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Environmental Research and Innovation

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INTRODUCTION

Climate action, environment, resource efficiency and raw materials

The era of seemingly plentiful and cheap resources is becoming a distant memory. Raw materials, water, air, biodiversity and marine ecosystems are all under pressure. The combined impacts of climate change and our production and consumption patterns are having a serious impact on the world we live in.

This publication presents a selection of recent projects supported through the EU's Seventh Framework Programme for research and technological development (2007-2013), part of a transformative agenda for a competitive, prosperous and resilient Europe.

Based on current trends, 9 billion people will have limited resources. Profound changes must be introduced involving policies, business models, technologies, consumption patterns and societal innovation by 2050. Our natural capital must be enhanced and our resource efficiency improved. A new kind of economy should emerge, one that is more resilient, sustainable, and proportional to the limits of the planet.

Transitioning to a sustainable economy through resource efficiency is essential, both for our well-being and for Europe's economic development. Handling and treating waste is at the forefront of technological and non-technological innovation in Europe – capitalising on this strength would further reduce Europe's dependency on the import of raw materials, thereby reinforcing its position as world market leader. The global waste market, from collection to recycling, is estimated at EUR 600 billion per annum and holds significant potential for job creation.

Water is an invaluable resource which is constantly put under pressure by climate change, urbanisation, pollution and over-exploitation. With a turnover of EUR 80 billion a year, the sector is a vital source of growth and jobs and innovation. Without improvements in efficiency, water demand is projected to overshoot supply by 40 % in 20 years' time.

The economy's ability to adapt and become more resilient to climate change, while at the same time remaining competitive,

depends on high levels of eco-innovation, both societal and technological in nature.

With the global market for eco-innovation worth around EUR 1 trillion per annum and expected to triple by 2030, this represents a major opportunity to boost competitiveness and job creation in European economies. New business and financial models, new technologies, and the evolving behaviour of citizens behaviours must be strongly encouraged and integrated into policy-making across the EU.

Investing in European success

Biodiversity and ecosystem services

GREEN SURGE

Blossoming partnerships for our cities' parks and plants

There is more to green spaces than parks, and there's more to parks than being pretty. In addition to boosting public health, our cities' leafy infrastructure can generate income for the community and help to mitigate the impact of climate change. The GREEN SURGE project is breaking new ground for the management of this crucial resource.

"We don't use our cities' green spaces optimally," says Cecil Konijnendijk van den Bosch of the University of Copenhagen. "Integrated and innovative approaches are needed."

Konijnendijk is the coordinator of the GREEN SURGE project, which set out in November 2013 to address this need. Over halfway into this four-year project, the partners have already completed detailed analyses of the situation in 20 European cities. They have also set up learning labs in five of these cities.

In addition to these city portraits and case studies, the project consortium intends to produce a handbook on urban green infrastructure planning and a set of policy briefs, along with a detailed overview of the state of the art, new methodology and fresh data.

No patch too small

A park may be the most obvious example of a public green space, but it is not the only one. Consider further pockets of vegetation, such as trees lining the streets, green roofs on public buildings, and the odd landscaped roundabout, and a much wider picture will emerge.

GREEN SURGE focuses on the role and management of this infrastructure. "We want to see if we can improve approaches to planning such spaces," Konijnendijk notes. "We also see a need for better governance approaches, for example to involve the various stakeholders – local communities, government actors and researchers, etc. – in their design."

Promoting this collaboration ties in with the central concept of biocultural diversity, i.e. the integration between biological variety and the cultural specificities of the infrastructure's

Participants

Denmark *(Coordinator), Finland, Germany, Hungary, Italy, Netherlands, Poland, Portugal, Slovenia, Sweden, United Kingdom*

http://greensurge.eu									
FP7	Proj. N°	603567	Total costs:	€7.3 m	EU contribution:	€5.8 m	Duration:	from:	11/2013
								to:	10/2017

users, he explains. "Biocultural diversity is rooted in the interaction between local people and local nature – the fact is that different communities use parks in different ways. There's no such thing as 'simply a park'. There are many different definitions, many different shapes, many different roles."

Establishing perennial alliances

The project's city portraits, which explore settings across the width and breadth of Europe, bear witness to this lush variety. Five of these case studies — Bari, Berlin, Edinburgh, Ljubljana and Malmö — have been selected to be developed into urban learning labs.

"In these labs, we work with local researchers, authorities and communities to jointly formulate key questions that research can help to address," Konijnendijk explains. "We hope that we can make some contributions in this way, for example to local planning processes, the development of new parks, or closer integration of less-involved resident groups." In Ljubljana, for instance, special attention focuses on the participation of younger adults who had been out of work.

GREEN SURGE is also conducting a review of the literature in its field. "We want to base our work on the state of the art," Konijnendijk notes, adding that the project is building on this body of knowledge to produce new insights and methodology.

For example, the team is working out how to assess biocultural diversity, analysing the specific benefits and ecosystem services provided by the various types of green space, and finding ways to measure these benefits.

Beyond mere foliage

Even the tiniest pocket park can be productive — notably as a public health asset where people can sit and unwind, or as part of a wider strategy to mitigate the impact of climate change. However, quantifying these benefits is no easy task, Konijnendijk notes.

"In one part of our project we have studied house prices. We now have figures for Malmö which clearly show that greener areas generally have higher house prices. We are also looking into other types of benefits that could be measured objectively, such as tourism or storm water regulation," Konijnendijk concludes.

PHARMAS

Getting a handle on pharmaceuticals in the environment

Thousands of pharmaceutical products are used in human healthcare. Since a patient's body does not fully metabolise some of them, they are excreted and can end up in the environment, where they can impact aquatic life, and potentially human beings. EU-funded researchers investigated how much concern is justified about anti-cancer drugs and antibiotics.

Most drugs are designed to do good. This is also true of anti-cancer drugs. But as they are intended to kill cancerous cells, they are toxic. This can make them a danger to other cells, which is why the PHARMAS consortium decided to focus the largest part of its research on these toxic pharmaceuticals.

Antibiotics, on the other hand, have long been in the public eye for fear that overusing them will diminish their effectiveness and ultimately create antibiotic-resistant bacteria. Evidently, if they are present in the environment and potentially in our drinking water, constant exposure of bacteria to antibiotics could contribute to developing resistance.

To conduct a sound risk assessment, PHARMAS needed to measure environmental concentrations and effects on aquatic organisms. "We looked at algae as a single-cell plant, the water flea daphnia, a small invertebrate, and juvenile as well as adult fish," explains project coordinator John Sumpter of Brunel University London.

"The results were very clear: it is possible to cause adverse effects, but you need very high concentrations of the drugs to do so, much higher than those found in the aquatic environment."

PHARMAS measurements showed that anti-cancer drug concentrations in the environment were in the region of nanograms per litre. To cause adverse effects in fish or daphnia, milligrams per litre would be necessary. Furthermore, the researchers did not detect any traces of the pharmaceuticals

Participants

United Kingdom *(Coordinator), Denmark, France, Germany, Italy, Netherlands, Sweden*

http://www.pharmas-eu.net/									
FP7	Proj. N°	265346	Total costs:	€3.6 m	EU contribution:	€2.8 m	Duration:	from:	01/2011
								to:	03/2014

in question in our drinking water. These are reassuring results at first glance.

'Something for nothing'

What happens with mixtures of pharmaceuticals, though? For instance, a sample may contain 15 different kinds of antibiotics, each one of them at a concentration too low to cause a measurable effect. Yet, together, they will have an impact, creating 'something for nothing', PHARMAS found.

Mixtures of pharmaceuticals and chemicals in general are of great concern to the scientific community. "You have hundreds, if not thousands of chemicals circulating in your blood which were not in that of your grandparents," Sumpter points out. "The question is not really: does the flame retardant in your blood cause an effect? The real issue is: does the collective mixture of chemicals cause an effect?"

Should the answer be 'no', there would be no reason to worry about individual substances, according to Sumpter. If the answer is 'yes', however, research would have to tease out which ones are of most concern and contribute most to the overall effect.

Research has its work cut out

In addition to encouraging the industry to develop new drugs that are 'green by design' and thus fully metabolised in the patient, the aim must be to identify the biggest culprits without testing all 9000 pharmaceutical products, and then reduce their usage. This is not an easy feat in itself, and even more difficult given limited resources.

In this context, a pharmaceuticals classification system would be a step in the right direction. It could help a medic to determine which one of 24 beta blockers with the same clinical effect licensed in the EU, for instance, is of least environmental concern. Ultimately, this should alter doctors' prescribing practices.

Work on such a system has already begun in Sweden, and PHARMAS used this as a basis for developing its own web-based prototype classification system. Improving and expanding this kind of tool to all 28 EU countries would, however, cost in excess of EUR 100 million, Sumpter estimates.

TURAS

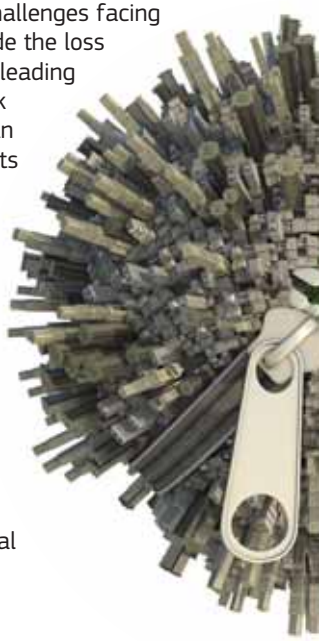
New ideas to improve city life

Cities can be magnets for people, business and culture, as well as drivers for progress. Yet as they continue to grow, they strain to with new demands on them, including the environmental costs of heavier transport and industry. The EU-funded research project TURAS is addressing these issues by testing new ideas to help cities manage such challenges.

The project team is crafting transition strategies to help European cities build resilience and sustainability, while reducing their urban ecological footprint. The European cities involved in the project are: Aalborg, Belgrade, Brussels, Dublin, Ljubljana, Nottingham, Rome, Rotterdam, Sofia and Stuttgart. Each is focusing on a particular strand of research before coming together at the end of the project with an integrated approach.

"As we move towards more sustainable growth, we do not want to jeopardise life in cities," says TURAS project coordinator Marcus Collier from University College Dublin (UCD), Ireland. "This project is about developing a series of strategies to change cities in piecemeal ways. And while some cities are more advanced in their adaptation, we want to develop a coherent strategy that everyone can use," he says.

The environmental challenges facing European cities include the loss of urban biodiversity leading to increased flood risk and the growing urban consumption footprints on the surrounding rural areas. TURAS project team brings together decision-makers from local authorities, SMEs and academics to develop the strategies, spatial scenarios and guidance tools needed to help cities address environmental challenges.



Participants

Ireland *(Coordinator), Belgium, Bulgaria, Denmark, France, Germany, Italy, Netherlands, Serbia, Slovenia, Spain, Taiwan, United Kingdom*

http://www.turas-cities.org/

FP7	*Proj. N°*	*282834*	*Total costs:*	*€9 m*	*EU contribution:*	*€6.9 m*	*Duration:*	*from:*	*01/2011*
								to:	*09/2016*

The research areas covered by the project vary. Flood risk is a particular concern for Rotterdam, Ljubljana, Stuttgart and London, and the researchers will look at new ways of using up rainwater. Stuttgart, for example, is building a "green wall" in a park area that can use the water while mollifying the heavy summer-time heat, using natural processes to cool the city.

In Brussels and Rome, the focus is on finding ways to support sustainable local businesses, while Dublin and Nottingham are looking at the feasibility of using derelict sites to increase urban biodiversity and improve urban community life. In Aalborg, it is about finding ways to implement the city's pledge to convert the municipal energy system to 100 % renewable sources by 2050.

"We do not want a one-stop shop for everyone," says Collier. "While the same overall rules should apply, how they are applied is different in each city. It is up to individual cities to do what they can," he adds.

A key element of the project is engaging with local citizens to get their input on sustainability issues. The TURAS project team is developing an interactive forum for people to access their own city services online and upload their own data, for example on bus services. "It is about developing a communication platform to inform citizens of what is happening and allowing them to give feedback," explains Collier.

The commitment to sustainable and green solutions won TURAS a Champions of European Research award, which was presented to the project by Irish President Michael D. Higgins in June 2012.

Investing in European success

Climate Action

EUPORIAS

Creating targeted climate-prediction services

Climate variability and change have an impact on everyone, including various industries. While climate-prediction technologies have come on in leaps and bounds in recent years, their output is often far from user-friendly. The EU-funded project EUPORIAS is tailoring climate-prediction services to specific user needs.

"We should try to use our ability to predict future climate conditions for the benefit of society," says EUPORIAS science coordinator Carlo Buontempo of the UK's Met Office. "If you look back at the past and the way climate information has been used, it has often been in the form of generic climate portals offering parameters that were believed to be relevant to the users. There are plenty of those portals in Europe – and some of them are very good."

EUPORIAS takes a different approach to near-term climate-predictions, from looking ahead to the next season to up to 10 years into the future. The team is attempting to develop products and services relevant, useable and useful to specific users.

Who are these users? When EUPORIAS started in November 2012, the project partners first came up with a number of proposals for climate-prediction prototypes, all based on a pre-defined set of criteria that the ideal climate service should take into account.

Five plus one case studies

An external panel of experts selected five proposals for prototype implementation, which they considered to be the most promising case studies. A sixth one is exclusively financed by the end-user – an umbrella organisation for the energy sector in Sweden – itself, testament to the commitment to and interest in the EUPORIAS approach. These case studies include a prototype for predicting local catchment water levels in France, possible transport disruptions in winter and agricultural planning in the UK. Another area of application EUPORIAS is focusing on is the renewable energies sector.

"The renewable energy fraction of the energy mix has increased steadily over recent years.

Participants

United Kingdom *(Coordinator), Denmark, France, Germany, Italy, Netherlands, Portugal, Romania, Spain, Sweden, Switzerland*

www.euporias.eu/									
FP7	Proj. N°	308291	Total costs:	€13 m	EU contribution:	€9 m	Duration:	from:	11/2012
								to:	01/2017

This is great in terms of greenhouse gas emissions, but it also poses a challenge, as its availability fluctuates," Buontempo points out. "A nuclear power plant can be switched on or off quite rapidly. If you have an extensive wind farm, however, you depend on what the wind does."

The prototype developed by EUPORIAS is designed to assess wind production over the coming months in Europe. To achieve this, the project team collaborated closely with the system's potential users, namely energy traders keen keen to know how much how much wind energy to expect.

Another prototype has been devised in a joint effort with the World Food Programme (WFP) and the government of Ethiopia, aiming to improve current capabilities to predict the number of people who will require food or financial assistance in the coming year. The software currently used for this purpose does not take into account seasonal predictions, but is solely based on current observations. EUPORIAS fed climate predictions into the existing software, which will help the government and the WFP to deal with this risk.

Putting prototypes to the test

Up until now, the partners' work has mainly been theoretical, fleshing out ideas and assessing the prototypes against historical observations. The next step is to run each of them under semi-operational conditions at least once, attempting to make a real prediction.

Obviously, the outcome is still uncertain. "These prototypes will be proof-of-concept exercises rather than end products. It is not even sure yet that the prototypes will all be successful. Out of five prototypes, there may only be one or two success stories and the others might not work," says Buontempo. "What I think is important – and this will be the project's legacy, I believe – is what we learn about interaction with users, how we manage that interaction and develop something on the basis of the dialogue."

In addition, EUPORIAS has gathered a wealth of information about who uses climate information in Europe – and how – which is highly relevant to the EU's Copernicus Climate Change Service and producers of climate information.

ICE2SEA

EU researchers have a crucial input in climate-change forecasts

The international project ICE2SEA began in 2009 in response to the most recent report from the Intergovernmental Panel on Climate Change (IPCC), which identified the unknown rate of ice loss from Antarctica, Greenland and glaciers worldwide as being the largest uncertainty of sea-level rise. The other important reason for a rise in sea-level due to global warming due to global warming is the thermal expansion of the oceans, which is relatively predictable.

With about EUR 10 million in funding from the European Commission, glaciologists, climate scientists and ocean scientists were worked together across 13 countries, from Chile to Antarctica to Norway, compiling and analysing data. Using satellite imagery and numerical simulations of ice behaviour, they tried to match past and present ice and sea conditions on computer simulations. Then, by projecting these climate models into the future, they ended up with a set of possible projections. This enabled the IPCC to make more accurate projections of future sea-level rises.

The rate of sea-level rise is an important indicator of the effects of climate change and the potential impact on coastal communities. ICE2SEA's research, which concluded in November 2013, was reflected in the IPCC's fifth report. The report captures the current state of scientific knowledge on climate change. It served as the main input into international negotiations at the UN Climate Change Conference which took place in Paris in November 2015.

Participants

United Kingdom *(Coordinator), Belgium, Chile, Denmark, Finland, France, Germany, Greenland, Iceland, Italy, Netherlands, Norway, Poland, Switzerland*

http://www.ice2sea.eu/

FP7	*Proj. N°*	*226375*	*Total costs:*	*€13.7 m*	*EU contribution:*	*€10 m*	*Duration:*	*from:*	*03/2009*
								to:	*11/2013*

ICE2SEA's research fills a crucial gap in scientific knowledge by allowing a more accurate calculation to be made of the rate of ice loss from the ice sheets of Antarctica and Greenland and glaciers around the world caused by global warming. One of the major ourcomes of ICE2SEA is a better understanding of how the oceans are affecting the ice sheets. Until recently, researchers assumed that climate change would have an effect on the ice sheet through atmospheric warming melting the surface of the ice. The reality, however, is that ocean changes are responsible for a lot of the effects of climate change. "There is a subtle swing towards understanding that the oceans have a huge role in affecting how the ice sheets are changing," says project coordinator David Vaughan of the UK's Natural Environment Research Council (NERC).

ICE2SEA's research methodology and models of ice sheets are currently being used and refined by other researchers in the field. For example, the project's research supported the creation of the Randolph Glacier Inventory, the first complete global inventory of glaciers. A current NERC project on the Filchner ice shelf in Antarctica is following up on research from ICE2SEA, says Vaughan.

"Scientific papers are still being published, applying ICE2SEA's models to wider geographical areas," he says. "The project's legacy continues in many areas of research."

LIMITS

Mapping a path to global agreement on limiting climate change

An EU-funded project has mapped the possible outcomes of upcoming global negotiations to curb greenhouse gas emissions – from success to failure. The project's work aims to support leaders in achieving a new global pact on how to limit global warming to agreed targets – good for the environment and our future well-being.

Present commitments to limit carbon emissions – even if fully implemented – will not succeed in keeping global temperature rises below 2º C by 2100. Nor can temperatures be kept below the 2º C limit without new technologies, such as carbon capture and storage.

These are some of the findings by researchers from Europe, China, India, Japan and the United States as part the EU-funded LIMITS project.

The project integrated and assessed economic, financial, energy and climate data to model the consequences of possible outcomes of global climate talks in Paris, France in 2015. The researchers aimed to help leaders understand the costs and benefits of their positions and reach agreement on how to limit global temperature rises to below 2º C.

The team entered data for various scenarios. These range from a successful outcome to negotiations in Paris in 2015 resulting in a strict global agreement on emission limits from 2020 (preceded by preparatory actions across the world), to complete failure and reliance on fragmented and regional actions to limit emissions. The models generated possible policy 'pathways' that show their probable climate effects, costs and risks.

Certain policy pathways failed to keep temperatures below 2º C by 2100, whatever the circumstances. These findings can be considered particularly robust, according to project coordinator Massimo Tavoni, an economist at Fondazione Eni Enrico Mattei in Italy.

Policy pathways that could emerge from the success or failure of the Paris talks were central to the modelling by the LIMITS team. The negotiation agenda agreed at the Durban Climate Conference in 2011, known as the 'Durban Platform', was one of the inputs for climate discussions in Paris.

The Durban Platform agenda includes: a 2º C global temperature limit as a target; seeking the inclusion of emerging nations as well as developed ones in legally binding targets; and a strong focus on regional and national climate action.

Potential policy pathways following Paris could include a cap on global emissions of either 450 parts per million (ppm) or possibly 500 ppm.

Participants

Italy *(Coordinator), Austria, Belgium, China, Germany, Hungary, Iceland, India, Netherlands, United Kingdom*

http://www.feem-project.net/limits/									
FP7	Proj. N°	282846	Total costs:	€4.5 m	EU contribution:	€3.5 m	Duration:	from:	10/2011
								to:	09/2014

The LIMITS team also took account of:

- the effects of mitigation actions prior to any global agreement;
- the possibility of a ten-year delay before global agreement, or;
- how the temperature rise could be kept below 2° C through fragmented actions in the event of failure to reach global agreement.

"Certain policy pathways have dramatic effects. It is clear that delayed action on reducing carbon emissions – even just ten years' delay – greatly increases the costs of limiting temperature rises to 2° C," notes Tavoni.

The longer the delay before mitigation starts, the greater the lock-in of global economies to fossil fuels, and the greater the transition cost, the research revealed.

And limiting global temperature rises will be extremely difficult without global agreement to put a price on carbon. The European Union has led the way in global climate change talks, pledging to cut its greenhouse gas emissions by 20 % by 2020 compared to 1990 levels.

The agreement this year to increase this emissions target to 40 % by 2030 shows the EU's continued commitment to cutting carbon emissions. The EU pushed hard for a global agreement in Paris.

Collaborative learning

The project highlighted important co-benefits and trade-offs between climate change mitigation and other national priorities, such as, air quality and energy security.

"It also added detail on the impacts of various policy pathways at a national and regional level. There is a tendency to discuss the impacts of climate change at a global level, as if the impacts of climate and energy policies would be felt uniformly," says Tavoni.

In fact, the effects will vary significantly across industries and regions, and the modelling brought this out.

"The LIMITS project provided negotiators at the Paris conference with scientifically based forecasts of the outcomes from the various policy pathways to be considered. Here, the international make-up of the LIMITS team had additional benefits," says Tavoni.

During the climate negotiation in Paris 2015, the negotiators have been very conscious of their national responsibilities. Every concession carries the risk of competitive disadvantage.

"The LIMITS project provided an opportunity for leading researchers from the major carbon-emitting regions of the world to come together in an open and collaborative way, to learn from each other and to gain a joint understanding of the challenges and opportunities that the world is facing," he adds.

Investing in European success

Cultural Heritage

HERCULES

Europe's landscapes – a better view

Europe boasts landscapes that are breathtakingly beautiful – and essential for wildlife, communal activities, human well-being and local economies. An EU-funded project is gathering data on how these landscapes are changing, helping to manage them wisely in the long term.

Think of the most beautiful regions in Europe, such as the petrified forests of Lesvos or the Armorique in Brittany. Over the years, these landscapes – and many others – have changed. Today, modern land use, the rural exodus to cities and the expansion of towns are altering them faster than ever before.

The HERCULES project is helping landowners, public authorities and NGOs protect and manage Europe's diverse landscapes, both those that are common and those that are particularly significant. The EU-funded project's researchers are learning how and why landscapes change as a result of both climate and human behaviour. They are also developing a programme to predict the impacts of new land uses and help keep our land heritage safe.

Landscapes are vital to rural economies and local products, biodiversity and a healthy ecosystem. They also provide irreplaceable views, historical heritage and outdoor recreation, which in turn can attract visitors and tourists.

Understanding the history of landscapes and predicting their future are vital to keeping these benefits alive, says project coordinator Tobias Plieninger of the University of Copenhagen. "Landscapes are co-created by people and the environment. We have to bring them back together," he says.

There is growing interest in studying the topic, both within and outside of Europe. HERCULES builds on the European Landscape Convention (ELC), which promotes European co-operation to protect, manage and plan European landscapes.

In its first 18 months, the three-year project has compiled information about the causes, patterns and outcomes of landscape variation. And to help researchers and policy-makers better understand these, it has developed a new system for classifying landscapes.

Project partners have also held a number of workshops and developed an online platform – the 'Knowledge Hub'. These allow researchers,

Participants

Germany *(Coordinator), Belgium, Denmark, Estonia, France, Greece, Netherlands, Slovenia, Sweden, Switzerland, United Kingdom*

www.hercules-landscapes.eu

FP7	*Proj. N°*	*603447*	*Total costs:*	*€3.9 m*	*EU contribution:*	*€3 m*	*Duration:*	*from:*	*12/2013*
								to:	*11/2016*

stakeholders and the general public to share data and advice on good land management.

Information centre-point

Much of the project's information about long-term landscape change is collected from archaeological, historical, environmental and satellite data. More detailed data comes from the project's case studies on nine diverse landscapes around Europe, which identify long- and short-term factors behind change.

The combined information is being analysed by HERCULES' researchers to predict the impacts of policy changes and find ways to preserve landscapes' historical and archaeological value.

In addition to the strong focus on academic research, researchers are seeking input based on practical experience of landscape issues.

In eight of the transpose studied landscapes, local stakeholders, such as landowners, businesses, municipalities and foresters are sharing views on how to preserve environmental and archaeological heritage. At the European level, HERCULES researchers have received valuable feedback from the European Commission, Members of the European Parliament, public-private bodies, companies and non-governmental organisations, says Plieninger.

Other decision-makers and individuals can access the project's research for free through the Knowledge Hub. This web-based application – developed by the project partners – is a store of detailed social and geographic data, presented through maps. Its interactive platform allows users to view regional changes, add information and model future developments.

"The Knowledge Hub is a central component of HERCULES," says Plieninger. "We are trying to provide tools that make landscape management more tangible."

With the case study fieldwork nearly complete, attention is now turning to completing the data analysis, finalising landscape modelling and making policy recommendations.

HERCULES can improve the understanding of the value of cultural landscapes for land users and policy-makers, says Plieninger. He is seeking funding for the Knowledge Hub after the project's end so that it can continue to support sustainable land management.

He praises the project's partnership between academic, commercial and policy-making interests. "It was an enormous enrichment to work with key players and institutions at an EU level."

MEMORI

Preserving cultural objects from harmful conditions

Objects showcased in museums or exhibitions are vulnerable to the effects of pollutants both from outside the building where they are housed as well as from potential substances found inside. Better measuring tools could enable curators and conservators of cultural artefacts to take the necessary steps to ensure their protection.

The EU-funded MEMORI project, which was coordinated by the Norwegian Institute for Air Research (NILU), developed an early-warning tool that is expected to help overcome the problem of harmful conditions on cultural heritage objects. “Such potential damage could be the result of a range of factors,” explains project coordinator Elin Dahlin from the NILU, “but while humidity, temperature, air flow and light are commonly measured in large institutions, pollution from outside traffic or the potential use of harmful materials in the construction of the exhibition/museum space are not often recorded,” she adds.

The project team put together a single system two different dosimeters (an instrument that measures an object’s exposure to a range of radiations) that had been developed by two previous EU-funded projects. “One of the dosimeters was developed here at our institute – this one reacts to traffic pollutants getting indoors from the outside environment. The second dosimeter, which was developed by the Fraunhofer Institute in Germany, detects acidic pollutants, often emitted from materials indoors,” says Dahlin.

The two-in-one dosimeters are placed in exhibition areas for a period of three months to give a true reading of the conditions. The readings are then analysed, using a “new technique that we have been able to develop,” adds Dahlin. “Previously, the information had to be sent back to the laboratories for analysis. Now, with this instrument, these analyses can be provided to the user directly.”

Participants

***Norway** (Coordinator), Austria, Belgium, Denmark, Germany, Ireland, Italy, Romania, Spain, United Kingdom*

http://www.memori.fraunhofer.de/									
FP7	Proj. N°	265132	Total costs:	€3.2 m	EU contribution:	€2.5 m	Duration:	from:	11/2010
								to:	10/2013

The MEMORI dosimeter reader is simply connected to a PC and a traffic-light system indicates the severity of the conditions. A green light means that the museum/exhibition area is fine. A yellow light indicates that there are some problems to be resolved, and a red light underlines the need to take corrective action urgently. "MEMORI researchers have also developed a set of guidelines that tell the user how to interpret the results," says Dahlin.

At the end of the MEMORI system's three-year development period, the museums working together with the project team showed interest in the early-warning tool. Museums and institutions, such as English Heritage and the Tate in London, the Music, Film and Theatre Museum in Lithuania, the Reina Sofia in Madrid, the Picasso Museum in Paris and the Cultural History Museum in Oslo, have all tested the new MEMORI dosimeter. The new tool has also been tried out by an end-user in Tokyo.

NILU is confident that there is demand for the new tool, and a marketing plan has been developed by the project team. "We have applied for more funding because there are some steps that need to be taken before we can decide who is going to produce the equipment," concludes Dahlin.

NANOMATCH

Booster shots for historical buildings

Looking at Europe's flamboyant cathedrals, it is easy to forget that even stone does not last forever. Without effective conservation, gargoyles erode, stained-glass shatters, and choir stalls eventually rot. EU-funded researchers have produced innovative compounds to protect our cultural heritage.

The Nanomatch project has developed nano-structured compounds for the preservation of stone, glass and wood in historical buildings. These products consist of nanoparticles suspended or dissolved in solvents that evaporate once applied. The substances deposited this way then react with ambient air and moisture, transforming into a filler material that reinforces the support.

"A product for the consolidation of glass will soon be on the market. Several other products – designed to consolidate stone or counter the acidification of wood – are also essentially ready," says project coordinator Adriana Bernardi of the Institute of Atmospheric Sciences and Climate of the Italian National Research Council (CNR).

However, she notes, a few more tweaks are needed to prepare them for large-scale commercialisation. She expects this process to take another two or three years.

A healthy injection of stone

Nanomatch set out to address a major conservation challenge: the degradation of calcium-based stone. In many cases, polymer-based products are used to consolidate this type of stone, explains Patrizia Tomasin of the CNR's Institute for Energy and Interphases, one of the project's key scientists. "But none of these really solve the problem," she says. "They deteriorate, and they can actually make the problem worse. There are other types of new consolidants," she adds, but few of the products that are currently on the market penetrate very far into the stone.

"Specific difficulties linked to polymer-based substances include discoloration over time, which means that the repairs can be quite noticeable. They are also difficult to remove if further treatment is needed," adds Luc Pockelé of R.E.D. srl, who was in charge of the project's market research.

Participants

Italy *(Coordinator), France, Germany, Netherlands, Romania, Spain*

http://www.nanomatch-project.eu/									
FP7	Proj. N°	283182	Total costs:	€3.1 m	EU contribution:	€2.6 m	Duration:	from: to:	11/2011 10/2014

Nanomatch developed an elegant solution to this consolidation challenge: a calcium-based product that diffuses into the tiniest fissures and partly evaporates, depositing nanoparticles that react with air and moisture to bind the carbonate structure of the stone. It is not quite liquid stone, but it is a liquid that transforms into stone. “At the end of the process,” says Tomasin, “our product has the same composition.”

This innovation was tested in four study sites around Europe, Bernardi adds. Treated and untreated samples of various types of stone were exposed to the elements at the Basilica of the Holy Cross in Florence, the Cathedral of Oviedo, Cologne Cathedral and the Stavropoleos Monastery in Bucharest, so that the performance of the consolidant could be observed.

“The results were encouraging,” says Pockelé, “even compared to the more advanced products that are currently available. The consolidant developed by Nanomatch is highly soluble,” he says, “depositing a particularly large volume of molecules even in very thin fissures deep inside the stone.”

A healing touch for glass and wood

Nanomatch also finalised the development of a consolidant for glass, says Bernardi, a process that was initiated by an earlier project dedicated to stained-glass windows.

Several of the partners from this predecessor project were involved in Nanomatch as part of the team that demonstrated the efficiency of the substance and adapted it for high-humidity environments. The new consolidant is used to reinforce glass with micro-fractures. It is based on the same principle as the substance proposed for stone, but it uses aluminium particles rather than calcium.

“In addition, Nanomatch has applied the calcium-based compound on wood, another building material of crucial importance to our cultural heritage. This treatment protects wood from acidification,” Pockelé reports, “and can also be combined with a biocide to guard it against various tiny, destructive organisms.

“The project ended in October 2014, and the consortium is now considering how to make its compounds available to prospective customers. The glass consolidant should soon be on the market,” Bernardi reports.

“More fine-tuning will be needed to prepare the other compounds for commercialisation,” says Pockelé, notably to optimise evaporation speed. “However”, he adds, “samples are already available to restorers upon request.”

Investing in European success

Disaster risk reduction

MIAVITA

Know your volcano, understand the risks

Do you live near a volcano? How exposed are you if it erupts? And what can be done to mitigate the risk? EU-funded researchers have helped communities in four countries to assess their vulnerability and plan ahead. They have also produced a handbook to inform similar initiatives elsewhere and set up monitoring systems to help detect signs of an impending eruption.

The Miavita project conducted research on volcanoes in Cape Verde, Cameroon, Indonesia and the Philippines. It engaged with local stakeholders to carry out disaster risk assessment and mitigation activities for the populations established in these hazardous areas.

As part of this exercise, the project developed new risk mitigation and crisis management methods and worked out suitable strategies for the various communities. In addition, the researchers installed or reinforced crucial monitoring, communication and information infrastructure. The system Miavita deployed to keep tabs on the activity of Cape Verde's Mount Fogo, helped to provide early-warning of the volcano's return to activity in late 2014.

The partners have also issued a handbook that will facilitate similar initiatives for other volcanoes. This publication provides guidance on aspects as diverse as hazard mapping, risk mitigation, civil protection activities during a crisis and ways to build resilience.

No room for complacency

Between eruptions, volcanoes may seem perfectly harmless. They can easily lull local populations into a false sense of security, but preparedness does pay off. Lives can be saved if the volcano is monitored, action has been taken to mitigate the risks and the services, infrastructures and strategies needed in the event of a crisis are in place.

Miavita focused on four very different areas threatened by four very different volcanoes: Mount Cameroon in Cameroon, Mount Fogo in Cape Verde, Mount Merapi in Indonesia and Mount Kanlaon in the Philippines. "While all are major hazards, the actual risk to the population depends on the nature of volcano and on the context," says project coordinator Pierre Thierry of

Participants

France *(Coordinator), Cameroon, Cape Verde, Germany, Indonesia, Italy, Norway, Philippines, Portugal, United Kingdom*

http://miavita.brgm.fr/default.aspx									
FP7	*Proj. N°*	*211393*	*Total costs:*	*€5.1 m*	*EU contribution:*	*€3.5 m*	*Duration:*	*from:*	*10/2008*
								to:	*11/2012*

the Bureau de Recherches Géologiques et Minières (BRGM).

Effusive volcanoes like Fogo and Mount Cameroon, he explains, mainly disgorge slow-moving streams of lava. This is bad enough, but less risky to the neighbourhood than the eruptions of explosive volcanoes like Merapi. Those are liable to unleash the full range of volcanic hazards which, for instance, also include powerful blasts, gigantic plumes of fire and flying rocks, ash clouds, landslides and rivers of mud.

And, of course, some volcanic areas are more densely populated than others. Mount Merapi, for example, borders on a bustling city. "In the case of Fogo," says Thierry, "the threat is mainly to buildings and crops, but not so much to the residents. Volcanoes like the Merapi, however, are extremely dangerous for populations because of the massive explosions. More than 380 people died when it erupted in 2010, and over 400 000 people were displaced."

Second-guessing a hot-headed neighbour

Miavita enabled adjacent communities to analyse their exposure and plan ahead for a potential crisis. Emphasising the need to involve all stakeholders, the project engaged with the authorities, the various emergency services and the residents. It produced detailed assessments of the vulnerability of populations, infrastructures and assets.

The project also helped to install or improve crucial infrastructures. For Mount Fogo, this involved setting up a particularly sensitive, cost-effective system to monitor the volcano, which is located on a small island, and finding a way to transmit the data to a scientific institution on a neighbouring island. Thierry reports that these upgrades were instrumental in predicting the volcano's eruption in November 2014, enabling a local scientist to warn the authorities more than a day in advance. The eruption destroyed two villages located near the peak of this sparsely populated volcano, but there were no casualties.

To support initiatives focusing on other volcanoes, Miavita has published a handbook on volcanic risk management. This publication offers clear, practical information for all stakeholders, including local authorities, emergency services and residents. If you live near a volcano, do check it out.

SAFELAND

Research improves Europe's protection against landslides

In the decades ahead, landslide risk will probably increase in some regions of Europe as a consequence of climate change and a growing population. But the danger of landslides can be hidden: although their destruction is plain, in official data landslides are often lumped in with their triggers, such as extreme precipitation, earthquakes or floods. This means that damage wrought by landslides is generally underestimated by analysts, and public awareness of landslide risk is less than that of comparable natural hazards.

Europe is affected by landslides largely because of the complex features of the continent's landscape and the density of the population. According to the Centre for Research on the Epidemiology of Disasters, over the last century Europeans have experienced the second-highest number of fatalities and the highest economic losses caused by landslides of any continent. Although the number of fatalities caused by landslides is not as high as other natural hazards, the number of people impacted is quite substantial. An estimate in Italy found that for each death, another 50 people experienced damage to their homes or property.

In order to examine landslide risk and predict changes over the next century, the European Commission provided EUR 6.7 million towards a recent research project called SafeLand. The first task of the research team, comprising 27 partner institutions in 12 countries, was to improve the scientific understanding of how landslides occur. Although common natural landslide triggers are known – such as extreme rainfall or snow-melt – they can also be caused by human actions, such as clearing land and road construction. Scientists are still trying to develop an understanding of the mathematical relationship between triggers and landslide risk. The process involves comparing theoretical predictions with observed landslide, and no-slide, events in recent years.

The researchers then applied these improved mathematical models to determine which areas of Europe are currently landslide "hot spots", determined both by the likelihood of a landslide as well as the risk of damage. They found hot spots clustered in predictable places, such as the mountain ranges of Italy and Norway, but also in less expected countries, including Montenegro, Macedonia and Romania. Approximately 40 % of the population of small alpine countries, such as Lichtenstein and Montenegro are exposed to landslides.

Participants

Norway *(Coordinator), Austria, France, Germany, Greece, Italy, Netherlands, Romania, Slovenia, Spain, Switzerland, United Kingdom*

http://www.ngi.no/en/About-NGI/VP09/International/SafeLand--Living-with-risk-in-Europe/									
FP7	Proj. N°	226479	Total costs:	€8.8 m	EU contribution:	€6.7 m	Duration:	from:	05/2009
								to:	04/2012

Finally, the research team studied how landslide risk in selected areas would change over the next 100 years. SafeLand applied models of climate change to landslide-prone regions in Scotland, southern Italy, the French Alps, and southern Norway. They found that, at a local level, each of these areas saw an increased likelihood of landslides, even when the results at the national scale indicated no significant change. They concluded that local modelling is essential to accurately predict the changing pattern of landslide risk.

Importantly, human actions are as significant as climate changes in shaping future landslide risk. "There are two dimensions of risk," explains Bjørn Kalsnes, head of the SafeLand project. "Our impression is that changes in demography are perhaps more important than changes in climate, at least over the timescale we're looking at."

That gives landslide-prone areas the option of managing development by, for instance, discouraging people from settling near slopes, or prohibiting forest clearing in order to manage landslide risk. SafeLand also screened 14 existing early-warning systems and reported on their applicability for different landslide types, scales and risk management steps. They created checklists which any regional authority can now use in choosing a landslide early-warning system.

Finally, the project demonstrated a new method for consulting the public on matters of natural hazards. In Nocera Inferiore, Italy, SafeLand researchers held meetings with residents, conducted surveys, and distributed information via lectures and websites. The goal of this work was to accurately communicate landslide risk and allow public participation to shape Nocera Inferiore's mitigation and prevention strategy, which is still under development.

"You may have the best technical solution in the world but if it is not possible because of political reasons, or resistance from the local population, then it doesn't help anybody," says Farrokh Nadim, scientific coordinator of SafeLand. "We looked at this from a scientific point of view in our case studies, and I think we made really groundbreaking progress, showing the way this can be done in the future," Nadim adds.

SAFER-REAKT

A global team is working on an earthquake early-warning system for Europe

Even 10 seconds can make a difference. When Japan was hit by an earthquake in 2011, early-warning systems were in place, and within seconds even the high-speed 'bullets' trains stopped. About half of Europe is also a high-risk earthquake area, especially Mediterranean countries like Greece and Italy, and other regions around the Black Sea.

Unlike the weather, there are currently no reliable methods to predict earthquakes. However, earthquakes do send a warning signal. "When an earthquake occurs, the first ground vibration is not dangerous yet it contains vital information about the event," says SAFER team member Paolo Gasparini at the university of Naples and AMRA Scarl, a research organisation of the University.

This initial ground wave travels very fast and arrives tens of seconds to minutes earlier than the main, destructive wave. The characteristics of this initial ground vibration will indicate the destructive power of the earthquake. But what is more important is that these seconds and minutes allow people to protect themselves or reach safety. The activation of early-warning systems can also mitigate the impact of an earthquake by shutting down railways, gas pipes and even nuclear power plants.

The SAFER project team, set up in 2006 and coordinated by the GeoForschungsZentrum (GFZ) in Potsdam, Germany, included researchers from 19 European institutions. Also participating in the project were researchers from four institutions in Egypt, Japan, Taiwan and the United States.

"The main aim of the project was to develop a novel, early-warning capability for Europe

SAFER

Participants

Germany *(Coordinator), Egypt, France, Greece, Iceland, Italy, Japan, Netherlands, Norway, Romania, Switzerland, Taiwan, Turkey, United States*

www.reaktproject.eu/

FP7	*Proj. N°*	*36935*	*Total costs:*	*€4.9 m*	*EU contribution:*	*€3.6 m*	*Duration:*	*from: 06/2006 to: 06/2009*

using the initial, information-carrying wave produced by earthquakes," says Gasparini.

Yih-Min Wu, Associate Professor of Geosciences at the National Taiwan University, participated in many SAFER meetings with the aim of introducing new methods to the project and sharing experiences with his European counterparts. "We analysed strong motion records from Southern California, Japan and Taiwan, and estimated intensity from various seismic waves to achieve the earthquake early-warning system" he says. "Our work was the foundation of the early-warning system and nowadays many European institutes use this approach," he adds.

Demonstrator projects were set up in Istanbul, Bucharest, Naples, Athens and Cairo. In Bucharest, a warning system is already operational in the city, while in Istanbul, such a system is being implemented for the bridge spanning the Bosphorus.

The prototype warning system developed by the SAFER project team consists of networks of seismic stations placed near fault zones. Each seismic station is equipped with seismometers and accelerometers that detect ground vibrations. The latter, low-cost instrument is comparable with the accelerometer that triggers the inflation of the airbags in cars during a collision.

These stations are linked via wireless systems to a processing centre where the data is analysed, leading to a real-time assessment of the magnitude of the earthquake. If the earthquake presents a danger, warnings are issued and actions to stop trains and close down industrial installations are taken automatically. "For example, Naples is protected by a prototype system consisting of 30 seismic stations placed around the fault zone under the Apennines, 80 kilometres east of the city," reports Gasparini.

SAFER - REAKT

An important result of SAFER was that it has primed the European research community for just this type of research. "We have developed a real network of international experts who have worked together for several years and together have gained valuable experience," comments Gasparini.

The development of response strategies to earthquakes, which was not part of the SAFER project, has been the main objective of REAKT (Strategies and tools for Real-time EArthquake risK reducTion), the successor of SAFER that dealt with people's responses.

In particular, REAKT explored how to use the information coming from earthquake forecasts, early-warnings and real-time assessments of the vulnerability of built structures. All this information has been combined in a probability framework to be used by emergency managers to make decisions in real time. This system for risk reduction was applied to vulnerable infrastructures, including trains, hospitals, bridges, and schools. REAKT also studied possibilities for forecasting earthquakes.

The REAKT project was carried out between September 2011 and December 2014. The project consortium included 23 institutes from 10 European countries - France, Germany, Greece, Iceland, Italy, Portugal, Romania, Switzerland, Turkey and the United Kingdom - and one each from Barbados, Japan, Taiwan, Trinidad and Tobago and the United States.

At the heart of REAKT are a number of strategic applications which have provided an

REAKT

Participants

***Italy** (Coordinator), France, Germany, Greece, Iceland, Jamaica, Japan, Romania, Switzerland, Taiwan, Trinidad and Tobago, Turkey, United Kingdom, United States*

www.reaktproject.eu/

FP7	*Proj. N°*	*282862*	*Total costs:*	*€10.2 m*	*EU contribution:*	*€7 m*	*Duration:*	*from:*	*09/2011*
								to:	*08/2014*

opportunity to implement and test scientific products and the results from both projects. They have also helped develop a better understanding of what end-users can expect by applying Earthquake Early Warning (EEW), Operational Earthquake Forecasting (OEF) and real time time-dependent vulnerability assessment to reduce earthquake-related risk at respective sites.

The applications included: i) nuclear (Switzerland), hydroelectric (Iceland) and coal (Portugal) power plants; ii) cable stayed (Greece) and suspension bridges (Turkey); iii) electric power (Iceland) and gas distribution networks (Portugal, Turkey); iv) oil refineries (Portugal); v) industrial and touristic harbours (Greece, Portugal); vi) railways (Italy); and vii) public schools (Italy) and hospitals (Greece). The applications were segregated into feasibility studies, prototype implementation and implementation efforts based on the maturity expected to be reached in each application within the project timeline.

Thanks to the strong involvement of different types of end-users, a comprehensive view of the conditions favouring or hindering the application of short-term earthquake forecasting and early-warning methodologies was produced, identifying scientific and regulatory problems to be addressed in future research.

Investing in European success

Earth Observation

SIGMA

Monitoring agriculture for sustainability

Producing more food to feed a growing global population will require more intensive and extensive farming over the coming decades. Ensuring this can be achieved in a sustainable way is the goal of EU-funded researchers developing methods and tools to monitor and map agricultural areas and crop production.

The SIGMA project involves 22 partners in 16 countries from Africa, the Americas, Asia and Europe. Its objective is to create tools and methods that will enable farmers, researchers and other stakeholders to gain an unprecedented long-term and worldwide perspective on how land is being used, what is being farmed, how yields and production are evolving and how agricultural activities are impacting the environment.

Already of critical importance, this data will be even more essential in the future amid predictions that global agricultural productivity will need to increase by at least 70 % to feed a world population estimated to reach almost 10 billion by 2050.

"There are two ways to increase agricultural production: expand the amount of farmland, or to farm existing farmland more intensely," explains SIGMA project manager Sven Gilliams of VITO in Belgium. "Both of those options have important effects on the environment and can prove unsustainable in the long term."

While several Earth observation-based crop monitoring systems are currently in use, they focus mostly on short-term agricultural forecasts and harvest predictions. The SIGMA team wanted to look beyond the current growing season to be able to envisage the impact of changing land use and agricultural activities years and decades into the future.

Scaling up from regional to global

The system they are developing builds on the past 20 years of earth-observation data, current satellite imagery and in-situ information from dozens of test sites around the world where models and methods can be tested and validated on a small scale. Everything from climate and terrain to irrigation and the use of fertilisers is taken into account.

"The results from the test sites can be scaled up by grouping agricultural areas into agro-ecological zones – areas with similar climate conditions, where farming is carried out in a similar way," Gilliams says. "This information can then be extrapolated and combined with earth-observation data to develop a global picture of pluri-annual changes, such as shifts

Participants

Belgium *(Coordinator), Argentina, Austria, China, Czech Republic, Ethiopia, France, Germany, Italy, Kenya, Netherlands, Niger, Russia, Spain, Switzerland, Ukraine*

www.geoglam-sigma.info/

FP7	*Proj. N°*	*603719*	*Total costs:*	*€11.2 m*	*EU contribution:*	*€8.8 m*	*Duration:*	*from:*	*11/2013*
								to:	*04/2017*

in cultivation practices, or the expansion or abandonment of agricultural land."

On the one hand, the data promises to contribute to the development of more sustainable farming practices worldwide. Farmers and other stakeholders would be able to identify successful strategies in one region of the world that could be applied in other areas with similar climate and geographical conditions.

On the other hand, a global overview would provide a clearer and more accurate picture of yields and production that should minimise spikes in food prices, Gilliams adds. This information could help avoid future crises, such as when wheat prices rose sharply in 2012 following droughts in Russia, or in 2008 during the global food crisis.

The Agricultural Market Information System (AMIS), managed by the UN Food and Agricultural Organization, was set up precisely as a result of the 2008 crisis in an effort to collect and supply information on agricultural markets worldwide.

It also obtains data from the G20 Global Agricultural GEO-Monitoring Initiative (GEO-GLAM) of the Group on Earth Observations (GEO), to which SIGMA will provide its tools, data and methods.

"Involvement in GEO-GLAM will ensure the long-term use of the systems we are developing. We are also carrying out capacity-building activities with agricultural ministries and scientific institutes around the world to share our methodologies and best practice," Gilliams says. "By the time the project ends in 2017, all stakeholders will have access to methods, maps and monitoring tools, as well as models of the environmental impact of agricultural activities and cultivation practices."

SWITCH-ON

Saving water through effective and open knowledge sharing

Freely accessible online tools to enable sustainable and efficient water resource management are being developed by the EU-funded SWITCH-ON project. The initiative is currently building a web portal to host innovations, such as a virtual water-science laboratory, product marketing point and meeting place.

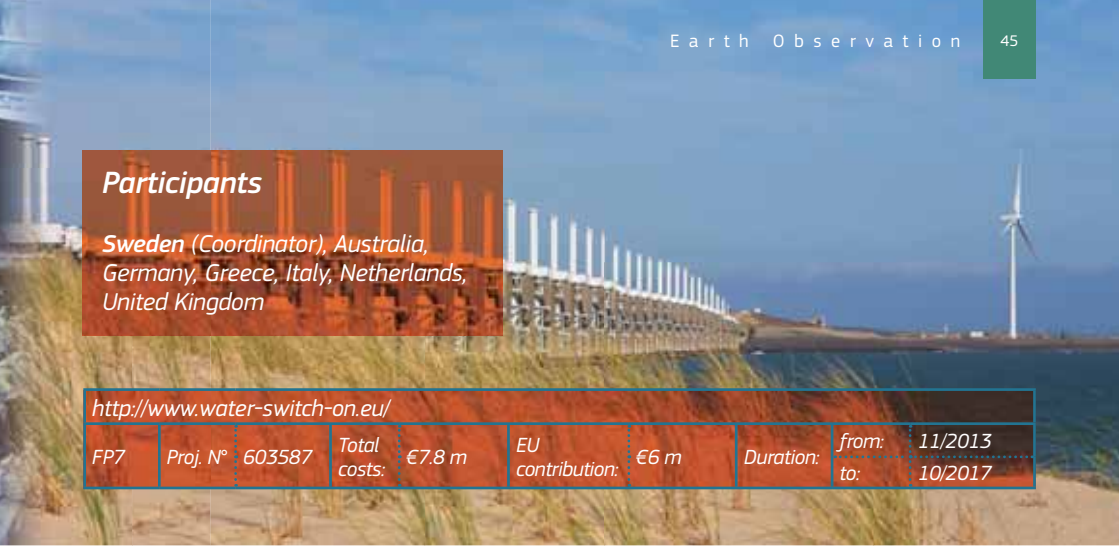
Environmental information tools are in high demand but not always available or accessible. This is due in part to a wide dispersion of potentially useful material and a lack of information on how to actually apply available tools at an acceptable cost.

SWITCH-ON, which began in November 2013, is promoting the use of open data tools to support sustainable water use. Open data is the idea that certain information should be freely available to everyone without restrictions.

By exploiting the untapped potential of open data, the project team believes it is possible to provide better water information, leading to more efficient environmental services and better handling of environmental problems, including those induced by climate and environmental change.

"This portal will be the first one-stop shop where you can find different kinds of water-information and users in one place," explains project coordinator Berit Arheimer, head of hydrological research at the Swedish Meteorological and Hydrological Institute (SMHI). "It will lead to more efficient water management tools, which can be used to create jobs that contribute towards a more sustainable and safe society."

The innovation will also help to foster new business opportunities and growth



Participants

Sweden (Coordinator), Australia, Germany, Greece, Italy, Netherlands, United Kingdom

http://www.water-switch-on.eu/									
FP7	Proj. N°	603587	Total costs:	€7.8 m	EU contribution:	€6 m	Duration:	from:	11/2013
								to:	10/2017

by facilitating the development of new products and services based on the principles of information sharing. SMEs and service providers are expected to be able to access new markets, increase their competences and achieve more efficient production as a result of collaborating within SWITCH-ON.

A one-stop shop

"We are currently developing the portal at www.water-switch-on.eu," says Arheimer. "This will contain 14 new products to aid operational water management, all based on open data. We have had stakeholder workshops to get feedback on the products so far, and to determine market potential." To ensure successful implementation, each product requires a detailed business plan and close cooperation with appointed end-users.

The virtual water-science laboratory is one tool currently under development. Dedicated software and modelling tools will enable scientists to contrast water-related processes in different environments, and help them understand complex processes in a more holistic way.

"The first scientific journal paper on using the virtual lab is currently under revision, while six new scientific experiments are now under way," adds Arheimer. Potential end-users include environmental consultancies, farmers, hydropower companies, insurance companies and governmental authorities.

The portal will also run an open virtual product market, with products and services for water managers. A virtual meeting place where visitors can have a dialogue on product development and marketing is also being constructed. "We want to build bridges between policy-makers, water managers, product developers and researchers with this one-stop shop," explains Arheimer.

While focused on water, it is hoped that the project will inspire the sharing of environmental and societal knowledge in other domains by demonstrating that openness and collaboration can lead to innovation. The latest information and presentation technologies, such as web-based visualisation tools and mobile phone apps, will be used to disseminate the project's findings to end-users in a quick and efficient manner.

SWITCH-ON also contributes to the intergovernmental Group on Earth Observations (GEO), which will act as an international platform to leverage the project's results and amplify its impact on a global scale.

WESENSEIT

Putting the citizen at the centre of flood prevention

Social media has broken down barriers between information providers and consumers. An EU-funded project is seeking to capitalise on this by enabling citizens to monitor and report on their own environment, and thus become the first line of defence against flooding.

Recent events in England and central Europe have once again underlined the human and economic costs of flooding. The number of people who will be affected is predicted to double over the next 70 years, with annual damages increasing from EUR 7.7 billion to EUR 15 billion. Europe's ability to mitigate and adapt to the effects of climate change is therefore one of the challenges of our time.

The EU-funded WeSenseIt project was launched in October 2012, with the aim of strengthening Europe's response to water management and to directly engage with citizens and communities on the front line.

So far the project team has successfully tested the concept of engaging citizens to monitor water levels. And one of the project partners is seeking to market a social media analysis tool developed by the team in 2013.

A citizen's observatory

When it comes to floods, citizens have often been thought of as mere consumers of information; potential threat warnings would trickle down from authorities to those living in areas at risk. But shouldn't citizens and communities be given a more active role and become part of the solution to better water management?

This is why WeSenseIt is developing the concept of a citizen-based water observatory, where communities form part of a two-way information chain. The advent of mobile phones and social media means that citizens can be fully active in capturing, evaluating and communicating valuable information on water levels, creating cost efficiencies and acting as early-warning systems for overstretched local authorities.

"There are so many rivers - it is impossible to monitor them all with sensors," explains project coordinator Fabio Ciravegna from the University of Sheffield in the UK. "Not all necessary information can be captured with sensors. Moreover, cost is a major issue: often the cost of the communication infrastructure to transmit data dwarves the cost of the sensors themselves."

Citizens – such as volunteer flood wardens in the UK or civil protection volunteers in Italy – can help by taking measurements using new

Participants

United Kingdom *(Coordinator), Czech Republic, Italy, Netherlands, Poland, Spain*

http://wesenseit.eu/

FP7	*Proj. N°*	*308429*	*Total costs:*	*€7 m*	*EU contribution:*	*€5.4 m*	*Duration:*	*from:*	*10/2012*
								to:	*09/2016*

apps currently being developed by the project and sending information and images by phone.

They can also help by reading existing sensors and sending authorities the data via mobile apps. The collected data will be made available through the Global Earth Observation System of Systems (GEOSS).

New technologies and approaches to water management are being tested and validated in three EU countries – the UK, the Netherlands and Italy. "For example, we are developing mobile apps so that flood wardens in the UK can walk along river banks and take tagged pictures if they think there is something of concern," says Ciravegna. "We have already received hundreds of pictures from Doncaster."

In Italy, an evaluation involving some 500 volunteers simulating a flood in the city of Vicenza was completed at the end of March 2014. The project has also been asked to provide assistance in supporting the city of Vicenza during the evacuation of some 50 000 people, in order to allow an unexploded World War II bomb to be diffused.

Sensing business opportunities

WeSenseIt has a strong focus on creating new economic opportunities, which is why eight small to medium-sized enterprises (SMEs) are involved. One company is already commercialising a tool developed during summer 2013, just 10 months into the project.

The tool, which carries out large-scale social media analysis to help emergency responders during large scale floods, found an application in monitoring large city-wide events in England. Events involving over 600 000 citizens were monitored with excellent results, reflecting the breadth of potential applications of this kind.

Overall, the citizen observatory concept will provide solid infrastructure within which SMEs can create and test applications and services at low cost, in a project setting that will give them high visibility. Businesses stand to benefit hugely from being able to apply developed technology to such an important issue.

"The long-term impact of this project will be the development of a new way of understanding the environment; that it is something shared by us all," says Ciravegna. "The real lesson here is that it is not just about monitoring emergencies, when everyone wants to help; monitoring and measuring on a daily basis enables preparation, prevention and understanding. I think, with this project, we are getting there."

Investing in European success

Eco-innovation

DRAGON

A tunnel yields a whole lot of valuable materials

An EU-funded research project has developed a system to automatically analyse and sort materials from the soil and rock excavated during the boring of tunnels and other underground structures. The system will cut waste, help tunnelling companies generate additional revenues and provide valuable materials to industry, say the researchers.

Boring a tunnel through a mountain for a railway, or beneath a city for a metro, produces many tonnes of excavated material. Tunnelling companies have to dispose of this muck – as the excavated soil and rock is called by the industry – in landfills as waste or for use in land reclamation.

That is a lot of valuable minerals and building materials going to waste. Industry's challenge has been to efficiently recover the usable materials from the muck. The EU-funded project DRAGON has developed an automated system to analyse and sort excavated material as it is removed from the tunnel face by boring machines.

The system could provide a stream of competitively priced materials for a range of industries, as well as new revenues for tunnelling companies. The system's units can be integrated into the large machines normally used for boring tunnels.

All materials are sorted and processed underground as soon as they are removed from the boring wall. From there, they can be transported out of the tunnel to be sold to industry, while the rest goes to waste.

"These breakthrough technologies will help Europe's tunnelling and underground construction industry to become more competitive," says project coordinator Robert Galler of Montanuniversität Leoben in Austria. "They would also substantially reduce environmental pollution, CO_2 emissions and land use by greatly reducing waste from underground construction."

How it works: from X-rays to microwave technologies

Ongoing and planned tunnels in Europe are expected to produce around 800 million tonnes of excavated material. "DRAGON's technology could be used to help excavation companies earn an additional estimated EUR 150 million a year from this material", says Galler.

DRAGON developed prototypes of advanced photo-optical, X-ray and microwave technologies that can be used directly behind the cutting head of a tunnel boring machine. The units analyse the stream of excavated rock and earth, providing information, such as size, shape and mineral and water content in real time. An underground plant then sorts the material based on the test results.

Participants

***Austria** (Coordinator), France, Germany, Switzerland, United Kingdom*

http://www.dragon-project.eu/									
FP7	Proj. N°	308389	Total costs:	€4.6 m	EU contribution:	€3.3 m	Duration:	from:	10/2012
								to:	09/2015

"This novel approach maximises the use of excavated material from underground infrastructure projects," Galler explains. "The sorted material can be used on-site as aggregates for constructing tunnel walls or can be sold to other sectors, such as the cement, steel, ceramic or glass industries."

He cites the example of the ongoing excavation of the Koralm rail tunnel in Austria. Two tunnels, each around 10 meters in diameter, are being bored underground over a distance of about 33 kilometres as part of a rail line between Graz and Klagenfurt.

The excavated granite gneisses are "good construction materials" of a better quality than available from most quarries, says Galler. "Yet we treat this material as waste," he adds. "That has to change."

Prototype test

After lab tests, DRAGON trialled some of its sorting system's prototype components at a factory belonging to project partner Herrenknecht in Germany. A component to monitor excavated material was tested at the Bossler rail tunnel, which is being built between Wendlingen and Ulm in Germany.

The prototype test used two conveyor belts to sort three different types of materials. It found quartz that could be used to make glass, limestone for steel production and material for making concrete. "The system could be expanded to sort five different types of materials", adds Galler.

DRAGON has held demonstrations of the technology at various conferences, including the World Tunnelling Congress at Dubrovnik, Croatia in May 2015. Other demonstrations are planned in Austria (Leoben and Salzburg) and France (Lyon). At such events, project partners also discuss the legal changes needed before DRAGON's technologies could be used in tunnelling operations.

For example, Galler says the EU needs a common law allowing industry to sell and use the materials recovered from excavating underground structures. Under current waste legislation, they are not able to process the muck they take out of tunnels to easily create mineral products; most of it must be sent to landfill .

Interest in the technology is high. The project has been invited by the authorities in France to make a presentation on how it could be used to recover materials during the construction of about 160 kilometres of new metro lines in areas surrounding Paris.

In the UK, DRAGON has been asked to present the technology for possible use during tunnelling operations for a proposed rail line between London and Manchester.

RESFOOD

A boost for efficient, safe food production

An EU-funded project has developed innovative technologies and techniques for recycling water, nutrients and by-products along the food supply chain, from horticulture to processing and on to shop shelves. These advances provide substantial savings for producers and manufacturers, increase competitiveness, and benefit the environment.

A lot of natural resources, such as water, minerals in fertilisers, soil and energy, go into crop cultivation and food processing to deliver the fruit and vegetables we eat. But this supply chain is very inefficient.

Some 20-50 % of the nutrients and 30 % of all food produced in Europe is wasted along the way, says researcher Willy van Tongeren of TNO, the Netherlands-based organisation for applied scientific research and the coordinator of EU-funded project RESFOOD.

The project brought together research and industry partners to demonstrate the ways the vegetable and fruit chain could recover valuable nutrients for reuse. Also they aim to reduce water use by 30-70 %, achieve energy savings of 20-80 %, and cut waste without any reduction in food quality and safety.

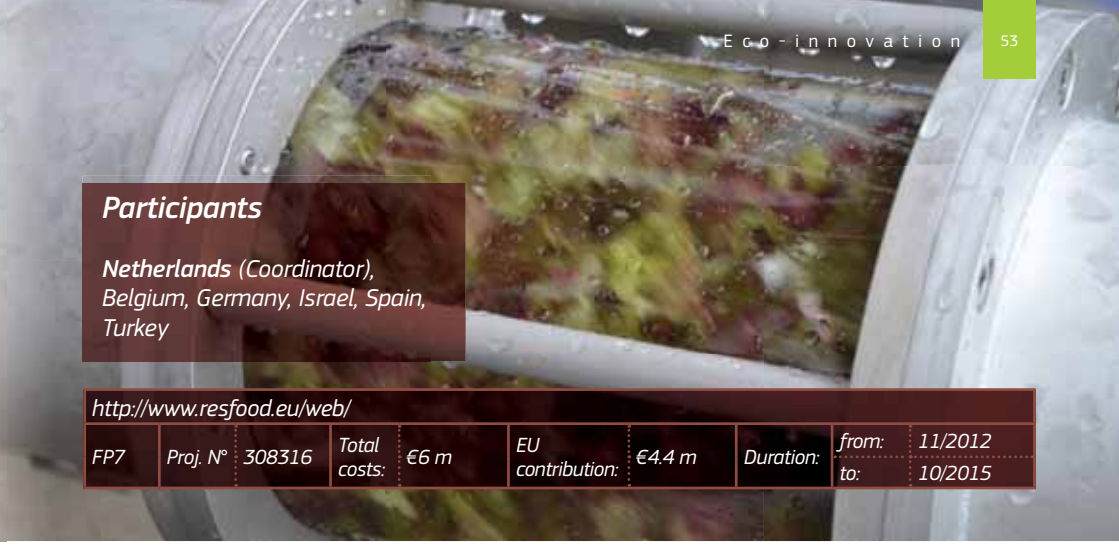
The three-year project has developed techniques to cultivate crops using recycled water and nutrients, and an industrial washer that dramatically reduces the amount of water needed to clean fresh-cut vegetables and fruit.

The project is also testing greener chemicals for disinfecting vegetables, processes to retrieve valuable nutrients from food waste, and a prototype device to detect food pathogens in less than two hours.

From the lab to the field

RESFOOD has scaled up the technologies and techniques developed to carry out field testing. In horticulture, the project developed a system to grow hydroponic crops in rows of gutters filled with water and nutrients. Instead of discharging used water, the system applies novel filtration techniques to remove accumulated salt and other contaminants. Nutrients, such as potassium and nitrates are also recycled to reduce fertiliser consumption.

Partners are currently testing these technologies to grow hydroponic tomatoes using the gutter system in the Netherlands, and blackberries in Spain. “Initial results indicate overall water use was cut by 35 % on average, while fruit quality and yield was maintained,” says van Tongeren.



Participants

Netherlands *(Coordinator), Belgium, Germany, Israel, Spain, Turkey*

http://www.resfood.eu/web/									
FP7	*Proj. N°*	*308316*	*Total costs:*	*€6 m*	*EU contribution:*	*€4.4 m*	*Duration:*	*from:*	*11/2012*
								to:	*10/2015*

Washing fresh-cut produce

For processors of fresh-cut produce, RESFOOD has provided a new washing machine that reduces water and energy use by 25-50 %, van Tongeren says. The machine uses membrane filtration to clean the water, which is then reused.

For most cut produce, the wash water temperature is cooled to about 2-4° C to maintain freshness and limit bacterial growth. Reusing the already cooled water means less energy is spent to maintain the temperature after it is filtered compared to cooling down a new vat of wash water.

"Vega Mayor in Spain is testing the washer in a processing plant to clean pre-cut, ready-to-use salad. Kronen in Germany plans to put the first machines on the market in 2015. Netherlands-based Vezet is testing a water recycling system on freshly chopped vegetables, by combining existing technologies. If the tests are successful, the system could be introduced to the market soon," says van Tongeren.

New chemicals for disinfecting produce

In parallel, RESFOOD's partners are testing a peroxyacetic, acid-based sanitiser and chlorine dioxide as alternatives to the chlorine wash widely used as a disinfectant. Industry faces increasing pressure to find alternatives to chlorine – which is currently banned as a wash for produce in some European countries including Germany, the Netherlands, Switzerland and Belgium.

Vegetable and fruit processors will also be able to take advantage of the tests RESFOOD has carried out on technologies to recover valuable materials from by-products, such as carotenoids, alkaloids, pectin and polyphenols.

The results are promising for extracting by-products from processing endives, carrots and apple pomace. Other by-products can be used for animal feed or to produce bioenergy.

Fast pathogen detector

"RESFOOD also developed a prototype fast detection device for food pathogens, to help producers and processors maintain safety. Conventional testing can take up to one day to deliver results – smaller processors often have to send samples to a lab outside their premises. The RESFOOD device is designed to be used on a production line, representing huge time and cost savings for farmers and processors. The device needs further development before it is ready for the market," says van Tongeren.

Summing up he adds: "These new technologies and techniques add up to market opportunities for small businesses. They will also boost consumer confidence in sustainable food production and food safety."

AGRI-FOOD

SPREE

Why buy when you can 'servicise'?

In industrial societies, consumption has traditionally been an end in itself. Growth is achieved by selling more products, but often also results in unnecessary waste, resource depletion, pollution and other environmental damage. It does not have to be this way. Research by an EU-funded project indicates that a switch to a more service-oriented approach could be better for the environment and society as a whole, while boosting growth and competitiveness.

Given the clutter of things in many people's garages, a little 'servicising' could help clear some space, and benefit the environment. What if, for example, people could easily rent a lawnmower for a decent price from a neighbourhood cooperative instead of owning one?

People would not have to buy, store or service their lawnmowers. They would instead share the cost with neighbours who are also part of the cooperative – which would also provide reliable advice on the best time to cut a lawn and maintain it.

This switch from selling a product to providing it as part of a service is behind the concept of 'servicising' as a sustainable, green business model for traditional manufacturing sectors. Servicising a business sector involves transforming the primary aim from selling products to offering service transactions. Cooperatives are just one application of servicising, and there are many more.

But could servicising work? The EU-funded project SPREE took up the challenge by developing case studies for three business servicising systems – crop protection management, car and bike sharing, grey water recycling and rainwater-harvesting systems.

The case studies based on research in Israel, Finland, Lithuania, Spain, Sweden and the UK fed into packages of policy proposals. SPREE's economic simulations indicate these proposals would encourage servicising in these sectors – and be better for the environment, while boosting growth and competitiveness.

The proposals are being disseminated at conferences and workshops, and in reports to policy-makers across Europe. SPREE's approach also provides a framework for further research into how appropriate servicising would be for other business sectors, says project coordinator Eugenijus Butkus of the Research Council of Lithuania.

"By servicising, suppliers may change the focus of their business models from selling products to providing services, turning demand for reduced material use into a strategic opportunity," he explains. "This new approach is part of the larger move throughout business to the provision of services which, evidence has shown, is linked to higher and more stable profits and new opportunities for economic growth."

Participants

Lithuania *(Coordinator), Finland, Israel, Netherlands, Spain, Sweden, United Kingdom*

http://www.spreeproject.com/

FP7	*Proj. N°*	*308376*	*Total costs:*	*€3.1 m*	*EU contribution:*	*€2.4 m*	*Duration:*	*from: 07/2012 to: 06/2015*

On-the-ground research

In the agricultural sector, SPREE's researchers studied the potential for applying servicising to pest and disease management on rapeseed farms in Lithuania, and in the vineyards of Spain's Rías Baixas region.

The researchers conducted surveys of farmers, agricultural companies and cooperative societies to gauge the social and economic barriers to change. They examined the potential benefits and costs of a switch to a system in which farmers would pay specialised providers for a pest-protected crop instead of purchasing the equipment and pesticides to carry out the work themselves, as is currently done.

Servicising would lead to an integration of pesticide protection into an information-intensive service package, the researchers conclude. The package would be designed to reduce pesticide use while maintaining a high-level of crop protection.

SPREE reports that servicising and the adoption of Integrated Pest Management (IPM) technology under EU rules could boost farm income, while reducing the use of chemical pesticides and related environmental impacts. IPM describes a range of techniques to control pests using safe, environmentally friendly approaches.

Crop protection companies would also benefit from increased profits after the initial costs incurred in making the transition to the servicising model, SPREE concludes.

Policy recommendations to encourage the shift range from providing information to farmers on the advantages of outsourcing pest management to specialised companies, to new laws and incentives to reduce pesticide use while maintaining crop quality. In the transport sector, SPREE studied the potential implementation of car- and bike-sharing services in the UK, Finland, Sweden and Israel.

Among SPREE's recommendations to encourage the switch to car and bike sharing are the restriction of private cars entering city centres at peak hours, additional shared bike stations in car parks and new rules and tax exemptions.

In the water sector, SPREE studied the potential servicising of grey water recycling systems and rainwater harvesting in the UK, Israel and Spain. 'Grey water' refers to waste water from such sources as baths, sinks and washing machines that has not been in contact with excrement.

SPREE's policy proposals span a mix of incentives, new laws, and measures. These include building regulations to make systems to recycle water and collect rainwater a requirement, and tax breaks for consumers who install such systems.

The researchers say that servicising would help reduce the consumption of water sourced from traditional water suppliers through mains, providing an overall environmental benefit and cost savings for consumers.

Investing in European success

Water

P-REX

New life for sewage sludge

Sewage may not look like a particularly precious resource, but it is home to phosphorus and other products, such as metals and biogas. EU-funded researchers are developing and demonstrating more efficient ways to extract these, turning waste into a valuable and renewable resource, creating new opportunities for companies and reducing its impact on the environment.

One of the research and demonstration projects is P-REX, which is helping to develop a market for recovered phosphorus from municipal sewage. Phosphorus, which is excreted in urine, is a nutrient needed by all living organisms.

Plants extract phosphorus from soil and farmers replenish it via fertilisers. To make the fertilisers and animal feed, the EU depends on imports of phosphorus. Around 90 % of the demand, about 975 000 tonnes annually, is imported mainly from North Africa and the Middle East, where it is mined from phosphorus rock.

This dependence could be reduced by recycling phosphorus from sewage sludge, the thick semi-solid material left over after treating municipal wastewater. "Recovered phosphorus from this sludge could theoretically cover about 20 % of Europe's current demand," says project coordinator Christian Kabbe of Kompetenzzentrum Wasser Berlin in Germany.

P-REX, which ended in August 2015, is advancing that process by evaluating the costs and benefits of 10 currently promising technologies to recover phosphorus from sludge, or from the ashes left over from its incineration.

Alongside market analysis, P-REX will produce a guidance document for policy-makers and industry, outlining the suitable phosphorus recovery options and recommendations for fostering a European market for products containing recovered phosphorus, such as fertiliser.

In 2010, some 42 % of Europe's municipal sewage sludge was treated and used on farmland, 27 % was incinerated, 14 % was disposed of by landfilling and about 17 % was disposed of in other ways, according to Eurostat.

But there are wide variations across Europe – and even between regions – in how each country currently treats and disposes of sludge.

Participants

***Germany** (Coordinator), Austria, Czech Republic, Finland, France, Spain, Switzerland*

http://www.p-rex.eu/									
FP7	Proj. N°	308645	Total costs:	€4.4 m	EU contribution:	€2.9 m	Duration:	from:	09/2012
								to:	08/2015

The P-REX recommendations are tailored to these differences.

"The aim is not to change the modes, but to recommend suitable recovery technology based on the infrastructure already in place," Kabbe explains.

"In Germany, for example, more than half of all sludge is incinerated, with the rest applied directly to land," says Kabbe. In the south, where most is incinerated, recovery from ash makes more sense. In the north, treated sludge is usually applied to agricultural land directly, so alternative technologies to recover phosphorus would be more appropriate.

A market for recovered nutrients

"But there will be no recycling without a market, which is dependent on price, quantity, handling, distribution, and the operational benefits of recovering phosphorus from sludge," says Kabbe.

"We know a lot about the technologies and how recycling phosphorus could work, but now we need to do the obvious and take action," he adds. "Industry needs incentives, such as reasonable subsidies and EU-wide policies, to reach the economies of scale needed to reduce our dependence on imports.

"Currently, only about 2000 to 3000 tonnes of struvite, a phosphorus-rich mineral, is produced each year in Europe from municipal sewage," says Kabbe. It represents the lowest hanging fruit and to increase this, the project launched an online platform in January 2015 to link European suppliers of recovered phosphorus with potential buyers.

The results of the project will be disseminated at international workshops and regional events to encourage more production.

"P-REX will provide an essential milestone for our future development into a recycling society," says Kabbe.

THESEUS

One-stop shop to combat coastal flooding

There is no doubt that climate change is happening worldwide as ice caps shrink, and sea and river levels rise. Coastal flooding not only damages buildings and engineering structures, but also the environment and the ecological balance in Europe.

The EU-funded THESEUS project has addressed these problems by providing a new approach to combat the effects of flooding, coastal erosion and climate change throughout Europe. In the words of project coordinator, Barbara Zanuttigh, Assistant Professor at University of Bologna, Italy, "it is important to involve all strands of society and address the issues at various levels (European, regional and local) and at different timescales (one year to 100 years)."

Each region in Europe faces a different set of challenges on account of their individual geographical and physical parameters, which makes coastal flooding problems diverse and multifaceted.

The THESEUS team looked at a wide range of individual issues and solutions, taking into account scientific, social, economic, environmental and cultural aspects which broadened the research spectrum. The research and information produced by the THESEUS project does not claim to solve all these problems. It has created a one-stop shop of comprehensive data gathered during the research.

Participants

Italy *(Coordinator), Belgium, Bulgaria, China, Denmark, France, Germany, Greece, Latvia, Mexico, Netherlands, Poland, Russia, Spain, Taiwan, Ukraine, United Kingdom, United States*

http://www.theseusproject.eu/									
FP7	Proj. N°	233104	Total costs:	€8.6 m	EU contribution:	€6.6 m	Duration:	from:	12/2009
								to:	11/2013

The new THESEUS decision support system (DSS) is a geographic information system (GIS)-based tool. “This tool will help decision-makers input all the conditions they are dealing with so the short-, medium- and long-term effects of building or developing within coastal communities could be identified,” says Zanuttigh.

The tool enables developers, builders and local authorities to minimise coastal risks and take into account physical and non-physical drivers, such as climate change, subsidence (undermining and sinking of land due to flooding), population and economic growth. “The THESEUS DSS is intended as a vehicle for communication, training, forecasting and experimentation,” adds Zanuttigh.

In addition to the DSS tool, a guidelines book compiled by the project team will assist coastal managers in the application of THESEUS methodology for coastal risk assessment and in the selection and design of mitigation options. The policy briefs developed are expected to support decision makers by identifying weaknesses and strengths of the existing policies and the key challenges to be addressed.

Last but not least, the information booklets, also produced by the THESEUS team, “aim to raise the general public’s awareness regarding the scale of the risks involved and help towards a more sustainable future,” concludes Zanuttigh.

VALUEFROMURINE

Saving the nutrients we piddle away

Where there's pee, there's phosphorus — and that is not a resource we can afford to flush down the drain. Nor should we waste the ammonia our urine contains, say EU-funded researchers who are developing a recovery process. Large buildings could soon house their own treatment systems to extract these substances for reuse, notably as fertilisers.

The ValueFromUrine project does exactly what the name implies. It produces technology that enables operators to extract valuable substances from urine. More specifically, it is developing self-contained processing units designed to recover phosphorus-rich struvite and the nitrogen compound, ammonia.

The project is devising the technology for these modules, which private sector partners in the consortium then intend to commercialise for large buildings, such as apartment or office blocks, universities or concert halls.

"The system fits into a 20-foot container, says project coordinator Martijn Bijmans of Wetsus European Centre of Excellence for Sustainable Water Technology the Netherlands. With another year to go in the project, the team has already designed an operational unit that has been running successfully for several months," he adds.

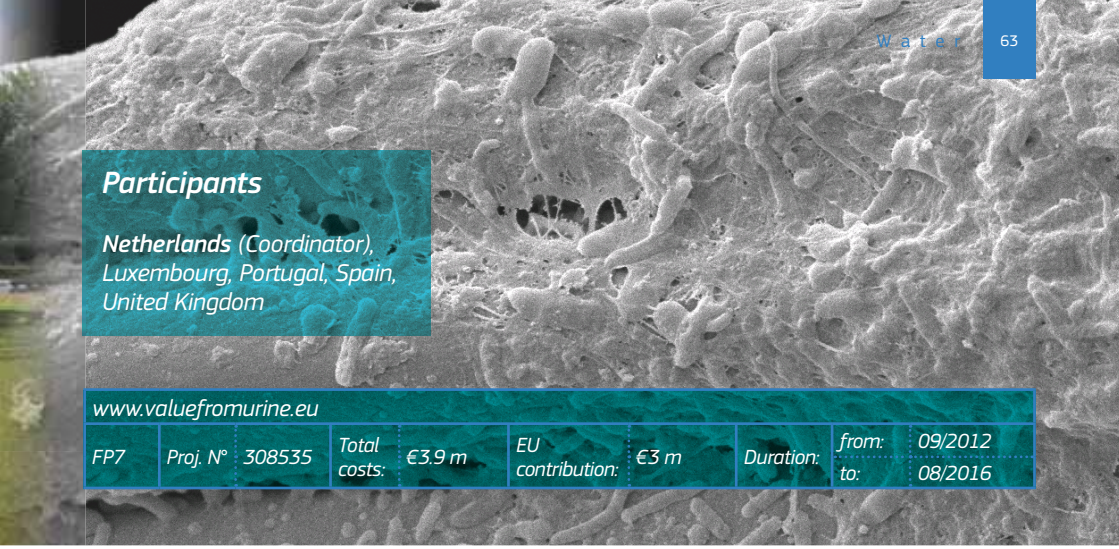
Why flush resources?

Some 80 % of the nitrogen and half of the phosphorus in domestic wastewater comes from urine. "We want to recover these substances, which are usually lost in wastewater treatment," Bijmans explains. Both are much-needed fertilisers, with many other uses.

Finding an effective way to retrieve phosphorus is crucial, as the world's mineral deposits of phosphate rock are running out, and nothing will grow without it. As for ammonium, recycling would save both the energy used to produce it for its many applications, and the energy needed to break it down in wastewater.

"So why not just use raw urine to feed our crops? Indeed, this remains common practice in many parts of the world. But even where it is allowed, this is not an efficient approach," says project manager Philipp Kuntke, also of Wetsus. "Urine is mostly water, so you have to secure large streams to obtain enough phosphorus for your field," he explains. Concentrated in a solid, this element is far easier to handle, to trade and to ship.

It is also difficult to control the exact amount of nutrients in urine, so there is a risk of



Participants

Netherlands *(Coordinator), Luxembourg, Portugal, Spain, United Kingdom*

www.valuefromurine.eu

FP7	*Proj. N°*	*308535*	*Total costs:*	*€3.9 m*	*EU contribution:*	*€3 m*	*Duration:*	*from:*	*09/2012*
								to:	*08/2016*

applying too much, Bijmans adds. Profligacy with fertiliser comes at a cost, both to the purse and to the environment.

A golden opportunity

"ValueFromUrine is developing a two-step process based on separate urine collections, typically from water-less urinals that empty into a storage tank through a dedicated set of pipes. In the first step, magnesium is added to precipitate the struvite," Kuntke explains. The remaining liquid is then treated in a bioelectrochemical system to extract the ammonia. This step also generates a bit of electricity, which helps to power the process.

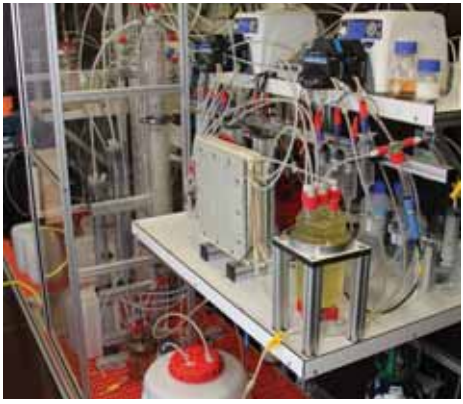
On average, people produce 1.5 litres of urine per day, Kuntke notes. In a large building, all these 'pennies spent' quickly add up.

By the time the project ends in August 2016, the partners plan to deliver the complete blueprint for a module that can handle one cubic metre per day. This volume would deliver about 1 kilogramme of phosphorus and 10 kilogrammes of ammonium.

ValueFromUrine is not the only project exploring the recovery of nutrients from urine. "But," says Bijmans, "we think that we have the best combination of technologies." One of the advantages of the partners' system is that the urine is processed at source, as opposed to approaches where it would have to be shipped to a central facility.

"The project's technology will be scalable for the pressing needs of individual constructions, but when and how it will be made available to customers remains to be seen. Another 10 years may be needed for full commercial development and so the business model is still under consideration," Bijmans comments.

That is plenty of time for Europe to get its head around urine recovery and the unfamiliar and potentially water-free plumbing it involves. "It's so weird that we still flush toilets with drinking water," Bijmans notes. "Phosphorus isn't the only resource we can't afford to waste."



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KI-02-15-974-EN-N

Europe has proven expertise in ensuring the sustainable management of the environment and its resources. This booklet presents a selection of recent projects supported through the EU's Seventh Framework Programme for research and technological development (2007-2013), focusing on the seven research priorities identified within the Environment research theme. These priorities are biodiversity and ecosystem services, climate action, cultural heritage, disaster risk reduction, earth observation, eco-innovation and water. Emphasis was placed on predicting climate, ecological, earth and ocean systems changes. There was also a focus on tools and technologies for monitoring, prevention, mitigation of and adaptation to environmental pressures and risks to health, as well as for the sustainability of the natural and man-made environment.

Project information

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