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RESULTS PACK

Resource efficiency: Powering green growth for Europe

EDITORIAL

RESOURCE EFFICIENCY: POWERING GREEN GROWTH FOR EUROPE

Europe aims to obtain 20% of its growth from industrial processes by 2020 and at the same time has set itself incredibly ambitious environmental targets. To achieve these conflicting ambitions in the face of limited natural resources, resource efficiency must be prioritised. This will not only contribute to the growth of a truly green economy but will also open many new economic opportunities for European businesses, including SMEs.

Growing demand and global competition for resources have been putting increasing pressure on the natural environment. Europe needs to stay competitive but it must also lead the way in finding sustainable and environmentally-friendly solutions to address these challenges. To square the circle, the EU has chosen to focus on resource efficiency as a Flagship Initiative under its EU 2020 Strategy for Smart, Sustainable and Inclusive Growth. The EU has also embarked upon a Roadmap to a Resource Efficient Europe that would see Europe's economy be transformed into a sustainable one by 2050.

Opportunities for all

By shifting to a low-carbon economy powered by green growth and a society that generates and shares economic and environmental benefits for all, European businesses will benefit from new opportunities that will save in material costs and allow them to grow in the face of pressing resource constraints and high environmental standards.

This will also serve to maximise resource productivity and minimise resource extraction and waste generation. A vast number of diverse sectors stand to benefit from such a paradigm shift, from waste, industrial production, raw materials and mining, food and agriculture.

EU research leads the way

However, these ambitions will not be realised without cutting-edge research and innovation and this CORDIS Results Pack will showcase eight projects that have been paving the way in transitioning Europe to a more sustainable resource-efficient future.

From the food and agricultural sectors, the **RESFOOD** *project has developed an innovative toolkit that will not only ensure the safety and security of our food but will also inject sustainable solutions into the entire food production industry, from reducing the use of water in agricultural and washing processes, to the development of new biosensors to better detect bacteria. The* **BIOECOSIM** *project meanwhile has pioneered an efficient method of converting livestock manure into safe and stable organic materials, reducing the environmental impact of fertilisers to achieve real resource efficiencies.*

EU-funded consortiums are also helping to increase Europe's cooperation with other countries and regions of the world. The **WATER4CROPS** *project is one such example, a joint collaboration that has harnessed knowledge and experience from Europe and India in developing new water efficiency technologies, targeted at the agricultural sector. Meanwhile, the* **EWIT** *project has fostered collaboration between European partners and four African countries (Kenya, South Africa, Zambia and Ivory Coast) to develop an innovative e-Waste toolkit to support better and safer recycling.*

Finally, empowering businesses and consumers with the tools and processes they need to be more energy efficient is just as vital a building block as new technologies in building a more sufficient, green economy. The **GREENECONET** *project has launched an online platform where SMEs can access tools to help them establish more sustainable business models. The* **MYECOCOST** *project has set-up a network that allows companies to calculate the 'ecoCosts' of their products or services, for the benefit of both producers and consumers, whilst the* **RESCOM** *project has developed a comprehensive framework to assist industries to reuse and remanufacture previously wasted materials, thus contributing to the development of a true Circular Economy.*

As the EU continues to place emphasis on green growth, resource efficiency and moves towards a circular economy in the coming years, future research projects funded under Horizon 2020 will power forward where these projects have left off. Consequently, this Results Pack will be regularly updated to reflect the newest European innovations for addressing some of the largest economic and environmental challenges to face Europe — and the world — in the 21st century.

Contents

Boosting rural business with innovative manure-based products

EU-funded researchers have developed an efficient method of converting livestock manure into safe and stable organic materials, reducing the environmental impact of fertilisers, achieving resource efficiencies and creating new rural business opportunities.

Farming in the 21st century is often a balancing act between meeting the ever-increasing demand for cheap and plentiful food, while ensuring that arable land remains fertile and productive. Livestock manure for example is a valuable agricultural resource — providing nitrogen, phosphorous and organic matter to fertilise crops — but overuse can cause significant damage.

Negative side effects include surface and groundwater contamination, the emission of greenhouse gases, and long term nutrient imbalances and an accumulation of heavy metals in the soil. This reduces productivity in the long term, in addition to damaging the environment. Around 1 800 million tonnes of manure are produced in Europe every year.

'These products will make crop farmers less dependent on synthetic, non-renewable and imported fertilisers to maintain or enhance their yields, and create new business opportunities for small agricultural entrepreneurs.'

Sustainable rural benefits

The EU-funded BIOECOSIM project sought to address this ongoing conflict by developing an energy-efficient pilot plant capable of converting livestock manure into safe and stable materials. A key benefit of the new technology is that it has been designed to treat manure directly at its place of origin, which means that farmers — especially those with high livestock densities and a surplus of nutrients in the soil — could adopt the technology to create a new revenue stream.

'The prototype plant can process 50 kg of raw manure an hour into fertilisers and organic soil improvers, which can then be mixed to match the nutritional requirements of any crop,' explains project coordinator Dr Jennifer Bilbao from Fraunhofer IGB in Germany. 'Water can also be reclaimed from the manure and used for irrigation. These products will make crop farmers less dependent on synthetic, non-renewable and imported fertilisers to maintain or enhance their yields, and create new business opportunities for small agricultural entrepreneurs.'


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A sustainable and fertile solution

Bilbao and her team tested the pilot processing plant on pig manure, which has a high water content of 90 %. It also contains valuable components such as plant nutrients — mainly nitrogen and phosphorus — and indigestible feed solids such as plant fibres.

To begin with, the manure is pre-treated so that the phosphorus dissolves completely. This is then separated by coarse filtration into a solid and a liquid phase. The solid phase is then dried using a process developed at Fraunhofer IGB; this works with superheated steam in a closed system and is highly energy efficient.

'Microorganisms are completely destroyed in this process,' explains Bilbao. 'Optionally, the dried organic components can be converted to organic biochar at over 300 °C by a pyrolysis process — in an atmosphere of superheated steam, as in the drying step.'

After removing the solid fraction, researchers were able to create a mineral phosphate fertiliser mixture from the remaining liquid. Finally, they also recovered ammonia from the liquid using gas permeable membranes. Lab-scale units capable of integrating all these processes were built to efficiently produce the biochar, gas, phosphorus and ammonia fertilisers and reclaimed water.

'Our extensive investigations and field studies have shown that the mineral fertilisers and organic soil conditioners made from livestock manure can be used directly in agriculture as readily available fertilisers and soil improver,' says Bilbao. 'The mass of the dewatered and processed products makes up only about 4 % of the original volume of livestock manure. The next step is to further develop and transfer these technologies into a marketable plant for serial production.'

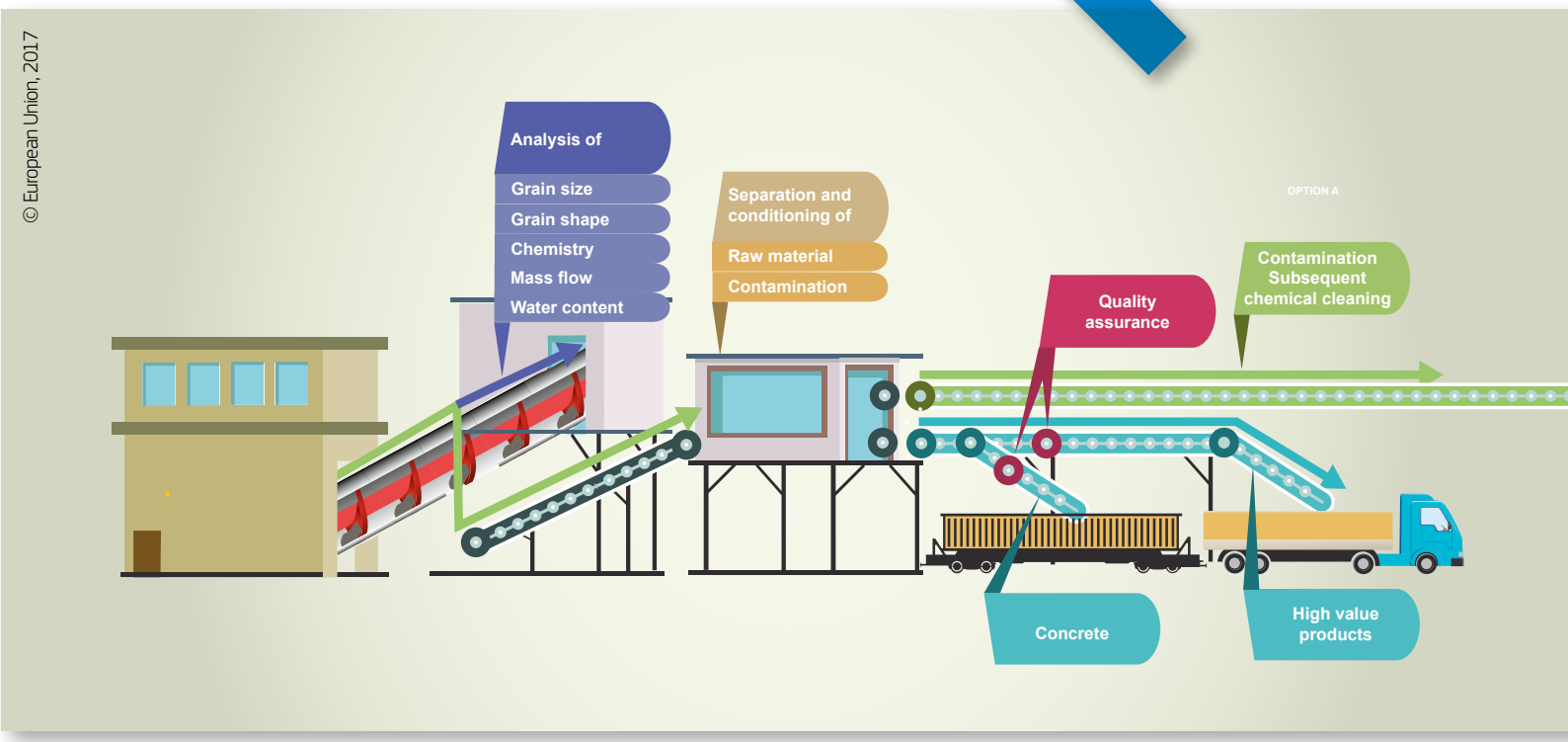
Project	**BIOECOSIM: An innovative bio-economy solution to valorise livestock manure into a range of stabilised soil improving materials for environmental sustainability and economic benefit for European agriculture**
Coordinated by	FRAUNHOFER GESELLSCHAFT ZUR FOERDERUNG DER ANGEWANDTEN FORSCHUNG E.V (Germany)
Funded under	FP7-ENVIRONMENT
Project website	http://www.bioecosim.eu/

Going underground: an integrated system for reuse of excavated tunnelling materials

The EU-funded DRAGON consortium has prototyped a system which enables valuable mineral resources excavated from underground construction projects to be economically and efficiently used, rather than ending up in landfill.

What happens to material excavated from tunnels? A three year EU project, completed in September 2015 has investigated how valuable mineral resources from underground construction projects can be used rather than ending up in landfill. DRAGON (Development of Resource-efficient and Advanced Underground Technologies) has prototyped a system to do this. 'Future tunnelling projects in Europe are expected to generate around 800 million tonnes of excavated material,' explains Professor Robert Galler, Chair of Subsurface Engineering at Montanuniversität in Leoben, Austria. 'Recycling of this material would substantially reduce the demand for primary mineral resources, and reduce environmental impacts.'

Montanuniversität was the coordinating partner of the project, which also has industrial and academic participants from Germany, Switzerland, France and the UK. Many partners are involved in large ongoing underground projects, where the use of excavated material has already been realised. One such project is the Les Farettes Hydropower Project in Switzerland, where excavated rock provides the job site with usable aggregates.



'Recycling of this material would substantially reduce the demand for primary mineral resources, and reduce environmental impacts.'

Underground analysis

The challenge for the DRAGON consortium was how to create an economic and efficient recycling process. 'The goal was to clearly separate materials which can be used in industry from those which can only be used for landfill,' says Prof. Galler. 'Automated online sampling and characterisation of physical, chemical and mineralogical properties provide the basis for assessing the excavated material.' The DRAGON project solved the challenge by developing a materials characterisation system, directly integrated into the tunnel boring machine. The entire process, from analysis to sorting takes place underground.

The project's five prototype units each automate a different process step. The prototype use automated sample analysis including X-ray elemental analysis, high-precision microwave moisture measurement, and photo-optical grain-size analysis. 'The equipment for the elemental analysis has to be protected by a special housing. An underground separation plant then handles the material, based on the test results and online materials classification. The excavated material can be sorted in-stream, and used directly on site or transported for another industrial sector,' says Prof. Galler.

Environmental and economic benefits

The DRAGON consortium has also demonstrated environmental benefit, through a Life Cycle Assessment. 'Generally the results for most indicators show that environmental performance improves as the proportion of excavated material that is diverted from landfill increases. The benefits accrue from avoiding impacts associated with landfill and from avoiding primary production,' explains Prof. Galler.

One important condition for both machine manufacturers and construction companies has been that the tunnelling rate should not be adversely affected by DRAGON's new process. The team is confident this condition can be met, but whether recycling is economically viable also depends on material demand at the job-site as well as from the surrounding industry. The DRAGON consortium calculated there is potential to reuse around 80 % of excavation material and that transport of excavated material to external receiving industries is economical within a 150 km radius.

Future impacts

The team now proposes that in any tunnelling project, a material management strategy should take into account excavated material in the planning stage, with the view to making projects resource-efficient, aiming at zero waste. Prof. Galler concludes, 'Our newly developed technologies will have a strategic impact on sustainable management of limited mineral resources and could decrease EU dependency on imports, improving competitiveness for companies associated with underground construction and new resource-efficient technologies.'

The DRAGON consortium now intends to use their results as an example for other companies in the construction industry, as well as their own ongoing projects. 'If the results of DRAGON could be applied to these projects, an immense amount of material could potentially be used now and during the next decades,' concludes Prof. Galler.

Project	**DRAGON: Development of Resource-efficient and Advanced underGrOund techNologies**
Coordinated by	MONTANUNIVERSITAET LEOBEN (Austria)
Funded under	FP7-ENVIRONMENT
Project website	http://www.dragonproject.eu/

Recovering e-waste in Africa

Sorting waste from discarded electrical equipment is a growing, often hazardous and unregulated business in many African cities. Working with groups in Europe and Africa, the EU-funded EWIT project has developed an e-waste toolkit to support better recycling and recovery systems.

What happens to discarded electrical and electronic equipment? Known as e-waste, in Africa it is often sorted by people on the margins of society, to extract valuable metals and plastics at low cost. But there are hazards. E-waste contains toxic substances such as arsenic, polychlorinated biphenyls, TBBA (tetrabromobiphenol-A) and mercury. Without the right extraction procedures, e-waste can negatively affect human health and the environment. Working together with African countries, in a two year project, the EWIT consortium has provided a toolkit to support safer recycling.

The EWIT project was taken on by the European Innovation Partnership on Raw Materials — a platform that brings together representatives from industry, public services and academia. The EWIT project involves organisations from five European countries and four African countries: Kenya, South Africa, Zambia and Ivory Coast.

The project progressed through a series of workshops, twinning European and African cities involved in the project. 'An African city and its partnering "twin" European city meet with the goal to understand the African scenarios concerning local e-waste management and brainstorm solutions with expert input,' says Isabella Capurso, project coordinator from Italian not-for-profit

e-waste management consortium, Consorzio Remedia. The workshops were held in Choma (Zambia), Kisii (Kenya), Johannesburg (South Africa), and Abidjan (Ivory Coast), followed by expert modelling workshops and a final set of twinned workshops to define action plans.

The outcome has been to produce an 'E-waste implementation toolkit' which provides a web querying interface that can be used by policy makers and local authorities in developing countries to retrieve information on how to set or improve their e-waste management systems. 'The tool is formulated like a "wizard" and contains many "typical scenarios" of e-waste management as reference examples,' explains Capurso. 'It brings the user across a self-evaluation test of their context, giving preliminary information on potential solutions to improve the e-waste management system.'

The project provides a huge set of step-by-step guidelines which go from the 'collection' of e-waste to its 'treatment' and the 'market for secondary raw materials' phases, which should support African local authorities to develop their own e-waste sectors. The consortium explored several models for the financing of e-waste management systems, as well as providing specific guidelines for central and local government implementation and finalisation of 'e-waste management' legislation.

An important aspect of the project was the inclusion and acknowledgement of the role of the informal sector in e-waste management. The roles of waste pickers, who work outside the law, were integrated as much as possible into any potential new 'formalised' system.

'An African city and its partnering "twin" European city meet with the goal to understand the African scenarios concerning local e-waste management and brainstorm solutions with expert input.'

EWIT has worked hard to make sure the accrued expertise and advice offered by the tool kit is disseminated to the widest possible audience. At the end of the project the consortium held conferences presenting the portal functionalities in target areas as well as in Brussels (Belgium), Dakar (Senegal), Cape Town (South Africa), and Nairobi (Kenya). 'The project is an example of Europe and Africa successfully working together and has laid a foundation for future cooperation in the area,' says Capurso. In the long-term the existing initiative will continue to collaborate on the recovery of secondary raw materials — many partners are already working to develop ideas arising from the project.

Project	**EWIT: Developing an e-waste implementation toolkit to support the recycling and the secondary raw material recovery strategies in metropolitan areas in Africa**
Coordinated by	CONSORZIO REMEDIA (Italy)
Funded under	Horizon 2020-3.5.4.
Project website	http://ewit.site/about-ewit/

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Helping SMEs go green with a centralised platform

EU-funded researchers have developed an online platform where SMEs can learn from each other, exchange best practices and access tools to help them establish more sustainable business models.

'The contribution of private enterprises and business communities towards the move to a green economy has often been underestimated'

The unsustainable path of our current economic system demands a paradigm shift. What is required is a 'green economy' that promotes the development and use of technologies, tools and services that can help society transition to low-carbon, sustainable and resilient economic development.

To facilitate this change towards a green economy, the EU-funded GREENECONET project is empowering Small and Medium Enterprises (SMEs). 'The contribution of private enterprises and business communities towards the move to a green economy has often been underestimated,' says GREENECONET project coordinator Corrado Topi. 'Yet SMEs and corporate actors are key players and have the power to change the socio-economic and physical landscape.'

Although many businesses have greatly contributed to this transition, a large part of the business community — and SMEs in particular — lag behind the 'best in class' benchmark for green business practices. To close this gap, GREENECONET developed a community where SMEs can learn from each other by exchanging information on best practices in the green solutions they have adopted or developed.

The reference point for all things green

The end result of this effort is the GREENECONET web platform, which has established itself as *the* reference point for all things relating to an SME's shift to a green economy model.

The GREENECONET platform helps SMEs by providing access to best in class products and services, financial and planning tools and market opportunities. It also features a space to have direct dialogue with policy makers and researchers, and the option to ask for tailored solutions to support questions. 'The website provides a user-friendly navigation system to search for green solutions, products and services using very specific themes and locations, and a powerful search engine that allows you to hone in on the solutions and tools most relevant for you,' says Topi.

A particularly popular feature is the platform's Green Economy Toolbox, a database of practical tools and online guidance for greening your small business. There are currently over 16 specific tools available, including the BalticClimate Toolkit and the Carbon Footprint Tool. The BalticClimate Toolkit provides local and regional policy makers, spatial planners and the business community with climate mitigation and adaptation support. 'This BalticClimate Toolkit supports the development of a company and assists in increasing its competitiveness,' says Topi. 'The toolkit assesses how climate change will affect transport, housing, energy and agriculture in a specific region — and what opportunities these new conditions and situations will provide'.

The Carbon Footprint Tool, on the other hand, allows SMEs to identify where the key carbon hotspots are along a product's lifecycle. Based on this information, the tool helps users develop low-carbon products and services and to choose the best green business options. 'In this way, SMEs are able to differentiate their products based on measured environmental characteristics,' says Topi.

Going global

The GREENECONET project has demonstrated a large learning potential for SMEs when they become familiar with green business success stories. However, project coordinators also found that the platform, by itself, was insufficient to fully tap into this potential.

'SMEs often operate in their own local or national networks, which tend to be offline and mainly facilitated by local and/or national networking organisations or multipliers,' says Topi. To ensure SMEs can learn from a broader set of best practices, GREENECONET has developed a combined approach based on online-offline interactions where the online platform populated by SMEs and multipliers supports and connects to a series of offline networking events, workshops and conferences.

To extend the learning potential for SMEs outside the EU, both in developed and developing countries, the platform management group has decided to broaden the geographical scope of its online-offline interactive model and make it global. For this, a hub-system is being developed that is centred around the online GREENECONET platform and that will soon connect international, national and subnational networks to a global database of best practice information on greening SMEs around the world.

Project	**GREENECONET: A best practice platform to support the transition towards a green economy**
Coordinated by	University of York (UK)
Funded under	FP7-ENVIRONMENT
Project website	http://www.greeneconet.eu/

A cost-effective accounting system for natural resources

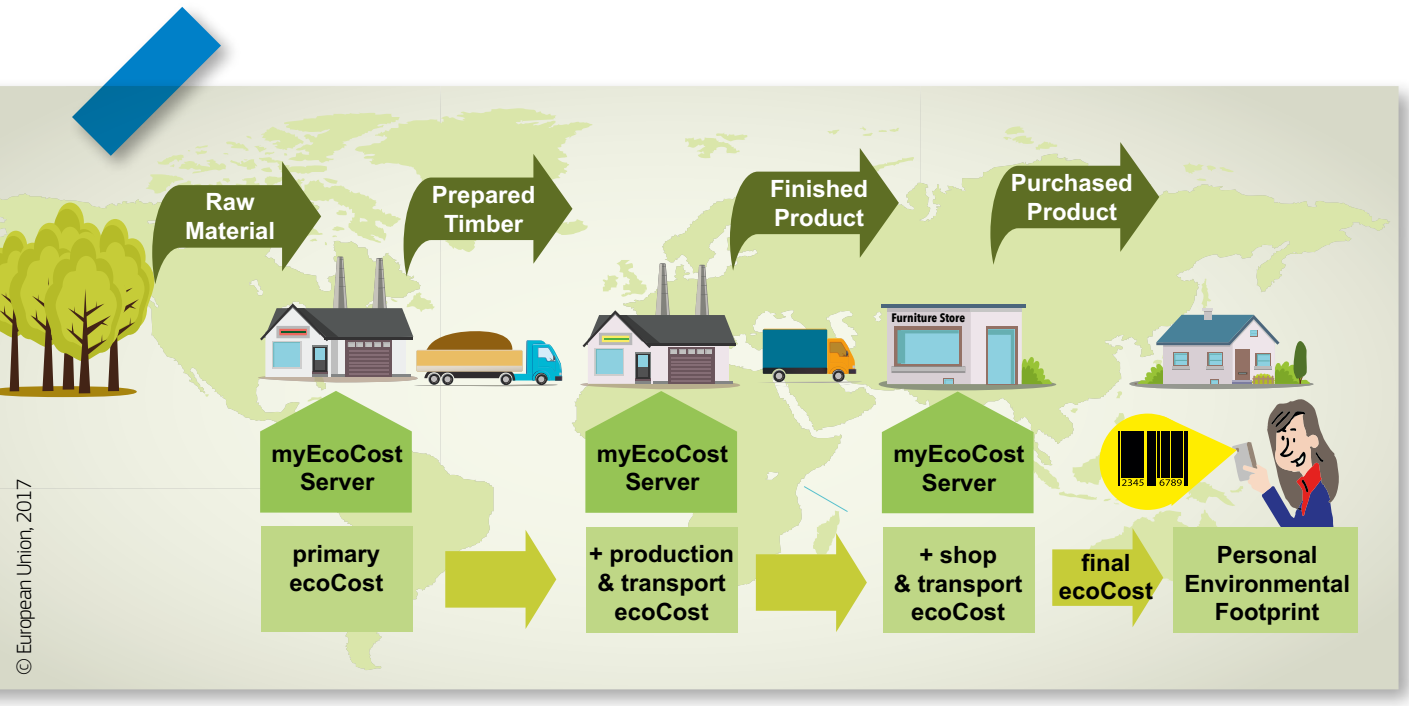
EU-funded MYECOCOST calculates the ecoCosts of a company's products or services, allowing both producers and consumers to make/take environmentally oriented decisions.

The need for a more sustainable growth, including reducing the material used and carbon emitted during both the production of materials and our consumption of them, is widely known and accepted. However, the complexity of global production systems and the limited availability of lifecycle data are two huge barriers to achieving the sustainable economy we need.

The MYECOCOST project addressed this challenge by offering an ICT-based 'eco-accounting' methodology that takes into account the environmental impact of products, services, technologies, businesses, supply chains and individual consumption. The highly-automated tool uses real-time lifecycle data to establish a global collaborative network of resource accounting nodes. These nodes, in turn, help overcome many of the problems our current practices of measuring resource consumption and environmental impacts suffer from.

'Businesses who join the MYECOCOST network can use the tool to calculate their resource inputs, outputs and emissions, thus finding the "ecoCosts" of their products and services,' explains project coordinator Nuria Riera. 'By gathering these ecoCosts along specific supply chains, from primary production to point of sale, reliable and comparable product-specific data is created in a cost-efficient way — supporting better, more environmentally oriented decision-making.'

'Businesses who join the MYECOCOST network can use the tool to calculate their resource inputs, outputs and emissions, thus finding the "ecoCosts" of their products and services.'



'We can now track our purchases and their environmental effects over time, assess whether or not our lifestyles are within acceptable ecological limits, and learn how to reduce our personal or corporate environmental impact.'

Optimising consumption habits

According to Riera, one of the key drivers behind the project was the fact that currently available data on production and consumption systems tend to neglect environmental burdens and are hardly accessible. 'In our digitised world, we see a big gap in the use of personal data,' she explains. 'Although huge amounts of datasets are collected on product and service systems, they fail to inform consumers about their own behaviour and the related environmental consequences of their decisions.'

Instead of useful data, consumers are drowning in a proliferation of product labels. In fact, in Europe alone there are more than 400 environmental labels claiming to provide consumers with an indication of the environmental and/or social value of their product. Needless to say, this has led to some confusion, with a recent Eurobarometer report showing that over half of all consumers questioned saying it is too difficult to differentiate environmentally friendly products from others.

It is against this background that the MYECOCOST project set out to develop a cost-effective accounting system for natural resources. 'Digitisation has enabled the facilitation of a global network formed by collaborative resource-accounting nodes that collect relevant environmental data at each stage of a production chain or stages in the provision of a service, which is the core function of the MYECOCOST project,' says Riera.

This collected data can then be passed from supplier to supplier and, eventually, to the consumer, via an invoice or on a price tag. Furthermore, as data can be aggregated along the supply chain, all the way down to the sales counter, specific information not only about a product group or brand, but also for an individual unit of a product, can be communicated to the end consumer. This information, in turn, allows the consumer to optimise the environmental impact of their consumption habits.

A new era of eco-awareness

According to Riera, with ecoCost values widely available, how society views various products and services could drastically change. 'We can now track our purchases and their environmental effects over time, assess whether or not our lifestyles are within acceptable ecological limits, and learn how to reduce our personal or corporate environmental impact,' she concludes. 'In this sense, we envisage a new era of eco-awareness in everyday life, with MYECOCOST providing a vital infrastructure that moves designer, producer and consumer decisions towards more sustainable lifestyles and an ecologically-based circular economy.'

Project	**MYECOCOST: A consumer oriented prototype — forming the nucleus of a novel Ecological Accounting System**
Coordinated by	TriaGnoSys GmbH (Germany)
Funded under	FP7-ENVIRONMENT
Project website	http://www.myecocost.eu/

Creating a circular economy by cutting out the waste

Can we decrease manufacturing's dependency on natural resources and reduce waste? The EU-funded RESCOM project thinks so, specifically through the interaction of improved product design, business models and technology.

Globally we generate well over a billion tonnes of waste per year. This represents a huge loss of resources, with many products discarded after use and their value lost. One EU-funded project has come up with ways to hang onto these wasted resources, through reuse and remanufacturing. The framework designed by RESCOM also mitigates business risks such as materials supply and price volatility, and creates new business opportunities for manufacturing industries.

The RESCOM team involves 12 organisations including universities, research and consulting organisations, industrial partners, and technology providers, from six EU countries. Project coordinator, Amir Rashid, from Sweden's KTH Royal Institute of Technology in Stockholm explains that RESCOM is trying to support manufacturing businesses to transit towards a 'closed loop' circular economy.

'The circular economy is a paradigm that is economically and ecologically regenerative by design,' he explains. 'To reach that goal, RESCOM uses a framework which simultaneously considers how business models, product design, supply chain and technology dynamically interact and influence the implementation of circular economy approaches.' This means managing the whole lifecycle of a manufactured product from inception, through engineering design and manufacturing, to service and recovery.

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The project is achieving its aims through a new software platform that allows manufacturers to improve product design and analyse new business cases to incorporate reuse and re-manufacturing practices. RESCOM assessed its platform using four manufacturing case studies based around its industrial partners. 'Each study represents a case of transition in manufacturing from linear to circular product systems,' explains Rashid. The cases included production of a baby stroller, a washing machine, a television and an automotive steering system. 'The scenario for each case study product is different, but all considered incorporating resource conservation approaches such as reuse, remanufacturing and if necessary, recycling,' says Rashid.

'RESCOM uses a framework which simultaneously considers how business models, product design, supply chain and technology dynamically interact and influence the implementation of circular economy approaches.'

The case studies provided several key findings, particularly the importance of upfront product design that incorporates the 'several lives' of a product — so there has been preparation for value recovery. It was also important to consider that design and supply chains need to be chosen with a circular manufacturing model in mind. For example, Rashid explains, 'leasing or product-service models where parts are reused after one use cycle have different design requirements than a conventional sales model where the products do not return to the manufacturer.'

And whilst innovative technology can always improve manufacturing efficiency, the behaviour of users can sometimes be of even higher significance. For example, damage to a product during the use phase is of high relevance. In renting or leasing models, customers might be less careful during use, since they do not own the product. This makes it more challenging to recover products or components after return.

In October 2017, a public version of the RESCOM platform will be launched and made available online so businesses can explore the concepts and learn from the project results. By the end of the project, a policy brief will be written with suggestions for decreasing manufacturing's dependency on natural resources and to reduce waste. The RESCOM team hope their results will encourage EU policy makers to strengthen current legislation on waste and recycling and try and restrict manufacturing's future consumption of material resources.

Project	**RESCOM: Resource Conservative Manufacturing — transforming waste into high value resource through closed-loop product systems**
Coordinated by	KUNGLIGA TEKNISKA HOEGSKOLAN (Sweden)
Funded under	FP7-ENVIRONMENT
Project website	http://www.rescoms.eu/

New solutions for a secure and sustainable food chain

The EU-funded RESFOOD project has pioneered a range of innovative solutions that aim to boost efficiency and develop a truly viable circular economy. The proposed method is to close the cycles of water, energy and raw materials in the European food chain.

The project has developed a toolkit of solutions for crop cultivation, fresh food processing and waste valorisation that should have a very real impact on the European food sector in the very near future. These include cutting edge techniques for microbial profiling of water to the creation of two pilot plants for fresh-cut vegetables which treats and reuses water, and are all ready-to-market technological solutions.

'Interested parties still request information on the project and its results are not only used in practice but are also utilised in new initiatives.'

Closing the water cycle in horticulture and food-processing

On average, 44 % of the total water abstraction in Europe is used for agriculture. The RESFOOD project has developed ICT solutions to address this issue. Tested in southern Spain, the project has proved in practice that these solutions make it possible to reduce the water use per ton of product in soil-based systems by over 40 %, without having an impact on production.

The RESFOOD team also showed that it is possible to recycle 50 % of the wash water — after treatment by UF and UV disinfection — without influencing the quality of the product. This solution was tested at full scale at a production line with different types of vegetables.

Water-efficient washing machine for fresh-cut food

The project also developed a water-efficient washing machine for fresh-cut food on the basis of research undertaken by Spain's CNTA on decontamination strategies. The demonstration of the technology showed promising results — the new machine reduced water consumption from 1.8 litres per kg to 1.3 litres per kg. 'We now want to use the results of this innovation to save energy also on smaller washing machines. We plan to reduce the water consumption, taking the water from the outfeed belt and bringing it back into the machine. We are also very proud that the machine was nominated for the 2015 Food Tech Innovation Award,' commented Eric Lefebvre from RESFOOD project partner Kronen that led on the machine's development.

Optical biosensing methods for rapid monitoring of bacteria

Food and water safety has also been one of the RESFOOD priorities, leading the way on a new optical bio-sensing system for rapid and onsite analysis of bacteria in water. The project has shown that the prototype system proved to be robust and performed well during two rounds of pilot tests.

The results of the second demonstrations have been processed and analysed and now the project partner Technion, who developed the system, is currently working with a leading Israeli food company, in order to further enhance its performance and adapt it to the company's products.

IS-Pro kit for microbial profiling of water

Also exploring bacteria in water, RESFOOD partners Microbiome developed the IS-Pro Kit. The team honed a process called IS profiling, which uses polymerase chain reaction (PCR) to detect bacteria by determining the length of a bacterial amplicon (a piece of DNA or RNA). The team has now been successful in achieving the necessary CE-IVD certification for the kit and it is now on the market. A portable filtering device, also developed during the project and accompanies the kit, has yet to reach the market but it is hoped that this will happen in the very near future.

Other RESFOOD solutions range from optimised irrigation management and improved technologies for water reuse and nutrient recovery to more environment-friendly extraction techniques of valuable materials from food by-products.


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Building on project successes

The Horizon 2020 FERTINNOWA project, which started at the beginning of 2016, will be used to further disseminate and build upon the knowledge collected through RESFOOD, also by showcasing results at grower locations. Another project, GREENPROTEIN, carried out within the H2020BBI work programme, which includes a number of RESFOOD partners began in the middle of this year and has only just held its first kick-off meeting.

'It is a pleasure to see that RESFOOD is still alive, almost one year after the final conference,' says project coordinator Willy van Tongeren of TNO, the Netherlands. 'A lot of interested parties still request information on the project and its results are not only used in practice but are also utilised in new initiatives. I also look forward to see how the RESFOOD partners and other stakeholders take the technology we developed forward.'

Project	**RESFOOD: RESOURCE EFFICIENT AND SAFE FOOD PRODUCTION AND PROCESSING**
Coordinated by	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK (TNO) (Netherlands)
Funded under	FP7-ENVIRONMENT
Project website	http://www.resfood.eu/web/

EU-India cooperation opens market for water-efficiency innovations

European and Indian researchers together have developed and tested new water efficiency technologies, targeted at the agricultural sector, and identified new commercial opportunities for SMEs interested in scaling-up and marketing these innovations.

In order to avoid instances of starvation, disease and conflict over resources in the future, coordinated global efforts are urgently needed to put into practice smarter and more sustainable methods of using and reusing water. This is especially pressing in rural-based economies, where between 70 and 90 % of freshwater is currently used in agriculture-related irrigation. This is simply unsustainable when one considers that in order to feed our growing population, almost 50 % more food must be produced by 2030, and must double by 2050.

'Increasing water efficiency is fundamental to improving human wellbeing and social equity and to reducing environmental risks and resource scarcity,' explains WATER4CROPS project coordinator Antonio Lopez from the Istituto di Ricerca Sulle Acque (IRSA) del Consiglio Nazionale delle Ricerche (CNR) in Italy.

Identifying sustainable opportunities

In order to achieve this goal, this EU-funded project, which brought together European and Indian institutions, universities, industries and SMEs, sought to identify innovative technical improvements and best practices in wastewater bio-treatment and water efficiency techniques, along with potential new agri-business opportunities.

Large-scale field trials were run in both regions. From these/as a result, the project was able to demonstrate effective methods for obtaining valuable products and chemicals from agro-food industry wastewaters, and how urban wastewater can be treated by technologically simple and economic sustainable plant-based technologies. By twinning successful examples from both Europe and India, the project was able to transfer knowledge and best practices.

'Increasing water efficiency is fundamental to improving human wellbeing and social equity and to reducing environmental risks and resource scarcity'

© WATER4CROPS

WATER4CROPS also showed that water saving and efficient water use can be achieved through the careful selection of optimised irrigation systems and strategies, and through accurate technologically-assisted estimations of crop water requirements. Drought tolerant crops were improved through selective plant breeding.

'Famers in Europe and India clearly stand to benefit from these positive results, but chemical industries should also be interested in the possibilities of recovering valuable products from agro-food wastewaters,' says Lopez. 'We also identified opportunities for local tech firms in developing and implementing advanced water-saving and recovering technologies.'

Turning results into reality

The results achieved were presented and discussed during several 'INNOVA' stakeholder platforms, which were held in both Europe and India throughout the project's lifespan. 'One of the things that was original and indeed challenging about our approach was that we really involved stakeholders — local technology producers and users, retailers and regulators — in order to ensure that our results were truly implementable,' says Lopez. 'Through these platforms, local bottlenecks in economic development were identified, along with locally existing frameworks to advance wastewater use in irrigated agriculture.'

Lopez points out that not everything is in the hands of researchers, and the project also examined the impact of regulations. 'In Europe for example, legislation on agricultural wastewater reuse is often so strict that they limit technology uptake, while in India, lack of reliable regulations or enforcements means the incentive to invest in treatment is less,' says Lopez. 'The challenge for any government or regulator is to strike a balance between being strict and lenient in setting water quality standards, and the project has sought to aid policy makers in making these calls.'

Following the completion of the project, Lopez is now keen to see promising technologies put to market as soon as possible. 'Over the course of this project, we saw the technical readiness of several technologies improve greatly. What we now need are larger pilot projects devoted to validate these technology clusters. I would like to see these pilots build upon technologies for which proof of concept has already been established; these technologies can then be applied, improved and developed for actual use. In the long term, we hope that our solutions will lead both Europe and India towards realising a green economy.'

Project	**WATER4CROPS: Integrating bio-treated wastewater with enhanced water use efficiency to support the Green Economy in EU and India**
Coordinated by	CONSIGLIO NAZIONALE DELLE RICERCHE (Italy)
Funded under	FP7-KBBE
Project website	http://www.water4crops.org/

research*eu
RESULTS PACK

Published by
The Community Research and Development Information Service (CORDIS)
managed by the Publications Office of the European Union
2, rue Mercier
2985 Luxembourg
LUXEMBOURG

cordis@publications.europa.eu

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The research*eu Results Packs are published by the Community Research and Development Information Service (CORDIS) and managed by the Publications Office of the European Union. Content is prepared using information featured on the CORDIS website, as well as original material collected specifically for this publication.

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ISBN 978-92-78-41457-3 (printed version)
ISBN 978-92-78-41461-0 (ePUB)
ISBN 978-92-78-41458-0 (PDF)

ISSN 2529-3265 (printed version)
ISSN 2529-2919 (ePUB)
ISSN 2529-2919 (PDF)

doi:10.2830/283421 (printed version)
doi: 10.2830/96028 (ePUB)
doi:10.2830/099743 (PDF)

ZZ-AD-17-002-EN-N

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