*Polymers are currently recycled at very low rates in most countries*

that one tonne of the polymer waste goes into one hundred metres of road, so potentially a lot of waste could be used in this way," says Prof Castro-Fresno. In Europe, some 300 million tonnes of asphalt mixes are produced annually. However, Prof Castro-Fresno points out that although construction companies are interested, the problem at the moment in Spain is a shortage of new road building and management work.

To help promote uptake of the technique, project partner VIA-M produced a Green Public Procurement (GPP) POLYMIX Guide. "It was at a time when communities around Spain started to propose manuals for GPP to encourage companies to include environmental criteria in purchasing decisions," says Ms Indacochea. "The guidelines enable construction companies to include environmental benefits in their proposals. The project's manual for GPP, I think, was the first such manual within the community of Madrid."

**Project number:** LIFE10 ENV/ES/000516

**Title:** POLYMIX - Polymer Wastes in Asphalt Mixes: a Way to Increase Sustainability of Roads Infrastructures

**Beneficiary:** University of Cantabria

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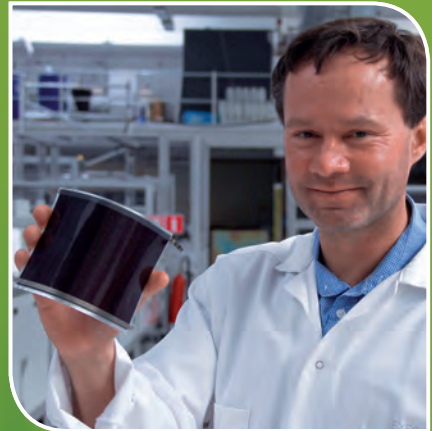
**Website:** www.polymixlife.eu

**Period:** 01-Sept-2011 to 31-Mar-2015

**Total budget:** €1 535 000

**LIFE contribution:** €760 000





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# BEST PROJECTS

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# Spain: Smart building technology for improved energy efficiency

The **DOMOTIC** project showed how intelligent construction with smart technologies can improve energy efficiency in buildings with high energy consumption, while also reducing carbon dioxide (CO<sub>2</sub>) emissions to help mitigate climate change.

**D**omotics is the term used to describe automated or semi-automated appliances that improve the efficiency of energy consumption in homes; inmotics is the equivalent term for such appliances in industrial buildings. This emerging smart building technology encompasses heating, ventilation and air conditioning (HVAC) and lighting systems. Given that HVAC and lighting account for over 40% of total energy use in the EU, models for 'intelligent systems' can significantly contribute to improved energy efficiency, and the reduced CO<sub>2</sub> emissions necessary to mitigate the negative impacts of climate change.

The main objective of the DOMOTIC project (**LIFE09 ENV/ES/000493**) was to show the potential of domotics and inmotics to reduce energy consumption in buildings with high-occupancy and high energy consumption. To achieve this goal, coordinating beneficiary San Valero Foundation (FSV) collaborated with the Natural Heritage Foundation of Castilla y León (Spain), Europe Innovation and Development (Spain), Association for Development and Sustainability (Spain), and Graz Energy Agency (Austria).

## Three demonstration buildings

The project implemented three models of automation in three demonstration buildings in Spain: FSV's training centre in Zaragoza; San Jorge University campus in Villanueva de Gállego; and the Environmental Education Proposals (PRAE) building in Valladolid.

Software and computer models were deployed to control automated devices in the demonstration buildings. The project used KNX-certified technology to enable products from different manufacturers to communicate with each other. Presence detectors, light brightness sensors, air quality, temperature and humidity probes, and daily and seasonal timers fed information into integrated control systems that adjusted HVAC and lighting. This took the form of automated



*The project proved the CO<sub>2</sub> emission reduction potential of domotics and inmotics*

opening and closing of windows and blinds, the automated dimming or switching off of lights when rooms are unused, the control of fuel consumption through metering, and the detection of 'phantom energy consumption' to facilitate the repair of leaks and malfunctions. In the PRAE building, the project also deployed renewable energy (solar thermal and biomass). The effects of the different energy-saving actions were closely monitored in all three buildings.

The project team made innovations in design, methodology and approaches to produce good building governance

models based on the use of domotic applications. Overall, the implementation of automated solutions in the three buildings led to a 63.9% annual improvement in energy efficiency, an emissions reduction of 680 tonnes CO<sub>2</sub>/yr, and an economic benefit of €162 000/yr. The average return on investment was calculated to be four years, with a durability period of 15 years.

In all three cases, savings of between 40% and 50% in electrical energy consumption were recorded. These savings were mainly achieved through the installation of presence detectors (20%), and changes in lighting systems (e.g. switching to LEDs) and the use of computerised lighting controls (50% with fluorescent and 71% with LED lighting).

Heating-energy savings of over 40% were achieved with the Building Management System (BMS) model used in the PRAE building, mainly due to the automated control of the HVAC system and the performance of the biomass boiler. The project's BMS model controlled four sub-systems (HVAC, lighting, computer equipment, and solar and biomass energy production) facilitating their integrated management. It enabled problems in temperature and flow in the heating system to be detected and corrected.

The demonstration buildings were of different ages and construction types, to demonstrate that the approach can be widely replicated. The project's models were designed to be versatile and scalable for ease of transfer. High replication potential is ensured due to the ready availability of automated devices on the market, the short payback period, and the considerable cost-saving and environmental benefits. In addition, the project's results are contributing toward the standardisation of smart installations across the EU.

### Raising awareness about energy consumption

To encourage building users to adopt more responsible behaviour in terms of energy use, the project created an online information tool to track energy consumption and savings in real-time in large buildings. The tool evaluates energy performance and CO<sub>2</sub> emission reductions for different energy-saving actions.

DOMOTIC's Manual of Good Practices summarises the project's findings in areas such as heating systems and interior and exterior lighting. The project contributes towards achieving a range of EU policy objectives, such as those in the Directive on energy performance of buildings (2002/91/CE), the Directive on energy end-use efficiency and efficiency services (2006/32/CE), and the European Climate Change Strategy - which identifies the building sector for special attention.



The project tested a range of techniques, including integrated control of lighting (pictured)

The project team established the Network of European Models of Energy Efficiency. This network, which already includes over 50 members, brings together managers of public and private buildings to facilitate the commercial uptake of domotics. Members of the network can display a plaque, which acknowledges their commitment to improving energy efficiency in buildings and taking action to mitigate against climate change.

After LIFE, the project beneficiaries are applying the models developed during the project in two buildings of heritage importance, the Diocesan Museum of Zaragoza and the Parish Church of La Magdalena, as well as in the San Valero Group's new headquarters in Zaragoza.

"The environmental and economic benefits obtained exceeded expectations, which demonstrates that domotic solutions have major potential for reducing energy consumption and CO<sub>2</sub> emissions," says Nieves Zubalez of FSV. "This is mainly by facilitating the control of consumption and thereby making it possible to manage energy better, improve efficiency, and detect leaks or malfunctions in the installations."

**Project number:** LIFE09 ENV/ES/000493

**Title:** DOMOTIC - Demonstration Of Models for Optimisation of Technologies for Intelligent Construction

**Beneficiary:** Fundación San Valero (FSV)

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**Website:** www.lifedomotic.eu/

**Period:** 01-Sept-2010 to 31-Aug-2014

**Total budget:** €2 355 000

**LIFE contribution:** €1 114 000



# Finland: Addressing concerns about urban street dust

The REDUST project changed street cleaning practices to reduce respirable PM10 street dust. This led to a reduction in the number of times when this form of air pollution exceeded daily limits in participating Finnish cities. Successful measures trialled by the project will be included in Helsinki's new air quality action plan.

Street dust is a major air quality issue in Finnish cities because of the traction control measures taken during the Finnish winter: usage of traction sanding and studded winter tyres, explains Jukka-Pekka Männikkö, environmental inspector, City of Helsinki Environment Centre. The mineral particles from traction sand, tyres and pavement wear accumulate in the street during winter. In spring, when snow and ice melt and surfaces dry out, the particles become airborne and are a major source of urban air pollution (PM10) in sub-arctic regions.

City residents and the Finnish media are well aware of the street dust problem, which particularly affects those who suffer from respiratory diseases. To address this health issue and to meet the limits required by the EU Directive on

ambient air quality and cleaner air for Europe (2008/50/EC), the City of Helsinki Environment Centre developed a LIFE project called REDUST (LIFE09 ENV/FI/000579).

## Testing new maintenance strategies

"The REDUST project sought to demonstrate the best maintenance measures for mitigating street dust issues. Over four years we tested different street cleaning, dust binding and traction control methods to study their impact on street dust and to develop new maintenance strategies," explains Mr Männikkö, who was the project coordinator. This also involved a cost comparison between current methods and the alternatives tested by the project in Helsinki and the neighbouring cities of Vantaa and Espoo.

*REDUST assessed the effectiveness and cost-efficiency of various techniques for reducing winter street dust in Helsinki*



The project assessed the impact of practices to improve traction control, such as winter tyres and traction sanding. It found that there was significant variation between different types of tyre, but in general studded winter tyres caused more dust emissions than studless ones. Wet sieved traction sanding material with the finest size fractions removed was also found to lower dust emissions.

Other techniques investigated by the REDUST team included new dust-binding solutions and dispersion techniques and changes to street cleaning practices, such as mechanical and vacuum sweepers, street scrubbers and combinations of different techniques and technologies.

### PM10 reduction

The REDUST project had a noticeable impact on street dust episodes in the areas where the new methods were implemented. For example, the dust binding and street cleaning measures carried out on a 10 km route in Helsinki in spring 2014 cut PM10 emissions by 15% - or some 1.6 tonnes of street dust.

There was a reduction in the number of days on which PM10 particles exceeded the limit value ( $>50 \mu\text{g}/\text{m}^3$ ) in Helsinki city centre, and the margin by which the limit was exceeded on poor air quality days was reduced; in Vantaa and Espoo, the limit value was not exceeded at all.

"We estimated that improved methods of dust binding and street cleaning could cut springtime street dust emissions by 25% in busy urban traffic environments," notes Mr Männikkö.

*An air quality monitoring station used by the project*



"The estimated quarter reduction will have significant environmental and health benefits in densely populated areas," he adds.

The project coordinator highlights the positive impact of two winter maintenance methods in particular: "Dust binding with calcium chloride is very effective in the Helsinki region, because it can be performed quickly, it is relatively cheap and it cuts street dust emissions typically by 30%-60% for a few days after treatment. Another effective way to mitigate fine street dust is to clean streets with high-pressure water washing techniques," says Mr Männikkö.

### Replication and long-term impact

Communication activities were very important for the success of REDUST. "During the project we continuously communicated the new results to Finnish and international audiences," says Mr Männikkö. The REDUST team organised annual street dust seminars aimed at national experts during each of the four years of the project, as well as two international seminars for Scandinavian and Baltic audiences. Project experts also attended a number of international events to spread the results even further afield.

As a result of the project, the City of Helsinki Environment Centre has received significant interest from other Finnish municipalities in the maintenance methods used. The cost effective best practices demonstrated by REDUST will also be included in the street dust section of the new air quality action plan for Helsinki for 2017-2024. One of the aims of the plan is to reduce the risk of exceeding the PM10 limit value. In the longer term, Helsinki has adopted a new environmental policy designed to reduce the annual maximum number of days when that limit value is exceeded from 35 to 18 per year by 2050.

"During and after REDUST, the PM10 levels have been improving in Helsinki. Improved street maintenance is believed to be one key contributor to this positive development," concludes Mr Männikkö.

**Project number:** LIFE09 ENV/FI/000579

**Title:** REDUST - Best winter maintenance practices to reduce respirable street dust in urban areas - demonstration of best practices, strategy development and implementation

**Beneficiary:** City of Helsinki Environment Centre

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**Website:** www.redust.fi/

**Period:** 01-Jan-2011 to 31-Dec-2014

**Total budget:** €1 046 000

**LIFE contribution:** €500 000





# Greece: Combating particulate matter pollution

ACEPT-AIR developed an innovative software tool to evaluate different methods of cutting emissions and quantifying the resulting reductions. Policy makers can use this to determine how best to cut pollution to meet EU limits.

Particulate matter (PM) is a major component of outdoor air pollution and presents a serious threat to human health and the climate. Fine particles (with a diameter of  $2.5\ \mu\text{m}$  or less,  $\text{PM}_{2.5}$ ) are most detrimental to health, but coarser fractions (with a diameter of  $2.5\text{--}10\ \mu\text{m}$ ,  $\text{PM}_{2.5\text{--}10}$ ) are also problematic. Despite improvements in air quality across the EU, levels of particulate matter remain a concern. In Greece, national monitoring programmes have recorded high ambient PM concentrations. More information was needed on their sources, though, in order to develop targeted reduction measures.

The ACEPT-AIR project (**LIFE09 ENV/GR/000289**) aimed to bridge this gap and distinguish which emission sources were causing PM concentrations that exceed the limits set by EU legislation. Specific goals included determining whether the emissions came from human or natural sources, and developing a tool to enable the authorities to evaluate and adopt different control strategies.

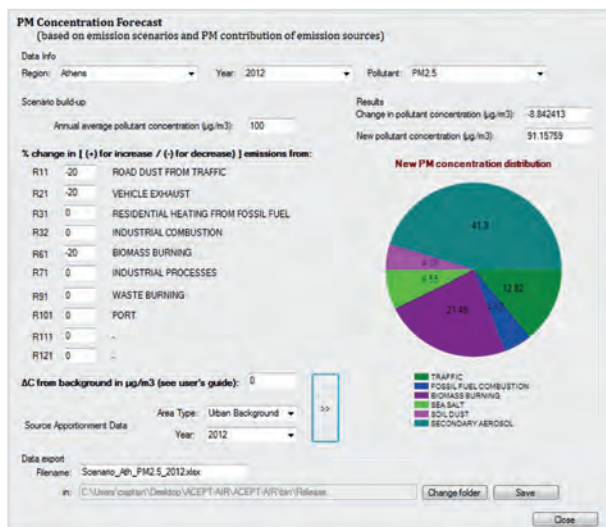
## Mapping the problem

The Greek National Centre for Scientific Research ('Demokritos') coordinated the project. The first stage involved a sampling campaign at three urban locations - in Athens, Thessaloniki and Volos - to establish the relative contributions of different sources to PM concentrations. Detailed airborne PM levels were recorded during the cold and warm seasons of 2011 and 2012. The project team then applied modelling tools to the data in order to specify whether the particulate matter originated from natural or anthropogenic sources and to produce emissions inventories. Natural sources of particulate matter include volcanic activity, wildfires and sea spray aerosol, while human sources include vehicles, central heating, waste disposal and industry.

A database of historical information was compiled to enable observation of trends in air pollution. The project found that PM levels were lower than in previous years but still exceeded EU limits in several cases. The issue was more acute during

*Through an intensive sampling campaign, the project recorded the levels of particulate matter in the three participating municipalities*





The tool developed by the project helps municipalities to pick the most suitable PM reduction measures

the winter because of particles trapped in lower layers of the atmosphere and increased residential burning of biomass because of higher prices for heating oil.

To tackle this problem, the project developed an innovative piece of software - the ACEPT-AIR Policy Tool - which enables users to estimate the PM reductions resulting from different emissions scenarios and control measures. In particular, it allows users to identify pollutants and their sources and estimate the contribution of each. This information can then be used to estimate pollution levels, compare different emissions scenarios and determine suitable reduction measures. Consequently, the tool can be used by policymakers when deciding how best to cut PM pollution to acceptable levels.

### Recommended reduction measures

The project also produced guidelines (available online) for national, regional and local authorities on how to formulate effective action plans to reduce PM emissions. These contain specific measures and policies to achieve the limit values and concentration reductions required by the EU Directive on ambient air quality (2008/50/EC).

The recommended measures for industry include: reduced fuel consumption through increased efficiency of burners, boilers and power generators or machinery using heavy fuel oil; high standards for fuels used in industry; and frequent inspections of facilities. Proposed methods of tackling PM pollution from road traffic include low emission zones, street cleaning, promoting new technology for low-emission vehicles, cutting transportation of goods by road, expanding public transport and reducing fares.

The guidelines also suggest enforcing restrictions on central heating of public buildings, ensuring they use efficient and low-emissions systems. For residential heating, they recommend

reducing biomass burning through several approaches, including: environmental education and awareness-raising measures; introducing and encouraging the use of natural gas and renewable energy sources; improving the thermal insulation of buildings; and promoting energy-efficient appliances and heating equipment.

Long term, ambient air quality is expected to improve as policymakers take advantage of ACEPT-AIR's software tool and data, significantly enhancing public health and the quality of the environment. This should have economic benefits, lowering costs related to hospitalisation, lost working days and reduced capacity to work, as well as other effects related to poor health and visibility. Policymakers will also be able to select the most cost-effective and resource-efficient mitigation strategies, yielding additional savings.

In the meantime, there has been a noticeable reduction in burning of biomass for residential heating, which has caused high PM concentrations during winter in the past. Awareness-raising and educational campaigns carried out by the project and the Greek Ministry of Environment and Energy, targeting people living in big cities, have contributed to the fact that there were fewer and less severe pollution episodes during the winters of 2013, 2014 and 2015.

"The development and application of the ACEPT-AIR Policy Tool, achieved with LIFE programme funding, has linked scientific knowledge and specialised modelling tools with active policymaking," says the project's scientific secretary, Lila Diapouli. "It has thus demonstrated to relevant authorities and other interested parties that scientific data and modelling tools are available and should be used for informed policymaking in air quality management."

The free tool can be updated with new data and used in other locations, both in Greece and internationally. "The only prerequisite for application of the tool is that PM source apportionment data and emissions inventories are available for the areas being studied," explains Ms Diapouli.

**Project number:** LIFE09 ENV/GR/000289

**Title:** ACEPT-AIR - Development of A Cost Efficient Policy Tool for reduction of Particulate Matter in AIR

**Beneficiary:** Demokritos (National Centre for Scientific Research)

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**Website:** [www2.ipta.demokritos.gr/accept-air/index.html](http://www2.ipta.demokritos.gr/accept-air/index.html)

**Period:** 01-Sep-2010 to 31-Aug-2014

**Total budget:** €1 750 000

**LIFE contribution:** €836 000



# Greece: Safe and sustainable disposal of brine from desalination

The SOL-BRINE project, using solar energy to separate the by-product of water desalination plants in the Cyclades, has eliminated the dumping of brine back into the sea, preserved the pristine marine environment, led to significant energy savings and created new economic opportunities.

As pressure on water resources increases, desalination is increasingly required for the provision of potable water to communities, especially those located in peripheral regions of the European Union. In the Cyclades, a group of islands in the Aegean Sea, desalination has become commonplace due to the depletion of groundwater reserves and the problems of saline intrusion and soil erosion. However, desalination brings its own environmental challenges – in particular the disposal of the highly concentrated brine by-product, which is twice as salty as the seawater that serves as the raw material for desalination plants.

The aim of the SOL-BRINE project (LIFE09 ENV/GR/000299) was to minimise the environmental impact of desalination by using solar power to separate the brine produced by desalination into its component parts – water and salt – which could then be marketed and used. This process would in turn eliminate the dumping into the sea of the brine, preventing the degradation of the marine ecosystem so important for communities as a food source and tourist attraction and provider of other ecosystem services. In tackling water scarcity and commercialising a waste product of desalination, this innovative project would thus help

to deliver the goals of the EU's Water Framework Directive, climate adaptation policy and circular economy package.

“It is vital to minimise the environmental impacts from desalination plants, especially brine disposal. The SOL-BRINE project aimed to resolve this pressing issue while at the same time recovering all resources from desalination using renewable energy,” says Professor Maria Loizidou from the National Technical University of Athens, a project partner.

The project's inputs were the simplest imaginable – sunlight and sea water. The project sought to place the desalination industry in the Cyclades archipelago on a more sustainable footing by addressing demand for water while at the same time reducing the intensive energy usage associated with desalination works.

## Cheaper, cleaner water

The focus of the project was the island of Tinos, where the municipality took the lead in improving the environmental footprint of the desalination plant in Agios Fokas. The facility commenced operations in 2002 and, using a system of reverse osmosis,

*The desalination plant developed by the SOL-BRINE project, used solar energy to separate brine into its component parts – water and salt – which could then be marketed and used*



produces 1 500 m<sup>3</sup> of drinking water a day, around two-thirds of the water demand of the island's capital, Chora.

However, during the summer months, when the island's population of 8 600 increases fourfold, Tinos becomes water-deficient. Until a few years ago, tankers from the mainland port of Lavrion shipped water to the island, but the onset of Greece's severe financial crisis obliged the authorities on Tinos to seek innovative ways of providing, managing and enhancing the island's water requirements.

"Tinos, like most of the Cyclades, needed a permanent and sustainable solution to the demand for water on the island," explains SOL-BRINE project manager, Tasos Vidalis. Working with the National Technical University of Athens and the private company Culligan Hellas S.A., local officials aimed to create a carbon-free system of brine reclamation that could be piloted, assessed and possibly shared with other islands and areas of Greece reliant on seawater treatment for their water needs.

In the implementation phase, the project focused on the design, testing and optimisation of technology to treat the brine by-product – two litres for every litre of drinking water produced. In the first treatment stage, an evaporator is used to create a water vapour stream, more than 90% of which is then recovered as fresh water, and a highly concentrated brine stream.

This effluent is then crystallised, producing slurry with humidity levels of approximately 50%, in a highly energy-efficient process using vacuum technology and a heat pump. The final stage is the drying, in which the slurry's moisture is removed and dry salt is produced.

In addition to the core activity of developing the pilot phase and refining the technology, project staff organised outreach activities to engage local communities in this pioneering effort, including school visits and training for teachers.

### Prospects for commercial rollout

SOL-BRINE's effect on Tinos has been profound. The prototype system has the capacity to treat 200 tonnes of brine annually and recover useful end products that can boost the local economy. The commercial value of the 12 tonnes of harvested salt offers new income streams for communities hard-hit by recession and heavily reliant on tourism. And the environmental effect is dramatic – not only in terms of vastly reduced carbon emissions and the production of 82 kWh of renewable energy, but in the rejuvenation of the inshore waters around Tinos, and in particular the health of the sea grasses that are the bedrock of the island's biodiversity.

Inspired by the successful outcome of the pilot phase, the project consortium sought to upscale and commercialise its work.

### Cost benefits for islanders

Water desalination is an energy-intensive industry, and the use of electricity derived from fossil fuels to power the process contributes to climate change. It can also contribute to higher water prices for consumers, which can be a burden in remote, low-income communities. SOL-BRINE, by supplying around 450 litres a day of high-purity water from recovered brine, and by doing so using renewable solar power, delivered cost benefits to the island's residents. Furthermore, the use of solar energy over the life of the project saved an estimated 94 tonnes of greenhouse gas emissions.

The project was awarded the first prize in the Blue Growth Piraeus Competition, receiving incubation support and coaching for the creation of a start-up company. The EU's Horizon 2020 research programme then awarded SOL-BRINE a grant to develop a strategic business plan – Green Desalination, which outlined a closed-loop system for full recovery of water and raw materials from the wastewater effluent.

In November 2015, a company, SEALEAU, was launched to take the Tinos pilot one step further by developing a circular economy approach for the re-use of metals and minerals recovered from brine effluent. "SOL-BRINE not only protected the marine environment but also provided critical insight on understanding the circular value of seawater desalination brine. It was the stepping stone for the continuation of our path towards next generation desalination: circular desalination," says Dimitris Xevgenos, chief executive of SEALEAU, who also worked as principal investigator on the project.



**Project number:** LIFE09 ENV/GR/000299

**Title:** SOL-BRINE - Development of an advanced innovative energy autonomous system for the treatment of brine from seawater desalination plants

**Beneficiary:** Municipality of Tinos

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**Period:** 01-Oct-2010 to 31-Dec-2013

**Total budget:** €1 210 000

**LIFE contribution:** €605 000



# Greece: Deriving fuel from non-recyclable urban waste

**A Greek project demonstrated that previously landfilled packaging waste can be converted into a valuable resource. It used a specially designed gasification unit at a recycling facility in order to produce syngas for energy production and thus reduce overall greenhouse gas emissions.**

The recycling of urban waste is increasingly common, but a significant fraction of solid waste still ends up in landfill. As this waste deteriorates it gives off greenhouse gases such as methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>). This waste material, however, could be used in the production of electricity by converting its carbon-based content into carbon monoxide (CO) and hydrogen (H). The resulting gas can be used as fuel.

The LIFE ENERGY-WASTE project (**LIFE09 ENV/GR/000307**) was set up to demonstrate the feasibility and environmental benefits of this process. WATT SA used its own waste recycling facility at Koropi near Athens in order to show that refuse-derived fuel (RDF) and solid recovered fuel (SRF) could be produced from the waste material. The end result was a fuel that was sampled and characterised according to the European CEN/TC 343 standard. The beneficiary then designed and installed a gasification unit in order to exploit the RDF/SRF to produce syngas that can subsequently be used for energy production.

## Meeting standards

First, the project assessed the potential waste streams available in Greece for RDF/SRF production along with the legal framework. To help with this task, it established a network of stakeholders involved in various stages of the RDF/SRF use chain. It then identified the main material streams generated in the treatment process at the facility of WATT, the project beneficiary. It was found that an estimated 85% of the remainder material had thermal capacity and was thus available for further processing.

Tests were then performed to identify the best way of processing this material for efficient RDF/SRF production. It was discovered that shredding it produced the best results and a shredder was thus purchased. Additional tests were carried out to determine the sampling procedure, such as the minimum and most effective sample size. Detailed analyses of

the collected samples were carried out for all the required parameters for CEN/TC 343 certification, along with some additional ones.

The next stage of the project was to carry out analysis of the thermodynamics, mass and energy balances, equipment sizing, process modelling and laboratory testing in order to help design the pilot gasification unit. Continuous testing of the different parts of the gasifier allowed mistakes to be corrected and alterations made during the construction process. Following the full installation, the whole gasification unit was cold and hot tested and final modifications were implemented.

The project performed pilot tests first with willow wood pellets and then with RDF pellets from the WATT facility. The research institute, CERTH, a project partner, assisted with this stage of the project. The gasifier's efficiency was estimated through the use of two different indicators – Cold

*The project demonstrated that a larger-scale version of the gasification technology tested could be commercially-viable*





Generating electricity from non-recyclable urban waste avoids landfill and reduces greenhouse gas emissions

Gas Efficiency (CGE) and Carbon Conversion Efficiency (CCE) – and by calculating the mass and energy balances. The ENERGY-WASTE team also assessed the gasifier's thermal energy efficiency and environmental performance and its potential to be scaled up.

The energy acquired from the use of RDF is almost half the energy required for the gasification process to proceed and maintain a steady temperature at the range of 750-800°C. As a result, the project concluded that scaling up the gasification pilot unit is necessary to make the operation most cost effective.

Finally, it carried out a life-cycle assessment to highlight the potential environmental benefits of the gasification technology and commissioned a further study of the benefits of gasification over incineration for RDF from the WATT facility. The project team then considered two scenarios for RDF production in Greece with different fuel qualities, electricity prices and gate fees. They found that gasification technology is economically viable for large-scale plants and that drying the fuel can be a more profitable solution, providing better returns on the same investment. For low-quality fuels and a gate fee up to €40/tonne, all investments can be profitable for electricity prices above €95/MWh, while for high-quality fuels all investments are profitable for €85/MWh of electricity.

The project showed that generating electricity from the non-recyclable fraction of urban waste is environmentally advantageous: less waste is disposed at landfills and thus CH<sub>4</sub> and CO<sub>2</sub> emissions are reduced. The project's use of urban waste for electricity generation is in line with the EU

circular economy package which states that when waste cannot be prevented or recycled, recovering its energy content is in most cases preferable to landfilling. 'Waste to energy' can create synergies with EU energy and climate policy when guided by the principles of the EU waste hierarchy, whereby only the non-recyclable fraction of municipal and solid waste should be used to produce energy.

The project's positive impacts were communicated at conferences and in scientific papers as well as being outlined in guides for other facilities to replicate the project's results. "Through meetings, conferences and site visits for both individuals and organisations, we had to explain that we had produced a state-of-the-art pilot gasifier which is far away and above from any mass burn waste management system," says Kostas Verganelakis, the project manager. The project team is now looking to design and build a scaled-up gasification unit next to the packaging waste sorting plant. "We hope that this success story can have multiple implementations at other plants and in other communities," he adds.

**Project number:** LIFE09 ENV/GR/000307

**Title:** ENERGY-WASTE - Energy exploitation of non-recyclable urban waste in a sustainable waste-to-energy market

**Beneficiary:** WATT

**Contact:** Kostas Verganelakis

**Email:** k.verganelakis@hutgmbh.com

**Website:** www.energywaste.gr/

**Period:** 01-Jan-2011 to 31-Dec-2014

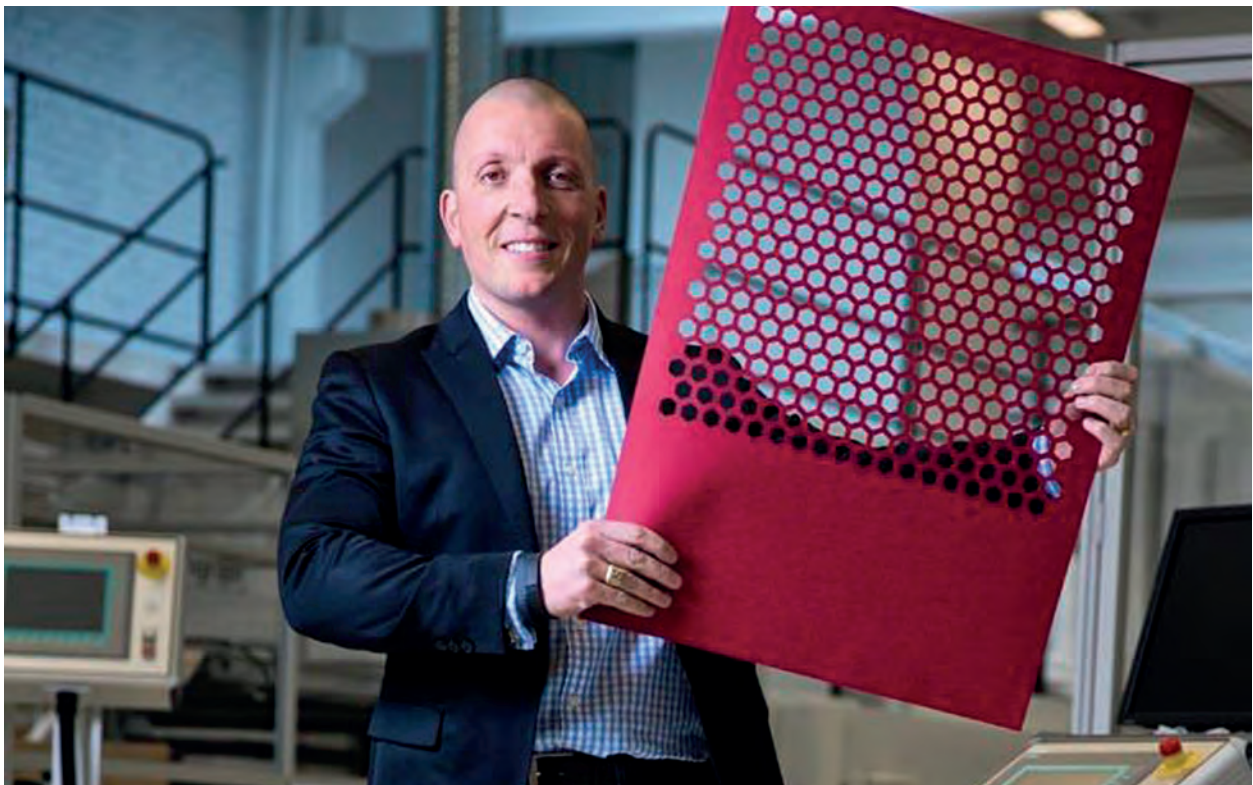
**Total budget:** €1 923 000

**LIFE contribution:** €900 000



# Sweden: A novel solar technology in Stockholm

**DYEMOND SOLAR proved the potential of screen-printing as a production method for manufacturing dye-sensitised solar cells. The new technology, together with the printing process, laid the groundwork for a full-scale factory in Stockholm.**



*Giovanni Fili, the founder and CEO of Exeger demonstrates the viability of dye-sensitised solar cells*

**P**ower generation constitutes 20-25% of CO<sub>2</sub> emissions and is therefore a focus for attempts to reduce the effects of greenhouse gases on the environment. There are currently two dominant outdoor solar markets: solar farms, and building integrated photovoltaics (BIPVs) – both of which have been installed since the 1970s and are a competitive sector, with silicon solar cells dominating. These two markets are often reliant on state subsidies and regulations for successful growth, because of strong competition.

## 'Most promising'

Dye-sensitised solar cells (DSCs) are the most promising latest generation solar cells. DSCs are based on the principle of photosynthesis, with dyes and titanium dioxide being two of the main components, both of which are abundant in

nature. Through the LIFE DYEMOND SOLAR project (**LIFE09 ENV/SE/000355**), the company Exeger has built and successfully demonstrated the first screen-printing pilot line for manufacturing solar cells, specifically DSCs. They are now ramping up yearly production capacity to 200 000 m<sup>2</sup> from the 20 000 m<sup>2</sup> achieved during the project.

DSCs are able to work better under indirect, diffuse and low light conditions than conventional solar cells, which means they are ideal for all weather conditions, and can even be used indoors. Exeger chose to produce solar cells with commercially available materials that are abundant and non-toxic. The end result is a completely clean and environmentally-friendly production line manufacturing solar cells made only of safe materials. This is also the reason the Exeger factory has been allowed to be located in one

of the most environmentally-friendly cities in the world, Stockholm. On top of this, DSCs have unique design properties that enable them to be produced in a range of colours, shapes and substrates.

Exeger was founded in 2009 in Stockholm. Originally funded by Giovanni Fili, the founder and CEO, grants were soon given by the Swedish innovation agency, Vinnova, to develop the first patent-family, the 1DPC (one dimensional photonic-crystal). The Swedish energy agency also subsequently supported the commercialisation of the technology. In 2010, Exeger sought funding outside of Sweden, turning to the LIFE programme.

The overall objective of the DYEMOND SOLAR project was to demonstrate a cost-effective means of producing DSCs, based on a patented technology to improve the efficiency and design of solar cells – through the construction of a pilot production line. Specific objectives were to demonstrate the suitability of the pilot line at a central location (i.e. in Stockholm); and to demonstrate its scalability into a fully operational DSC factory.

### Pilot-line phase

The demonstration phase of the pilot line was successfully completed in November 2014, with the production of 50 m<sup>2</sup> per day of semi-transparent, flexible solar cells, over a period of five consecutive days. This milestone in the company history was inaugurated by King Carl XVI Gustaf of Sweden. The successful demonstration also led to numerous national awards such as the 'Swedish Nano Company of the Year 2015' and a placing on the list of the 33 most promising young Swedish companies for two consecutive years, which in turn led to coverage in the national press.

The 50 m<sup>2</sup>/day production of these specific solar cells translates to 200 pieces daily. The cost of material was within the forecast. Accelerated lifetime tests according to industry standards showed less than 10% loss of electrolyte, demonstrating

a sustainable product. In addition, long-term testing of solar cells driving a mechanical device showed that, in line with expectations, cells made in November 2014 continued to deliver power to March 2015 (the end of the LIFE project).

### Demonstration is key

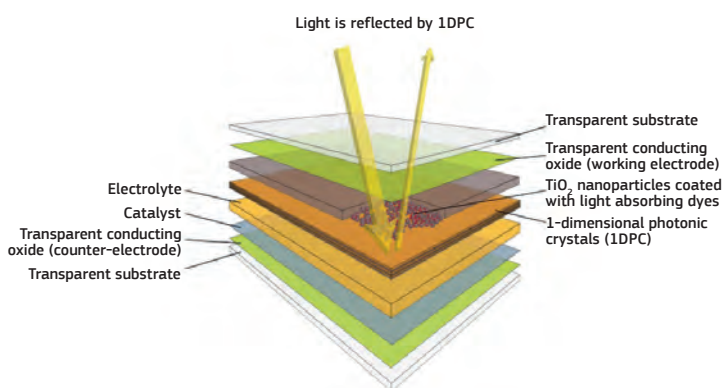
Meanwhile, the company has grown from two employees in 2009, to 48 people working in the world's largest screen-printing based factory for manufacturing of solar cells. By creating green jobs and helping in the transition to a green economy, this LIFE project is fulfilling the goals of the EU's Green Action Plan for SMEs, Resource Efficiency Roadmap and Eco Innovation Action Plan.

As with any new technology demonstration is a key factor in convincing an audience of a new technology's potential. Much focus after LIFE has therefore been geared towards dissemination. Since the factory's inauguration, Exeger has invited the press, international trade delegations, academics and government agencies to its Stockholm headquarters to witness the pilot line.

A ramp-up for global market penetration is taking place in Stockholm during 2016. The factory is being finalised, including securing of logistics, supply chain, customer service, etc. prior to the global launch. Numerous joint development agreements have already been signed with some of the largest global consumer electronics companies.

According to project manager, Giovanni Fili, the LIFE programme was, "pivotal in helping this technology reach a commercial phase. Funding from the EU has greatly accelerated the development of the production method and has laid the groundwork for future global expansion. We now hope to build a gigafactory in the EU and expect that funding from the European Investment Bank and European Fund for Strategic Investments is the natural next step in the globalisation of a solar technology which grew from two employees in Stockholm, Sweden."

Structure of a dye-sensitised solar cell



**Project number:** LIFE09 ENV/SE/000355

**Title:** DYEMOND SOLAR - Innovative Technology for Low Cost Production of Energy Efficient Dye-Sensitized Solar Cells

**Beneficiary:** Exeger Sweden AB (formerly NLAB Solar)

**Contact:** Giovanni Fili

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**Website:** www.dyemonsolar.com/

**Period:** 01-Sept-2010 to 31-Mar-2015

**Total budget:** €3 522 000

**LIFE contribution:** €1 736 000





# UK: Bringing waste information into the 21<sup>st</sup> century

The edoc project developed an online system to record and manage movements of non-hazardous waste. In so doing, it ended the inefficient practice of dealing with waste using a paper system.

In the UK all waste-producing businesses (companies, public bodies and charities) have a 'duty of care' to deal with waste responsibly. By law all businesses must have written information for the waste they handle. Each transfer of waste from one party to another must be documented, agreed and signed by both parties, and traditionally captured using waste transfer notes (WTNs).

According to estimates, some 23 million WTNs are produced annually in the UK in paper format and there are close to 50 million notes in storage at any one time, creating a mountain of unnecessary paper and an administrative headache for businesses as these notes have to be stored between two and six years. Furthermore, with no centralised system to hold data, there is no way that the data can be analysed in a meaningful way to improve systems.

Recognising that this system was inefficient, the Environment Agency decided to come up with a UK-wide internet-based interface with the help of LIFE.

## A simple, free and intuitive tool

The Electronic Duty of Care (edoc) project (LIFE09 ENV/UK/000023), designed a streamlined and reliable system enabling waste producers, brokers, carriers, receivers and regulators of waste to use a single common procedure rather than creating multiple paper records.

Edoc was launched in January 2014: a free, online system to create, share, sign and record WTNs. The system enables companies to create WTNs securely online and to manage, search, interrogate and retrieve them quickly and easily. It cuts down on unnecessary administration, saves time and money as well reducing the need for paper and storage.

An added benefit of edoc is that it gives a more accurate recording of data than a traditional paper system. Handwritten records are sometimes incomplete or difficult to read. In addition, different users completing paper records in the waste transfer chain can make mistakes and record information incorrectly. Edoc, on

*To boost uptake of the online waste management system, the project involved potential users at the design phase*



the other hand, offers drop down menus, pick lists and prompts that help businesses file complete and more accurate records.

Edoc can be used to highlight opportunities for minimising waste by helping identify synergies between different waste streams, thereby allowing companies to better plan their waste prevention strategies.

At a higher level, government and waste planners can also benefit from edoc as the system allows for a more accurate picture of waste arising at local, regional and UK levels and provides better information for planning resource management than has previously been available.

“As a product, edoc is an important milestone. It provides a modern means of recording waste transfers that reduces the administrative burden on businesses. It’s a simple system to use, with so many benefits, from compliance with the legal duty of care, to better data and understanding on waste arising in the future, to reduced opportunities for waste crime,” said Chris Deed from the Environment Agency and edoc’s programme manager. By making it easier for businesses to manage their waste and tackling the problem of waste crime, the project is addressing some of the obstacles to higher levels of material recovery identified in ‘Closing the loop – an EU action plan for the Circular Economy’.

### Involving all stakeholders

To get the support and backing of potential edoc users, the project partners carried out extensive research, which involved in-depth interviews with sector experts as well as a survey of over 1 800 business managers dealing with environmental issues in six target sectors: agriculture, construction, food and drink, health, retail and waste.

Thanks to the information collected, the team was able to create eight profiles representing the most typical and influential business users. The profiles included their specific needs and

*One of the main advantages of the tool is its user-friendliness*



requirements as well as their motivation for using an online system.

To ensure edoc’s success, the team worked with representatives from each of the profiled typical users and target sectors from the design phase through to final testing. All the features and functions were tested in several cycles of controlled testing. This allowed the team to check for any security vulnerabilities and resolve any shortfalls. It also allowed the potential users to feel part of the process. As they became more aware and interested in edoc’s value, their enthusiasm for the finished product increased.

### Resounding success

Thanks to this approach and the fact that edoc is such a user-friendly product, by March 2016 over 4 500 businesses had registered as users. There was also an increase in the number of public sector organisations, including local authorities, fully implementing edoc. “The level of interest from businesses and organisations from a cross-section of sectors indicates that people understand, accept and embrace the system and the wide range of benefits it can offer. Edoc continues to provide businesses with a free and easy option to manage their waste transfers, improve their resource efficiency and comply with their legal duty of care,” says Mr Deed.

While many large organisations already have their own electronic systems and cannot simply switch over to edoc, Mr Deed believes that, “businesses will eventually move to edoc because of the benefits and efficiencies they will gain from its use.”

### Next steps

While edoc is currently a voluntary service, the Scottish government announced in February 2016 that it planned to make it mandatory. Meanwhile, Wales launched a consultation last year which includes a question on whether the use of edoc for managing duty of care transactions should be made mandatory in the public sector.

**Project number:** LIFE09 ENV/UK/000023

**Title:** EDOC - Electronic Duty of Care

**Beneficiary:** The Environment Agency

**Contact:** Chris Deed

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**Website:** www.edoconline.co.uk/

**Period:** 10-Jan-2011 to 18-Dec-2014

**Total budget:** € 4 176 000

**LIFE contribution:** €2 088 000



# Spain: Turning bakery waste into packaging

The BREAD4PLA project showed how bakeries can become part of the circular economy by creating an industrial symbiosis with the packaging industry. It converted bakery waste into packaging film that was used to make bags and trays for bread and other products.

The BREAD4PLA project (LIFE10 ENV/ES/000479) established a new use for bakery waste: packaging for bakery products, including shortbread, biscuits and sliced bread. By turning this waste stream into a source of biopolymers, the project avoids the problems associated with using agricultural land to grow crops earmarked for use in biodegradable plastics, rather than for food, including fluctuations in food prices, monocultures and biodiversity loss.

Led by AIMPLAS, a research and technology centre for the plastics industry, the project drew on the expertise of a consortium of partners. Constant feedback between the four organisations was crucial to the success of the project. The team set up a pre-industrial scale pilot plant to convert bakery waste into poly-lactic acid (PLA) and then closed the life-cycle by extruding it into a 100% biodegradable packaging film for baked goods. The project also analysed the properties of the packaging made from this waste stream and determined the replicability of the whole process.

## The production process

BREAD4PLA's cradle-to-cradle approach began with an analysis of the organic waste produced by bakeries, namely sliced bread crusts and sponge cake trims. This task was carried out by project partner, CETECE. The project team identified the optimum conditions for the preservation, storage and transport of industrial bakery waste, defining a protocol for handling the material from collection through to the production plant.

A second partner, ATB (The Leibniz Institute for Agricultural Engineering Potsdam-Bornim), established the fermentation process for turning the waste material into lactic acid. This used a low-energy process with water-based enzymes.

Researchers from Bangor University in Wales established a polymerisation process to turn the lactic acid into PLA by chemical routes. AIMPLAS subsequently used standard extrusion techniques to turn the PLA into packaging products for the bakery industry.

*The project showed that PLA packaging made from bakery waste performed as well as as PLA packaging produced from cereal crops*

Photo: Charo Pascual



## Fit for purpose

CETECE was again involved in the project, assessing the properties and performance of the packaging produced by the BREAD4PLA pilot plant. It convened a panel of expert testers who performed a number of sensory tests of bread, biscuits and shortcakes packed in standard packaging and in bags and trays made from bakery waste. The tests were carried out on items packaged for 0, 6, 10 and 12 months and covered factors such as flavour, texture, odour, sugar aspect and rancidity.

The results were positive: "The new packages have suitable barrier properties, especially for the packaging of shortcakes and shortbread, achieving a 12-month shelf life, equal to the polypropylene packaging traditionally used for these kinds of products," explains project manager Raquel Giner Borrull. One interesting finding was that products in PLA packaging were less rancid than those in commercial polypropylene packaging. This could have a cost benefit for food producers as it would allow them to decrease the use of antioxidants, which are commonly added to shortcakes.

## Scaling up the process

An important outcome of this LIFE project revolved around identifying the conditions necessary for industrial scale-up and commercial replicability of the bakery waste to packaging chain. Through conversations with commercial producers of lactic acid, lactic acid derivatives and lactides (an intermediate substance between lactic acid and PLA), the project was able to determine the following conditions as necessary for turning the pilot process into a viable industry:

1. The substrate must be available in sufficient quantities.
2. The supply of substrate must be constant, rather than seasonal.
3. The bakery waste should be sourced from as few locations as possible to simplify logistics, minimise transport costs and ensure consistency of quality.

*The solution developed is ready for market uptake*



Photo: Charo Pascual

The project was able to quantify the yields of the different processes involved. The fermentation of waste bread enables the production of 0.35 kg of lactic acid per kg of bread, similar to other feedstocks. PLA yields of 48% were achieved at the pilot plant. The BREAD4PLA team calculates that this would increase to 77% at industrial scale. It also calculates that the cost of using bakery waste would be significantly lower than the cost of using other feedstocks, such as corn or tapioca.

The project analysed data supplied by large bakeries in Spain and the UK and concluded that they could divert up to 25% of their food waste to manufacture packaging (the other 75% being used for animal feed). This amount of waste, some 4 000 tonnes/yr, would convert to 680 tonnes/yr of PLA from a single large bakery, cost-effectively replacing the equivalent amount of conventional plastics.

Since Germany and the UK generate the most bakery waste in the EU, they are the countries where an industrial-scale plant is most likely to be implemented. With some modifications, the process piloted by this LIFE project could also be used to produce biodegradable packaging from fruit and vegetable waste.

The project results feed into EU circular economy policy in two ways. Firstly, as a versatile example of industrial symbiosis, and secondly by targeting one of the priority areas of the Circular Economy Package, namely food waste. The project outcomes also help to implement the Waste Framework Directive (WFD) and other European legislation relating to waste and recycling.

"Thanks to this project, a new fully biodegradable and compostable packaging made of polylactic acid (PLA) for bakery products has been successfully developed, using as raw material the bakery and pastry wastes generated by the industry," concludes Raquel Giner Borrull.

**Project number:** LIFE10 ENV/ES/000479

**Title:** BREAD4PLA - Demonstration-plant project to produce polylactic acid (PLA) biopolymer from waste products of bakery industry

**Beneficiary:** Asociación de Investigación de Materiales Plásticos y Conexas (AIMPLAS)

**Contact:** Raquel Giner Borrull

**Email:** proyectos@aimplas.es

**Website:** www.bread4pla-life.eu/

**Period:** 01-Oct-2011 to 31-Sept-2014

**Total budget:** €1 117 000

**LIFE contribution:** €489 000



# Spain: Improving urban water eco-efficiency

This innovative LIFE project developed practical management tools that can be used to evaluate the impact of different activities on the urban water cycle and enhance eco-efficiency.



*Eco-efficient urban water management limits the environmental impacts and associated costs of water treatment*

Urban water systems ensure a reliable supply of clean water as well as the proper treatment and disposal of wastewater. The urban water cycle covers a range of activities such as water extraction, drinking water treatment, water transport and distribution, the sewer network, and wastewater treatment and discharge. All of these processes have environmental impacts, as they consume electricity, use chemicals and generate waste.

With 80% of Europe's citizens living in urban areas, cities play a key role in sustainable development. Hence management of the urban water cycle should ensure that the activities within it are performed in a sustainable way, reducing their environmental impacts and the associated costs. However, urban water activities and their environmental effects are frequently not quantified. There is, therefore, a need to understand the balance between the environmental benefits and burdens of the urban water cycle.

The goal of the AQUANVEC project (LIFE10 ENV/ES/000520) was to enable more sustainable management of the urban

water cycle. The coordinating beneficiary, CETaqua, aimed to achieve this by providing decision-making tools for optimising eco-efficiency, using environmental and economic life-cycle analysis (LCA). Managers and policy makers could then use these tools when making decisions on water-related issues, such as whether to improve quality standards at the expense of higher costs and greater consumption of energy and chemicals.

In particular, the project set out to assess the impact of urban water activities on global warming, terrestrial and water toxicity, eutrophication, acidification and depletion of resources. Armed with this information, it would then identify means of reducing these environmental impacts. AQUANVEC also aimed to assess the economic effects of the different operations and identify possible cost savings.

## Gathering data

The first phase of the project revolved around defining the methodology of LCA and life-cycle cost (LCC) analysis for each stage of the urban water cycle. This involved gathering data



from various sources, including technical literature, databases, stakeholders and water companies, as well as a project questionnaire. The project conducted two case studies - in Betanzos, Galicia, and in Calafell, Catalonia - to test the LCA/LCC methodology under different conditions (e.g. climate, water quality and water-use patterns). The resulting information, covering the construction, operation and maintenance phases of water facilities, was put into a new database and integrated with the other sources of data.

The project then used the life-cycle approach to evaluate the environmental impacts and economic costs of the different processes within the urban water cycle, to identify the best ways of reducing them. This information helped define a set of indicators for monitoring and evaluating environmental and economic efficiency throughout the cycle. A user-friendly web tool was developed - the AQUAENVEC tool - which uses this comprehensive set of indicators and the project's other outputs to enable policy makers and public and private sector water managers to assess water activities easily and improve their eco-efficiency. The tool facilitates more sustainable decision-making, supporting implementation of the water framework and priority substances directives, as well as other EU initiatives and legislation.

## Seeing results

Before this LIFE project, few studies existed on the costs of the complete urban water cycle, although there was a variety of information available for individual processes. Thanks to AQUAENVEC, a generic tool and methodology has been produced which is applicable to any city in Europe. Users can evaluate alternative scenarios for different aspects of the urban water cycle and optimise processes, securing economic benefits. Many are already taking advantage of the tool - 175 users were registered with 329 projects as of June 2016. "We have carried out several training and dissemination sessions for water utilities and sessions open to the public. Some water utilities are currently implementing the tool," says project manager, Desirée Marin.

The project also produced best practice guidelines on how to reduce the environmental and economic impacts associated with activities in the urban water cycle. These contain a range of measures to help improve urban water eco-efficiency throughout the cycle, with recommendations on, for example, how to buy green electricity, implement more efficient sewer cleaning techniques, and properly select pipe materials, design trenches and construct networks. The guidelines are aimed at decision-makers, such as local entities who decide the bid conditions for network construction or facilities operation, engineering companies that plan and design water infrastructure, and utility companies operating and maintaining the water infrastructure which can select materials, chemicals and energy providers.



Photo: Ferran Martí

*The project also raised awareness of the urban water cycle*

In addition, the project has helped inform local communities about certain water-related issues (e.g. consumption behaviour, savings and water quality) and improved awareness about the urban water cycle, especially in Betanzos and Calafell, where the two case studies were carried out. One means of raising awareness was by installing specially-produced information boards explaining the urban water cycle at pools, river promenades, beaches and the offices of utility companies.

"The AQUAENVEC tool provides a new vision of the urban water cycle's role in the improvement of sustainable development in cities. It provides planners and managers of urban water cycle activities with the analysis of environmental, economic and eco-efficiency indicators, and generates information that is increasingly relevant for citizens," says Ms Marin.

CETAqua is now focused on disseminating the tool even more widely among water utilities. It also hopes to include social aspects in future, thus addressing the use stage of the urban water cycle. This would involve adding new indicators to the tool which are more related to citizens and industrial and agricultural users. Expanding the tool in this way would enable its use for addressing issues such as green growth in cities, efficient irrigation and water tariff schemes, among many others.

**Project number:** LIFE10 ENV/ES/000520

**Title:** AQUAENVEC - Assessment and improvement of the urban water cycle eco-efficiency using LCA and LCC

**Beneficiary:** CETAqua (Water Technology Centre)

**Contact:** Desirée Marin

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**Website:** www.life-aquaenvec.eu/

**Period:** 01-Jan-2012 to 31-May-2014

**Total budget:** €1 594 000

**LIFE contribution:** €789 000



# France: Making noise pollution easier to understand

The **HARMONICA** project made noise information more easily understandable to the general public and decision-makers. It defined a new index that better reflects people's perception of noise.

In densely populated urban areas, noise generated by human activities is a considerable environmental problem. In the EU, nearly 100 million people are exposed to noise levels considered as damaging to their health. To address this issue, the Commission introduced the Environmental Noise Directive (2002/49), which requires Member States to develop and publish strategic noise maps using modelling data that can be gathered over a large area at a relatively low cost. However, the results can often seem removed from people's perceptions of noise pollution, and as a result it is necessary to raise awareness of the problem so that effective policies can be introduced to reduce it.

Noise information is published every five years, and includes maps and noise management action plans for major agglomerations, roads, railways and airports. Member States apply the noise indicators  $L_{den}$  and  $L_{night}$  to prepare and revise the strategic mapping, but these indices are technical and not readily understood by the layperson and the policy maker.

The HARMONICA project (**LIFE10 ENV/FR/000211**) was thus set up to define a simpler noise index, taking into account

people's feedback. Instead of using decibels, which follow a logarithmic scale, the index ranks noise perception from 0 to 10, from background noise to peak noise events that exceed this background. These figures, which are derived from data collected by noise measurement devices, are calculated for one-hour time slots, so it is possible to represent changes during the course of a day and derive average results for any given time period. Results of this rigorous noise analysis are presented as user-friendly graphics.

Key to the success of the index according to Fanny Mietlicki, project manager, was the inclusion of the local population in field trials and the creation of a multidisciplinary team of engineers, statisticians and experts in psychoacoustics, communication and information systems. The graphical representation of the index is simple and easy to understand, which was confirmed by a survey of 800 people.



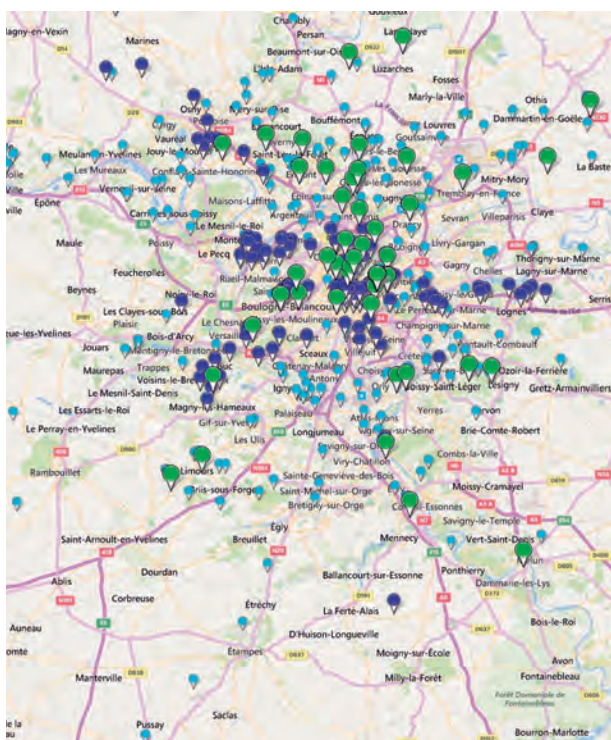


Photo: Acoucité

*Toots is a user-friendly tool that allows users to understand noise levels in their areas*

The index is represented by a triangle on top of a rectangle, in order to clearly translate its two components, and with colours (green/orange/red) indicating how the noise environment compares to the WHO's environmental quality objectives and the values recognised as critical for noise. "The graphical representation of the index, which is concise and clear, has played a very important role in its acceptance by the public and the authorities," says Ms Mietlicki.

## Widening use

To maximise uptake of the index, a free software tool, Toots, was made available that allows users to calculate the index for their home situations. The project team also produced a short film that explains the features of the index to both professionals and the general public. A 32-page methodological guide was also produced. Furthermore, the project developed online tools for sharing information on noise abatement operations across Europe. These tools comprised a platform displaying the index, a database of European noise abatement actions (e.g. reduced road speed and new asphalt coatings) and a web portal, Noise in EU ([www.noiseineu.eu](http://www.noiseineu.eu)), which provides information and support for an expert community network.

The end result is reliable, clear, and easy-to-understand information on noise pollution for EU citizens and decision-makers. The project made the web tools, database, guides and a film available to the public and professional users (local authority decision-makers, private companies and NGOs) via

the Noise in EU portal. It also disseminated its results through workshops, a website and the media. "By communicating in a transparent manner about the noise levels in cities using the Harmonica index and by sharing the best practices conducted by the various stakeholders, the Noise in EU platform intends to become a key reference tool for reporting on environmental noise and decision-making at the European level," says Ms Mietlicki.

## Comparable data

Another key outcome of the project is that its index and common protocol for noise measurement has enabled data collected by different noise monitoring managers to be made available on the same platform for the first time. At the end of the project, data was being displayed from 50 stations managed by the project beneficiary, Bruitparif, and 10 by project partner, Acoucité. Other organisations are expected to join the platform, and a questionnaire sent to cities around the EU helped identify interested future partners, such as Barcelona, Brussels and Lille.

The increasing use of the HARMONICA index to identify and assess noise abatement actions will help harmonise noise monitoring results across the EU. This will allow comparisons to be made between different regions, ensure monitoring results better reflect how noise is perceived by people and lead to better access to information on noise exposure. The educational tools to communicate the benefits of noise abatement actions will help promote such policies and raise awareness among the general public and decision-makers. In the long term, the project outcomes should contribute to the development of policies to combat noise pollution and to a better integration of noise issues into territorial policies or programmes at European, national and local level. This should lead to a reduction in noise pollution, which currently affects nearly 100 million people in the EU. With numerous scientific studies establishing a link between noise pollution and health problems (e.g. disturbed sleep and stress), the project, by contributing to noise pollution reduction, could help bring about significant socioeconomic benefits.

**Project number:** LIFE10 ENV/FR/000211

**Title:** HARMONICA - HARMONised Noise Information for Citizens and Authorities

**Beneficiary:** BRUITPARIF

**Contact:** Fanny Mietlicki

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**Website:** [www.harmonica-project.eu](http://www.harmonica-project.eu)

**Period:** 01-Oct-2011 to 30-Sept-2014

**Total budget:** €1 734 000

**LIFE contribution:** €867 000





# Greece: Resolving the sticky problem of waste oils and petroleum residues

The ELINA project addressed the problem of waste oils and petroleum residues, particularly in the country's shipping sector. The project identified sources of waste and collection points, developed a separate waste stream for recycling and engaged with stakeholders to press for regulatory improvements.

Waste oils and petroleum residues account for a significant proportion of the organic liquid waste produced in Europe, and the amount produced in Greece alone is around 170 000 tonnes/yr. This waste originates from large-scale industrial activity, especially shipping, which remains one of Greece's most important industries.

Waste oils and petroleum residues require careful handling to avoid environmental damage. They also frequently contain additives such as lead and impurities that form as a result of chemical reactions. Contamination can also occur from mixing with other oily fluids or liquid wastes, which can affect recycling efforts.

The sheer volume of waste oils and petroleum residues produced poses a significant challenge to environmental policy-making – but also significant economic opportunities for reuse and regeneration if the waste can be collected, handled and reprocessed efficiently.

Much of it can be recycled if it can be separated from other content, and the economic benefits of limiting the amount of waste oils and petroleum residues going to final disposal could be substantial – especially if burning can be avoided, which not only contributes to climate change but also releases harmful substances such as dioxins into the environment.

## A life-cycle approach

The ELINA project (**LIFE10 ENV/GR/000606**) was conceived as a platform for the implementation of EU and Greek legislation on the integrated management of waste oils and petroleum residues. The beneficiary was LPC S.A., a Greek petrochemicals company active in the manufacture of lubrication products and the reprocessing of some 38 000 tonnes/yr of waste lube oils. The two project partners were ANEK Lines, a prominent shipping company in Greece, and the Ecological Recycling Society, a Greek NGO.

*The shipping sector is a significant producer of waste oils and petroleum residues*



The project's first responsibility was to find out more about waste oils and petroleum residues in Greece. It compiled a database of sources and quantities of waste, cataloguing waste producers and points of waste collection. This work, combined with a questionnaire sent to more than 200 stakeholders in the public and private sectors, enabled the team to confirm the scale of the challenge.

"We found that more than 90% of waste oils and petroleum residues originated from the shipping sector. The questionnaires helped us to pinpoint that shipping accounts for around 150 000 tonnes annually and non-marine activities for around 15 000 tonnes," explains Maria Emmanouilidou, coordinator of the project.

Subsequently, the project collected almost 7 500 tonnes of waste oils and petroleum residues from 500 sites across Greece and recycled these materials into new products, including asphalt extender and intermediate petroleum products for re-refining. Experts analysed the chemical composition of waste oils and petroleum residues from hundreds of sources, which helped to identify the most appropriate recovery strategies. The project also identified existing infrastructure for treating waste oils and petroleum residues in Greece, helping to maximise opportunities for recycling and identify future needs in this sector.

The ELINA project's innovative approach has helped to establish political and business support in Greece for an integrated, closed-loop life-cycle approach to the management of waste oils and petroleum residues. As highlighted by the EU's circular economy action plan, effective treatment of hazardous waste is a significant barrier that must be overcome in order to increase the amount of valuable materials that find their way back into the economy.

### Integrated and dedicated waste streams

The project team held several meetings with the Greek Environment Ministry and the Hellenic Recycling Agency. The agency financed a study into setting up a sustainable scheme for managing waste oils and petroleum residues, resulting in the establishment of a separate waste treatment stream similar to that already established for waste lube oils. This was an important step because waste lube oils are frequently mixed with waste oils and petroleum residues, complicating separation and re-processing operations. This development should make it much easier for waste oils and petroleum residues to be recycled, and will have a significant impact on costs.

The project team attached great importance to networking and information dissemination. Stakeholder mapping identified around 1 000 private companies, public structures and non-governmental organisations across Greece, which were kept

### Law on handling waste

There are three legal methods to handle waste oils and petroleum residues in Greece:

1. Collection, possible pre-processing and disposal at crude oil refineries for re-refining.
2. Mixing with wood chips for the production of a stable secondary fuel, with a relatively low heat capacity, for use in cement kilns.
3. Exporting for disposal abroad.

informed of project developments by regular newsletters, updates on the project's website and events.

Six stakeholder forum meetings were held during the project cycle, involving representatives of more than 100 organisations and companies, with the aim of strengthening legislation focusing on producer responsibility. Among the project's suggestions for further action was a recommendation to the European Commission to close a legal loophole relating to waste oils and petroleum residues by drafting legislation at EU level rather than relying on the inadequate and outdated framework provided by international maritime conventions.

The project confirmed the possibility that waste oils and petroleum residues from the shipping sector can be collected and separated on board ships and then discharged for treatment at ports, providing enough space is available for storage tanks. This environmental innovation requires little investment by ship operators but it could have a major impact on enhancing the sector's reputation, in particular with regard to the burgeoning cruise industry.

"Our project has shown that with proper management, waste oils and petroleum residues can be transformed into high-value products rather than being discarded or burned," says Ms Emmanouilidou. "Our approach has shown significant environmental, social and economic benefits for stakeholders willing to commit to maximising opportunities from this waste, and we hope it will be a model for all of Europe."

**Project number:** LIFE10 ENV/GR/000606

**Title:** ELINA - Integrated green life-cycle management of waste oils and petroleum residues

**Beneficiary:** LPC S.A.

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**Period:** 01-Sept-2011 to 28-Feb-2015

**Total budget:** €2 041 000

**LIFE contribution:** €1 000 000



# Italy: Win-win use of poultry waste in tannery bating

The PODEBA project developed a sustainable process for the environmentally-problematic bating phase of leather tanning. With results equal to traditional techniques, the eco-friendly process saves resources and reduces waste.

In order to comply with environmental regulations<sup>1</sup> and to maintain competitiveness in the global market place, European leather producers must exploit raw materials more efficiently and eliminate from industrial processes the negative impacts of waste materials (hides and skins). The raw materials required for tannery processes generate wastes that currently have significant negative environmental and economic impacts. However, tannery by-products can be reused or converted into higher value secondary raw materials for other industries and the agricultural sector.

Tanning is a multi-phase process through which animal skins are treated against degradation, thus becoming leather. One of these phases is known as bating, whereby the skins are neutralised with acid ammonium salts and treated with enzymes. The result is softer and smoother leather suitable for high-end (fashion) goods. However, this part of

<sup>1</sup> Key environmental regulations concerning Europe's tanning industry include: Directive 2010/75/EU on industrial emissions (the Industrial Emissions Directive or IED), the Water Framework Directive (2000/60/EC) and the REACH Regulation.

The leather treated with the new agent complies with industry standards



Photo: INESCOP

the tanning cycle produces the largest amount of ammonium and nitrogen present in tannery wastewater.

## Innovative material

The overall goal of the LIFE project, PODEBA (**LIFE10 ENV/IT/000365**), was to demonstrate the use of an innovative material, a recycled waste – poultry dejection (manure) – for the bating phase in the leather tanning process, a process whereby the hides used for high-quality leathers are treated with enzymes to soften them. As well as the eco-sustainability benefits, the use of a by-product of poultry farms promises savings in costs, energy and water consumption. PODEBA is thus an excellent example of industrial symbiosis, a key goal of the EU's circular economy package.

ENEA, the Italian national agency for new technologies, energy and sustainable economic development led an Italian-Spanish consortium who began work on the 30-month demonstration project in 2012. PODEBA tested the new process at laboratory, semi-industrial and pre-industrial scales. The first stage involved bio-treatment of poultry manure for the purpose of deodorisation. Enzyme measurements were then carried out on the deodorised poultry manure (DPM) to assess its effectiveness as a bating agent. To ensure there was no biological risk to people working in tanneries, the project carried out a series of physical-chemical characterisation and microbiological tests. It then assessed the effectiveness of DPM on different samples of skins during the bating phase, at laboratory level and at semi-industrial level. Odour emission tests were carried out on the treated poultry manure, on skin samples during processing, on the bating floats and on the final product.

## Good performance

The treated poultry manure showed good performance as a bating agent. At laboratory, semi- and pre-industrial levels, PODEBA demonstrated the applicability of this technique in terms of quality of the final product and reduction of environmental problems. Importantly, according to Marco

Mazzoni, technical spokesperson for consortium member, Colortex, "The finished leather doesn't have any particular smell and looks almost identical to the leather obtained with traditional bating methods."

The tests of the leather samples treated with the natural product confirmed the following environmental improvements compared with chemical bating agents:

- An 80% reduction in odour in poultry manure treatment;
- A 40% reduction of the conductivity and chemical oxygen demand (COD) of wastewater; and
- A reduction of more than 40% in the nitrogen and ammonium load and an 80% reduction of the sulphide load in the bating floats.

Laboratory and pre-industrial tests showed that the technical and physical properties of the leather treated with DPM complied with the recommended values for leather products and with the EU Ecolabel standards for footwear. "The quality of the goods produced is appreciable and exactly like other commercial leather products," says Mercedes Roig, tanning technician and spokesperson for another member of the consortium, INESCOP.

Furthermore, the tests done at pre-industrial scale demonstrated that the manure-based bating agents have competitive production costs, thus they could be soon ready for the market. A cost of €0.46 per kg at industrial scale production was estimated by AMEK (a third project partner), which represents a reduction of €5.9 per tonne of salted hides compared with chemicals currently in use (i.e. equivalent to overall savings for bating agents of some 30%). Scaled up annual savings of around €300 000 in Italy and €400 000 in Europe are forecast if the product was used to replace just 10% of the commonly used industrial bating agents, indicating a strong potential for replicability.

Commenting on the LIFE Best project award, project manager, Alice Dall'Ara says she is, "extremely pleased," espe-



*The PODEBA solution is a good example of industrial symbiosis*

cially given the tough competition. "The project was based on the exceptional know-how and knowledge of all participants: a special patented technology from AMEK and the tanning technology competencies of Colortex and INESCOP, with all consortium members familiar with finding tailored solutions and innovation."

Looking ahead, the consortium members are working to promote the project's results as a Best Available Technique (BAT), according to the EU Recommendation (2013/179/EU) on the use of common methods to measure and communicate the life-cycle environmental performance of products and organisations. They are looking to be supported in this process by the Italian tannery industry association, UNIC.

### PODEBA's green credentials:

- Innovative reuse of a waste (poultry manure) normally associated with environmental problems.
- Significant reductions in the nitrogen load in tannery wastewater.
- Application of an innovative treatment able to deodorise poultry manure, reducing ammonia by 80%.
- Use of recycled animal waste with savings in costs, energy and water consumption.
- Production of high-end (fashion) leather goods with eco-friendly properties.

**Project number:** LIFE10 ENV/IT/000365

**Title:** PODEBA - Use of poultry dejection for the bating phase in the tanning cycle

**Beneficiary:** "Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile - ENEA"

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**Website:** [www.podeba.eu/en/](http://www.podeba.eu/en/)

**Period:** 01-Jan-2012 to 30-Jun-2014

**Total budget:** € 1 201 000

**LIFE contribution:** € 586 000



# Italy: Recovering unsold food to feed those in need

The NOW project helped recover 1 500 tonnes of unsold supermarket food that was still fit for consumption. Instead of being landfilled or incinerated, this food waste was donated to those in need, saving resources and CO<sub>2</sub> emissions in the process.

Europeans produce 8.8 million tonnes of biodegradable organic waste every year. When this waste is landfilled, it undergoes anaerobic decomposition (because of the lack of oxygen) and generates methane (CH<sub>4</sub>), a greenhouse gas 20 times more potent than carbon dioxide. As part of its 2030 commitment to reduce greenhouse gas emissions by 40%, the EU requires Member States to reduce the amount of biodegradable organic waste being sent to landfill by 65% compared to 1995 levels.

One simple and easy way to stop organic waste being landfilled is to recover as much of it as possible. With this in mind, a groundbreaking Italian project was launched to test a new model of management for food waste. The NOW project (LIFE10 ENV/IT/000404) was set in motion in 2011 by CAUTO, a charity that helps the socially disadvantaged find employment in Brescia in Lombardy, northern Italy. The idea was to establish a system to combat food waste that would result in a series of positive financial, social and environmental repercussions for all those involved.

The idea behind this LIFE project was to partner with supermarkets to recover and reuse most of the food products which have reached their sell-by date but are still suitable

for consumption. While supermarkets and retailers normally discard these products as waste, NOW chose to collect them and distribute them to those in need with the help of charities.

The initial pilot scheme was launched in 2012 and involved eight supermarkets in the city of Brescia. The waste was selected by the supermarket's employees and collected by CAUTO before being handed over to a number of charities.

In 2014, the project was extended to cover the entire province of Brescia and agreements were signed with two major retail groups - Italmark and the Bennet group - which have networks of 52 and 67 sales outlets respectively across Italy. Agreements were also reached with two municipal agencies that manage environmental services in the province.

## Creating a virtuous circle

The NOW food bank, which was the first of its kind in Italy, allowed for some 1 500 tonnes of food to be recovered from a total of 26 participating supermarkets around Brescia and donated to 70 charities through the help of 13 municipalities

*Every year thousands of tonnes of food is discarded by retailers when it reaches its 'sell-by date'. Much of this is still suitable for consumption*

Photo: Cauto Food Bank



and 60 volunteers. This food was re-distributed weekly to some 5 000 people. What could not be used was sent to kennels, catteries and farms. The project also enabled 20 tonnes of waste to be reused as products such as pallets and crates.

The project's novel partnership has brought benefits to all involved. Charities were guaranteed a constant supply of food, allowing them to plan their operations better and make the most of their resources. Retailers, meanwhile, benefited from lower waste disposal costs, tax cuts and optimised logistics. The environmental benefits associated with less waste also benefited society as a whole. Furthermore, the project led to the creation of 16 jobs, 4 of which were for disadvantaged people.

Now that the project has ended, the partnerships it successfully set in motion between retailers, municipalities and charities are still going strong. "CAUTO is currently in discussion with the public authorities at regional level to establish the right level of tax reduction for supermarkets to encourage them to donate their food waste," says project coordinator Anna Bresciani.

### Changing the law

The NOW project not only helped change people's attitude to food and waste, it also helped, in conjunction with a network of other Italian LIFE projects, to change Italy's food legislation. Each project had encountered a number of legislative obstacles to their efforts to close waste cycles. They therefore decided in February 2014 to present an appeal to both the Italian parliament and the Ministry of Environment

*The NOW project managed to create 16 new jobs*



*In total, 26 supermarkets, 13 municipalities and 70 charities participated in the project*

identifying the critical limitations of the Italian waste regulations and submitting concrete proposals to overcome these.

Thanks to this initiative, Italy is set to become the second European country, after France, to pass legislation encouraging supermarkets and restaurants to stop throwing away unsold food. The Italian bill on food waste passed its final reading in the lower house on 16 May 2016 and is now awaiting a decision by the Senate. If approved, the bill will allow shops and restaurants to give any products that are past their 'best before' dates to charities. Unlike in France where fines were introduced to stop supermarkets throwing away food, the Italian bill favours a rewards-based approach with companies able to claim tax rebates when they give food to charities.

The Italian initiative is timely as the European Commission's recently adopted package on the circular economy identifies food waste as a priority sector in the fight against waste and the path towards a sustainable economy. The package recognises that there is a social angle to food waste and proposes the donation of food that is still edible but which for logistical or marketing reasons cannot be sold.

**Project number:** LIFE10 ENV/IT/000404

**Title:** NOW - No more organic waste. A new integrated system to eliminate organic waste in the organised large scale distribution

**Beneficiary:** Cantiere Autolimitazione Cooperative Sociale a r.l. (CAUTO)

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**Website:** [www.nowlife.eu/progetto.html](http://www.nowlife.eu/progetto.html)

**Period:** 01-Oct-2011 to 31-Dec-2014

**Total budget:** €1 921 000

**LIFE contribution:** € 688 000



# Italy: Reducing legislative burdens to enhance environmental performance by SMEs

**The B.R.A.V.E. project produced guidelines and proposed measures for regulatory relief and other incentives to improve and simplify environmental legislation. This will enable organisations to more efficiently reduce their environmental impacts.**

**E**MAS (Eco-Management and Audit Scheme) is an EU environmental management tool, designed to help registered organisations enhance their environmental performance, credibility and transparency. First adopted in 1993, and now in its third version (Regulation (EC) 1221/2009), the EMAS scheme operates through incentives that reward commitments to sustainability. By late 2014, over 4 000 private and public European organisations were EMAS registered.

Regulatory burdens can become excessively complicated or time-consuming, especially for small and medium-sized enterprises (SMEs), making it harder for them to comply with environmental legislation. Therefore, the European Commission has been working to improve and simplify existing environmental legislation, so that businesses spend less time on administration and more time on their core activities. One aim is to encourage more organisations to join the EMAS or other environmental certification schemes that operate under international management system standard ISO 14001, such as the EU Ecolabel scheme.

## Simplifying procedures

The B.R.A.V.E. project (**LIFE10 ENV/IT/000423**) was part of this legislative streamlining process. It helped to identify and develop effective measures for improving environmental legislation, by reducing financial and administrative burdens for companies registered with eco-management schemes. The project supported the full integration of EMAS, and other voluntary certification schemes such as the EU Ecolabel, into the environmental legislation of two EU Member States: Italy and Spain.

The project analysed around 200 existing European environmental directives and regulations in Italy and Spain,

and from this analysis proposed over 230 incentives for organisations registered with eco-management schemes. The project's participatory process involved establishing working groups at regional, national and European levels. All these groups worked to define simplification and regulatory relief measures. This facilitated the creation of a consensus for the proposed measures, and led to the drafting of 184 simplified proposals relating to existing legislation (91 at regional, 39 at national and 54 at European level). The project

*The project drafted 184 proposals to simplify legislation and reduce regulatory burdens on business*





tested 35 of these proposals with the direct involvement of competent authorities. Furthermore, it encouraged the adoption of the proposed measures in other areas of Italy and Spain.

### Regulatory relief and other rewards

At least 23 measures developed by the B.R.A.V.E. project have been adopted within environmental legislation in the regions of Friuli-Venezia Giulia, Liguria, Lombardy and Tuscany in Italy, and in Andalusia and Valencia in Spain. In addition, Veneto, a region not originally involved, has adopted one of the proposed measures as a result of the project's dissemination activities.

In the B.R.A.V.E. project's Layman's Report, the team set out the adopted measures in terms of a series of underlying principles: if there is trust, you loosen the restrictions; the lesser polluter pays less; from risk to opportunity (deployment of financial guarantees); most EMAS, less controls; when the environmental management system avoids duplication; and reward the best, to inspire everyone else.

For each legislative simplification or regulatory relief adopted there are therefore a range of different types of advantage for organisations registered under ISO 14001 schemes. These eliminate inefficient actions or provide rewards to help increase productivity and competitiveness and also provide significant recognition for organisations committed to environmental improvements. As a result of the B.R.A.V.E. project, measures adopted within environmental legislation have included authorisation simplification for environmental licence renewal, reduced costs for administrative procedures, tax benefits, financial guarantees for high-risk environmental projects, and favourable status for goods and services linked to the EU Ecolabel and other schemes.

Administrative burdens, for example, were reduced within mining industry legislation in Tuscany, by extending the time period for authorisation. SMEs in Tuscany registered with EMAS can seek tax credits of up to €15 000 or a more favourable tax rate. Cost reductions on emissions permits and checks of 30% have helped a range of EMAS-registered companies in Lombardy; while in Friuli-Venezia, Giulia and Liguria, EMAS-registered companies now have simplified procedures for checks and monitoring by competent authorities.

In general, green public procurement was encouraged and two adopted amendments to environmental legislation were specifically aimed at encouraging the market for Ecolabel products in public services. In Italy, for example, an amendment was made to legislation requiring Ecolabel certification to



One of the 11 B.R.A.V.E. working groups

be taken into account when assigning grants, benefits and funding under environmental legislation aimed at promoting the green economy and reducing the over-exploitation of natural resources.

The project published guidelines ('Guidance tool for the EMAS-based regulation and better regulatory relief') so that its approach can be transferred to other regional governments. This was distributed to all regions involved in the project and to 11 other regions in Italy and Spain. This tool introduces the project's methodology and sets out recommended approaches for improving and streamlining environmental legislation. The project team organised a series of stakeholder consultations to further improve the guidelines. The approach could be replicated in other EU Member States.

"Significant results, in terms of improved environmental legislation and incentives for EMAS organisations, have been made possible thanks to the challenging activities of development, sharing, proposal and implementation of simplified measures in favour of EMAS, carried out during the project," concludes project manager Marco Frey.

**Project number:** LIFE10 ENV/IT/000423

**Title:** B.R.A.V.E. - Better Regulation Aimed at Valorising Emas

**Beneficiary:** Sant'Anna School of Advanced Studies

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**Website:** www.braveproject.eu/

**Period:** 01-Oct-2011 to 01-Jan-2015

**Total budget:** € 2 220 000

**LIFE contribution:** € 1 110 000





# France: Biological tools to remove micro-pollutants

The BIOTTOPE project created a real-time monitoring tool called the FrogBox. This contains organisms that have been genetically modified to turn fluorescent when in contact with specific endocrine-disrupting compounds (EDCs). By combining biological and tertiary wastewater treatment systems, the project reduced emissions of selected EDCs by at least 50%.

Endocrine-disrupting compounds (EDCs) are a large and diverse collection of chemical substances that cause developmental disorders in aquatic organisms. The EU identified EDCs as ‘substances of very high concern’ in the REACH regulation on the safe use of chemicals; they are also identified as significant pollutants in the Water Framework Directive (WFD).

Most wastewater treatment plants were designed and built before EDCs emerged as a concern in the last two decades. Therefore there is a pressing need to accurately measure the impact of these compounds and to propose new technologies for their removal.

*The FrogBox exhibited at the Salon Pollutec 2014*



With co-funding from LIFE, the BIOTTOPE project (LIFE11 ENV/FR/000742) aimed to develop and validate an automated tool for detecting EDCs in treated wastewater.

## Enter the FrogBox

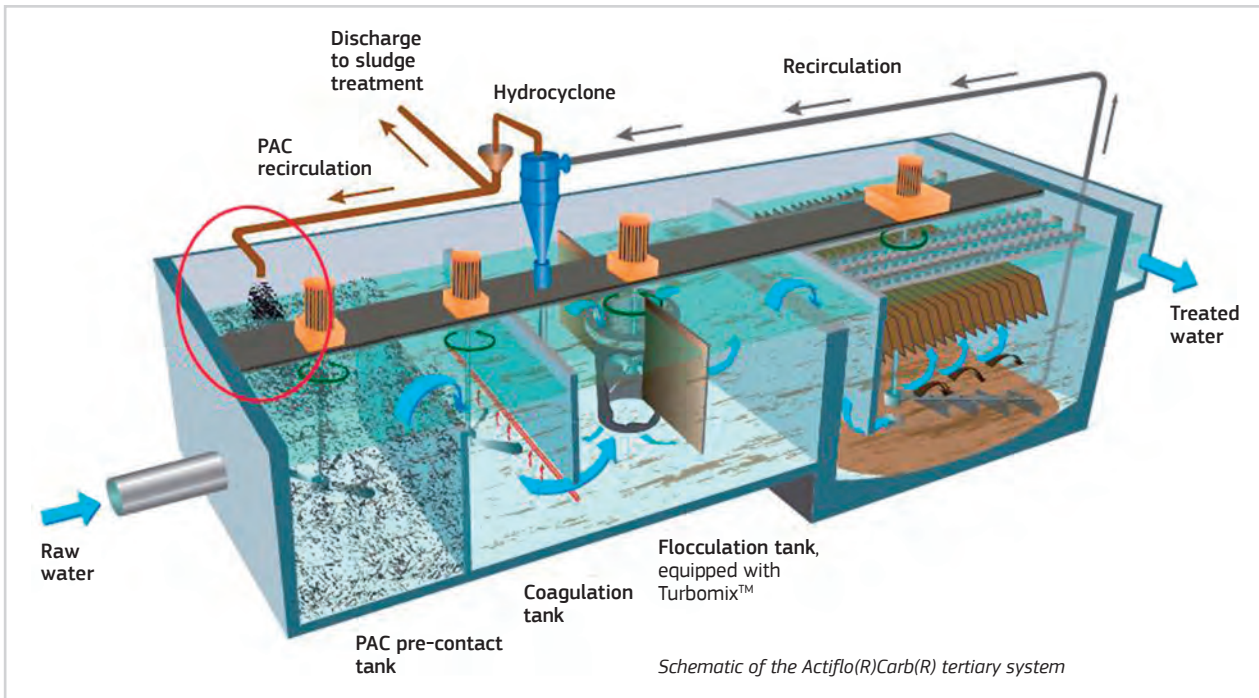
The tool trialled by the project is called the FrogBox. BIOTTOPE project manager Gaëlle Méheut explains that the FrogBox is, “the first online equipment able to continuously evaluate the quality of effluents generated from wastewater treatment plants, based on endocrine disruption measurement.” It consists of exposed tadpoles or fish fry genetically modified to become fluorescent in the presence of certain EDCs in the effluent and to measure the fluorescence when it occurs.

This biological tool enables on-site, real-time assessment of the endocrine disruption impact (oestrogenic and thyroidal effects) of treated wastewater. Information from the FrogBox allows treatment plant operators to alter functioning conditions to reduce the impact of effluent on ecosystems. This includes knowing when to apply tertiary treatments because the risk of endocrine disruption is present.

## Two kinds of treatment

LIFE project beneficiary, Veolia Environnement Recherche et Innovation SNC, installed the FrogBox at two of its wastewater treatment plants, in Saint Thibault des Vignes (France) and Brussels (Belgium). Both facilities use standard urban wastewater treatment technologies, thus making it simpler to replicate the results at other treatment plants.

The aim was to use the real-time analysis provided by the biological tool to assess the effectiveness of two different existing wastewater treatment strategies for removing micro-pollutants that could cause oestrogenic and thyroid disruptions.



At Saint Thibault des Vignes, a full-scale wastewater treatment plant for 190 000 inhabitants, the project team optimised the operating conditions of a conventional biological treatment process to make EDC removal more efficient.

In the Brussels wastewater treatment plant, which handles effluent for a population of 1.4 million, the project tested a pilot tertiary treatment process based on activated carbon adsorption and an accelerated settling step.

### Efficient removal

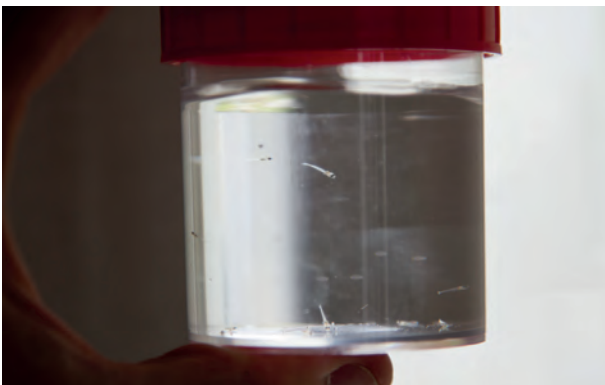
Results from the trials were impressive and confirmed the efficiency of both the FrogBox and the treatment processes. The project demonstrated that the overall improvement in wastewater quality was greater than a 50% reduction in selected emerging pollutant emissions. By adding a tertiary treatment, such as the Actiflo®Carb® process, the project demonstrated that it was possible to remove 90-100% of oestrogen hormones and 50-

100% of pharmaceuticals. "When present, endocrine disruptors could be reduced by using the ActifloCarb technology, as a tertiary treatment," explains Gaëlle Méheut.

If upscaled and replicated, the project technologies "will allow wastewater treatment plants to only discharge effluents of good quality, reaching thus a 'good status' for coastal and inland waters," says Ms Méheut. As well as restoring water quality, the new technologies can reduce impacts on aquatic ecosystems and biodiversity due to lower endocrine disruption activity, with direct benefits for human health. The FrogBox should cut the cost of laboratory analysis of water quality by utilities and the treatment technologies represent a potential reduction in the cost of treating effluent.

The project team presented the prototype technology at a number of trade events, including the IWA World Water Congress & Exhibition 2014, as well as in peer-reviewed scientific journals. The beneficiary is now planning to commercialise the technology before the end of 2017.

*The project used larvae of the amphibian xenopus and medaka fish*



**Project number:** LIFE11 ENV/FR/000742

**Title:** BIOTTOPE - Biological tools to Optimize Treatment Technologies to remove micro Pollutants and Endocrine disruptors

**Beneficiary:** Veolia Environnement Recherche et Innovation SNC

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**Period:** 01-Jun-2012 to 30-Jun-2015

**Total budget:** €2 417 000

**LIFE contribution:** €1 194 000



# Italy: Fighting disposable culture

The PRISCA project, aimed at boosting waste prevention initiatives in Italy, successfully prolonged the life-cycle of bulky reusable waste while strengthening the local economy and helping the socially excluded.

According to Eurostat, Italy produces some 541 kg of waste per capita. Only 30% of the total waste produced is sorted into separate streams and 56% of the country's waste is sent for disposal, mostly landfilling, producing CO<sub>2</sub> emissions.

The main objective of the PRISCA project (LIFE11ENV/IT/00277) was to reduce the flow of bulky waste being sent to landfill in Italy, and, in line with the EU objective of moving towards a circular economy, to recover and reuse as much of that waste as possible. In the EU waste hierarchy, preparation for reuse is placed just after prevention, occupying a privileged position compared to recycling and other forms of recovery. Reusing goods is a means of limiting the production of solid urban waste. Thanks to the process of preparation for reuse, promoted by the EU Waste Framework Directive (98/2008/EC), reuse has become both desirable and feasible, giving unwanted goods a second life with obvious economic, social, and environmental benefits.

PRISCA set out to demonstrate the viability of reuse as an alternative to landfill by creating centres for reuse in Vicenza (Veneto) and San Benedetto del Tronto (Marche). The

two centres aimed to divert and reuse 60% of the recyclable bulky waste that ends up in municipal collection points (such as furniture, homeware, appliances, bicycles, furniture, homeware, bathroom fixtures, toys) to provide low cost or free household goods to low income families. A fundamental aspect of the project was to raise awareness of waste reduction, emphasising the importance of the reuse of goods, and the need to make environmentally sustainable consumer choices.

## Viable centres for reuse

The effectiveness of the project's centres for reuse depended on an accurate analysis of the local market – linked to reuse and to recycling – necessary for the development of an appropriate model of implementation. Equally important was an in-depth knowledge of legislation governing the management of the centres, since Italy has adopted a series of measures aimed at promoting initiatives designed to encourage reuse and preparation for reuse.

The buildings housing the two centres were carefully chosen to have ample storage facilities and be easily accessible.

*PRISCA integrated the second-hand product sector and the reuse supply chain to increase recovery of reusable items*

Photo: Wikard/Daniel P.





Sixteen jobs were created at the two reuse centres established by the project

They were equipped with the appropriate equipment for weighing, checking, moving, repairing, cleaning and storing the goods according to season and market requirement.

An “industrial approach” was used to standardise processes and make every step, from interception of unwanted goods to marketing, more efficient and economically viable. Dedicated software was used for the optical reading of labels. By replacing the manual input of codes this made it easier and faster to trace goods, as well as allowing the centres to cope better with market demand. The project also set up a lab for testing and repairing goods and produced a technical manual.

### The flow of goods

The process is identical at the two centres of reuse: when goods are intercepted at municipal collection points, donated or gathered via door-to-door collections, they arrive in the reception areas and are selected, evaluated and sent to the workshop to be cleaned, disinfected and repaired. Every reusable item is catalogued electronically and stored in a spacious warehouse, before being sold in stores, second-hand shops, to traders or via direct retail. Thanks to the market analysis carried out in the first phase of the project, each item is sorted and grouped for distribution according to seasonal and market requirements, with staff trained to make these distinctions and to effectively carry out all steps of the process.

“Centres for reuse can provide local job opportunities for disadvantaged groups. For this reason the most suitable option for their management would be social welfare groups and cooperatives,” believes project coordinator, Marco Frey.

The project team also found that the financial viability of the centres depended on three basic principles: the waste diverted needs to be easily resalable; business networks and markets have to be constantly expanded, developed and strengthened; and initiatives like this depend on collaborative efforts bringing together all stakeholders (local authorities, managers of municipal solid waste, private and social enterprises must work together. “A collaborative effort can only be of benefit to the community,” says Mr Frey.

### An instant success

The success of the project was visible almost immediately. In terms of social benefits, the two centres created 16 jobs, some of which were made permanent. In addition, by allowing the re-entry of used goods onto the market at lower prices than new items, PRISCA ensured that those with lower incomes had access to them. PRISCA also helped spread the culture of reuse based on the principle of environmental protection and social solidarity.

In terms of environmental benefits, as an example, the centre of reuse in Vicenza treated a total of 533.6 kg of reusable waste and reusable goods in 2014 and 2015. Following preparation for reuse, cleaning and testing, on average, 62% of these assets were put back on the market. The project carried out a life-cycle assessment, which estimated CO<sub>2</sub> savings resulting from the goods and materials put back into use in Vicenza in 2014 were 1 911 tonnes of CO<sub>2</sub> equivalent.

The project also had the objective of facilitating the replication of the centres of reuse model throughout Europe: this will allow the reuse of a significant quantity of goods within the municipal solid waste stream, thereby contributing to the delivery of the EU action plan for the Circular Economy. “Too often an organised reuse industry is lacking in many EU countries with the end result being that perfectly good items end up being landfilled or incinerated when they could be reused,” explains Mr Frey.

**Project number:** LIFE11 ENV/IT/000277

**Title:** PRISCA - Pilot project for scale re-use starting from bulky waste stream

**Beneficiary:** Scuola Superiore di studi universitari e di perfezionamento Sant'Anna

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**Period:** 01-Sept-2012 to 30-Jun-2015

**Total budget:** €1 647 000

**LIFE contribution:** €762 000



# Poland: Tapping heat energy from deep underground

The GeoPyrz project developed Poland's vast potential to generate energy for its heating needs from geothermal sources. It pioneered methods of maximising the efficiency of heat absorption from the geothermal layer, contributing to lower emissions of greenhouse gases.



The project was implemented in the geothermal plant of Pyrzyce, Poland

**G**eothermal energy – originating deep underground in water heated by hot rocks – has the potential to provide a renewable and reliable source of energy for heating. As a sustainable, cost-effective and environmentally friendly source of energy, geothermal power contributes to reducing carbon emissions into the atmosphere and can reduce reliance on fossil fuels.

Geothermal plants typically pump hot water from below ground to a surface facility, where the water is passed through a heat exchanger, generating electricity. The water is then fed into injection wells which take it back down to the underground reservoir, where the heating and pumping process can begin again.

The geothermal plant at Pyrzyce, in north-west Poland, contributes to Poland's development of renewable energy and mitigation of climate change. Experts believe Poland could

meet as much as one third of its heating requirements using heat from underground. However, geothermal energy production is not without its challenges. In the case of Pyrzyce, the main obstacle to maximum efficiency was the absorption capacity of the geothermal layer, which was being replenished by water fed from injection wells. This water became progressively contaminated through mineralisation and prone to clogging up both the injection wells and the reservoir from which the plant was drawing.

The GeoPyrz project (**LIFE11 ENV/PL/000447**) was conceived to address the systemic problems afflicting the power plant – in particular, the regular interruptions required to clean the corroded injection wells and regenerate the geothermal layer's absorption capacity. These interventions were both limiting the amount of energy produced by the plant and using additional energy from non-renewable sources to compensate for the gradual loss of pumping efficiency from the aquifer.

“Our objective was to show not only that geothermal energy can be an increasingly important part of Poland’s energy mix, but that this energy source can be provided in a more reliable way and cleaner way,” says Bogusław Zieliński, the project manager.

### Enhancing efficiency, maximising energy

Pyrzyce, like many geothermal plants, employed a process known as soft acidising. Highly diluted hydrochloric acid was pumped down the injection wells to dissolve the minerals and impurities, especially calcium carbonate, or limestone, sediment contained in the brine returned to the underground reservoir.

The innovative team at the Pyrzyce plant decided to experiment with this system. They created a mechanism to deliver regular, small doses of acid, combined with antiscalants and dispersing agents, across the injection wells, as a way of both dissolving the accumulated mineral deposits and eliminating their future accretion. They found that by tweaking their operating system, they were able to increase the productivity and efficiency of the water extraction, and to limit the maintenance of the injection wells that was hitherto so time-consuming. They called their new process super soft acidising. “By experimenting with various chemical concentrations we were able to achieve the optimum solution for ensuring the long-term sustainability of the geothermal layer,” explains Mr Zieliński.

The LIFE project was therefore designed to build on these observations and improvements in a way that would test the plant’s reliability under fully operational conditions. The GeoPyrz team was also keen to mainstream its method and promote it as a commercially viable prospect for similar geothermal facilities elsewhere. It did not take long for word about the technology pioneered by the project to spread through the sector.

“Our innovative approach gained a lot of attention from the operators of other geothermal plants in Poland who were keen to learn from us and to build on our success,” says Mr Zieliński. Engineers from all over Poland came to assess our methodology, and we had visitors from as far afield as Denmark curious to know more.”

### Positive results

Over the evolution of the full-scale trial period, the team found that using super soft acidisation to maintain the chemical consistency of the recycled brine had a significant effect on the absorption of the geothermal layer – an improvement of 12% in pumping efficiency and a reduction in the number of interruptions necessary to break down the accumulated mineral deposits.



*The prototype installation improved the absorption of the geothermal layer by 12%*

The refinement of this chemical intervention process also resulted in dramatic savings in the use of gas to power the cleaning of the depositional layer in the aquifer. The project team surpassed expectations, reducing annual gas consumption by 416 000 m<sup>3</sup>, in turn resulting in 817 000 kg less carbon dioxide released into the atmosphere. The project therefore had a double-edged effect on climate change mitigation – first, by enhancing the efficiency of the renewable geothermal plant, and second by scaling back the non-renewable fuel inputs previously required to maximise the system’s operability.

The project also showed the cost savings that can be generated from applying the super soft acidizing technology pioneered by the team. The cost of removing impurities in the recycled water injecting back into the reservoir fell by 82%, which made the geothermal energy cheaper to produce. The success of the project is apparent to the local community: Pyrzyce’s residents are seeing tangible benefits through lower energy prices and cleaner air.

“This really shows the added value of the LIFE programme,” says Mr Zieliński. “The lessons we learned through LIFE’s investment in our idea can now be replicated elsewhere, which means significant energy and cost savings for the sector.”

**Project number:** LIFE11 ENV/PL/000447

**Title:** GeoPyrz - Demonstration of the innovative technology of the improvement of absorption of the geothermal deposit layer

**Beneficiary:** Geotermia Pyrzyce» Spółka z ograniczoną odpowiedzialnością

**Contact:** Romuald Grabiec

**Email:** geotermia@inet.pl

**Website:** www.acidizing.com.pl/en/

**Period:** 03-Sept-2012 to 30-Sept-2014

**Total budget:** €453 000

**LIFE contribution:** €226 000



# Italy: Waste recovery for green composite sinks

The LIFE GREEN SINKS project developed a new range of green products, including innovative kitchen sinks, manufactured from 100% recovered materials from closed loop and open loop recycling.

The market for composite kitchen sinks is growing rapidly. Among the three main types – polyester/acrylic, quartz composite and granite-based – quartz composite (60-70% quartz and 30% resin filler) provides a much more durable surface than the use of polyester/acrylic. To date, however, the manufacture of quartz composite sinks has been dependent upon the use of virgin materials – no secondary raw materials have been used. Furthermore, most of the waste produced in the manufacturing process of quartz composite sinks from methyl methacrylate (MMA) and poly-methyl methacrylate (PMMA) fillers (20-30% and 10% respectively) is sent to landfill as ‘special industrial waste’.

It is estimated that the waste from composite sink manufacturing in Europe amounts to more than 3 000 tonnes/yr of minerals, heavily polluted with polymers, and worldwide to around 8 million tonnes/yr. Moreover, the use of quartz and quartz-like primary materials places a heavy demand on the availability of natural mineral resources and is harmful to the environment. The recovery of waste from composite sink manufacturing would therefore help offset the landfilling of this type of waste and reduce the excavation

of primary raw materials such as quartz, cristobalite and minerals.

To reduce this landfilling and use of raw materials, DELTA, a manufacturing SME based in the town of Montecassiano in Italy’s Marche region, launched, the project LIFE GREEN SINKS (LIFE12 ENV/IT/000736) to create a new green range of products including innovative kitchen sinks manufactured from 100% recovered materials. These materials originate from closed-loop recycling (waste generated during the sink manufacturing process) and from open-loop recycling (using the production waste of other industries in Italy).

Externally recovered quartz can be obtained easily and cheaply – it is not as expensive as virgin material – but its quality isn’t as high and it isn’t perfectly white. Also, its variable composition creates an added difficulty in its use in composite materials.

The substitution of raw materials was achieved by replacing one raw material at a time and testing the new corresponding

*Recycled materials are used in the production of the new sinks, reducing CO<sub>2</sub> emissions and energy consumption*





*The project achieved a 15% reduction in the costs of materials*

formulas in the laboratory. The most promising formulations were then produced on a pilot industrial scale. To achieve this objective, the project team built a prototype sink and synthesised a new compound to effectively bind the components of the formulations tested. At the end of this process, 12 green formulations were selected for use in the production of sinks. They are different in composition, type of raw material used and colour. DELTA finally chose three of the formulations to create a new green products line, ECO GREEN, to be marketed in the short term as the first green sinks in the world.

### Environmental benefits

The new product range requires fewer extracted raw materials. Since these are typically transported long distances, the company was able to lower its energy consumption and carbon emissions, thereby limiting the environmental impact and economic cost of its industrial production process. It estimated that it achieved a 56.3% reduction of CO<sub>2</sub> emissions and a 64.5% reduction in energy consumption.

Additionally, the amount of scraps and waste to be land-filled was also significantly reduced.

One of the chief outcomes of the project was demonstrating the technological feasibility of replacing 100% of the raw materials with recycled raw materials at industrial scale. In particular, the beneficiary succeeded in producing green formulations with around 22% of the total recovered fillers deriving from the reuse of its scraps.

In total the amount of material recycled was 7 849.3 kg of PMMA, 1 611 kg of MMA and 27 548.6 kg of quartz. It was estimated that by the end of 2018, the three green sinks developed by the project would help to avoid around 140 tonnes of waste material (corresponding to 10 000

sinks) being sent to landfill, with quartz accounting for more than 60% of this amount. Moreover, 490 tonnes of CO<sub>2</sub> and 5 130 000 MJ equivalent of energy would be saved due to the use of recycled MMA and PMMA in comparison to current sink production.

### Scaling up for success

The project team demonstrated the overall economic feasibility of the green manufacturing process. Though the labour requirements remain the same, the cost of materials is 15% lower than for conventional sinks. The internal minerals, however, are still more expensive than the external ones, due to higher grinding costs, and sinks based on internal fillers are thus not economically feasible at the present time. "The hope is that the consumer will appreciate the work done and the great results obtained during the project by buying ecological ECO GREEN sinks. They have been on the market since 2015," says Maria Savina Pianesi of DELTA.

The beneficiary's business plan predicts an increase in turnover and profits of at least 7-8% on account of the 10 000 green sinks that will be put on the market in 2016-2018.

Large-scale green sink production would lead to a 6-7% increase in staffing levels, including skilled technicians, sales people and other specialists. The forthcoming production of green sinks is also expected to have a positive socio-economic impact on the region overall, creating new employment opportunities, reducing the amount of waste disposed and transferring knowledge to other industrial sectors.

The project's achievements are in line with EU environmental policy, including the 7<sup>th</sup> Environmental Action Programme, the thematic strategy on the prevention and recycling of waste and the 2011 roadmap to a resource-efficient Europe. Furthermore, the use of secondary raw materials from closed loop processes and symbiosis with other industries through open loop recycling fulfil two aims of the EU action plan for the circular economy.

**Project number:** LIFE12 ENV/IT/000736

**Title:** LIFE GREEN SINKS - Realization of green composite sinks substituting organic and mineral primary materials by recovered waste

**Beneficiary:** DELTA Srl

**Contact:** Antonio Bugiolacchio

**Email:** antonio.bugiolacchio@plados.it

**Website:** www.greensinks.com/en/

**Period:** 01-Jul-2013 to 01-Jul-2015

**Total budget:** €1 581 000

**LIFE contribution:** €767 000





# Slovenia: Tapping into unused waste streams

**REBIRTH raised awareness about the importance of reusing and recycling construction, demolition and inert industrial waste. This LIFE Information and Communication project exceeded its targets for increased recycling of these waste streams in Slovenia.**

Construction and demolition waste (C&D) and some inert industrial waste can be transformed into raw materials for the construction industry, thus reducing the amount sent to landfill and the need for virgin raw materials. Both of these waste streams were untapped in Slovenia, which produces some 2 million tonnes/yr of C&D waste and uses some 20 tonnes/yr of mineral raw materials for construction.

The Slovenian National Building and Civil Engineering Institute set up the REBIRTH project (**LIFE10 INF/SI/000138**) with the goal of increasing the recycling of industrial and C&D waste for use in the construction sector. It aimed to achieve this by raising awareness of the recycling possibilities for these materials at national, regional and local level.

Specific goals included boosting recycling rates by up to 10% for C&D and up to 15% for inert industrial waste, as well as reducing the rate of raw material extraction by 1.5%. The project also aimed to reverse a trend of illegal dumping; there were some 10 700 illegal dump sites in Slovenia, most of which contained a high proportion of construction and demolition waste.

## Reaching out

The project team organised a range of activities designed to reach a wide audience, from the general public to highly specialised professionals, and provide them with diverse information.

The team held eight workshops that provided information on the demands stemming from waste and chemicals legislation, and on construction product requirements. They also highlighted the importance of green public procurement and showed how to include environmental criteria in public procurement procedures. The workshops attracted a variety of participants, from steelwork foundries, the chemicals and construction industries, power plants, municipal services, project design consultancies, project planners, inspectorates,

administrative units and agencies, as well as civil engineering students.

An important aspect of the project involved practical demonstrations – supported by life-cycle assessment – of recycling and reuse of different types of C&D and industrial waste, including steel slag, building rubble from illegal waste dumps and cold in-place recycling for reconstruction of pavements. Four practical demonstrations aimed at local authorities and relevant professional groups served as the basis for the production of five manuals and four videos on the use of waste. The manuals contain technical guidelines for experts, whilst the videos are aimed at the general public and decision-makers and highlight good examples of recycling and reuse of industrial and C&D waste in the construction sector.

*The project organised conferences, lectures, workshops and practical demonstrations, such as this one*



In addition, the project organised 14 lectures for students of technical secondary schools and colleges to improve understanding of the importance of using waste among future professionals (e.g. architects, construction engineers and researchers). A travelling exhibition visited 20 different locations (including schools and municipalities) to help raise public awareness about the advantages and difficulties of recycling industrial and C&D waste, as well as the problem of illegal dump sites.

## Making a difference

REBIRTH had a significant impact: its events attracted a large number of professionals and members of the public, with around 1 300 people attending the conferences, lectures, workshops and practical demonstrations. Surveys of the participants showed increased awareness of the importance of proper demolition, recycling and reuse of C&D and industrial waste. The practical demonstrations and workshops were found to be particularly useful in raising awareness and disseminating best practices among the expert public, such as waste producers, demolition companies, building contractors, local and national decision-makers, and inspectors.

Overall, thanks to the project, knowledge and awareness of the reuse and recycling of C&D and industrial waste increased and recycling rates improved, surpassing the original targets. Between 2011 and 2014, the recycling rate of C&D waste rose by 11.6% and that of inert industrial waste by 21%. Meanwhile, the use of virgin materials fell by 9%. A survey conducted among all 212 Slovenian municipalities also found that illegal dumping had declined and that municipalities were strongly aware of, and active in preventing, illegal dumping. These improvements are expected to continue as the country's construction sector gradually recovers from the downturn that started with the economic crisis in 2008 and the amount of C&D waste that can be reused increases.

REBIRTH also led to the preparation of environmental criteria for road construction and repair, for use by state and municipal authorities in the procurement process of these services. This may help further encourage recycling and boost demand for alternative, rather than virgin, materials. The use of these guidelines is being encouraged, especially at the national level. The REBIRTH project's targeted guidelines for reuse and recycling of materials and its promotion of best practice among stakeholders uphold the goals of EU circular economy policy. C&D waste is one of the priority sectors targeted by the European Commission's circular economy action plan.

In the wake of the project, the beneficiary is working with the country's Ministry of the Environment and Spatial Planning on proposed legislation or amendments to regulations in several areas. These include: green public procurement;



*Construction and demolition waste is one of the priority sectors of the new Circular Economy Package*

the concentrations of dangerous substances in the leachates of construction materials; and defining end-of-waste criteria for C&D waste. The institute also aims to produce guidelines for classification of C&D waste. "A group of experts has been formed which is building bridges and filling gaps between different legislative areas, such as matching environmental legislation on waste with legislation on end-products for construction," explains project manager, Alenka Mauko Pranjic.

She adds that REBIRTH found great acceptance with its target audience, who have continued to provide positive feedback: "The construction industry is able to use large amounts of recycled materials, and, in cases where such materials are not environmentally inert, various binders or processes can be used to permanently immobilise their dangerous components. Such products are also often cheaper than virgin ones and they have a smaller environmental footprint."

**Project number:** LIFE10 INF/SI/000138

**Title:** REBIRTH - Promotion of the Recycling of Industrial Waste and Building Rubble for the Construction Industry

**Beneficiary:** Zavod za gradbeništvo Slovenije (Slovenian National Building and Civil Engineering Institute)

**Contact:** Alenka Mauko Pranjic

**Email:** alenka.mauko@zag.si

**Website:** en.re-birth.eu/project-rebirth/

**Period:** 01-Oct-2011 to 31-Dec-2014

**Total budget:** €804 000

**LIFE contribution:** €402 000



# Available LIFE Environment publications



## LIFE Environment brochures

**LIFE and Climate change adaptation** (2015, 116 pp. – ISBN 978-92-79-52308-3 – ISSN 1725-5619)

**LIFE and Climate change mitigation** (2015, 92 pp. – ISBN 978-92-79-43946-9 – ISSN 1725-5619)

**LIFE and Air quality** (2014, 76 pp. – ISBN 978-92-79-38304-5 – ISSN 1725-5619)

**LIFE and Soil protection** (2014, 68 pp. – ISBN 978-92-79-38305-2 – ISSN 1725-5619)

**LIFE creating green jobs and skills** (2013, 76 pp. – ISBN 978-92-79-25091-0 – ISSN 1725-5619)

**LIFE's Blueprint for water resources** (2012, 80 pp. – ISBN 978-92-79-27206-6 – ISSN 1725-5619)

**LIFE and coastal management** (2012, 96 pp. – ISBN 978-92-79-25091-0 – ISSN 1725-5619)

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**Water for life - LIFE for water: Protecting Europe's water resources** (2010, 68 pp. – ISBN 978-92-79-15238-2 – ISSN 1725-5619)

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**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 – ISSN 1725-5619)

**LIFE on the farm: Supporting environmentally sustainable agriculture in Europe** (2008, 60 pp. – ISBN 978-92-79-08976-3 – ISSN 1725-5619)

## Other publications

**Environment & Resource Efficiency Projects 2015 compilation** (2016, 63 pp. – ISBN 978-92-79-54915-1)

**Environmental Governance & Information Projects 2015 compilation** (2016, 20 pp. – ISBN 978-92-79-47117-9)

**Best LIFE Environment projects 2014** (2015, 68 pp. – ISBN 978-92-79-51705-1)

**Environment & Resource Efficiency Projects 2014 compilation** (2015, 58 pp. – ISBN 978-92-79-47116-2)

**Environmental Governance & Information Projects 2014 compilation** (2015, 11 pp. – ISBN 978-92-79-47117-9)

**Best LIFE Environment projects 2013** (2014, 68 pp. – ISBN 978-92-79-40171-8)

**Environment Policy & Governance Projects 2013 compilation** (2014, 134 pp. – ISBN 978-92-79-37961-1)

**Information & Communication Projects 2013 compilation** (2014, 12 pp. – ISBN 978-92-79-37957-4)

**Best LIFE Environment projects 2012** (2013, 48 pp. – ISBN 978-92-79-32961-6 – ISSN 1725-5619)

**Environment Policy & Governance Projects 2012 compilation** (2013, 157 pp. – ISBN 978-92-79-29479-2)

**Information & Communication Projects 2012 compilation** (2013, 14 pp. – ISBN 978-92-79-29475-4)

**Best LIFE Environment projects 2011** (2012, 24 pp. – ISBN 978-92-79-28217-1 – ISSN 1725-5619)

**Environment Policy & Governance Projects 2011 compilation** (2012, 122 pp. – ISBN 978-92-79-25247-1)

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

<http://ec.europa.eu/environment/life/publications/lifepublications/index.htm>

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>

**LIFE** "L'Instrument Financier pour l'Environnement" / The financial instrument for the environment

The LIFE programme is the EU's funding instrument for the environment and climate action

Period covered 2014-2020

EU funding available approximately €3.46 billion

**Allocation of funds** Of the €3.46 billion allocated to LIFE, €2.59 billion are for the Environment sub-programme, and €0.86 billion are for the Climate Action sub-programme. At least €2.8 billion (81% of the total budget) are earmarked for LIFE projects financed through action grants or innovative financial instruments. About €0.7 billion will go to integrated projects. At least 55% of the budgetary resources allocated to projects supported through action grants under the sub-programme for Environment will be used for projects supporting the conservation of nature and biodiversity. A maximum of €0.62 billion will be used directly by DG Environment and DG Climate Action for policy development and operating grants.

**Types of projects** Action Grants for the Environment and Climate Action sub-programmes are available for the following:

- > "Traditional" projects – these may be best-practice, demonstration, pilot or information, awareness and dissemination projects in any of the following priority areas: LIFE Nature & Biodiversity; LIFE Environment & Resource Efficiency; LIFE Environmental Governance & Information; LIFE Climate Change Mitigation; LIFE Climate Change Adaptation; LIFE Climate Governance and Information.
- > Preparatory projects – these address specific needs for the development and implementation of Union environmental or climate policy and legislation.
- > Integrated projects – these implement on a large territorial scale environmental or climate plans or strategies required by specific Union environmental or climate legislation.
- > Technical assistance projects – these provide financial support to help applicants prepare integrated projects.
- > Capacity building projects – these provide financial support to activities required to build the capacity of Member States, including LIFE national or regional contact points, with a view to enabling Member States to participate more effectively in the LIFE programme.

**Further information** More information on LIFE is available at <http://ec.europa.eu/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/life.htm>

## Contact

European Commission – Directorate-General for the Environment – B-1049 Brussels ([env-life@ec.europa.eu](mailto:env-life@ec.europa.eu)).

European Commission – Directorate-General for Climate Action – B-1049 Brussels ([clima-life@ec.europa.eu](mailto:clima-life@ec.europa.eu)).

European Commission – EASME – B-1049 Brussels ([easme-life@ec.europa.eu](mailto:easme-life@ec.europa.eu)).

**Internet** <http://ec.europa.eu/life>, [www.facebook.com/LIFE.programme](https://www.facebook.com/LIFE.programme), [twitter.com/life\\_programme](https://twitter.com/life_programme), [www.flickr.com/photos/life\\_programme/](https://www.flickr.com/photos/life_programme/).

LIFE Publication / Best Environment projects 2015

