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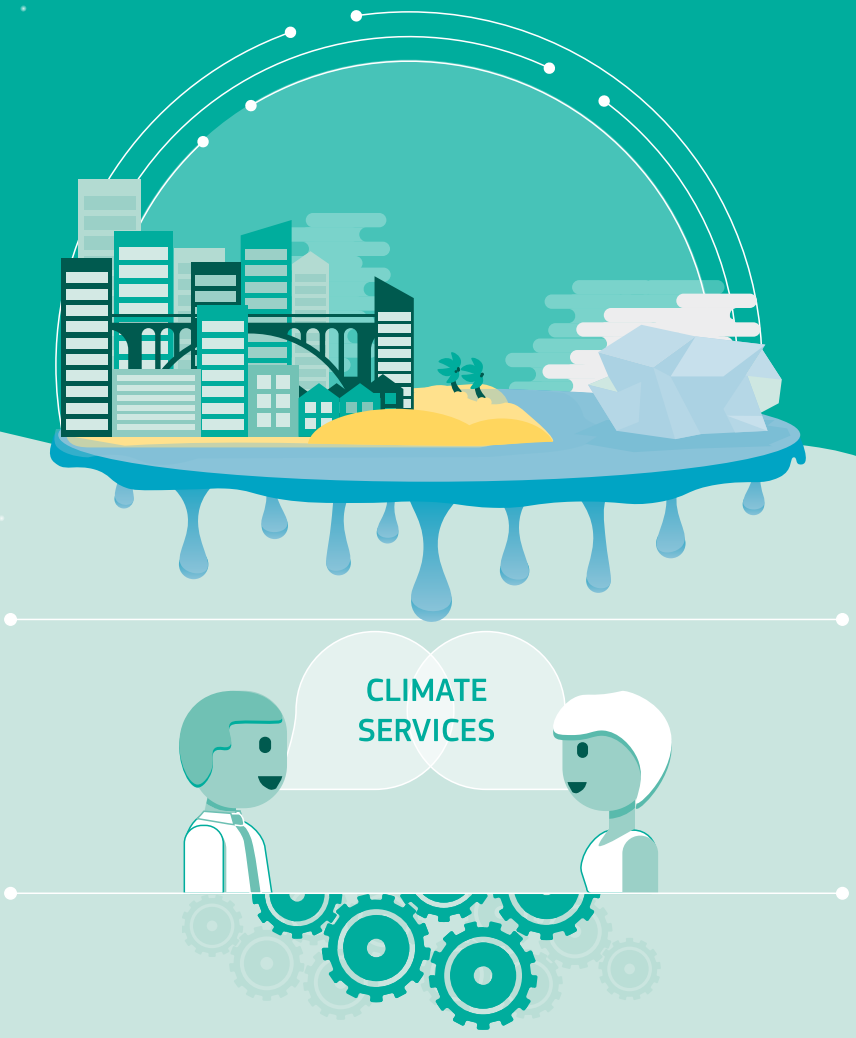
RESULTS PACK

A European market for climate services through innovative EU research



EDITORIAL

A EUROPEAN MARKET FOR CLIMATE SERVICES THROUGH INNOVATIVE EU RESEARCH

The European Union has ambitious targets for reducing its carbon footprint and leading the world in the ongoing fight against global warming. To ensure that Europe has the services, tools and knowledge necessary to provide effective responses to climate change and increase its overall resilience, there is a pressing need to nurture and grow a dedicated and successful climate services market.

Climate change remains one of the world's most pressing challenges and the European Commission is committed to a 'forward-looking climate policy' that will see a reduction of fossil fuel emissions by 80 to 95% by 2050 – and their complete phase-out by 2100 – and significant adaptation efforts to society and the economy to make this happen.

Climate services will be a significant component in the creation of effective adaptation strategies solutions. Whilst a relatively new and specialised sector, the European Commission, as recognised through its 2015 European Research and Innovation Roadmap for Climate Services, believes that it has the potential to become, in essence, a key resource and intelligence behind the transition to a climate-resilient and low-carbon society.

Today's pressing challenge for climate services is to analyse and disseminate information on the full range of likely impacts of climate change (under different scenarios) and provide effective responses and bolstering the resilience of vulnerable communities. The use of the best available climate data and knowledge is essential to create effective tools, products and services that will spark innovation on adaption, mitigation and disaster risk reduction. This will allow for better and more informed decision-making, enable a more robust approach to risk management, foster the development of a market for climate services, create jobs, and make a positive contribution to Europe's future and sustainable economic growth.

This Results Pack casts a light on four innovative and ground-breaking projects funded through the EU's Seventh Framework Programme (FP7) that are making big and exciting advances in developing Europe's climate services market. Each of the four projects is contributing to the advancing of our scientific understanding on climate change and the role that we humans are playing in this process.

The projects' successes have helped to plug some of the many gaps in our collective understanding and have laid the groundwork for a thriving sector that will continue to be supported by the EU over the coming years through ongoing and future research support through the Horizon 2020 programme and other relevant funding mechanisms.

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New climate services for informed decision-making

EU-funded researchers have collaborated with stakeholders to develop prototype climate services that meet the specific needs of those using climate change information.

In addressing the reality of climate change, Europe must balance the need to become more resilient to hydro-meteorological hazards with the ability to manage the risks and opportunities that come with climate variability and change. Doing this requires: a better understanding of climate and related user needs; an enhanced ability to predict climate change on all timescales; and improved accessibility, quality and usefulness of climate services (i.e., the provision of climate information in such a way as to assist decision making).

These challenges have been recognised by governments, scientists and decision makers around the world, leading to the creation of the Global Framework for Climate Services. As part of this, many countries have developed and delivered climate services geared towards better meeting societal needs. However, to effectively meet user needs, these services must be based on scientifically credible information and arise from user and provider engagement.

Here in Europe, the EU-funded EUPORIAS project was set-up to develop prototype climate services operating on a seasonal-to-decadal timescale. 'The vision of EUPORIAS was to

We researched methods for transforming seasonal forecast data into relevant information for making informed decisions.

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develop climate services and demonstrate their value in informing decision-making, thus stimulating market demand and improving the resilience of society to climate variability and change,' says project coordinator Chris Hewitt from the UK's Met Office.

Engaging users

With the mission of ensuring more effective use of climate forecasts, EUPORIAS researchers worked with stakeholders to determine the specific needs of those using climate change information. The project developed new technologies and tools for both exploiting climate information and for engaging with users. 'Previous analyses in this area tended to focus on the longer timescale climate change projections, and little was known about who was using short-term information or how they were using it,' says Hewitt.

During this phase, one important theme quickly emerged: a need to reduce the gap between the way climate information is provided and the formats required by users. For example, a common scenario for users is to find themselves working with imperfect forecasts. Here, EUPORIAS researchers developed six prototype climate services on the seasonal timescale, along with delivering standard tools for calibrating, downscaling, bias correcting and visualising the skill of climate predictions.

Another focus of the project was to improve user understanding of their vulnerability in the face of varying climate conditions and preparing them to mitigate these vulnerabilities by using climate forecasts. 'We researched methods for transforming seasonal forecast data into relevant information for making informed decisions,' explains Hewitt. These methods included transforming raw variables into user relevant indices through statistical post-processing and using impact models, as well as regional climate models.

Ongoing legacy

EUPORIAS' work is helping reduce the risks and costs associated with responding to a changing climate – and businesses, governments, NGOs and society in general are all becoming better positioned to manage the risks and opportunities resulting from climate change because of it. 'By forging engagement between various actors, with the aim of improving communication, mutual understanding and co-development of prototypes, our research has successfully improved the interface between climate service providers and decision makers,' says Hewitt. 'This in turn has allowed EUPORIAS to give substance to some of the concepts proposed by the Global Framework for Climate Services.'

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Although the project has closed, its legacy lives on through new collaborations, research findings in peer-reviewed publications, the prototypes (some of which are being developed further) and sustained engagement between certain climate service developers and end users. 'Not only will these legacies benefit other EU-funded projects and activities, they will also lead to new and even stronger engagement between users and providers of climate services,' concludes Hewitt.

Project	**EUPORIAS: EUropean Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale**
Coordinated by	Met Office (UK)
Funded under	FP7-ENVIRONMENT
Project website	http://www.euporias.eu/

Assessing the risks of climate change

By developing a set of coherent scenarios of what to expect in a world where temperatures continue to rise, EU-funded researchers are making the need to adapt to our changing climate both more understandable and manageable.

Although the Paris Agreement committed countries to limiting global warming 'well below 2 degrees', emissions cuts pledged so far are not yet deep enough to achieve this. But what will such a warmer world actually look like? What impacts do we wish to avoid, and what we will need to adapt to? There are a multitude of climate change impact projections, and while they have many common messages, they also differ greatly in many important details.

Within this context, it is easy to become overwhelmed. To help, the EU-funded HELIX project is assisting decision-makers and the research community by making adapting to our changing climate both more understandable and manageable. To accomplish this, project researchers are developing a set of credible, coherent global and regional scenarios of what one can expect in a world where the temperature continues to rise. A key aim is to explain to policymakers that a range of outcomes are possible, allowing them assess risks accordingly.

From two to six via 1.5

As a base, the project started by looking at the impact of climate change above 2°C global warming. 'It is widely recognised that we are still on a trajectory of greenhouse gas emissions that will probably take us above this level within the next few decades,'

says HELIX project coordinator Richard Betts. 'For this reason, the HELIX project is looking at what the climate may look like – both globally and regionally – at this level of climate change.'

Looking at the world as a whole, with a particular focus on Europe, Africa and South Asia, the researchers are studying the physical impacts that climate change could have, including flood risks, drought, ecosystems and biodiversity. They are also looking at how rising temperatures could impact humans, from our health and the well-being of our economies to such issues as migration and security. 'We don't pretend to be able to predict the future, but we want to be able to look at a range of plausible climate change scenarios consistent with global warming at 2 °C and 4 °C, and even 6 °C,' says Betts.

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Halfway through the project, an extra requirement became clear. As the Paris Agreement included an increased ambition of limiting warming as close as possible to 1.5 °C, HELIX was asked to look at impacts at this level too, to see what could be achieved by avoiding even 2 °C.

Increased flood risks

For example, according to one area of HELIX research that looked specifically at flood risk and economic damage, if global temperatures rise by 4 °C, the flood risk in countries representing more than 70 % of the global population and global GDP could increase by more than 500 %. In the case of a 2 °C temperature increase, both the affected population and the related flood damages could rise by 170 % compared to present levels. And even under the most optimistic scenario of a 1.5 °C temperature increase, it's estimated that the flood-affected population would still double, with flood damages increasing by 12 %.

The HELIX team made this projection by analysing a selection of high-resolution climate projections and simulations, along with the frequency and magnitude of river floods and their expected impacts under future scenarios. The result is essentially a global assessment of the economic costs and the populations affected by river flooding under different global warming scenarios.

Informing mitigation and adaptation

HELIX researchers hope that their results will be kept in mind by policymakers as they follow up on the Paris Agreement. However, they stress that this is a matter of risk assessment and one shouldn't expect to be able to act on firm prediction. 'This is an estimate based on current understanding, not a prediction,' explains Betts. 'There are of course large uncertainties, but it gives an idea of the kind of impact we might be looking at if we do not avoid these levels of warming or do not adapt to the changing climate.'

Project	**HELIX: High-End cLimate Impacts and eXtremes**
Coordinated by	University of Exeter (UK)
Funded under	FP7-ENVIRONMENT
Project website	http://www.helixclimate.eu

How to prepare for rising sea levels

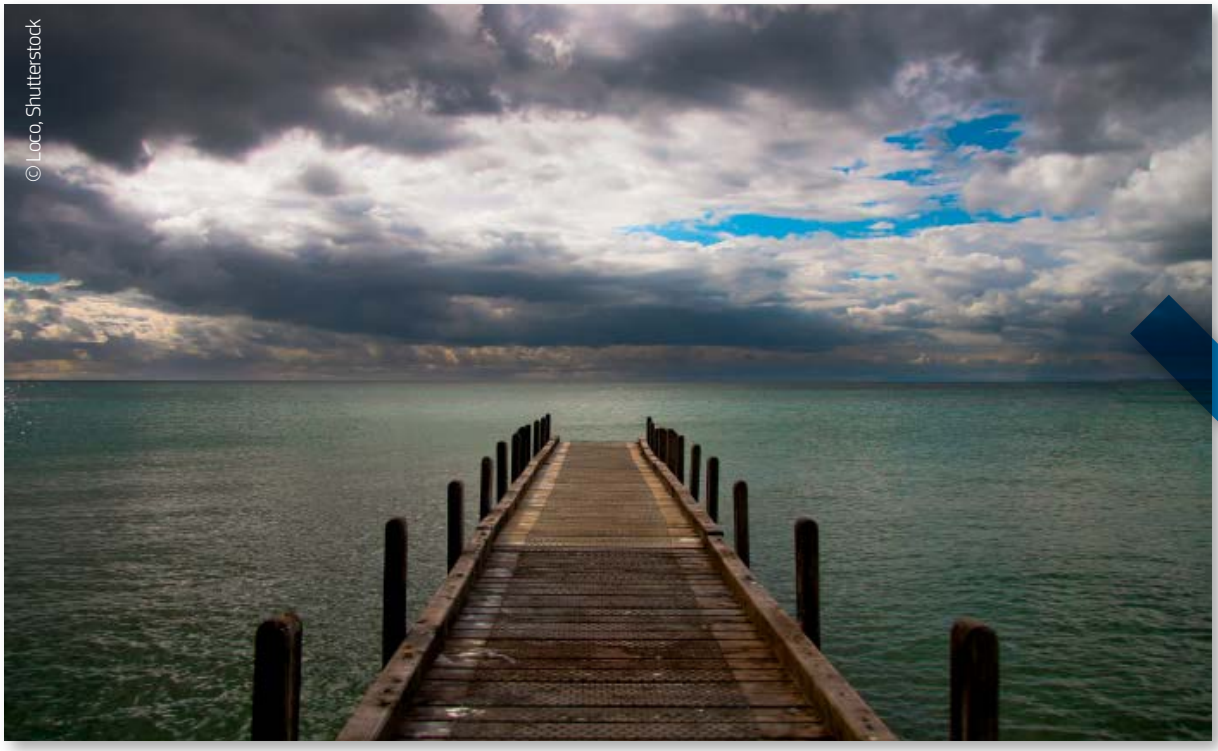
Even if greenhouse gas emissions are cut and global temperatures stabilise, sea levels will continue to rise for several centuries. Humanity must therefore learn to adapt and develop strategies to deal with future events.

Coastal areas around the world are extremely vulnerable to the effects of climate change, such as sea level rise, increased river flow and extreme weather events. Moreover, 40 % of the planet's population and 35 % of its GDP are located here, with developing countries being particularly vulnerable due to the growth of megacities in subsiding river deltas.

Our current understanding of coastal impacts is fragmented however, as they are measured at either the local or regional scale. In addition, assessments mainly focus on direct damage while disregarding economy-wide impacts, especially for high-end scenarios where global average warming is greater than 2 °C.

These knowledge gaps are now being addressed by the EU-funded project RISES-AM-. Its goals were to determine how much climatic change coastal zones can deal with, how best to assess the effectiveness of attempts to defend our coasts, and what communities can do to protect themselves.

One of our most important findings has been the importance of enabling nature to work in combination with more conventional engineering solutions.



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Adapting to rising sea levels

Scientists investigated the societal impacts of climate change by developing adaptation strategies across local, regional and global scales. The strategies deal explicitly with uncertainties in the pressures facing coastal zones and in their responses to climate change.

These advances are being applied to policy recommendations at the regional, European and global scales, with all three focusing on coastal adaptation under extreme climate scenarios. 'This will enable us to determine how effective coastal policy and decisions will be in reducing climate impacts,' explains Prof. Augustin Sánchez-Arcilla, RISES-AM- project coordinator.

A clearer picture of climate impacts and possible countermeasures is now possible thanks to local-scale analysis, which combines the effects of coastal erosion, flooding and salinization. Ranking coastlines at the regional scale has allowed planning authorities to prepare adaptation plans over different time horizons to ensure greater safeguarding of the natural and socioeconomic value of our coasts. Meanwhile, studies at the global scale show from a purely economic point of view that raising the height of sea dikes or building new ones can be justified for 10 % of the world's coastline.

Coastal communities, managers and decision makers will all benefit from RISES-AM- by becoming more aware of the risks associated with living in such a dynamic environment.

Working with nature and not against it

'One of our most important findings has been the importance of enabling nature to work in combination with more conventional engineering solutions,' says Prof. Sánchez-Arcilla. 'Examples include allowing storm waves to wash over a beach and deposit material, thereby improving its stability over the mid to long-term; or enabling coasts to receive more river sediment to make them more resilient.'

RISES-AM- results demonstrate that flexible interventions, including planned retreat, may offer a higher level of sustainability and provide a more viable long-term solution, economically speaking. Planned retreat allows the natural processes of erosion to continue, rather than resist them through the use of engineered structures.

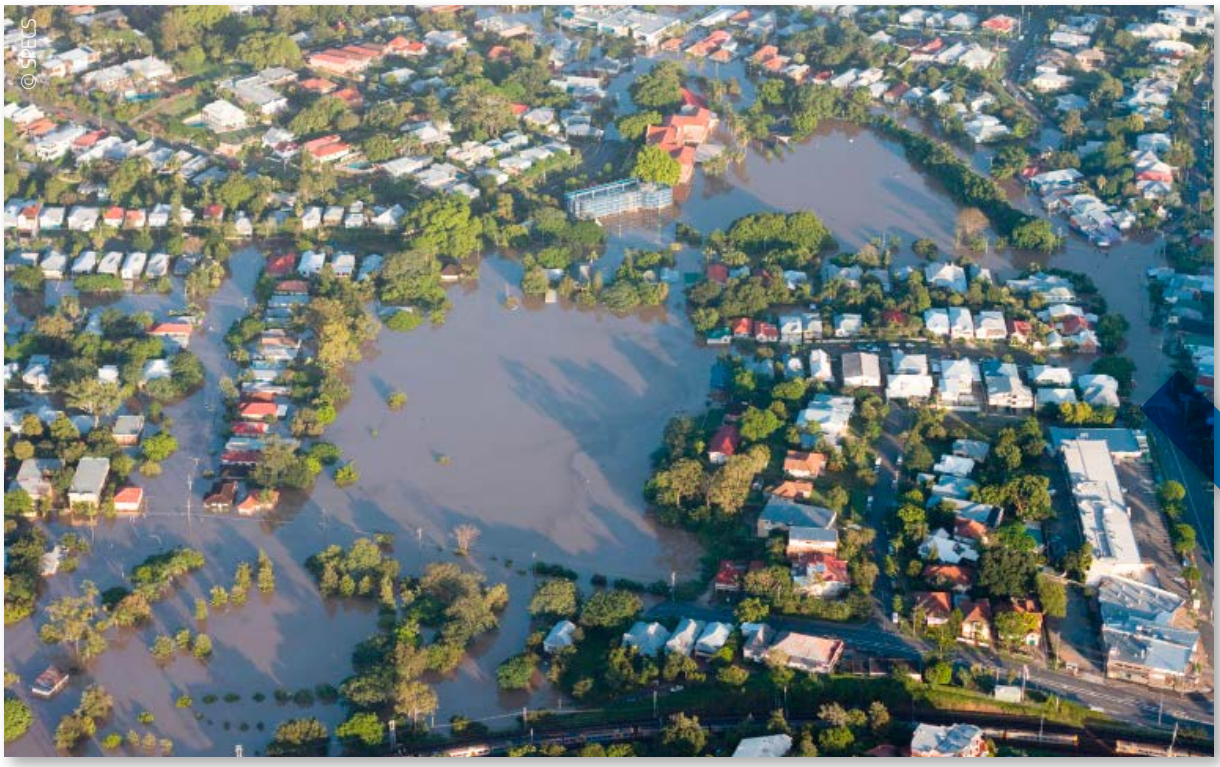
Furthermore, rigid solutions such as sea walls only provide short-term benefits and may actually result in increased erosion. Case studies also reveal that the main barriers to coastal adaptation are of the socioeconomic type, since enough technical solutions exist to provide, at least in the short term, sufficient coastal protection and the reduction of risk levels.

'Coastal communities, managers and decision makers will all benefit from RISES-AM- by becoming more aware of the risks associated with living in such a dynamic environment,' concludes Prof. Sánchez-Arcilla. 'They will also gain a greater appreciation of how flexibility in land planning and nature based coastal solutions may be more sustainable than rigid short-term alternatives.

Project	**RISES-AM-: Responses to coastal climate change: Innovative Strategies for high End Scenarios -Adaptation and Mitigation**
Coordinated by	UNIVERSITAT POLITECNICA DE CATALUNYA (Spain)
Funded under	FP7-ENVIRONMENT
Project website	http://www.risesam.eu/

Improving seasonal-to-decadal climate forecasting

EU-funded researchers have introduced a range of seamless solutions for better predicting seasonal-to-decadal climate changes.



Despite a recent call by the World Meteorological Organisation (WMO) for more robust climate information to be used in economic, industrial and political planning, Europe lags behind in terms seasonal-to-decadal (s2d) climate forecasting. According to SPECS project coordinator Francisco Doblas-Reyes, the lack of s2d climate prediction capability found in many of today's research projects, along with the fact that many climate services focus only on long-term climate change problems, makes the business of climate prediction an unknown player within the European context.

'Traditionally, seasonal-to-decadal climate prediction had limited forecasting quality, especially in Europe for shorter time scales,' says Doblas-Reyes. 'Furthermore, progress in seasonal forecasting has been slow, mainly because new tools and model components for addressing the role of sea ice, land surface, stratosphere and ocean did not make their way into the systems providing real-time information. Yet it was also obvious that these systems could greatly benefit from untapped climate predictability.'

To fill this gap, the SPECS project set out to identify the main challenges in s2d prediction and to introduce a range of seamless solutions, both in terms of timescale and for facilitating communication between the producers of climate predictions and the users.

SPECS has answered the call for a coordinated European response to the need for global seasonal-to-decadal climate forecasting.

Forecasting for tomorrow

The project's key objective was twofold. First, it wanted to develop a new generation of European climate forecasting systems that made use of the latest scientific progress in climate modelling and operational weather forecasting. Second, it aimed to develop efficient local and regional forecast methods capable of producing skilful and reliable predictions over land areas at both the local and large scales.

Once this information was available, the project then sought to illustrate how this improved, high-resolution climate prediction information could be used, especially in terms of integrating it with other services focused on the overarching challenge of addressing global climate variability and change.

To achieve these goals, the project undertook a number of specific, innovative experiments in global forecasting, the data of which has been made publicly available. 'On the one hand, these experiments delivered a better understanding of the role of the natural modes of variability, the initial state and the description of the crucial processes for climate prediction,' says Doblas-Reyes. 'On the other hand, they also tested radical changes to forecast systems in terms of variable radiative forcing, improved and more realistic processes, and an increase in spatial resolution in global forecast systems.'

The glue that binds

The SPECS project's extensive research resulted in several important developments. For example, by better initialising different components, researchers found that forecast quality over land can be improved to the level of satisfying the requirements of a number of socioeconomic applications. Also, increased spatial resolution of forecasts – including the role of interactive vegetation, snow and sea ice, atmospheric composition and volcanic ash – provided much better information on short-term extreme climate events. The project also addressed fundamental challenges in climate prediction, such as reducing the impact of initial shock, systematic error and drift – all of which are critical aspects for improving forecast systems.

Furthermore, the project successfully improved s2d climate information to a wider audience. In this sense, one could say that SPECS is the glue to bind together many different initiatives, including research that doesn't address the climate prediction problem, climate service operators with few resources, and a unique set of stakeholders and international institutions working in the field of climate forecasting. 'SPECS has answered the call for a coordinated European response to the need for global seasonal-to-decadal climate forecasting,' concludes Doblas-Reyes. 'As a result, government planning, society and European businesses now stand to benefit from having access to improved, reliable and better communicated s2d climate information.'

Project	**SPECS: Seasonal-to-decadal climate Prediction for the improvement of European Climate Services**
Coordinated by	BARCELONA SUPERCOMPUTING CENTER - CENTRO NACIONAL DE SUPERCOMPUTACION (Spain)
Funded under	FP7-ENVIRONMENT
Project website	http://www.specs-fp7.eu/

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CORDIS Results Packs are a thematic grouping of articles based on EU-funded projects and aim to disseminate information about new studies, contemporary scientific findings and technologies to the relevant target audience, in order to facilitate their exploitation across Europe and beyond. Eligible projects are those currently funded under the Seventh Framework Programme (FP7) and Horizon 2020.

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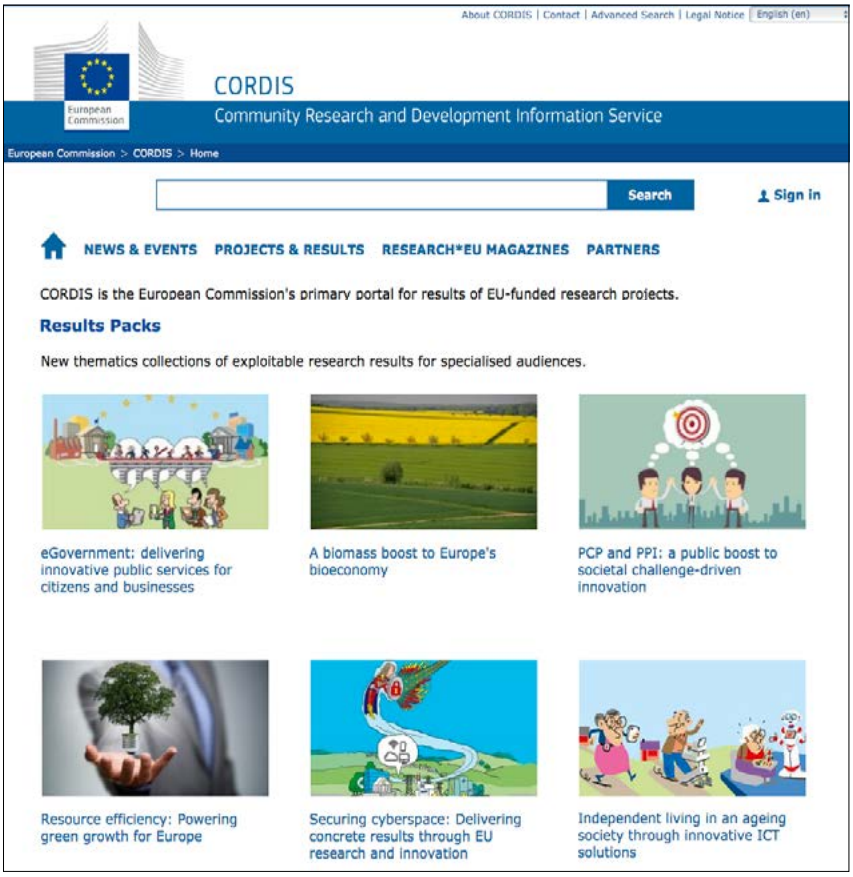

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