European Commission

Annual Report 2018

Joint Research Centre

The European Commission's science and knowledge service

Joint Research Centre

Foreword by Commissioner Tibor Navracsics

When this Commission's mandate began in 2014, President Juncker asked me to develop the Joint Research Centre's role as a crucial support for all Commission services, using its knowledge and expertise, breaking silos and building bridges between science and policy. Coming towards the end of my mandate, I am very proud that, thanks to a bold vision, our dedicated team and sheer hard work, we have achieved this ambition together. By 2018, the Joint Research Centre (JRC) had cemented its role as a strategic partner at the heart of the Commission, and it is widely recognised as a world leader in knowledge management for public policy.

As part of its enhanced strategic role, the JRC has had a pivotal role in preparing the next Multiannual Financial Framework. It has continued to provide important support to key initiatives such as cybersecurity and the energy union, and has also become an indispensable partner in policy implementation in areas such as dual quality food and the European Semester.

2018 was a breakthrough year for the JRC's knowledge management activities, and our team organised the first-ever Commission-wide Knowledge Week, helping to strengthen knowledge management capacity across the organisation. The JRC now hosts six knowledge centres as well as six competence centres, all of which are providing invaluable expertise and tools to assist policymakers. It has also launched a new series of reports synthesising the current state of knowledge on complex policy issues, such as artificial intelligence and soil degradation. These have proved relevant and interesting to policymakers and other stakeholders, both inside the Commission and beyond. I am particularly pleased that the JRC is continuing to bring science and art closer together, and is experimenting with innovative approaches to engage citizens.

The JRC's policy support and knowledge management activities build on its long-standing track record of world-class knowledge production. With citations in the top 1 % of scientific journals worldwide, it is also experimenting with innovative approaches, such as its Centre for Advanced Studies programme and novel forms of cooperation with European universities, offering new opportunities for doctoral students to focus on policy-relevant research.

2018 was an excellent year: the high level of ambition and performance and its position at the centre of advice to policy is reflected in a solid proposal for the JRC's place in the next Framework Programme for Research and Innovation. I look forward to seeing the JRC build on the excellent foundations laid by the current vision, and continue to support EU policymaking for better European societies into the future.

Tibor Navracsics
European Commissioner for Education, Culture, Youth and Sport

Observations from the Board of Governors

Generating and managing knowledge and evidence for the design of European Union (EU) policies are at the heart of the JRC's role as the Commission's science and knowledge service. This role is becoming ever-more important as the challenges our society faces are complex, the pace and scope of change is striking and, as JRC research shows, the impact across countries, regions, sectors and social groups is diverse. The Board of Governors gave the JRC advice throughout 2018 on its priorities and major projects, including on the implementation of its strategy, role in Horizon Europe and its work programme, through three dedicated ad-hoc working groups. The Board welcomes the JRC's important contributions to addressing new challenges in 2018.

This year, the deliberations continue around the shape of Horizon Europe proposed by the Commission in June. As a Board, we underline the importance of adequate funding to support the JRC's mission, full implementation of its 2030 Strategy, and maintenance of its unique and world-class research infrastructures. The Board emphasises the JRC's unique role in EU policymaking and recognises its provision of excellent multi-disciplinary research, fundamental for addressing the EU's complex societal challenges and issues emerging on the policy horizon. The Board values the JRC as being instrumental in driving the Commission's knowledge centres in priority areas, collaborating with the Member States and tapping into the best academic and scientific organisations, to ensure the delivery of independent, fit-for-purpose science and support throughout the entire policy cycle.

We, the Board, appreciate the changes ushered in by Strategy 2030 in 2018, which have transformed the JRC into a more outward and forward-looking broker of evidence for policies across the European Commission, at both Member State and regional level. We welcome the increasing attention being given to engaging policymakers on how to do evidence-based policymaking through events like the Knowledge Week, and bringing citizens into a conversation on science through initiatives such as ARTEFACTS at Berlin's Natural History Museum. We support the JRC's enhanced engagement with external peers, which offers fresh perspectives, as well as new ideas to help the JRC to grow and develop its work in areas like artificial intelligence, the future of jobs, skills and education, health, hybrid threats and societal trends.

This year, the Board congratulates the JRC on its contribution towards developing and managing evidence on food fraud and quality, foresight, megatrends, health promotion and disease prevention, fairness, cities, technology transfer, global food security, and migration, through the launch of new knowledge and competence centres and communities of practice. The Board welcomes the JRC's forthcoming reports on new or multidisciplinary issues – the future of cities, resilience, fairness, the future of education and work, decision-making behaviour, values, blockchain, artificial intelligence, innovation in China, demographics, clean and connected mobility, and cybersecurity – visible products through which policymakers and stakeholders can access robust evidence to inform their debates.

The Board endorses this Annual Report and appreciates the work of the JRC staff throughout 2018. The Board looks forward to giving guidance and support to the JRC in 2019.

IMPLEMENTING THE JRC STRATEGY 2030 AN INTERVIEW WITH THE JRC DIRECTOR-GENERAL, VLADIMÍR ŠUCHA

What sets 2018 apart from previous years?

2018 was very important because we are in the process of adopting the new financial framework. And when we are talking about the money, then the friendship goes aside, as we know very well. We have got a lot of positive remarks before, but the most important was to have this appreciation somehow expressed through the legal proposals of the next MFF (Multiannual Financial Framework). We have been sitting together with the Regulatory Scrutiny Board and the other corporate services and we have been screening all the evaluations processes of existing regulations and spending programmes. For the new Regulations, we have been supporting most of them with impact assessment, with modelling, with other relevant capacities, so I think this was quite a high level of appreciation and trust of the work of the JRC.

How did the knowledge management activities develop over the past year?

Knowledge management became, I would say, mainstream not only in the JRC but also in the Commission, which is quite a success. If you look at what is going on in the Commission, there is a huge interest in knowledge management – many Directorates-General are embarking on this, because they feel that there is so much data, information, knowledge out there, that they need to do something to get oriented in this tsunami, in this fog. So we organised this year the first ever Knowledge Week together with the Secretary General and Directorate General for Human Resources promoting knowledge management as a tool, as an approach, and we had 2400 Commission people participating, so I think this is very good. Knowledge week in a way also helped us understand that we are not beginners in knowledge management. Actually, we are in quite a good leading position worldwide in this respect.

How would you explain the JRC's increased focus on foresight and anticipatory capabilities?

It is very important that all these anticipatory exercises are helping to tune your mind more forward than backward looking or focusing right now on urgent things instead of important things. The Commission, but also the governments, are more in a reactive mode, preventing them from focusing on important, longer term issues. And I think in this world where all is happening so quickly and changing so fast, we need to change our mindset.

One of the tangible results of foresight activities in 2018 is definitely the organisation of the FTA conference – the Foresight Technology conference; which is the recognition of the leading role of JRC in the worldwide community of foresighters. We also achieved very good results of horizon scanning, with the involvement of a lot of people, and a growing interest overall. For the first time this year, other services expressed an interest in joining and this is very important: we cannot do horizon scanning only on our own; we need policy DGs to be part of the process – confirming, debating and selecting the most important elements.

'Artificial Intelligence is already shaping our present and will be shaping our future even more'

What particular example of 2018 knowledge management activity do you consider an achievement?

Artificial Intelligence is already shaping our present and will be shaping our future even more, so I am very proud of the JRC report 'Artificial Intelligence: A European Perspective'. This is a benchmark of Knowledge Management: there is no new research behind this report, but it does bring new knowledge. This is also an excellent example of collaboration within the JRC: 12 units have been working together and they had never been working together before. And the result is absolutely great; the feedback is extremely positive – feedback from policy makers, but also from very good experts in the field, so I think this is excellent.

What would be your main take away from the ongoing elaboration of the next Research Framework Programme, Horizon Europe?

Horizon Europe and its part on EURATOM are the fundamental regulations which are the basis for our future work. The way how this was constructed by the European Commission, how it was approved and how the negotiations are going on in both the European Parliament and the Council – it is very positive for us. All in all, we did not notice one negative remark. From the European Parliament there is one demand to work more on cross-silo issues and on our anticipatory capacity, looking at how technologies and new developments are going to shape policy and society in the future – so I think it is very positive. And there is also one new, in a way, policy or political innovation: for the first time there is a separate programme for nuclear decommissioning. The role of JRC in this respect is very positive. And here we also have a good example, because the European Parliament came with the request, and it was fully supported by the Council as well, for the JRC to collect knowledge from all the decommissioning activities going on in Europe and make it available, in order to increase the quality of decommissioning activities across Europe.

Looking ahead, what are your views on the challenges of 2019?

2018 was internally a very important year, and I think that we achieved a very high level of performance, and a high level of appreciation from different partners inside and outside the Commission. Definitely we have a very challenging year 2019 ahead of us. Every five years, we have important changes in the political leadership, but 2019 will be a very special year because we see a lot of turbulence across Europe, across the world. And I think that we need to step up our activity also as citizens; that we are not shy to talk about the positive sides of Europe. It is not perfect because it is a human construction, but it is the only way to survive and thrive in the coming years.

TAKING STOCK OF JRC'S STRATEGY 2030 IMPLEMENTATION

The relationship between science, policy and society is in a state of flux. Policy challenges are more complex than ever, the amount of available data and information has increased exponentially, as too have the sources from which knowledge originates. Universities are no longer alone in the knowledge landscape, but have been joined by a whole host of other entities, including citizen scientists and entrepreneurs, often using technologies which disseminate information to the world at such a pace that leaves little time for validity and quality checks. Society is starting to question the authority of scientific experts, yet find it difficult to navigate through the sea of knowledge and to determine what evidence they can trust.

With these changes as a backdrop, the JRC, which sits at the crossroads between science and policy, took the courageous step two and half years ago to undergo a complete reform. Implementation of the 2030 Strategy marks a step change in the organisation's activities. It is still relatively early days, but there are numerous beacons of light, encouraging signs, that new approaches are gaining ground, gaining recognition and cementing the value of the JRC as a 'boundary' organisation.

The mission driving the organisation as a knowledge provider at the core of the Commission is now echoing in the policymaking corridors of the Commission's headquarters and Directorates-General. JRC's impact on policy has grown from strength to strength to support a wider number of Commission services. The creation of European Commission knowledge centres means that by co-designing work and tapping into expertise, (political and scientific), via communities of practice, policymakers are now being informed in a transparent, tailored, concise and independent way. JRC competence centres provide complementary skills and expertise in the use of modern analytical tools, such as modelling and composite indicators to synthesise data and deliver fit-for-purpose and impactful products. ***[see pages 14-15]***.

By instilling a culture of 'one JRC' and facilitating working in an integrated manner across policies and disciplines, the JRC is better placed to tackle today's complex challenges. By exploring new approaches to deliver on emerging areas, the JRC provides more anticipatory support to the Commission. A megatrends hub provides a dynamic collective intelligence system to support forward-looking thinking, whilst a new Centre for Advanced Studies explores such topics as demographic trends, migration and the societal and economic impacts of digital transformation, where findings may be uncomfortable and regulatory measures a necessity. ***[see pages 18-19]***.

Throughout the JRC's transformation, it has remained grounded in excellence. Nearly 40 % of its publications appear in the top 10 % most-cited journals. However, concerted efforts are being made to complement these more traditional scientific articles with the release of short, sharp, accessible briefs on topics, sometimes controversial, but of general interest to both policymakers and the public. Such documents serve to distil out and present the different sides of a scientific debate, in order to inform and distinguish facts from dis-information. A new series of JRC Flagship reports coupled with their science for policy briefs also serve to inform a wider audience of the issues/challenges appearing on the horizon. ***[see page 11]***.

Building partnerships and reaching out to academia, private enterprises and young scientists are important for sharing information, stimulating new ideas, staying at the forefront of scientific developments and training the next generation of scientists on the specificities of the science-policy interface. Open-access status given to 12 of the JRC's world-class research infrastructures has stimulated interest from over 78 European institutions and more than 250 users. An innovative new collaborative programme for doctoral students means that young scientists will have hands-on experience at the policy interface. Over time, they will act as multipliers, thereby increasing the numbers of those with the skills to work in knowledge management for policy purposes. ***[see page 29]***.

At the crossroads of science and policy, the JRC is constantly exposed to changing political priorities. There are different pathways to follow. The lessons being learnt from the changes introduced within the JRC are proving invaluable to understanding how best to function – i.e. which route to take – to successfully bridge the gap between scientific disciplines and policy fields. Monitoring our performance and critically evaluating what we are doing and how we do it means the implementation of the strategy is a continuous process.

MANAGING KNOWLEDGE FOR EVIDENCE-INFORMED POLICY

The policy challenges we face in the 21st century are increasingly complex. There is plenty of potentially useful information to address these challenges, but the sheer amount is overwhelming and can be biased or even deliberately fake. And like all human beings, decision-makers are influenced by many factors other than facts and logic alone. JRC knowledge-management activities are intensifying to better rise to these challenges.

To deliver on its core mission of supporting policymaking with the best-available scientific evidence, the JRC needs to map, collate, analyse and quality check policy-relevant data, information and knowledge. Beyond collecting facts around specific topics and presenting them in reports, the JRC must effectively look into the very mechanism by which the best available knowledge is gathered and channelled through for the benefit of the EU and its citizens.

As a result of this drive, two years into its Strategy 2030, the JRC has consolidated its leading role in knowledge management for policy, providing a range of tools, training and processes to help policymakers take informed decisions, not only within the European Commission, but also on the global stage.

Implementing the JRC Strategy 2030 knowledge management objectives

In 2018, the JRC intensified its action in support of the 2016 Communication on Data, Information and Knowledge Management objectives. It is now offering consultancy to other Directorates-General to improve collaboration and knowledge management capacity. The JRC took the lead in organising a Knowledge Week in Brussels. Opened on 4 June with a two-day International Conference on Future-oriented Technology Analysis, it continued with three days of discussion for all Commission Services, in which 1 350 participants from 46 DGs and Agencies interacted with more than 80 knowledge management experts, both internal and external to the Commission.

Besides operating the Commission's knowledge and competence centres ***[see pages 14-15]***, the entire JRC has embraced a silo-breaking culture, leading to intense networking and collaboration across organisational barriers. Whereas the best examples of this cultural change are probably the #Facts4EUFuture Reports (see below), other initiatives have flourished, such as the Socio-economic regional microscope (SERM) series. These are short publications which aim to open up new areas of analysis and present stories which can only be told using regional socio-economic data. Each report presents EU socio-economic indicators according to a data storytelling principle, using a combination of data, visuals (maps) and narrative. So far, five SERM issues have been published on topics ranging from the role of Europe capital cities in leading cultural change, to mapping the burden of cancer and childhood obesity, to research and innovation in the energy union to regional upgrading for the digital age.

On the global stage, the JRC strengthened its collaboration with other leading organisations of the knowledge management community, including the International Network for Government Science Advice (INGSA) and the Organisation for Economic Co-operation and Development (OECD). The JRC notably contributed to the INGSA 2018 biennial conference, and with the OECD Public Governance Directorate co-organised a participatory workshop on evidence-informed policymaking in Public Services. The JRC also contributed sessions in major international conferences such as the AAAS Annual Meeting in Austin, USA, in February and the EuroScience Open Forum (ESOF) in Toulouse, France in July.

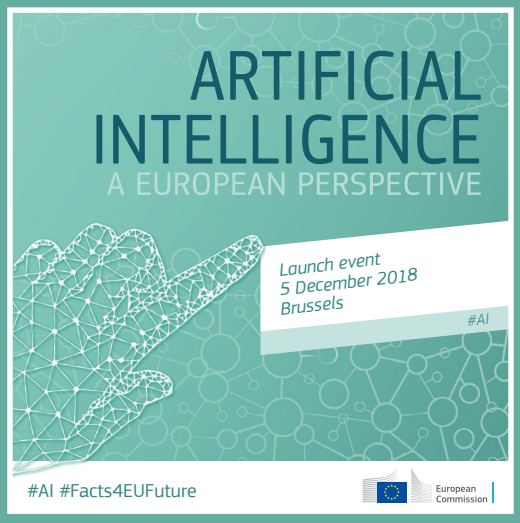
The increased standing of JRC in the field of knowledge management for policy also materialised into an increasing capacity to deliver training and capacity building, both internal and external to the Commission, by organising summer schools and other learning events (see below).

Last but not least, the JRC has intensively pursued knowledge-dissemination activities to promote citizen engagement towards the EU project, including collaborating with science museums across Europe (see below). The emphasis has been on digital communication, in particular, including social media and virtual reality, which will continue to increase in the coming years.

#Facts4EUFuture: a new generation of JRC reports

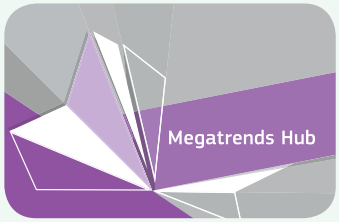
In 2018, work progressed steadily to enrich the collection of next-generation JRC reports, also dubbed #Facts4EUFuture reports. Inaugurated in 2017, the series is intended to bring salient points in a concise and easy-to-grasp way, with new titles presenting state-of-the-art scientific knowledge in response to high-priority political topics for the EU institutions, including, to name just a few, the future of transport and mobility, blockchain technologies, cybersecurity and the future of cities.

Of this new 'wave' of reports, Artificial Intelligence: A European Perspective was launched in December. It presents a European view of artificial intelligence (AI) based on independent research and analysis by the JRC to inform the debate at the European level ***[see page 46]***.



Important achievements in 2018

Security and space: in June and October 2018, the JRC coordinated two workshops on space security and security for space. The JRC plays a pivotal role in gathering together EU space policy stakeholders and in linking their input on operational requirements to the development of R&D programmes, assisting and in partnership with GROW to shape the future work programmes.

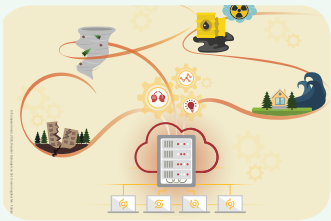


As part of the project 'Behavioural Insights for Agricultural Policy', the JRC EU Policy Lab conducted focus groups with EU farmers in order to understand their perceptions and needs associated with the common agricultural policy (CAP). More precisely, the focus was on agri-environmental policies designed to incentivise farmers to adopt more sustainable practices. The results of these focus groups were included as an annex to the Impact Assessment of the reform of the CAP (SWD(2018) 301 final).

Two new knowledge centres (for food fraud and quality and on global food and nutrition security) and two new competence centres (on foresight and on technology transfer) were launched ***[see pages 14-15]***.

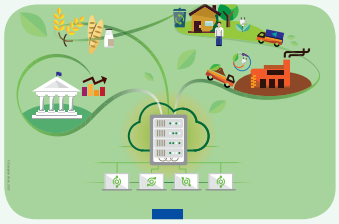
The Evidence and Policy Summer School in Laxenburg, Austria, was co-organised on 5-7 September by the JRC, the International Institute for Applied Systems Analysis (IIASA), the International Network for Government Science Advice (INGSA) and the Global Young Academy (GYA). It was held under the auspices of the Austrian Presidency of the Council of the European Union, bringing together 75 researchers and policymakers from 40 different countries. This year's focus was on science, policy and demography with an emphasis on migration.

The JRC supported the Commission in the negotiations on the energy union governance regulation, the key instrument for monitoring the implementation and further development of the energy union across its five dimensions. It also provided guidance regarding the section on Research, Innovation and Competitiveness Dimension, which paves the way for the future assessment of Member States' national energy and climate plans. In this context, during the European Sustainable Energy Week in June, the JRC successfully piloted an innovative session on storytelling in the energy domain, which will be further developed into a masterclass for scientists working at the science/policy interface.



The Disaster Risk Management Knowledge Centre (DRMKC) collaborated with CONRIS (Cooperation Network for Risk, Safety and Security Studies) to develop a one-week training course based on last year's disaster risk management flagship report. The course was developed to train Bachelor and Master students who want to work in disaster management, emergency planning, humanitarian assistance and community resilience. In 2018, it was delivered both at Saxion University (Enschede, the Netherlands), as a compulsory part of the safety and security management curriculum, and at Coventry University (UK).

On 27 November 2018, in Brussels, JRC scientists and researchers from across Europe presented the final results of the JRC Data for Integration challenge (D4I). This includes maps showing the extent to which migration is not just limited to big cities, with rural areas and small towns becoming increasingly characterised by high levels of social and cultural diversity. Through the challenge, the JRC opened a unique European migration dataset to researchers, with detailed maps covering 45 000 local administrations down to the level of streets and neighbourhoods.



The Knowledge Centre for Bioeconomy (KCB) launched its Commission-wide community of practice, and released a new web-based interactive map and dashboards of policy developments in different countries, based on survey research undertaken in collaboration with the Bio-Based Industries Joint Undertaking (BBI JU) and the International Energy Agency (IEA) Bioenergy. It also published a series of briefs that provide a concise summary of scientific evidence in response to specific policy-relevant questions.

The ARTEFACTS exhibition is collaboration between the Berlin Museum für Naturkunde, the photographer J. Henry Fair and the JRC. The exhibition, which opened its doors in Berlin on 9 October, explores new ways of communicating science and illustrates how science and politics work together to find solutions for urgent environmental issues of our time, by focusing on the themes of food, energy, water, air and climate. The project also encompasses a digital version of the exhibition and a virtual reality experience.

The sixth edition of the Future-oriented Technology Analysis (FTA) international conference, organised by the JRC on 4-5 June 2018 in Brussels brought together over 400 practitioners, academics and policymakers interested in how to reflect future emerging issues in policy design. The participants explored today's key challenges in policymaking, such as increased complexity and lack of trust in policymakers; the proliferation of actors and new channels of involvement and influence; and how the speed of change requires not only rapid reaction by policymakers but also the creation of new meaning and sense. The Competence Centre on Foresight was launched.

The Big Data for Migration Alliance (BD4M) was launched in May 2018 to harness the potential of big data for migration, steered by the Knowledge Centre on Migration and Demography (KCMD) and the International Organization for Migration's Global Migration Data Analysis Centre (IOM/GMDAC). The BD4M is part of the work undertaken by the KCMD to improve data on migration, a key priority of the 2016 New York Declaration and the Global Compact for Migration, and essential for migration governance, as foreseen in Agenda 2030, in particular Sustainable Development Goal (SDG) 10.7.

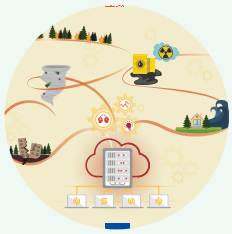
In September 2018, the Knowledge Centre on Migration and Demography launched the 'International Migration Drivers – a quantitative assessment of the structural factors shaping migration'. The report, including a dashboard and infographics, was presented in Brussels to a diverse audience of about 90-100 people. It considers both the structural characteristics of countries of origin and destination of migrants and the individual characteristics of people considering or preparing to migrate. The work contributes to formulating better-informed migration scenarios for the future.

Knowledge and competence centres

Integral parts of the knowledge management activities are the knowledge centres and competence centres. These virtual entities are designed to bring together experts, stakeholders and knowledge from inside and outside the European Commission. Knowledge centres are built around topics, while competence centres focus on analytical tools. Together, they inform policymakers, stakeholders and interested citizens about the latest scientific findings relevant for the policy problems at hand. They provide contextualised evidence, reviews, data analysis and visualisation, communicating in a concise way through infographics, the web and social media. Three years after launching the first of these initiatives, two new knowledge centres and two new competence centres were launched, bringing the total to six of each operated by the JRC.

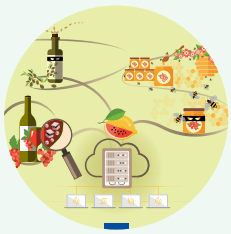
The Knowledge Centre for Territorial Policies (KCTP) gathers, manages and makes sense of the vast amount of knowledge available on European cities and regions to help boost their competitiveness, preserve their diversity, and improve the quality of life of their citizens.

The Knowledge Centre on Migration and Demography (KCMD) provides evidence and knowledge for EU policies related to migration and demography. Supporting the European Agenda on Migration, the focus is on analysing comprehensively and systematically developments on a global scale and their societal impact on the EU in the medium to longer term.



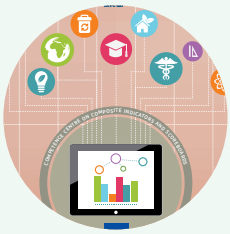
The Knowledge Centre for Disaster Risk Management (DRMKC) provides better knowledge, stronger evidence and a greater focus on transformative processes and innovation to improve our understanding of disaster risk, to build resilience and risk-informed approaches to policymaking, and to contribute to smart, sustainable and inclusive growth.

The Knowledge Centre for Bioeconomy (KCB) collects, structures and makes accessible data and information on the bioeconomy from different sources, pulling together the knowledge and expertise needed to assess the status, progress and impact of the bioeconomy.



The Knowledge Centre for Food Fraud and Quality (KC-FFQ) aims to create a formalised science/policy interface to support initiatives for safeguarding the quality and authenticity of agri-food products and protecting the integrity of the food chain. It complements the activities of the EU Food Fraud Network.

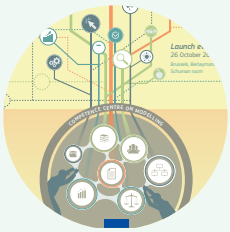
The Knowledge Centre on Global Food and Nutrition Security (KC-FNS) makes the existing information and tools available to EU policymakers and stakeholders, identifies priority topics to foster better knowledge and collaboration around these, and promotes the European Commission's role in generating new knowledge and supporting relevant international initiatives.



The Competence Centre on Composite Indicators and Scoreboards (COIN) develops methodologies to construct robust composite indicators that help policymakers shape policy and monitor progress. COIN is renowned worldwide for its expertise on statistical methodologies and technical guidelines.

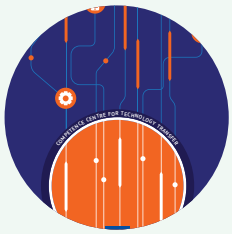
The Competence Centre on Microeconomic Evaluation (CC-ME) helps to enhance the EU policy process through ex-post causal evaluation and impact assessment. It also provides advice on data collection and evaluation design, capacity-building on counterfactual methods, microeconometric analysis and counterfactual impact evaluation

The Competence Centre on Text Mining and Analysis (TMA) addresses policymakers' needs for timely access to relevant information that is often buried in large amounts of textual data. TMA is relevant to virtually all policy areas and the centre provides the skills and expertise required: computational linguistic research, applied IT and support.



The Competence Centre on Modelling (CC-MOD) leverages modelling capacity and competences across the Commission and beyond. Starting with a Commission-wide modelling inventory, it supports the proper documentation, use and reuse of models, further helps in identifying common approaches to quality and transparency of model use, and establishes a community of practice on modelling

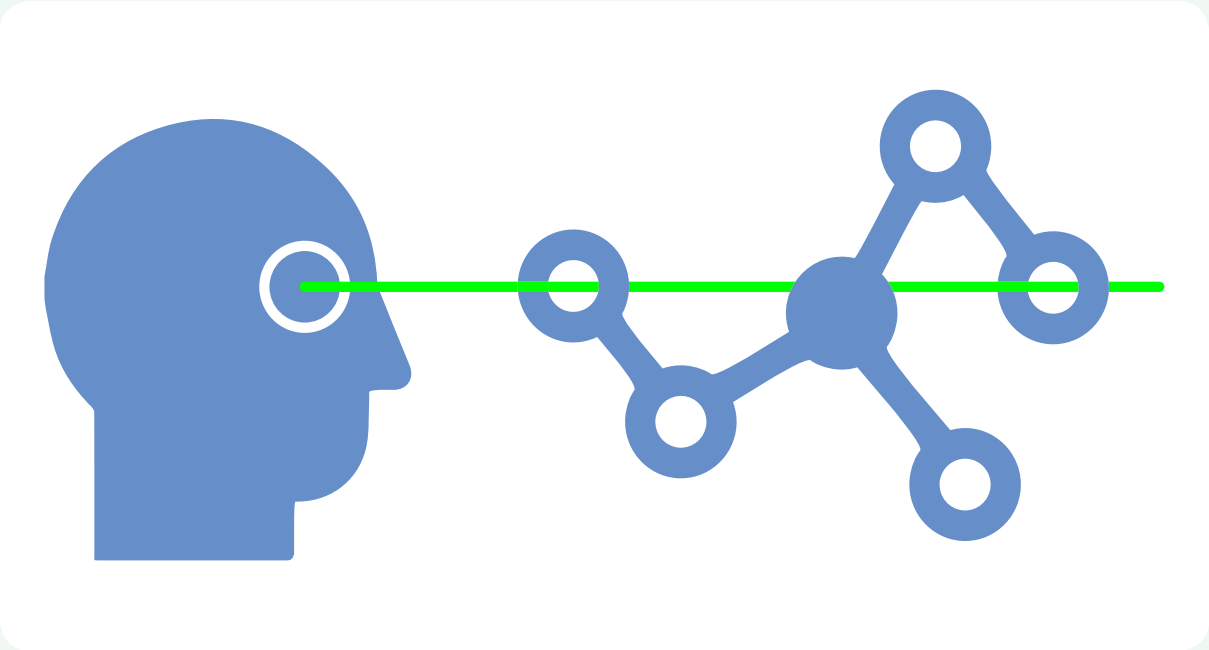
The Competence Centre on Foresight (CC-Foresight) provides direct strategic and future-oriented input into EU policymaking, boosts the uptake of foresight and forward-looking approaches, and continuously advances in-house foresight capacity, methods and tools to make it more practical for decision-making processes. One of its prominent outputs is the Megatrends Hub, a dynamic collective intelligence system assessing a set of 14 global megatrends relevant for the future of Europe.



The Competence Centre on Technology Transfer (CC-TT) complements other JRC activities in the broader domain of support to innovation policies and makes available operational experience and understanding of the technology transfer process – for example, for the practical implementation of smart specialisation strategies and for a deeper understanding of the role of technology transfer in innovation ecosystems.

ANTICIPATING FUTURE TRENDS AND SOCIETAL TRANSFORMATIONS

The JRC relies on foresight to increase anticipatory thinking capabilities for strategic planning and policymaking. Foresight helps us to identify and understand the dynamics of emerging issues and assess the arising challenges, opportunities and potential implications for future decision-making.



Foresight studies explore changes that may affect research and EU policies within a horizon of 5 to 30 years. They combine qualitative and quantitative methods and techniques such as scenario building, horizon scanning, trend analysis, vision building, Delphi studies, etc. They are highly participatory, engaging experts from different backgrounds as well as stakeholders from the European Commission's policy Directorates-General, industry, research organisations, universities and NGOs.

In 2018, the JRC published its first foresight study on blockchain and other distributed ledger technologies (DLT) for industrial/non-financial sectors. Combining foresight with empirical science and technology studies and speculative design, the study highlighted a number of opportunities and challenges ***[see page 48]***. In 2019, the JRC will focus on DLT for social and public good, in particular how governments, civil society or other public-sector organisations can potentially transform the way they operate and deliver their services to and with citizens and businesses through the implementation of such technologies.

Another highlight of the year is the foresight study on the future of migration in the EU. Migration is increasingly a divisive topic in the EU and around the world. To enable a more balanced and less polarised debate, the study engaged stakeholders to explore and reflect upon the needs of EU policymaking and European responses around future migration challenges and opportunities. The final report was accompanied by a migration discussion toolkit comprising interactive tools and processes to guide strategic, future-oriented discussions on migration. A prominent part of the tool kit is a migration version of the JRC's Scenario Exploration System – a serious game used to explore various future scenarios and the opportunities and constraints faced by different groups of stakeholders.

Exploratory research

The aim of the JRC Exploratory Research (ER) programme is to enable the JRC's scientific and technical staff to pursue ambitious research of an exploratory nature in order to build new scientific competences for future policy demands.

In 2018, the revised ER programme became fully operational for both the project tier – focusing on the topics to be explored in projects lasting up to two years – and for the activity tier – focusing on smaller self-contained studies and activities. Five ER workshops were organised on challenging topics: poverty and inequalities in the water-energy-food-ecosystems nexus; energy sustainability in the transition to renewables; near-space high-altitude drones; evidence-based fisheries management; and safe Li-ion batteries. In addition, three (expert) studies were carried out to assess the emergency preparedness and response to floods; to collect satellite-guided crop phenology data; and to assess the functional time-series dynamic of income distributions.

The completed ER projects (from previous calls in 2014 and 2015) produced significant scientific output of interest to both the scientific community and to the policy DGs. One registered a patent (E4iBuildin) in the innovative and sustainable building sector, while the ART ER project laid the foundations for JRC Ispra to become a test lab for automated driving.

Centre for Advanced Studies

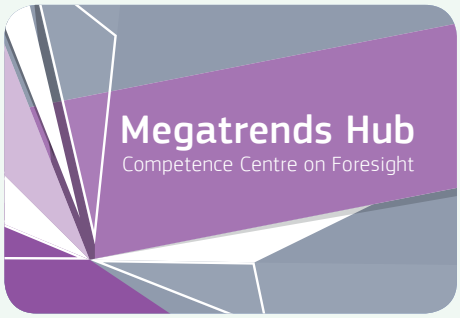
By exploring topics and emerging challenges in the fields of developing technologies and advanced analysis, the Centre for Advanced Studies (CAS) seeks to ensure that the JRC effectively supports those Commission services addressing upcoming challenges. In 2018, relevant CAS projects developments included the following:

The Centre of Expertise on Population and Migration (CEPAM) collaborated closely with the Knowledge Centre for Migration and Demography (KCMD) and contributed projections on a wide range of migration-related themes and issues to its data hub, covering the fiscal impact of migration, linguistic integration and residential segregation. A major outcome of the project was the report on Demographic and Human Capital Scenarios for the 21st Century launched in April.

The CAS project on 'Big data and forecasting of economic developments' was initiated with the aim of harvesting and using big data to improve our understanding of economic events and in particular the accuracy of short-term economic forecasts.

The Human behaviour and machine intelligence (HUMAINT) project is an interdisciplinary project exploring the impact of AI on human behaviour, especially cognitive and socio-emotional capabilities and decision-making. Research topics cover the fairness of algorithm-supported decision-making, child-robot interaction, and music. The HUMAINT project published its first report in 2018.

The DIGITRANSCOPE projects aim to build a network of experts interested in the governance of digitally transformed human societies. The knowledge they create, collect and curate will help policymakers to meet the challenges Europe will face in the coming decades. The network took part in an international event in Amsterdam involving 500 children to virtually design the future of their neighbourhood.



Horizon scanning and Megatrends Hub

The Horizon Scanning and the Megatrends Hub are major pillars of JRC's anticipatory work. Through a structured, systemic and systematic process, they help identify and monitor emerging issues and weak signals of change and events that might have significant future implications for the EU but are not yet on the policy radar or being adequately addressed (early warning).

Horizon Scanning is an internal JRC process based on the collaboration of experts from several JRC domains (Directorates). The identification of interesting news items is followed by a review in thematic and/or cross-disciplinary sense-making sessions for detecting potential 'weak signals and emerging issues', the prospective relevance of which is then further assessed together with their possible policy implications. Horizon Scanning is also the main source for updating the Megatrends Hub.

The Megatrends Hub is a dynamic collective intelligence system assessing a set of 14 global megatrends – long-term driving forces which are already being observed and are most likely to have significant influence on the future. It offers a framework for better understanding the factors of change and their interplay and potential effect on society and policymaking. The structure of the Megatrends Hub provides concise up-to-date information, bringing together qualitative and quantitative views from authoritative and validated sources. Each megatrend features current developments and forecasts, indicators, potential implications, as well as references for further information. The 14 megatrends, ranging from environmental trends to geopolitical and social ones, are global but are explored and analysed from a European perspective.

COLLABORATING WITH NATIONAL AND INTERNATIONAL PARTNERS

Effective collaboration with the European and international research community is crucial for the JRC. By sharing knowledge, competences and facilities with over 1 000 partners worldwide, the JRC maintains a high level of expertise, informs policymaking with the best scientific evidence and tackles societal challenges.

JRC collaboration with Member States, partner countries and international partners takes many different shapes and forms. In 2018, highlights included assessing the impact of changes to the CAP with France, exploring alternative energy-security scenarios with Estonia, expanding cooperation and capacity building with South Africa, reinforcing JRC contributions to United Nations initiatives, engaging Western Balkans and South East Europe countries over macro-regional strategies, and deploying innovative nuclear safeguards together with the International Atomic Energy Agency (IAEA) to name but a few.

GDPR explained through gaming in Friuli-Venezia Giulia, Italy

European Regulation (EU) 2016/679 on personal data protection, better known as GDPR (General Data Protection Regulation) entered into force on 25 May 2018. Reading and understanding a regulation can be complicated. Therefore, the JRC developed a mobile game to create awareness among young people on their rights to protect their personal data and the related risks in case of a violation of privacy. The 'CyberChronix' game is a first experience towards employing 'edutainment' tools to raise awareness about data protection and teach young people some of the fundamentals of the GDPR. On 25 May 2018, Friuli-Venezia Giulia and the JRC organised an event bringing together a selected number of parents, teachers and students from 10 schools in the region to kick off the validation of the game. This took place in the context of the collaboration established between the JRC and the region of Friuli-Venezia Giulia in 2017, formalised in a Memorandum of Understanding.

Cooperating with the United Nations (UN)

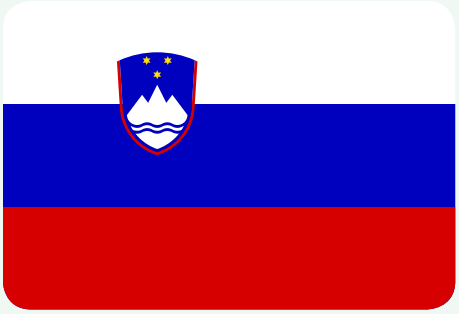
On 20 February 2018, the JRC co-organised an information session with UNESCO at the UN headquarters in New York. The aim was to present the collective contributions of the two organisations regarding the implementation of the SDG on water, as well as other water-related goals and targets. The event was attended by the President of the UN General Assembly (UNGA) and took place in front of an audience of 120 diplomats, UN staff, media and civil society representatives. In his opening statement, Miroslav Lajčák, UNGA President, underlined the need for science to find solutions to the water challenges and to bridge the gap between science and policy. The JRC Director-General reminded the audience that more work and global collaboration is needed to fully understand the interdependencies and trade-offs of water (water-energy-food-ecosystems nexus). JRC also presented the Global Surface Water Explorer, the first-ever global mapping of surface water based on 30 years of satellite data.

Between 7-13 February 2018, the JRC participated in and organised several sessions during the World Urban Forum (WUF9) of the UN-HABITAT, entitled 'CITIES 2030, Cities For All: Implementing the New Urban Agenda' which took place in Kuala Lumpur, Malaysia. The JRC was represented in two high-level sessions: one on open and big data, which discussed the tools and methodologies related to the development and use of data and information for effective monitoring and reporting on SDGs and the New Urban Agenda; and a special session on urban data. The JRC also organised two training events: one on 'JRC open data and tools for the New Urban Agenda' and one on 'City energy and climate action plans: how to set targets and develop a plan'. Furthermore, the JRC co-organised three side events: 'Developing a global, people-based definition of cities and settlements: a progress report', 'Analysing the past and exploring the future: the leverage of data and scenario making in the policy process' (together with the Global Parliament of Mayors), and 'Monitoring 40 years of global urban development in all cities of the planet with the open and free Global Human Settlement Layer (GHSL) database'.

On 7-9 May 2018, the JRC contributed to the fourth meeting of the United Nations Statistics Division (UNSD) Meeting of the Expert Group on International Trade and Economic Globalization Statistics, which took place at the Food and Agriculture Organization premises in Rome. In its decision 46/107, the UNSD established this expert group to address the challenges posed by emerging global production arrangements to macroeconomic and business statistics. The challenges include the recording of domestic and cross-border transactions and positions in national accounts and balance of payments statistics, among others. The expert group's main task is to develop a handbook that will detail the measurement of global value chains accounting. The JRC has contributed one chapter in collaboration with Eurostat.

On 10-22 November 2018, the JRC participated in and contributed to the 14th meeting of the Conference of the Parties (COP14) to the Convention on Biological Diversity (CBD) which took place in Sharm El Sheikh, Egypt. It organised and contributed to four side events at the COP14, including bridging Aichi Targets 5, 11 and 15 with the Digital Observatory for Protected Areas and the World Atlas of Desertification, as well as on biodiversity and nature-based solutions, and issues related to a partnership for achieving Aichi Biodiversity Target 11.

Finally, on 9 December 2018, the JRC organised a side event, 'From theory to practice: innovative uses of evidence for forward-looking migration policies', at the Intergovernmental Conference on migration in Marrakech.

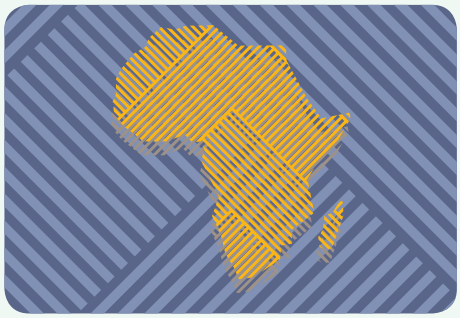


Supporting the implementation of Slovenia's Action Plan on Circular Economy

The JRC partnered with two knowledge and innovation communities (KICs) of the European Institute of Innovation and Technology (EIT), the Climate KIC and the Raw Materials KIC, as well as with the Slovenian ministries in charge of the country's Action Plan on Circular Economy.

This project can be seen an important test for future collaboration between the EIT, the KICs, the JRC and European Structural and Investment Funds (ESIF) communities, including national/regional implementation bodies of Research and Innovation Strategies for Smart Specialisation (RIS3 strategies).

The project stemmed from a joint matchmaking event organised in March 2018 in Ljubljana by the JRC's Stairway to Excellence community and EIT Climate KIC, together with the Managing Authorities of the territories where the RIS partners of the EIT Climate KIC are located. At this event, participants explored collaboration opportunities and identified more than 100 project ideas.



Collaborating with South Africa

On 10 December, the JRC and South Africa's Department of Science and Technology (DST) signed a collaboration arrangement aiming to streamline the cooperation with different South African research organisations and giving impetus to developing further collaboration.

The JRC organised a pan-African capacity-building seminar on Evidence-Informed Policymaking (EIPM) in Pretoria in December. The seminar was organised in collaboration with South Africa's DST and the African Academy of Sciences, UK Research and Innovation and the International Network for Government Science Advice. It brought together 150 of Africa's best scientists and policymakers to train them on how to use evidence for policy, by means of interactive, highly-participatory master classes organised around the topics of water, energy and food security.

Within the 4th Science Forum South Africa (SFSA 2018), the JRC organised a session on 'Smart specialisation, empowering local communities to shape innovation-led socio-economic transformation agendas'. This focused on the inclusive character of smart specialisation, its adaptability to local socio-economic patterns, and its potential to respond to transformational challenges for developed countries as well as for economies in transition and less-developed regions. Within this framework, South Africa's experience of local innovation systems was highlighted, with a view to fostering smart specialisation within the African continent and beyond, taking on an increasingly global perspective and moving across and beyond the traditional geography of development.

In nuclear science the JRC, the University of Pretoria and the Steve Biko Academic Hospital are collaborating on a nuclear medicine project which is using a novel therapy to treat cancer – the targeted alpha therapy (TAT) – with impressive treatment perspectives.

Engaging Estonia on energy security

On 17 April 2018, an 'evidence for policy' event in Tallinn served to discuss latest JRC studies on energy security and their policy impact with Estonian politicians and policymakers. Two sessions were held: one in the morning in collaboration with the Estonian Academy of Sciences, and one in the afternoon with the parliamentary committees. Among the studies presented and discussed were the results of the JRC assessment of alternative scenarios enabling the full integration of the Baltic electricity system within the EU power and energy market. The scenario of synchronisation with the continental European network emerged as the most cost-effective option. This finding, together with other market analyses and studies on infrastructure investment, helped the Baltic States to decide the preferred way of synchronising their electricity grids with the European network which is envisaged for 2025.

Following the Estonian Presidency of the Council of the EU in the second half of 2017, the Ministry of Education and Research of the Republic of Estonia and the JRC signed a Memorandum of Understanding early in 2018 to enhance cooperation with Estonian stakeholders in several fields, energy being one of them.

Socio-economic transformation in coal transition regions – pilot case of Upper Nitra, Slovakia

The decline in coal use and production presents a significant economic and social challenge for a number of regions across the EU. If not carefully planned and managed, the closure of coal mines can result in decades of structural unemployment, social deprivation and a significant burden on public finances. In the context of the Clean Energy for All Europeans package, the European Commission launched the 'Coal Regions in Transition' initiative in autumn 2017 to help the affected regions with their transition to clean energy.

The JRC supported the pilot phase of the initiative with a report on socio-economic transformation in the region of Upper Nitra in Slovakia. Four well-established methodological approaches were applied for the initial analysis of the various economic and social impacts of the mine closure in Upper Nitra and its implications for energy transition and security of the energy supply. It also included a proposal for a possible strategic approach based on smart specialisation and its application on research and innovation strategies in lagging regions. The report served as a basis for discussions between the Commission services and the national authorities about the foreseen phasing-out of coal mining in Slovakia.

Western Balkans, South East Europe and macro-regional strategies

The JRC's activities on Western Balkans, South East Europe and macro-regional strategies are usually interconnected and complementary, especially in the context of the EU Strategy for the Danube Region (EUSDR) and the EU Strategy for the Adriatic-Ionian Region (EUSAIR).

In 2018, the JRC took part in several events related to macro-regional strategies, including the EUSDR 7th Annual Forum in Sofia. The JRC has a long tradition of significant participation in this annual gathering. This year, it took the opportunity to present JRC-developed digital tools of use not only to decision-makers but also to citizens.

Smart-specialisation-related work also intensified in 2018, especially with the most recent EUSAIR and EU Strategy for the Alpine Region (EUSALP). As a side event to the EUSAIR 3rd Annual Forum held in May 2018, a workshop was organised to stimulate the debate on how to promote research and innovation cooperation and support R&I investments at the macro-regional level, focusing on possible synergies between the ESIF and direct thematic funds such as the EU programme for the Competitiveness of Small and Medium-sized Enterprises (SMEs). In the EUSALP framework and in particular within its Action Group 1 on R&I, collaboration activities increased and the JRC has played an important role in pitching smart specialisation as a 'vehicle' for closer R&I cooperation.

Since 2017, the JRC has also been providing methodological support and expertise to the governments of Serbia and Montenegro (EU candidate countries) in the smart specialisation process (S3). In 2018, this support expanded to the remaining four Western Balkan countries. Two training sessions on S3 capacity were organised (Ljubljana in April; Brussels in November) with participants coming from all the Western Balkan countries.

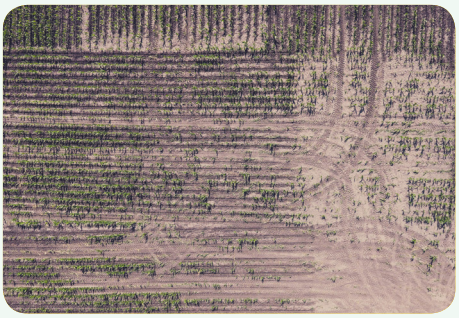
Furthermore, the JRC conducted a pilot initiative to accelerate technology transfer in the Western Balkans region by creating a community of practice and defining the tools to support related office management, and science parks and incubator creation and management; to map and explore the new investment instruments; and to improve access to finance for start-ups and SMEs.

The JRC also published a report on Supporting an Innovation Agenda for the Western Balkans–Tools and Methodologies in preparation for the Smart Specialisation and Technology Transfer as Innovation Drivers for Regional Growth conference held in Sofia in May 2018.

IAMC
Integrated Assessment Modeling Consortium

Supporting the UNFCCC's scenario analyses and strengthening climate collaboration with China

On 13-15 November, the annual Integrated Assessment Modelling Consortium conference took place in Seville and was co-organised by the JRC. More than 200 energy, environmental and climate-policy-scenario analysts shared data, discussed results and analysed expected policy impacts, paving the way to the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (CoP) in Katowice in December. On that occasion, the JRC and the Chinese National Center for Climate Change Strategy and International Cooperation also signed a collaborative research agreement, aiming to mutually reinforce the analytical capabilities and robustness of the jointly conducted policy analyses. Further to this EU-China collaborative effort on climate policy, a joint event took place during the UNFCCC CoP in Katowice, with interventions from the EU Commissioner for Climate Action and Energy, Miguel Arias Cañete and Chinese Climate Change Minister, Xie Zhenhua.



Partnering on agriculture and climate change research with France

In 2018, the JRC and French National Institute for Agricultural Research (INRA) signed a strategic partnership in the research fields of agriculture and climate change. The agreement formalised long-standing scientific cooperation between the two institutions. In the framework of this agreement, five projects have been identified as implementation priorities, which cover the following topics: (1) impact of systemic innovations agriculture; (2) monitoring of the impacts of agricultural systems on environment and ecosystems; (3) development of economic and biophysical models; (4) soil carbon sequestration and GHG emissions reduction; and (5) evaluation of the impact of research on policymaking and society at large.

These projects are addressing issues relevant to the current agricultural policy agenda. In that respect, under project 4, INRA and the JRC are currently exchanging expertise to support the development of the JRC's first EU-wide individual farm-level model (IFM-CAP). The aim of this model is to analyse the impacts of changes in the CAP on EU farms from an economic and environmental perspective. Building upon this partnership and involving other agricultural research institutions, a community of practice in the field of agricultural research is currently being explored which could support policy requirements relevant to the CAP, climate, natural resources and biodiversity. Areas of cooperation that could benefit from such a community of practice will be further assessed in 2019, the second year of implementing the agreement.

Innovating for nuclear safeguard implementation

The European Commission operates as an effective regional nuclear safeguard system (implemented by the Directorate-General for Energy (DG ENER) and maintains a close partnership with the IAEA. In 2018, as in previous years, DG ENER relied heavily on the JRC's scientific and technical expertise to fulfil its safeguard function.

The JRC researches and develops safeguards tools and methods, analyses samples in its nuclear facilities and laboratories, delivers verification and containment technologies, and assists in-field and trains Euratom and IAEA nuclear safeguards inspectors on the nuclear safeguard measurement methods and the use of advanced and specialised equipment.

The JRC has developed and deployed an innovative nuclear safeguard approach by combining more than 10 different measurements, identification and surveillance methods within a smart and user-friendly analysis interface. This new system provides an efficient and effective means of safeguards for EU inspectors while also benefiting the nuclear facility operator. Applied for safeguarding the transfer and storage of plutonium in a major EU facility, the new safeguards approach allows for reliable remote monitoring, saving resources and time-consuming operations for both inspectors and the facility operator.

A similar win-win approach, enabling the strengthening of EU safeguards and the nuclear facility, was developed and deployed by the JRC in a gas centrifuge uranium enrichment plant in France. It is envisaged the same concept will be used in addressing future EU safeguard challenges both for the long-term interim dry storage of spent nuclear fuel and the encapsulation of spent nuclear fuel before final disposal.

REACHING OUT TO STAKEHOLDERS AND CITIZENS AT LARGE

The JRC strives for scientific excellence, an important element of which relies on our ability to share knowledge and information with our partners and the broader outside world. As a multidisciplinary organisation, the JRC works with a large variety of stakeholders: policymakers at all levels of government, from international to local, as well as scientists and academics from private and public organisations alike. It also engages in outreach activities towards the public, which go well beyond the legitimate need of any organisation to raise its profile vis-à-vis its stakeholders. One of the JRC's key roles is to engage and share knowledge and expertise with the widest possible audience.

In 2018, activities that contributed to these core aspects of the JRC's mission included targeted initiatives such as open access to JRC research infrastructures, collaborative doctoral partnerships, the Science meets Parliaments/Science meets Regions pilot project, engaging with the European Council and European Parliament, and the JRC Alumni network.

As in previous years, events, media outreach, publications, online presence and social media interaction played their role.

Open access to JRC research infrastructures

The open access to JRC research infrastructures initiative was launched in 2017 to allow, under certain conditions, the research community, public authorities and industry in EU Member States, candidate countries and H2020-associated countries to make use of its unique facilities.

The initiative is part of the JRC's strategy to enhance scientific knowledge dissemination, boost competiveness, bridge the research-industry gap and provide training and capacity building. Relevance-driven access is mainly granted in areas relevant to the JRC's strategic priorities and of importance for European standardisation, integration and cohesion, sustainable growth and competitiveness. It is based on a peer-review selection process following calls for proposals.

Market-driven access is granted upon payment of a fee covering the full access costs of the JRC, and it is mainly targeted at industry. Projects are selected on the basis of their strategic importance for the EU.

In 2018, the JRC offered access on a pilot basis to 12 research infrastructures: the nanobiotechnology laboratory, the Reaction Wall and the Hopkinson Bar Facility of the European Laboratory for Structural Assessment (ELSA) in Ispra; three energy storage laboratories in Petten; four for nuclear reaction and decay data measurements in Geel, and two on actinides for safe and secure operation of nuclear applications in Karlsruhe. Overall, a total of 69 eligible proposals were received, 58 have been accepted, 15 have signed agreements with the JRC, and 6 have been completed. The pilot will gradually be extended to include another 25 facilities.

Institutions from 24 countries have answered the 14 calls for proposals from 9 different research infrastructures. Four calls remain open for the ELSA HopLab and the energy storage facilities. The accepted proposals total 87 user institutions and 199 users which have or will have access to JRC research infrastructures. Of these, three user Institutions are from industry and SMEs.

Collaborative doctoral partnerships

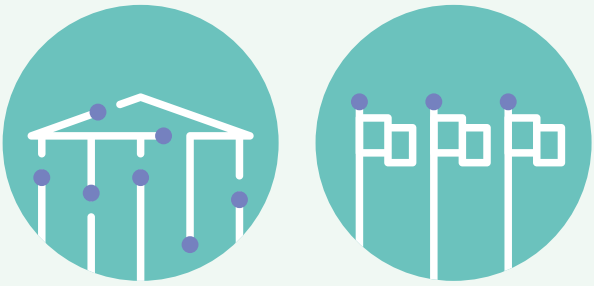
At the end of 2016, the JRC launched a new CDP scheme in cooperation with universities from the EU Member States and H2020-associated countries. The scheme offers opportunities to a new generation of doctoral students, with particular focus on research for policymaking.

Through the CDP, the JRC seeks to establish strategic collaborations with universities that have an international reputation in science and technology and provide doctoral studies. Students will be able to work at the science-policy interface, gain an understanding of research needs at different stages of the policy cycle, and learn how to communicate science more effectively.

The partnerships should also lead to strengthened collaboration between the JRC and universities by promoting mutual enhancement of related skills and competences, combining knowledge, capacities, and networking in key scientific areas.

In the project's pilot phase, six thematic areas were identified: energy and transport modelling, soil and land-use change, bio-economy and forests, machine learning, genomics and bioinformatics, and nuclear decommissioning and waste management.

In 2018, the first collaboration agreements were signed with the University of Ljubljana, University College Dublin and KU Leuven, covering the fields of soil and land-use change, the bio-economy and forests, machine learning, and genomics and bio-informatics, and the first students were selected.



Pilot Project: Science meets Parliaments Science meets Regions

In 2015, the JRC and the European Parliament's Science and Technology Options Assessment (STOA) panel launched 'Science meets Parliaments', which has since become an annual event organised in the European Parliament. The objective of this initiative was to build closer links between scientists and EU policymakers in order to promote a culture of evidence-informed policymaking.

However, policymaking also takes place outside the Brussels bubble, and the regional and local dimension is vital. For this reason, 'Science meets Regions' was launched in 2016, in close collaboration with the Committee of the Regions.

After a number of pilots (Karlsruhe, Hessen, Trieste, Bratislava, Sofia and Espoo), more countries and regions joined the scheme in 2017. A final high-level event concluded this initial phase.

The initiative was so successful that the European Parliament decided to finance a pilot project 'Science meets Parliaments/ Science meets Regions', which was approved at the end of 2017. The project, which expands the previous ad-hoc initiatives across the whole of the EU and creates a systematic framework for them, comprises three main lines of action:

1. Organising events in EU Member States, under the full ownership of the concerned authorities and focusing on a topic relevant to the regional/national level;

2. Conducting scientific studies to support these events and their follow-up; and

3. Raising awareness about the science-policy nexus (by developing an educational package and training courses for policymakers).

National, regional and local authorities will be able to participate using a flexible framework. The local and international scientific community will be strongly represented and, last but not least, businesses and civil society will also be involved in many cases.

In the course of 2018, the preparatory actions were set up (starting from a large-scale call for expression of interest), and 23 events spanning the EU were selected, the first of which was held in December 2018. The formal launch was scheduled to take place during the flagship event at the European Parliament in February 2019.

Engaging with the Council and European Parliament

In an effort to put science and evidence at the heart of EU policymaking, the JRC has been stepping up its cooperation with the European Parliament and the European Council.

A high point in JRC-Council collaboration came at the Agriculture and Fisheries Council on 16 July where Director-General Šucha gave a presentation on technology for the simplification and modernisation of the common agricultural policy. A two-day conference in Sofia on 'Smart specialisation and technology transfer as innovation drivers for regional growth' was another highlight of the year. In 2018, the Director-General also met individually with the ministers responsible for science and research in Bulgaria, Austria and Romania, and participated in two informal working breakfasts where he laid out the JRC's work and vision for space applications for the role of policy and scientific competences in measuring policy impact. Important JRC input was also provided at several working group meetings under the Bulgarian and Austrian presidencies, addressing a wide range of research topics including desertification, hybrid threats and consumer protection, to name but a few. The Council working party on technical harmonisation and the working party on foodstuffs also carried out site visits in Ispra and Geel, respectively. Working ever more closely with Member States plays an important part in shaping up Horizon Europe, the next EU Framework Programme for Research and Innovation.

In terms of relations with the European Parliament, 2018 was also a busy year. In September, the Committee on Industry, Research and Energy visited the JRC's Ispra facilities and attended presentations ranging from cybersecurity to resilience and territorial development. In October, MEPs from the Committee on Employment and Social Affairs were introduced to the JRC's work on fairness, the social scoreboard and the future of work, among other issues. Throughout the year, JRC representatives gave six presentations during official European Parliament committee hearings and delivered numerous expert presentations and informal events, thereby informing political discussions and promoting the role of evidenced-based policymaking. It also organised the exhibition 'Putting science at the heart of European policymaking' in the European Parliament in Strasbourg, which provided a further opportunity to create closer links between scientists and politicians and to highlight the European Commission's state-of-the art science.

JRC Alumni Network

In 2018, the JRC Alumni Network grew from 323 registered members to 435, showing a continuing trend throughout the year.

In February, the first annual JRC Alumni Network Event brought 38 participants to Brussels from 14 countries and laid the foundations for 2018 activities, mainly through a dedicated workshop on 'How to make the Alumni Network more attractive' and the subsequent discussions in the Alumni Advisory Group (AAG).

Responding to a request from the JRC Alumni, the secretariat invested time and effort in dedicated activities such as promoting the network on social media channels and constantly improving the JRC Alumni Network's website. Exclusive activities for JRC-Alumni were also negotiated in relevant scientific events and conferences while interested Alumni were given tailored information focusing on their professional development and networking opportunities.

Another activity, which had a very positive response, was the creation of regional subgroups within the Network. The idea is to foster reconnection and networking among the JRC Alumni community in their regions. To further develop this in 2019, regional pre-meetings will be arranged (on demand) back-to-back with the 2019 edition of the annual JRC Alumni Network Event held on 5 February 2019, in Brussels.

Communication activities

The JRC's communication activities help the organisation to achieve its goals and to position it as the European Commission's science and knowledge service. Events, media outreach, social media interaction and publications all contribute to increasing the JRC's visibility and boosting its reputation with stakeholders.

Publications

*A total of **2348** publications have been produced:*

915
Books and articles in peer reviewed journals*

1424
Scientific, policy and technical reports

9
PhD Theses

* Books, monographs with JRC editorship, article contribution to a monograph, article contribution to peer-reviewed periodicals listed in the ISI Science Citation Index Expanded and/or Social Science Citation index, article contribution to other periodicals.

Events

179 events, including 70 "high level" events

Nearly **8500** participants mobilised in total

Media

132 JRC web news pieces published

Over **3300** articles mentioning the JRC

Nearly **2200** JRC newsletter subscribers

Social media

In 2018, the JRC has achieved:

Over **9.21 million** impressions and 36.65K engagements on Twitter

Over **4.33 million** impressions and 10.54K engagements on Facebook

Over **2.66 million** impressions and 12.09K engagements on LinkedIn

91k views and 483 interactions on YouTube

Web

Over **2 million** visits from nearly 1.6 million unique visitors

Nearly **4 million** page views, including over 3.1 million unique page views

AN ENGAGED AND COLLABORATIVE BOARD OF GOVERNORS

The JRC Board of Governors advises the Director-General and the Commission on the strategic role of the JRC and its scientific, technical and financial management. Its members and participants bring a wealth of experience from their respective countries. As high-level representatives at the science-policy interface, former ministers and high-ranking civil servants, and eminent academics from renowned universities, the Board members closely engage in the JRC's activities. Receiving regular briefings from the Director-General, they, in turn, give advice and inform JRC management about relevant national developments.

Where justified, dedicated ad-hoc working groups are created for more in-depth scrutiny and a better understanding by the Board as a whole. In 2018, three such groups were active: on the Implementation of the JRC Strategy 2030, on the JRC Work Programme 2018-2019, and on Horizon Europe.

The Board of Governors met on three occasions in 2018. Here is a brief recap of the discussions in each of these meetings.

114th meeting in Seville (8-9 March)

The Board had the chance to hear about and discuss work done by the JRC's Directorate for Growth and Innovation, such as its contributions to the European Semester, the Global Energy and Climate Outlook, digital transformation and AI, and relations with industry, including industrial emissions, oil-refining fitness check, and the circular economy. The Ad Hoc Group on the Implementation of the JRC Strategy 2030 reported its latest conclusions to the Board. The Board established an Ad Hoc Group on Horizon Europe to advise and support the JRC on its position in the future programme and during the ongoing negotiations.

115th meeting in Petten (14-15 June)

The Board discussed the JRC's position in the Ninth Framework Programme (FP9) proposal, following a report from the Ad Hoc Group on Horizon Europe. It discussed the recommendations from the JRC's Critical Friends Group and exchanged views on the Knowledge Centre for Food Fraud & Quality, the external communication strategy, the opening of research infrastructures, and the JRC's work in the field of energy, including contributions to the Covenant of Mayors, energy security activities, and energy storage and sector coupling. Board members visited the JRC laboratories, including the House of the Future – where homes, grids and mobility interoperability come together, battery safety, bunker and fuel cells hydrogen storage safety, fuel cell performance and nuclear material behaviour studies. Board members and participants also met with scientists at poster exhibitions and demonstrations on the JRC's Exploratory Research Projects and the 10-year anniversary of the SET-Plan.

116th meeting in Ispra (15-16 November)

The Board discussed the JRC's activities in foresight, AI, the future of education and work, and citizen engagement. It endorsed a report from the Ad Hoc Group on Horizon Europe on progress in the FP9 negotiations, approved the JRC's Work Programme 2019-2020 following the recommendation from the Ad Hoc Group, and endorsed its foreword to the present Annual Report 2018. During the meeting, the Board interacted with young Austrian scientists during a poster session and was shown a series of posters with examples of the JRC's services and support to Member States. It then met JRC scientists involved in exploratory research projects, cybersecurity research, vehicle emissions, the artefacts exhibition and virtual reality experience, and food quality and food fraud. Board members and participants also had the opportunity to visit the Essor reactor to discuss the JRC's work in nuclear decommissioning.

SCIENCE FOR POLICY HIGHLIGHTS

More often than not, the JRC's knowledge-production and management work is carried out in a collaborative, multidisciplinary approach. This inclusive approach imposes itself as policies – which the JRC must contribute evidence to – that are growing ever-more complex and intertwined. It also responds to the high-level political priorities that have been driving the European Commission's actions throughout President Juncker's term in office. The following chapters provide a series of examples of what the JRC has achieved in 2018 through the prism of the so-called Juncker priorities.

A new boost for jobs, growth and investment

Collective and coordinated efforts at European level continue to be required to put Europe on the path to renewed economic prosperity. As the first of the 10 Juncker priorities, Commission work in this area covers a variety of policies, a number of which the JRC contributed to in 2018.

Informing the correlation between external trade and employment, ensuring EU leadership on technologies critical to e-mobility, ensuring the sustainable growth of the EU Blue Economy, promoting swifter innovation-to-market translation, preventing land degradation and the loss of vital soil services, and supporting European cultural heritage are just a few examples of Commission activities which the JRC backed with its expertise in 2018.

EU EXPORTS TO THE WORLD SUPPORT 36 MILLION JOBS ACROSS EUROPE

The JRC and the Commission's Directorate-General for Trade have collaborated to produce two studies on the impact of external trade on employment and income, respectively.

As a follow-up to the first edition in 2015, the 2018 edition of EU Exports to the World: Effects on Employment features a series of indicators to illustrate in detail the relationship between trade and jobs for the EU as a whole and for each EU Member State, using the new World Input-Output Database for the year 2016 as its main data source.

Among many interesting findings, the study established that EU exports to the world support 36 million jobs across Europe, two thirds more than in the year 2000; and 14 million of these jobs are held by women. In addition, EU exports to the world generate EUR 2.3 trillion of value added in the EU.

Since the beginning of this Commission in 2014, the number of jobs supported by exports has increased by 3.5 million. Exports also create and support jobs across the EU, and the numbers are rising. Since 2000, the biggest increases have been seen in Bulgaria (+312 %), Slovakia (+213 %), Portugal (+172 %), Lithuania (+153 %), Ireland (+147 %), Estonia (+147 %) and Latvia (+138 %).

These figures highlight an important positive spillover effect from exports to the world. When EU exporters in one Member State do well, workers in other Member States also benefit. This is because firms providing goods and services along the supply chain also gain when their end-customer sells the final product abroad. For example, French exports to the rest of the world support around 627 000 jobs in other EU Member States.

Finally, EU exports to countries around the world support almost 20 million jobs outside the EU. These jobs have more than doubled since 2000. For instance, more than 1 million jobs in the United States are supported by the production of

US goods and services that are incorporated into EU exports through global supply chains.

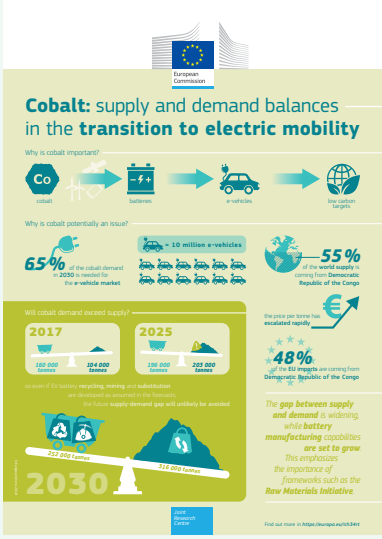
An interactive map featuring 28 country factsheets and 1 EU factsheet complemented the publication of the study.

ENSURING EU LEADERSHIP IN BATTERY INNOVATION AND MANUFACTURING

In the years to come, the competitiveness of the EU automotive sector will increasingly depend on a strong independent capacity to develop and produce batteries. In 2017, The European Commission launched the European Battery Alliance to establish competitive, innovative and sustainable battery manufacturing in Europe. The JRC is contributing to various dimensions of this initiative.

In preparation for the eco-design regulation that will set performance and sustainability criteria for the EU market, the JRC assessed standardisation gaps in the performance, degradation and lifetime of electric vehicle batteries. It also proposed measuring and testing methods to evaluate the compliance of electric vehicle batteries with eco-design requirements.

The long-term reliability of batteries is another essential aspect for both product developers and users. In the frame of its Exploratory Research programme, the JRC identified thermal propagation (a defective battery cell spreads fire throughout an entire pack and its surroundings) as a key challenge for safer Li-ion battery systems. Further pre-normative research is needed to develop testing methods and standards as



well as faster and more accurate early-detection tools. This is important, as Li-Ion batteries are in high demand in the automotive industry, as well as in many other applications.

Using Li-Ion batteries as one of the key solutions to power mobility raises concerns as regards the availability of raw materials, such as cobalt, for their production. In a recent report, the JRC anticipated a demand-supply gap as early as 2020 and pointed to a fragile global supply chain (more than half of the worldwide supply is mined in the Republic of the Congo and half of the refined cobalt worldwide is produced in China) leading to rising prices in the mid-to-long term. A set of measures has been proposed, including promoting cobalt extraction and attracting private investment, consolidating trade agreements with other cobalt producers, encouraging cobalt recycling, and assessing potential substitutes for cobalt (e.g. nickel).

HELPING TO KEEP MARINE POLLUTION AT BAY

In its 2018 Annual Economic Report on EU Blue Economy, the JRC presented the current status, recent trends and opportunities in economic activities related to oceans, seas and coastal areas. With a turnover of EUR 566 billion, the sector generates EUR 174 billion of value added and creates jobs for nearly 3.5 million people. In several EU Member States, the Blue Economy has grown faster than the national economy in the last decade and proved more resilient in riding the financial crisis wave, thereby softening the effects of the downturn on coastal economies.

However, the marine environment's ecosystem services and economic opportunities should not be taken for granted. There are many threats to water quality and biodiversity. Among other instruments, the EU's Marine Strategy Framework Directive requires Member States to address these and take action. In 2018, the JRC helped the Commission to propose new legislation and Member States and others to meet their obligations.

The JRC compiled a single reference list of contaminants to support the harmonised assessment and identification of substances deserving particular attention. The list features priority, regulated substances and 'emerging pollutants', i.e. substances that are still largely unregulated and the damage potential of which is real yet poorly understood. The prominence of emerging pollutants on the list highlights the importance of work to understand their environmental occurrence and potential

effects, agreement on the most significant substances and their incorporation into future regulation, as necessary.

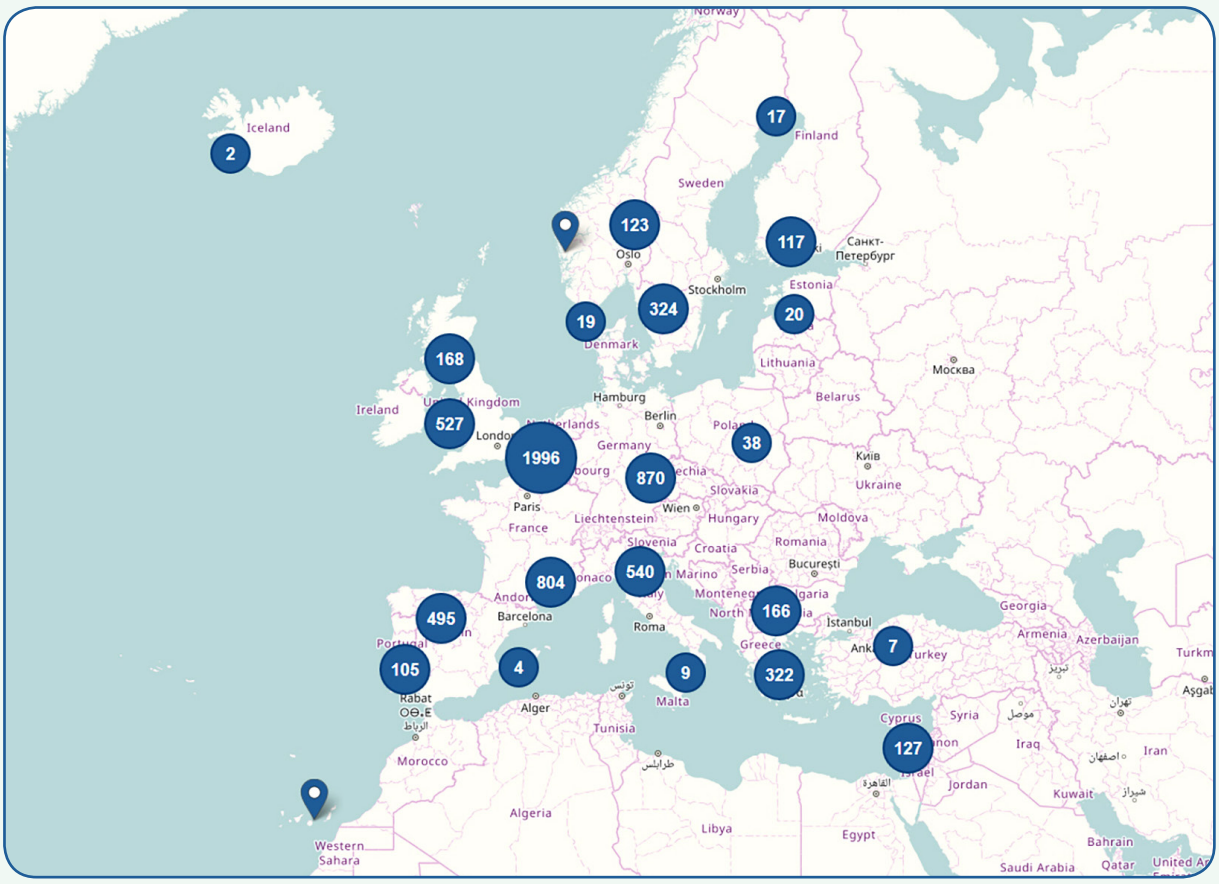
JRC scientists also produced the first EU-wide analysis on the most frequently occurring beach litter. Plastic bottle caps and cigarette butts as well as crisp packets, sweet wrappers, string, fragments of plastic objects and cotton buds are among the top 10 most frequently found items which account for nearly 70 % of the total rubbish found on European beaches. These findings fed directly into the Commission proposal for new EU rules on single-use plastics presented in May 2018.

MATCH-MAKING FOR FASTER INNOVATION TO MARKET

In April 2018, the European Commission launched the Innovation Radar – a data-driven online tool to help match innovators with those who can help get their innovations to market.

According to the Innovation Radar, EU-funded R&I projects yield an average of two innovations. Exploiting the full potential of those innovations requires further nurturing as projects typically focus more on technology than on commercialisation and deployment. The main stumbling blocks for innovators exploiting their ideas are financing, intellectual property and regulation. At the same time, innovators in EU-funded projects need support in partnering with other companies, expansion to new markets and business plan development.

Matching European innovations with entrepreneurs to exploit their full potential is fundamentally a data challenge. The JRC offered its big data and knowledge management expertise to create the Innovation Radar in view of increasing



The Innovation Radar platform maps EU-funded innovations and innovators.

the return on EU investment in R&I, and making it more transparent and accountable.

With its real-time data-collection and intuitive interface, the Innovation Radar enables the identification of high-potential innovations and the innovators behind them in EU-funded R&I projects. In essence, it is a policy tool for innovation management and commercialisation, designed to connect innovators in EU research, development and innovation projects and external stakeholders, such as investors, technology scouts or incubators.

To capture the different maturity levels of innovations on their way to commercialisation, the JRC scientists established four categories based on the Innovation Management and Innovation Readiness Indicators: exploration (getting things started), creation (technology preparation), commitment (market preparation) and optimisation (ready for the market). These four levels can be used as search filters in the Innovation Radar.

The Innovation Radar tool can be accessed via the web or as a smartphone app (download from the iOS and Android app stores).

SCIENCE AND INNOVATION SUPPORTING EUROPEAN CULTURAL HERITAGE

In 2018, the JRC lent its expertise to preserving and promoting the EU's cultural heritage, from the safety and security of buildings, through three-dimensional (3D) laser-scanning technologies to neutron-resonance analysis for archaeological applications, and more.

The recent earthquakes in central Italy have reminded us how urgent and important it is to adopt a methodology to improve the stability and seismic protection of cultural heritage buildings, traditionally more vulnerable than modern ones.

The JRC's European Laboratory for Structural Assessment (ELSA) in Ispra, Italy, has a long history of work in the field of cultural heritage, combining research and interventions on monumental buildings damaged by earthquakes. The JRC characterises the behaviour of historical structures during earthquake events and helps define and assess retrofitting and restoration methods. Sometimes, it also intervenes in culturally significant buildings damaged centuries earlier.

JRC researchers have also developed a 3D laser-scanning technology that can be transported to the damaged zone in a backpack. Originally developed for nuclear safeguards, this technology can be applied for the detailed 3D mapping of damaged historical buildings, which is the basis for damage assessment and the planning and monitoring of reconstruction efforts.

JRC's Geel Linear Accelerator (GELINA), an electron accelerator-driven neutron facility, is normally used for nuclear research activities. From its original applications, JRC researchers have developed a non-destructive analysis technique called neutron resonance analysis (NRA) to determine the elemental composition of objects. NRA has been employed to reveal the secrets of archaeological artefacts, either to uncover imitations or to investigate their methods of manufacture.

Other activities relevant to cultural heritage this year included publication of the report Are capitals the leading cultural and creative cities in Europe?, and Cultural gems, an app under development to promote cultural heritage in cities

through a gamified exploration experience.

LAND DEGRADATION THREATENS THE WELL-BEING OF PEOPLE AND THE PLANET

The world's first comprehensive evidence-based assessment of land degradation and restoration highlighted some sobering facts about how worsening land degradation caused by human activities is undermining the well-being of 3.2 billion people

(two fifths of the world population), driving the extinction of species, intensifying climate change, and leading to the increased risk of migration and conflict.

The Summary for policymakers of the landmark Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Assessment Report on land degradation and restoration, co-chaired by JRC scientist Dr Luca Montanarella, was launched in March 2018.

The report details the dangers of land degradation, which cost the equivalent of around 10 % of the world's annual gross product in 2010 through the loss of biodiversity and ecosystem services, together with a catalogue of corrective options. Avoiding, reducing and reversing land degradation is an urgent priority to mitigate climate change and to protect biodiversity and vital ecosystem services.

Another recent JRC study published in the Land Degradation and Development Journal identified soil erosion as the biggest threat to soil fertility and productivity. It combined biophysical and macroeconomic models to determine the direct and macroeconomic costs of soil erosion, and the results are striking. At the EU level, soil erosion affects over 12 million hectares of land – about 7.2 % of the total agricultural land – and leads to EUR 1.25 billion loss in crop productivity and a cohort of indirect costs in terms of biodiversity loss and damage to public infrastructure.

A separate report focusing on soil contamination allows for a modest degree of optimism as it observed that over 5 000 new sites have come under remediation or risk-reduction measures since 2011, even though there are more than 650 000 officially registered contaminated sites across Europe. A significant effort is being made by Member States to identify priority sites for remediation or risk-reduction measures.

READ MORE

- **Health Promotion and Disease Prevention Knowledge Gateway**
  This Gateway provides public health policymakers and citizens with short, impactful, concise and up-to-date briefs on how to promote health and well-being while reducing the risk of non-communicable diseases.
  https://europa.eu/!hr96Nh

- **Change your diet to save both water and protect your health**
  A detailed nationwide food-consumption-related water footprint study takes into account socio-economic factors of food consumption, for both existing and recommended diets in France, Germany and the UK.
  https://tinyurl.com/yb66a5lx

- **Critical raw materials: are we circular yet?**
  The answer is 'no, not yet'. Critical raw materials are not used to their full extent as part of the circular economy and there are several opportunities available to improve the reuse and recycling of these materials.
  https://europa.eu/!gD46cR

- **EU coal regions: opportunities and challenges ahead**
  Over the past decades EU coal production and consumption has been in steady decline. Regions across Europe face challenges and opportunities as coal is phased out to make way for renewables, innovation and digitalisation.
  https://europa.eu/!Jg49pK

- **The e-vehicle market in Europe is slowly gaining momentum**
  A new JRC analysis on the deployment of electric vehicles in Europe concludes that the sector evolved significantly between 2010 and 2017, although progress is still too small to be characterised as full-scale commercialisation.
  https://europa.eu/!hQ86pJ

- **Reporting cancer burden statistics and trends across Europe**
  The JRC launched the European Cancer Information System, a one-stop-shop for geographical and temporal patterns of cancer incidence, mortality, and survival from data available at country and regional levels.
  https://europa.eu/!qw49Tr

A connected digital single market

The internet and digital technologies have a hugely transformational impact on our economy and society. However, fragmentation and barriers in digital services across the EU reduce the chance of reaping the full benefits of the digital economy in the EU single market. The Digital Single Market Strategy was launched as a set of 16 important initiatives to tackle the various obstacles to and opportunities for digital transformation.

The JRC is supporting the Commission in shaping and implementing these initiatives which aim to ensure that Europe's economy, industry and employment take full advantage of what digitisation has to offer. Boosting digital literacy in education, assessing digital employment trends, gauging the influence of creative content streaming platforms, or ensuring that eCall devices meet compatibility and performance requirements are just some of the many activities the JRC pursued in 2018.

INSIGHT INTO THE PRESENT AND FUTURE OF ARTIFICIAL INTELLIGENCE IN EUROPE AND THE WORLD

As early Artificial Intelligence (AI) applications enter our everyday lives, Europe must act swiftly to shape its own AI future. The main message of the JRC report Artificial Intelligence: A European perspective is clear: at stake is whether its future and its many ramifications in our lives, jobs and interpersonal and societal relations will remain in our hands or will be decided elsewhere.

The report takes stock of current global developments and lays out some of the options and pitfalls for EU policymakers in the face of strong competition, and competing visions, from other global players. It also looks at recent AI developments linked to greater processing power, improvements in algorithms, and the exponential growth of digital data. While these can be extremely beneficial, they also raise many concerns, especially in sensitive areas like political campaigning, human resource management or the criminal justice system. Without a full understanding of the inner workings of many AI technologies, our ability to exert human supervision, assess algorithms scientifically, or recover from adversarial events is limited.

AI players are currently concentrated in the US, China and Europe, and their respective vision often differs. In-between 'AI for profit' and 'AI for control', Europe could embrace 'AI for society' and make fair AI systems that are 'secure and ethical by design' the hallmark of European development in this field.

Other important aspects addressed by the report include the brain drain of AI specialists, the risks of hosting European data outside Europe, and the jobs landscape shift and its implications, to name but a few.

To get AI right, the report concludes, the EU relies on a coordinated strategy built on our strengths in research and

industry; on our traditions in balancing individual and societal interest; and on our diversity, which could be harnessed through local data-sharing ecosystems.

The Commission presented its European approach to AI in April 2018 and a coordinated plan in December 2018. It also set up the European High-Level Expert Group on Artificial Intelligence to draft ethics guidelines.

#BLOCKCHAIN4EU: BLOCKCHAIN FOR INDUSTRIAL TRANSFORMATIONS

Blockchain and other distributed ledger technologies (DLTs) are immutable, encrypted and time-stamped databases in which data is recorded, validated and replicated across a decentralised network of nodes. A range of opportunities and challenges could emerge through such technologies that will potentially enable parties who are geographically distant, or have no particular trust in each other, to record, verify and share digital or digitised assets on a peer-to-peer basis with few to no intermediaries.

The #Blockchain4EU: Blockchain for Industrial Transformations project, coordinated by the JRC's EU policy lab, explores the existing, emerging and potential applications based on blockchain and other DLTs for the industrial/non-financial sectors. It relies upon an innovative experimental approach to generate ideas on how blockchain and other DLTs could exist in the near future and ultimately test new narratives and plausible scenarios around it.

The project entailed a mix of desk and qualitative research with a series of interviews, surveys and ethnographic explorations, together with co-creation workshops. These 'prototyping for policy' workshops resulted in the collaborative envisioning, design and creation of five prototypes aimed at physically showcasing how blockchain could be applied in five specific sectors: energy, transport and logistics, creative industries, advanced manufacturing, and health.

The outcomes of the project and the accompanying report were presented at a closing event in May 2018. The researchers signalled a number of key insights for implementation and uptake by industry, businesses and SMEs. They also put forward a number of strategic recommendations and notably urged policymakers to support experimentation and piloting with simplified requirements; support the integration of blockchain with other key industrial technologies; stimulate open-source knowledge sharing; foster interoperability and open standards; promote adequate digital skills training; design stable regulatory frameworks; and champion blockchain in public and governmental sectors.

BOOSTING DIGITAL LITERACY, A KEY ROLE FOR SCHOOLS

In January 2018, the European Commission launched the Digital Education Action Plan to promote a better use of digital technologies for teaching, and improved digital competences among students and teachers.

Most relevant in this context, the JRC has produced competence frameworks to enable citizens (DigComp), teachers (DigCompEdu), schools and educational organisations (DigCompOrg) as well as education and employment authorities to assess and improve these skills. Among these tools, SELFIE enables schools to better embed digital technologies into teaching, learning and student assessment.

After a successful pilot in 2017, involving 650 schools in 14 European countries, the full version of SELFIE was released in October 2018 in all 24 official EU languages for all schools to use free of charge. SELFIE gathers – anonymously – the views of students, teachers and school leaders on how technology is used in their school. This is done using short statements and a simple 1-5 agreement scale. The statements cover areas such as leadership, infrastructure, teacher training and students' digital competence. The information is used to generate a report on strengths, weaknesses and potential areas for improvement, which in turn helps to initiate the dialogue within the school and action plan to improve the use of digital technologies. The Digital Education Action Plan foresees the scaling up of SELFIE to 1 million users by the end of 2019.

In 2018, the JRC also published a report on Young Children (0-8) and Digital Technology which confirmed the critical influence of schools on the acquisition of digital competences – including creative use – when digital technologies are

integrated as active learning tools rather than mere information sources. It also urged schools and teachers to enhance children's digital and media literacy as early as possible and highlighted the importance of developing a digital competence curriculum and digital pedagogies as part of teacher training.

DIGITAL EMPLOYMENT PLATFORMS: GAUGING LABOUR MARKETS AND POLICY IMPLICATIONS

In response to calls by the European Council and the European Parliament, the JRC, in collaboration with the European Commission's department for employment, social affairs and inclusion, has produced a survey and the subsequent report Platform Workers in Europe as an initial attempt to provide quantitative evidence on digital platform work and to reflect on its policy implications.

According to the survey, which gathered responses from more than 32 000 people across 14 Member States, 1 in every 10 adults (16-74 years) has used online platforms at least once to offer labour services. While for the majority it remains only a sporadic source of secondary income, 2 % of the adult population surveyed works more than 20 hours a week or earns at least half of their income via online labour platforms.

The survey helped to outline the main socio-demographic characteristics of platform workers, learn about their working

conditions and motivations, and describe the type of services provided through digital labour platforms.

The emergence of digital platform work has important implications for employment, education and welfare policies. A critical obstacle to designing appropriate policy responses is the lack of reliable evidence. The report's findings suggest an emerging phenomenon of increasing importance but still modest in size.

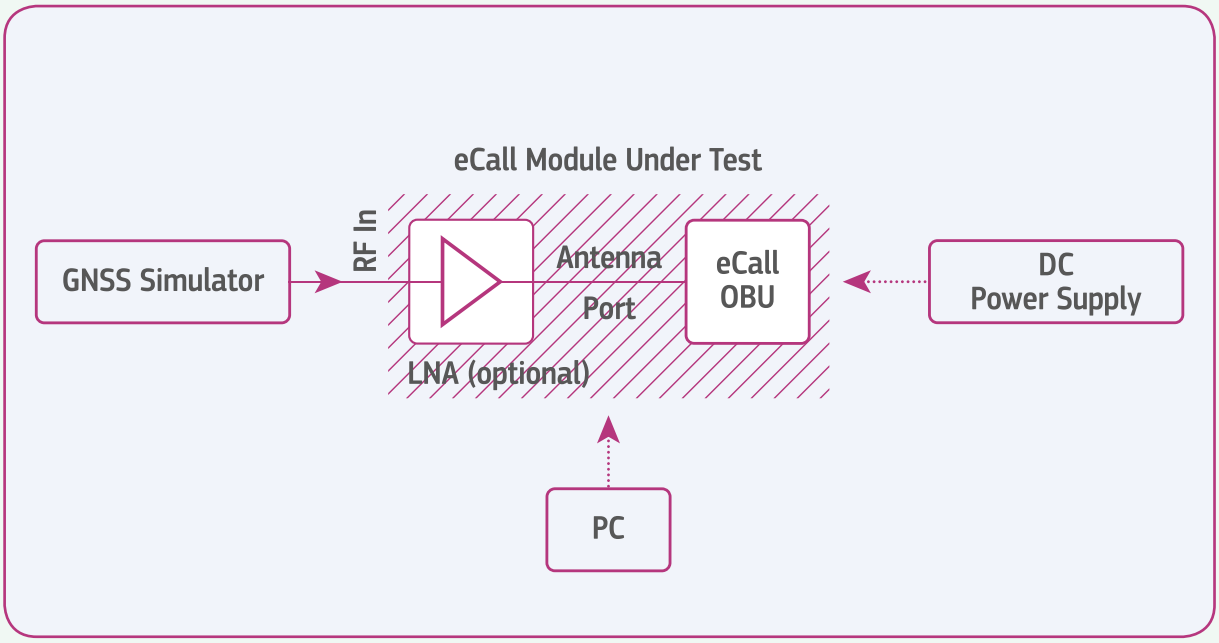
If platform work remains significant but small in the future, a two-pronged policy response is likely to suffice, focusing on fully grasping its job creation and innovation opportunities, and adjusting existing labour market institutions and welfare systems to the new reality while mitigating its potentially negative consequences for working careers and working conditions.

However, if platform work continues to grow in size and importance to become a more significant reality in our labour markets, or if some of the key features of platform work (such as the rating mechanisms) spread across other forms of employment, policy interventions may need to be further advanced.

SAVING LIVES ON OUR ROADS: ENSURING 112 EMERGENCY AUTO-CALL TECHNOLOGY WORKS

An eCall device works by receiving the signals from EU's Galileo and GPS satellites. When fitted to a vehicle, eCall will automatically dial 112 – Europe's single emergency number – in the event of a serious crash, providing vital information such as the vehicle type, the location and time of the accident and the direction of travel (most important on motorways), even if the driver is unconscious or unable to make a phone call. By speeding up emergency response times by up to 40 % in urban areas and 50 % in rural areas, the technology could save 2 500 lives across Europe each year.

The JRC and the Agency responsible for the EU's satellite navigations system (GSA) have released guidelines to ensure that eCall devices meet compatibility and performance requirements. This will help test centres and manufacturers to be fully prepared ahead of their compulsory installation in all new cars and vans from the end of March 2018.



eCall devices guidelines provide a set of considerations and requirements regarding both test conditions and test procedures.

The guidelines follow intensive testing of the eCall on-board units at the JRC's state-of-the-art Global Satellite Navigation System (GNSS) laboratory in Italy, where manufacturers have been sending in their devices for testing and preliminary feedback on a voluntary, free-of-charge basis. The testing campaign has also been extended to manufacturers of the eCall testing platforms that will be used by the technical centres approving these devices for installation. The testing campaign has proved popular so far, with many manufacturers sending samples of their eCall modules and four major commercial vendors making their eCall testing platform equipment available to the JRC.

As well as being a major innovation in road traffic safety, the roll-out of eCall through EU Regulation 2017/79 will provide the second largest market for Galileo and other satellite-positioning systems, after the location-based services running on smartphones. By working closely with industry, scientists are helping to ensure that the implementation of the Regulation goes smoothly.

READ MORE

- **'Cyber Chronix': GDPR explained through gaming**
  The JRC has launched 'Cyber Chronix', a mobile game to help raise awareness of privacy risks and data protection rights in the context of the entry into force of the European GDPR.
  https://europa.eu/!kv46tJ

- **How safe is your email?**
  My Email Communications Security Assessment (MECSA), an online tool developed by the JRC, allows you to check whether your email provider offers a good level of protection in your email communications.
  https://europa.eu/!HK67Xg

- **Streaming platforms influence consumer choice and artists' revenue**
  The JRC looked into how digitisation and online distribution impact revenue streams in the music sector and lead to new consumption patterns, both of which are relevant to the European Commission's Music Moves Europe framework.
  https://europa.eu/!XN84bu

- **Blockchain potential to transform education**
  Blockchain technology can help improve old models of data management and bring benefits to learners and educational institutions in the EU – if policymakers are well prepared to embrace the change.
  https://europa.eu/!bt77yg

- **A new lab for the smart communities of the future**
  Officially launched in November 2018, the JRC's new Smart Grid Interoperability Laboratory researches and evaluates ways to achieve integration and interoperability between smart devices and systems.
  https://europa.eu/!JF36Hd

A resilient European energy union with a forward-looking climate change policy

The EU's energy and climate policy aims to promote the transition towards a competitive low-carbon and resilient economy that helps to slow down global warming and mitigate its effects while ensuring affordable, secure and sustainable energy for businesses and households.

In 2018, the JRC's contributions to climate change policy covered both mitigation and adaptation efforts, notably through economic and climate modelling/assessments, monitoring and analysing emissions from different sources, assessing climate change impacts (economic and non-economic), vulnerability, resilience, and adaptation options. On energy specifically, the JRC contributed to carrying out security, safety, risk and techno-economic assessments of the EU's energy supply, assessing the resilience of the EU power grid to natural hazards, promoting nuclear safety, and supporting the implementation of renewable energy and energy efficiency legislation.

SUSTAINED CLIMATE ACTION BRINGS MULTIPLE BENEFITS

The EU has long been spearheading the global efforts to mitigate climate change. A recent update of the Emissions Database for Global Atmospheric Research (EDGAR) shows that globally fossil CO_2 emissions are still rising (+ 23 % in 2017 with respect to 2005), although not in Europe (-16 % compared to 2005). Man-made methane emissions are also on a non-sustainable path (17 % increase from 1990 to 2012). The JRC found that without specific measures to reduce overall methane emissions from the energy, waste, waste-water and agriculture sectors, there could be between 40 000 and 90 000 more premature deaths globally by 2050, due to the impact that methane has on ozone concentrations.

Indisputably, sustained climate action at the global level is urgently needed. In its Global Energy and Climate Outlook (GECO) 2018 report, the JRC quantified the actions needed to limit temperature rise to 2 °C, a level at which both natural ecosystems and human economic activities can survive: halve total global greenhouse gas emissions in 2050 compared to 1990 levels, expand the use of renewables to half the world's energy system, and increase the role of electricity energy consumption. Aiming for 1.5 °C would require even larger reductions, particularly in the 2020-2040 period, as also confirmed by the IPCC special report, co-authored by one of the JRC's scientists. The GECO 2018 also indicates that such actions would still produce global economic growth despite the increased investment needs. This analysis underpins the Commission´s long-term strategy for the evolution of the EU's energy and climate objectives, published on 28 November 2018 in preparation for the UNFCCC process.

Beyond global warming control, climate action has many side benefits. By combining climate, energy, atmospheric chemistry, and economic models, a Nature Communications report authored by the JRC found that it also improves air

quality, prevents deaths and enhances food production. An integrated policy approach maximises benefits for climate, energy and health and unlocks the potential to reach several SDGs. The First Clean Air Outlook, to which JRC researchers contributed with a macroeconomic cost-benefit analysis, captures these co-benefits.

SUPPORTING MEMBER STATES AND NEIGHBOURING COUNTRIES TO INCREASE THEIR GAS SUPPLY SECURITY LEVEL

Natural gas is one of the main sources of energy contributing to Europe's energy needs. Nevertheless, gas supply is jeopardised by a number of possible events (both intentional and unintentional). Regulation 2017/1938 is the main legal tool to address and improve security of gas supply in the EU. Key elements of this Regulation are the Risk Assessment (RA, to be developed at national and regional level), the Preventive Action Plan (PAP) and the Emergency Plan (EP).

Over the last nine years, the JRC has accumulated knowledge and developed tools (hydraulic regional and national models, mass-balance EU-wide models, tools to identify relevant events and scenarios, etc.) to implement RAs and plans. In particular, in 2018, the JRC supported five Risk Groups (RG, i.e. groups of countries jointly affected by specific gas supply route disruptions): RGs from the Ukraine, Belarus, Libya, Trans-Balkan and the North-Eastern group . In most cases, the support comprised helping define the key scenarios considered in the RA and estimating the consequences of each scenario using the available models. In some cases, for example the Trans-Balkan RG, the JRC also provided support in estimating the probabilities of scenarios.

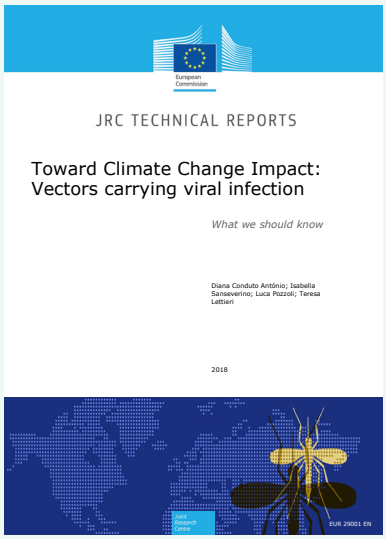
The JRC gave significant support to Ukraine in the same field, helping the country to align its legislation with EU legislation and to implement it with the best available tools. In particular, alongside Ukrainian experts, it developed the RA for the gas years 2016-2017, 2017-2018 and 2018-2019. The JRC has also delivered yearly recommendations to improve gas supply security in the country. Finally, the JRC organised two table-top exercises (2017 and 2018) to train Ukrainian experts in the implementation of Ukraine's National Action Plan (equivalent to the EU emergency plan) and identified solutions for improving it.

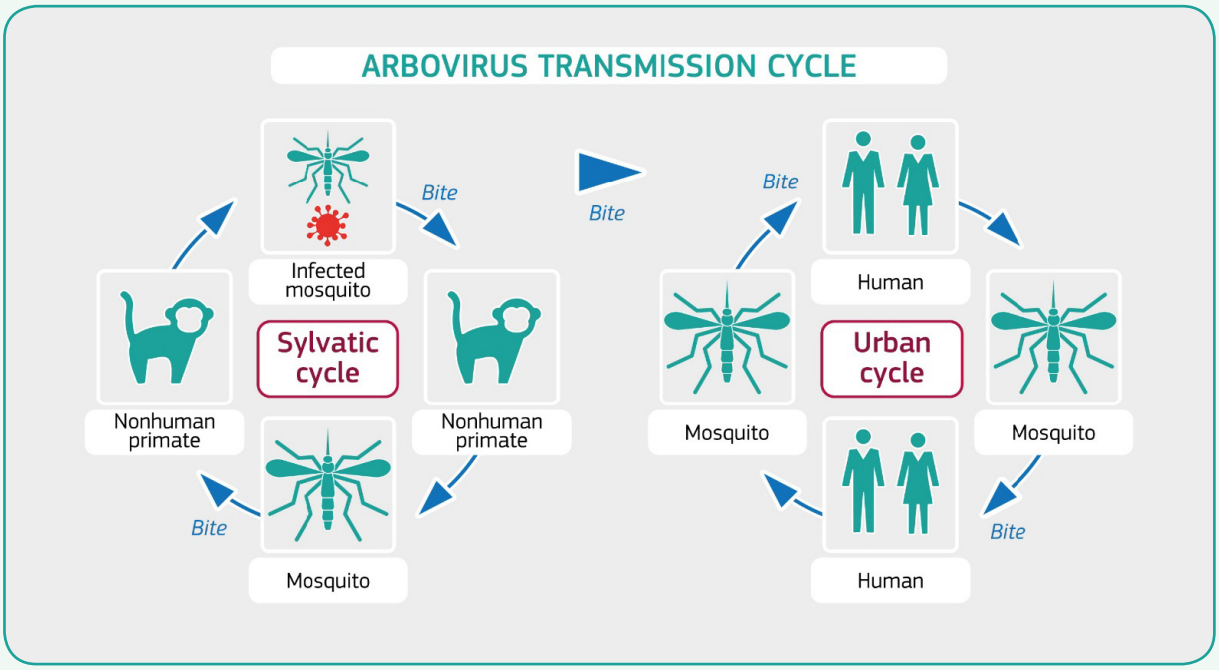
ASSESSING CLIMATE CHANGE IMPACTS FOR A RESILIENT EUROPE

While emissions-reduction research supports the 'how' of climate action, the JRC has also provided valuable insights on 'why' and 'where' that action is important – by assessing the potential impact of climate change across sectors and spaces.

The JRC's PESETA III report presents much of that work. It shows how, in the absence of adequate adaptation measures, Europe is in danger of being exposed to more frequent and intense extreme weather conditions, which will also have significant economic impacts. The report quantifies these impacts and highlights that acting now to limit emissions can prevent the worst effects. Insights from the report helped inform a review of the EU's 2013 Strategy on adaptation to climate change.

Several JRC studies call for adequate adaptation measures in specific areas. For example, scientists explored the potential future impact of coastal flooding. With one in three EU citizens living within 50 km of the coast, the rise in extreme sea levels caused by climate change could lead to between EUR 93 billion and EUR 961 billion of annual damage across the EU by the end of the century, with up to 3.65 million EU citizens being affected every year. These impacts were found to be greatly reduced with effective emissions reduction and coastal adaptation measures. A separate study on river flood risks found that most of Central and Western Europe will experience a substantial increase in flood risk at all warming levels, and the higher the warming, the higher the risk.





On health impacts, a JRC report warns of the threat posed by the spread of arboviruses (arthropod-borne viruses). Spurred on by climate change, international travel and international trade, disease-bearing insects are spreading to ever-wider parts of the world.

JRC scientists also demonstrated how clearing vegetation from land is causing the Earth's surface to heat up. Activities like cutting down evergreen forests for agricultural expansion in the tropics create energy imbalances that lead to higher local surface temperatures and contribute to global warming.

SETTING THE COURSE FOR ENERGY EFFICIENCY

Throughout 2018, the JRC's work continued to pave the way towards achieving the energy union Strategy's objective of 'putting energy efficiency first'. An analysis of Energy Consumption and Energy Efficiency Trends in the EU-28 noted progress in reducing energy consumption in the EU over the 2000-2016 period but highlighted that while in 2014 the EU already met its 2020 final energy consumption target, consumption rose again in 2015 and 2016, moving away from the 2020 objective.

The potential for further reductions is still vast. On cogeneration, for instance, the JRC assessment of the Member State reports produced in implementation of Article 14 of the Energy Efficiency Directive confirms that the economic potential identified by Member States back in 2011 has in most cases not been exhausted, while awareness of the energy-efficiency potential in the heating and cooling sector has grown.

The pulp and paper industry – Europe's fourth most energy intensive – is another sector that can reduce its energy consumption even with increased production. A JRC study on Energy Efficiency and GHG emissions scenarios in this sector estimated a possible reduction of 14 % by 2050 compared to 2015 levels if only new mills adopt existing best practices and technologies as they become operational.

Over the past few years, the huge data centres powering the internet have significantly improved energy efficiency by adopting best practices, thanks to, among others, non-regulatory initiatives such as the JRC-managed EU Code of Conduct. In an award ceremony celebrated in 2018, the efforts of the best companies in class were recognised.

JRC research also showed local level action is key to fully achieving the potential of energy-efficiency measures, e.g. through initiatives such as the Covenant of Mayors. The JRC

found that cities had already reduced their emissions by 23 % in 2016, well above the EU 2020 emission reduction target. A 2018 JRC analysis of the Mediterranean region showed that more can be achieved by, among others, strengthening technical capacities (e.g. through guidebooks developed by the JRC) and financing.

HELPING THE EU TO MEET RENEWABLE ENERGY OBJECTIVES

The recast Renewable Energy Directive foresees a binding, renewable energy target of 32 % for 2030, including a review clause by 2023 for an upward revision of the EU level target; 14 % of the energy consumed in transport must also be renewable. The JRC calculated the default emissions values and contributed to defining the sustainability criteria for bio-based fuels. The default emission values of alternative aviation fuels, which can be used by airline operators in the framework of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), are also based on JRC research.

The agreed renewable energy targets are expected to spur rapid growth in the renewable energy industry. This is confirmed by the 2018 JRC PV Status Report which found that the installed PV power capacity of 408 GW at the end of 2017 could triple by 2023. Already at the end of 2018, worldwide solar PV power was expected to exceed 500 GW – capable of producing roughly 2.8 % of worldwide electricity demand. IN 2017, the EU's share was about 26 % of the worldwide installed capacity and it was able to provide about 4.5 % of its electricity demand. For less-developed countries, particularly in Africa, renewables can grow exponentially due to their high potential for increasing access to modern energy services. A JRC-owned offline app is being implemented to support rural electrification with off-grid systems on the ground in Burkina Faso.

Innovation has played a key role in this transformation and the JRC is actively enabling it, among others, through its pre-normative laboratory work on energy rating standards and measurements of new innovative photovoltaic systems (e.g. organic, bifacial, perovskites). It has also shed light on an array of innovations that can bring ocean energy to the market, an emerging sector where Europe has the opportunity to maintain its leadership. The JRC found that a more accelerated development of future emerging technologies for ocean energy relies upon the adoption of a systemic approach, the transferability of solutions from other sectors, as well as the development of new technologies and materials.

SUPPORTING THE IMPLEMENTATION OF AN EU NUCLEAR SAFETY POLICY

Nuclear power plants (NPPs) currently produce around a third of the electricity consumed in the EU. Nuclear energy is presently an asset in combatting climate change, and meeting increasing energy demands and the need for energy security. As many EU NPPs will enter into long-term operation in the coming years, comprehensive ageing management programmes for nuclear plant and equipment are vital to maintain a high level of nuclear safety in the EU.

In 2014, the Directive establishing a framework for the nuclear safety of nuclear installations was amended to increase transparency on nuclear safety matters, establish new provisions for on-site emergency preparedness and response, as well as to set up an EU system of peer reviews for nuclear installations. Peer reviews aim to provide a mechanism for EU Member States to examine topics of strategic importance to nuclear safety, to exchange experience and to identify opportunities to strengthen nuclear safety.

Ageing management was the first focus for the topical peer reviews. Coordinated by the European Nuclear Safety Regulators Group, which assembled a team of experts from the European nuclear regulatory authorities, the national assessment reports of 16 EU Member States and 3 EU

neighbouring countries (Norway, Switzerland and Ukraine) with NPPs or research reactors, were peer reviewed.

Mandated by the amended Council Directive, the European Commission Directorate-General for Energy participated in the peer review, supported by the JRC's nuclear safety experts. The Centre's expertise in the relevant areas was instrumental to the thorough assessment of the sub-topics of ageing management, namely electrical cables, concealed piping, reactor pressure vessels or equivalent structures, and concrete containment structures. The JRC team also discussed and identified good practices and areas for improvement in the peer review workshop and contributed to drafting the final report.

READ MORE

- **Forest fires in Europe, the Middle East and North Africa 2017**
  The report combines data from the JRC-managed European Forest Fire Information System (EFFIS) and statistics and information provided by EU Member States and neighbouring countries.
  https://europa.eu/!BB44Cr

- **Is snow load on roofs increasing with global warming?**
  JRC research published on climate risk management suggests that a European project would help national competent authorities to redraft the national snow-load maps for the design of buildings with Eurocodes.
  https://tinyurl.com/yc88joqq

- **Sharing nuclear safety best practices**
  The JRC celebrated the 10-year anniversary of 'the EU Clearinghouse', a regional network of nuclear safety regulatory authorities and their technical support organisations sharing best operational practice.
  https://europa.eu/!uh69MU

- **Global wheat yields at risk due to ozone pollution**
  The benefits of increasing global wheat yield are significantly offset when increasing concentrations of ground-level ozone force crops to divert resources away from growth and seed production to fight the pollutant.
  https://tinyurl.com/ybrdmwzx

- **Credible accounting of mitigation in managed forests**
  A JRC-led group of forestry research experts has developed a rigorous new fact-based carbon accounting system that reflects how forest management practices can help mitigate greenhouse gas emissions.
  https://tinyurl.com/y8dvj8rh

- **Drought and Water Crisis in Southern Africa explained**
  A JRC technical report has found that the massive water shortage that happened in 2018 in the Western Cape Province in South Africa, while exceptional, is characteristic of longer-term weather patterns.
  https://europa.eu/!WP36fR

A deeper and fairer economic and monetary union

Completing the economic and monetary union remains a key objective of the European Commission's current term. Putting the public finances of Member States on a sound and sustainable footing is critically important for the stability and prosperity of the euro area. Completing the financial union is equally important. Likewise, ensuring fair taxation and the correct functioning of welfare systems is crucial. A well-regulated capital markets union encompassing all 28 Member States should mobilise capital in Europe and channel it to all companies – including SMEs – so that they can carry out the long-term sustainable projects that are needed to expand and create jobs.

In 2018, the JRC carried out socio-economic analyses to improve macroeconomic, budgetary, structural, and financial development policies in the EU. It monitored foreign direct investment and assessed Member States' resilience to the financial crisis. It looked into correlations between private investments and employment and growth. It provided modelling and economic analyses, too, in support of fiscal policies.

LEARNING FROM THE FINANCIAL CRISIS: RANKING EU MEMBER STATES' RESILIENCE

Although the financial and economic crisis that began in 2007 was felt across the EU, its impact was uneven. A JRC report looked at countries' resilience and concluded that mere 'shock absorption' may not be the only possible or best strategy looking forward. Instead, adaptation and transformation have helped some countries use the crisis as an opportunity. The JRC study measured the degree of economic and societal resilience of each Member State during and after the crisis, and identified particular country characteristics linked to resilience. It also looked at which EU countries were able to use the crisis as an opportunity to "bounce forward" and emerge stronger.

The analysis is based on the JRC conceptual framework for resilience, which places at its core the well-being of individuals. Broadening the perspective from a purely economic to a socio-economic viewpoint considerably changes the assessment of country resilience. For example, Bulgaria proves more resilient when social variables such as exclusion, happiness and health are included in the analysis, while Hungary becomes less resilient when the social dimension is factored in. The importance of this broader perspective further reinforces the case for the European Pillar of Social Rights, and for strengthening the social dimension in the work of the European Semester.

Resilience is not necessarily to bounce back to the pre-crisis stage, but to bounce forward and potentially improve upon it. In this respect, country performance is markedly varied: while Germany, Malta and Slovakia managed to bounce forward in many areas, countries like Greece, Italy and Spain have not moved across most socio-economic dimensions. Countries have been generally able to bounce forward more as far as the monetary aspects of well-being (gross domestic product, consumption and income) are concerned, compared to the non-monetary aspects (e.g. happiness, equality, social inclusion

and youth employment, education and training). Once again, this latter finding confirms the need to consider the social dimension in crisis response and economic management.

ASSESSING THE IMPACT OF THE INVESTMENT PLAN FOR EUROPE ON JOBS AND GROWTH

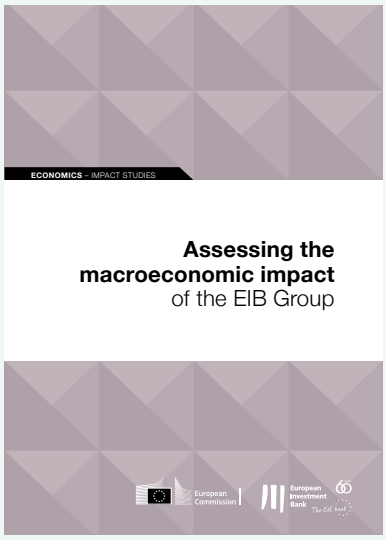
Since the global economic and financial crisis, the EU has been suffering from low levels of investment. The Investment Plan for Europe, the so-called Juncker Plan, was adopted to address this situation by removing obstacles to investment, providing assistance to investment projects, and by making smarter use of financial resources. One pillar of the Investment Plan, the European Fund for Strategic Investments (EFSI), was launched to mobilise private investment in the EU, in collaboration with the European Investment Bank (EIB) Group.

The JRC worked with the Commission and the EIB to quantify the impact of the Investment Plan and provide evidence on its positive impact on jobs and growth across the EU.

The JRC teamed up with the EIB to conduct a macroeconomic assessment of the impact of the Bank's operations under the EFSI. The first results are documented in a joint EIB-JRC paper. Using RHOMOLO, a well-established regional macroeconomic model, the JRC was able to determine that the Juncker Plan has already increased EU gross domestic product (GDP) by 0.6 %, a figure set to reach 1.3 % by 2020. It also showed that the EFSI has already supported more than 750 000 jobs, which is expected to rise to 1.4 million jobs by 2020.

Furthermore, the JRC also applied its modelling expertise to assess the combined macroeconomic impact of the full and timely implementation of regulatory reforms identified in the domains of the Digital Single Market, the Single Market Strategy, the Capital Markets Union and the energy union. JRC figures helped the Commission carry out a stocktaking exercise of the Investment Plan, as outlined in its 'Investment Plan for Europe: stocktaking and next steps' Communication. They also showed that those reforms may result in an extra 1 million jobs to be created by 2030 and an additional increase in EU GDP of 1.5 % by 2030. This analysis is based on the expected removal

or reduction of existing barriers to investment by the legislative proposals the Commission has adopted as part of these four policy packages.



SCREENING FOREIGN DIRECT INVESTMENT IN STRATEGIC ECONOMIC SECTORS

In recent years, a growing number of foreign acquisitions of European companies have been controversial, intensifying calls for action at the EU level. Both the European Parliament and Council asked the European Commission to screen third-country foreign direct investments (FDI) in the EU in strategic industries, infrastructure and key future technologies. In response, the Commission put forward the Communication Welcoming FDI while Protecting Essential Interests, which notably announced an "in-depth analysis of FDI flows into the EU", to be carried out by the end of 2018.

The JRC contributed to this initiative by producing a comprehensive picture of foreign ownership of EU enterprises based on available firm-level data sets and inward foreign investments based on bilateral data. The JRC contribution was used by the Directorate General for Trade to assemble the Commission Staff Working Document on FDI flows into Europe.

In particular, the JRC constructed a dataset of European firms, listed and unlisted, controlled by owners located outside the EU. Stock data on foreign ownership were complemented by flow data on merger and acquisitions and green-field investments made by non-European investors. These data enable the European Commission and policymakers to create a picture (from 2007 until the present day) of the industrial sectors and countries mainly interested by non-European investments and access to information on both the controlled firms (e.g. market share and employment) and controlling firms (e.g. private firms or state-controlled ones).

JRC scientists found that non-Europeans control about 150 000 companies in Europe. The lion's share of non-European investors comes from the USA and Canada (31 %), and they control more than half of all foreign assets in Europe and about half of the employment in foreign-controlled firms. The European Free Trade Association (Switzerland and Norway) represents the second largest investor, while offshores countries are the third (particularly Bermuda, Cayman and British Caribbean) with 13 % and 11 % of the foreign control, respectively.

EUROPEAN SEMESTER TAX AND SOCIAL BENEFITS REFORMS ANALYSIS: INCREASING FOCUS ON FAIRNESS

The JRC has long supported the Commission services in charge of tax and social policy issues, including the Directorate General for Employment, Social Affairs and Inclusion, the Directorate General for Economic and Financial Affairs and the Directorate General for Taxation and Customs Union. In 2018, these support activities expanded significantly, in particular in the context of the 2018 European Semester, for which the JRC was asked to provide detailed modelling analyses of reforms discussed or enacted in the EU Member States.

The scope of analyses carried out for the European Semester was also significantly extended to better cover fairness aspects. A number of social policy reforms were analysed including, among others, minimum income schemes in Spain, social security contributions and minimum wages in Romania, and family support policies in Italy. In order to be in a position to assess the impact of these reforms on income distribution and poverty, the JRC had to expand its modelling toolbox.

EUROMOD-based simulations were used to develop a number of indicators. Analysing the fairness dimension of reforms was made possible by breaking down standard

inequality indicators (such as the Kakwani index) in order to isolate the role played by the progressivity of the tax and social benefit system. A social welfare indicator was also developed to assess jointly the impact of reforms on household income level and inequality.

The JRC provides policy DGs with a broad range of fairness and inequality-related indicators for different types of households, distinguishing them by employment, age and family status. Such analysis enables the identification of individuals and households categories most at risk of social exclusion. All reforms analysed by the Commission services for the European Semester are considered systematically from a fairness perspective, along with their fiscal impact, thanks to JRC support.

MACROECONOMIC FORECASTING USING DETAILED STRUCTURAL MODELLING

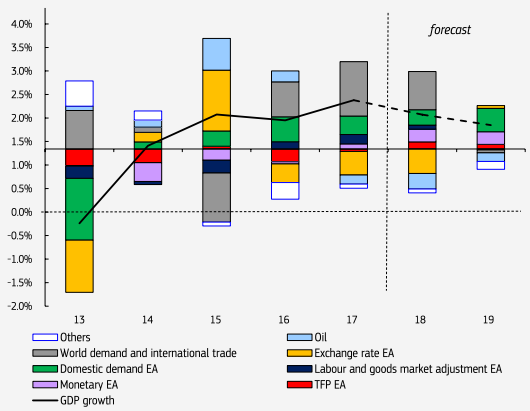
The global multi-country (GM) model is a macroeconomic model jointly developed by the JRC and the Directorate-General for Economic and Financial Affairs (ECFIN) to perform forecasting, medium-term projections and spillover analysis in sync with the EU's annual cycle of economic surveillance procedures (the European Semester).

In Spring and Autumn Forecasts 2018, JRC and ECFIN analysts continued to put the GM model to good use in understanding the drivers of euro-area GDP growth. It also contributed to the 'thematic boxes' that are included in the Spring and Autumn Forecast documents.

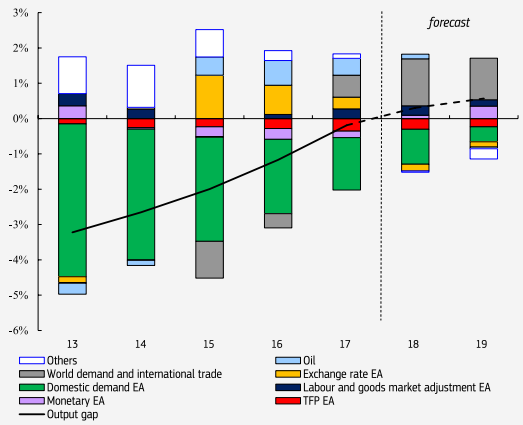
Thematic Box I.3 of the 2018 Spring Forecast provides a model-based breakdown of the euro-area recovery since 2013, extending an historical time series with the 2018 Spring Forecast data from the European Commission. The estimated GM model attributed the post-2013 euro-area GDP growth recovery mainly to the sustained recovery in domestic demand, supported by persistently strong growth in the rest of the world, and by a temporary boost from falling commodity prices in 2014-2015. The box also discussed how below-trend inflation mainly reflected the legacy of the demand slump and foreign factors.

Thematic Box I.3 of the 2018 Autumn Forecast presents a breakdown of the growth forecast. The discussion focused on the forecast for 2019 annual real GDP growth and discussed

Graph 1: **Euro area real GDP growth**



Graph 2: **Euro area output gap**



The global multi-country model (GM) helps performing forecasting, medium-term projections and spillover analysis.

inflation and trade balance implications. Taken together, the results presented in the box attributed above-trend euro-area real GDP growth in 2019 to the strengthening of private domestic demand and continuous monetary accommodation. The former, however, remains below the sample average, which also explains low levels of inflation and a significant part of the trade balance surplus in the euro area.

Using a structural model enables a policy-meaningful interpretation of macroeconomic data as it enables breaking down the dynamics of GDP, inflation, consumption, investment, trade, employment, etc. into key drivers, such as the evolution in domestic and foreign demand, commodity prices, productivity, fiscal and monetary policy.

READ MORE

- **Taxation of the digital economy – underpinned by science**
  JRC scientists have supported the digital economy taxation package by providing data and estimates on the corporate profit allocation of web companies and by analysing the macroeconomic impact of the proposal.
  https://europa.eu/!gu33kB

- **Supporting a stronger international role of the euro**
  The 2018 Communication 'Towards a stronger international role of the euro' used JRC evidence on the use of the euro in invoicing by aircraft manufacturers, one of the key strategic sectors identified by the Communication.
  https://europa.eu/!hn38Cb

- **Exploring the resilience of the financial system**
  The first Annual Conference of the JRC Community of Practice in Financial Research took place in November 2018. It covered topics such as banking regulation, systemic risk, Fintech, financial networks and sustainable finance.
  https://europa.eu/!GH48uc

- **Informing European Deposit Insurance Scheme negotiations**
  The JRC examined EDIS design options, explored risk-based options for payment distribution, and quantified the liquidity shortfalls impact for deposit insurances of a non-Banking Union Member State joining the EDIS.
  https://europa.eu/!WP88Cc

A deeper and fairer internal market with a strengthened industrial base

The internal market is key to boosting growth and jobs. The areas with the highest growth potential are services, networks and the digital economy. Industry accounts for over 80 % of Europe's exports and private R&I and almost 25 % of jobs in the private sector. The EU's internal market policy focuses on helping to turn the EU into a smart, sustainable and inclusive economy by implementing the industrial and sectoral policies under Europe 2020.

In 2018, JRC activities contributing to strengthening the internal market included standardisation, reference measurements and product safety; support for industrial sectors to enhance their environmental efficiency, energy performance, climate resilience and GHG emissions reductions; resource efficiency and the circular economy, and more.

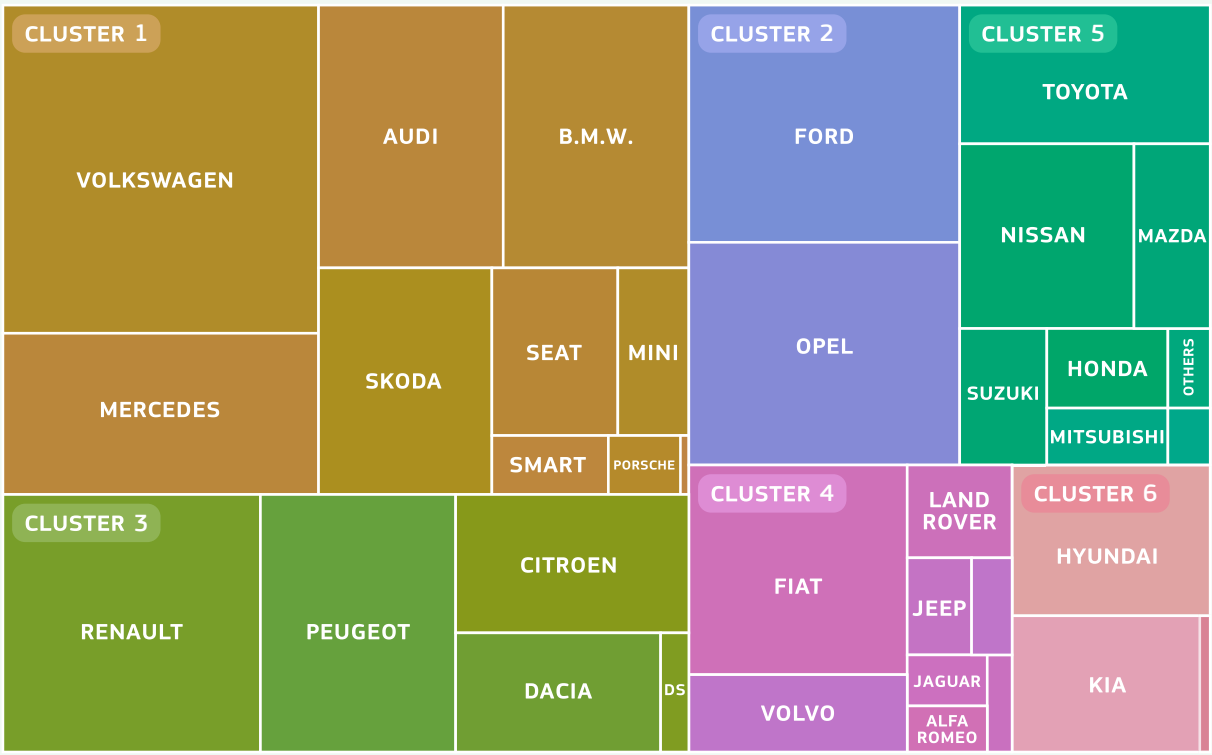
JRC RAMPS UP ITS LEADING ROLE IN VEHICLE EMISSIONS OVERSIGHT

Achieving reductions in deep CO_2 and pollutant emissions in the transport sector remains a persistent challenge, in particular in the context of the Commission's strategy for a climate neutral Europe by 2050.

The regulatory initiatives to address this – e.g. the new Type Approval Framework and the certification procedure for heavy-duty trucks – should pave the way to significant improvements in vehicle emissions performance. But according to a JRC study published in 2018, continuous monitoring is critical for ensuring the implementation of and compliance with the new vehicle emissions legislation. In this context, the JRC has been assessing vehicle emissions control technologies and vehicle emissions performance both in the laboratory and on-road (the results are summarised in a Science for Policy report). Among other tools, and to improve the methodology and to support Member-State-led investigations, it put testing protocols and new emission measurement methods to good use to identify anomalies in emissions patterns potentially caused by defeat devices.

These tests are part of a set of activities that will prepare the JRC to take on the role – on behalf of the Commission – of checking the compliance of vehicles with the type approval regulation and the Real Drive Emissions requirements. In the same context, the JRC signed a contract for building two new facilities (VELA 10 and VELA 11) which are scheduled to start testing cars in 2020.

Besides its foreseen role in monitoring compliance, the JRC continued to prepare the ground for a future regulatory initiative for certifying CO_2 emissions and fuel consumption for other heavy-duty vehicles, namely buses and coaches. Following a test campaign to investigate the possibility of extending the existing methodology for trucks to coaches and buses and to check the representativeness of the CO_2 emission



Share of new passenger car registrations in Enlarged Europe (source ACEA).

calculations made by the official simulator (VECTO), the JRC has already confirmed the practical feasibility of an ex-post verification method based on transient, on-road tests for buses and coaches, even though further testing is needed.

NEW TEST METHODS FOR PLASTIC AND RUBBER PRODUCT SAFETY

JRC scientists have developed new methods to better measure the content and migration of polycyclic aromatic hydrocarbons (PAHs) from rubber and plastic items.

PAHs are a group of hazardous compounds – many of which are known carcinogens – that can be found in the raw materials used in the manufacturing process of products ranging from children's toys to bicycle grips and sporting goods. They are also found in products made from secondary raw materials, such as granules and mulches used in synthetic turf pitches, or in loose forms at playgrounds and other sports facilities, often coming from end-of life rubber tyres. In recent years, considerable public attention has been paid to the potential for children and adults to be exposed to PAHs through skin contact, including inside the mouth.

While current EU legislation already limits PAH levels in consumer products, these new methods give laboratories a novel, sensitive and cost-effective analytical method to determine PAH content in rubber and plastic. They will also enable tests to be carried out to reliably determine the migration rate of PAHs from such products, should a migration-based limit for PAHs be considered in the future.

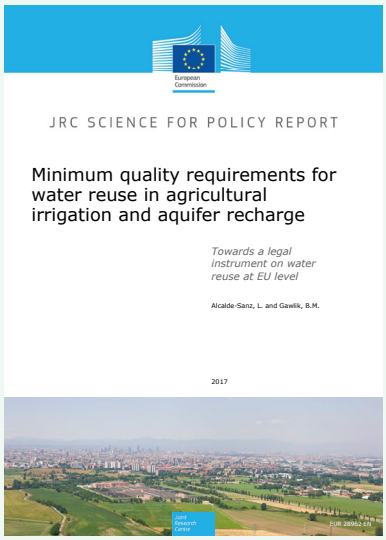
The novel and more sensitive analytical methods, together with new insights into the migration behaviour of PAHs from different types of plastic and rubber materials, provided by JRC scientists as an outcome of this project will contribute to the discussion about the revision of the PAH limit values in the REACH Regulation and to possible future standardisation work in this domain.

This will also enable owners and operators of sports fields to determine compliance with limits that could be proposed in the context of the ongoing REACH restriction revision process.

MINIMUM QUALITY REQUIREMENTS FOR WATER REUSE IN AGRICULTURE

Water scarcity and shortages are a growing problem around the world. Pressures from droughts and urban development, exacerbated further by climate change, have put a strain on freshwater supplies in Europe, too. Recycling waste water has become increasingly important for improving efficient water use.

Agriculture – especially agricultural irrigation – is one area which offers many opportunities for reusing treated waste water. However, before recycled water can be reused in agriculture, it must meet the necessary safety and quality standards to safeguard human health and the environment.



The JRC has published a report on the minimum quality requirements for the use of treated waste water for agricultural purposes.

At the moment, a lot of the waste water which could be reused is wasted. We are not using the available water to its full potential. In support of the EU's efforts to encourage efficient use of water, the report assessed the health- and environment-related risks linked to the reuse of waste water in agricultural irrigation, and developed the minimum quality requirements to be respected so that recycled water can be used safely in agriculture.

The report establishes the microbiological and physico-chemical parameters, the associated limit values and monitoring frequencies for the use of treated waste water in agricultural irrigation. It also defines the preventive measures to be adopted and establishes the main elements for the implementation of a risk management framework, as recommended by the World Health Organization.

The JRC report is an important contribution to the EU's circular economy objectives. It was used as the basis for defining EU legislation on the reuse of water in agriculture, notably the Commission proposal for a new Regulation on the use of treated water for irrigation, which was adopted in May 2018. The impact assessment that accompanied the proposal was also largely based on a 2017 JRC policy report Hydro-economic analysis on the potential of water reuse for agricultural irrigation in the EU.

NEW EU EMISSION STANDARDS FOR WASTE TREATMENT AND GUIDANCE FOR INDUSTRIAL INSTALLATIONS

New emissions and efficiency standards emerged from a review of the best available techniques (BAT) reference document (BREF) for waste treatment. The BAT conclusions provide national authorities with the technical basis for lowering the environmental impact of existing waste-treatment installations and setting permit conditions for new ones. The JRC led the drafting of the BAT conclusions through its European Integrated Pollution Prevention and Control Bureau with the involvement of experts from industry, EU public authorities, environmental NGOs and other European Commission services.

While the main aim is to reduce emissions, other environmental issues – such as energy efficiency, resource efficiency (water consumption, reuse and recovery of materials), prevention of accidents, noise and odour, management of residues – are also covered. The BAT conclusions also include standards for how the technology is used and how installations are designed, built, maintained, operated and decommissioned.

The BAT conclusions include BAT-associated emission levels (BAT-AELs) which have the potential to drive a significant reduction of emissions from the waste-treatment sector when translated into emission limits. They apply to the most

common waste treatments, including mechanical, biological and physicochemical treatments and treatment of water-based liquid waste, as well as to temporary waste storage and independent waste-water treatment plants.

The existing waste-treatment installations (i.e. first permitted before the publication of the BAT conclusions) have four years to comply with the new standards; new installations must comply immediately.

In a related development, the JRC published a new guidance document to help Member State competent authorities regulate emissions to air and water from large industrial installations. The new guidance does not include BAT conclusions, but supports their implementation and drafting and contains useful information for operators. The report will facilitate the development of new or improved environmental standards in the future.

SUPPORTING MEMBER STATES AND THE COMMISSION IN TACKLING FOOD QUALITY AND FOOD FRAUD ISSUES

The issue of dual quality foods in the single market was discussed in April 2018 in a European Parliament event gathering industry and consumer representatives, politicians, and policymakers to assess progress and explore the way forward. At this occasion, Tibor Navracsics, Commissioner for Education, Culture, Youth & Sport, responsible for the JRC, announced a new EU harmonised testing methodology for comparing food quality characteristics. He also presented the work of the JRC-operated Knowledge Centre for Food Fraud and Quality.

In recent years, studies in some Member States had uncovered differences in the composition or characteristics of certain branded foods, but based on different approaches, their results were not readily comparable. The new harmonised methodology makes recommendations for the selection of products, their sampling and testing and data interpretation. It can be used to assess objectively the differences between food products offered on the Internal Market. It was developed by the JRC in close cooperation with food supply chain stakeholders, Member States experts, and relevant Commission services. It also served as a basis for a pan-European testing campaign which was launched end of 2018 with expected results in early summer 2019.

The Knowledge Centre for Food Fraud and Quality was launched in March 2018 as a network of experts in and outside the Commission, providing EU policymakers and national authorities with access to up-to-date scientific knowledge on food authenticity and food quality issues. It notably coordinates market surveillance activities, operates an early warning and information system on food fraud, links information systems of Member States and the Commission, and generates country-specific knowledge.

In another 2018 development related to food and nutrition, JRC scientists have compiled a report which indicates the sugar contents of several food and drink categories available on the European market in 2015. It provides a baseline to monitor implementation of sugar reduction initiatives and supports the EU target to reduce added sugars by a minimum of 10 % by 2020.

SUPPORTING CUSTOMS POLICIES AND THE FIGHT AGAINST CUSTOMS FRAUD

Customs play a crucial role in the implementation of the Internal Market. As the volume of traded goods arriving and leaving the EU continues to grow, customs authorities need to persistently improve the efficiency and effectiveness of their controls protecting the financial interests of the Union as well as its safety and security. The recent amendment to

the legislation (EC) 515/97 gave EU customs access to a new source of information on the status and movement of all shipping containers transporting goods to the EU by maritime means. However, the nature and volume of the currently accessible data challenges the effective use of this new source of information.

The JRC collaborated with the Directorate General for Taxation and Customs Union and the European Anti-Fraud Office (OLAF) to develop the ConTraffic prototype data analysis and visualisation system. This prototype demonstrates a number of techniques that enable customs officers to use the new source of information efficiently on the status and movement of shipping containers. It is used systematically by customs officers around Europe in their daily work. In 2018, the JRC provided support to OLAF in the implementation of an operational system based on the technology developed in ConTraffic. The ConTraffic prototype was also used in the pilot analysis of millions of import declarations and provided indications to customs officers about potential fraud cases. JRC support in the customs anti-fraud domain was extended even further in 2018 with a new project, in collaboration with OLAF, on the mapping of data and best practices in the EU and sharing knowledge in this domain by establishing a community of practice and organising visits and workshops.

The JRC also concluded a study on the importance of the new data source on the movement and status of shipping containers for customs risk management. The report not only demonstrates and documents the importance of using analyses of real customs data but also proposes solutions and methods for the integration and use of this new data source in customs operations.

READ MORE

- **JRC experts share insight on the updated EU Bioeconomy Strategy**
  The JRC played a key role in the preparation of the updated EU Bioeconomy Strategy. It provides the Commission services with data, models and analyses of EU and global biomass potential, supply, demand and sustainability.
  https://europa.eu/!mk84BN

- **Distribution of bumblebees across Europe**
  Declining plant and crop pollination is threatening ecosystems and agriculture. Scientists have mapped the distribution of bumblebees in Europe and created a predictive map to monitor and mitigate bumblebee decline.
  https://europa.eu/!MD79QV

- **First global seafood consumption footprint published**
  Global seafood consumption has more than doubled in half a century. Currently at over 20 kg per capita per year, it challenges the sustainability of fish stocks and puts the impact of seafood supply chains under scrutiny.
  https://europa.eu/!pw93YP

- **Predicting the spread of an invasive pest threatening EU forests**
  JRC scientists co-authored a published article describing a new spread prediction model of the pine wood nematode, which is most harmful for EU forests and, as such, is regulated as a 'quarantine pest' under EU law.
  https://europa.eu/!fF44Qw

- **Record high profits for EU fishing fleet, 2018 report finds**
  The 2018 Annual Economic Report on the EU Fishing Fleet shows record peak levels in the economic performance of the EU fishing fleet in 2016 and closely links this achievement to the use of sustainable fishing methods.
  https://europa.eu/!hN64cb

- **Securing raw materials for the future**
  The Raw Materials Scoreboard 2018 points to some encouraging signs of development and recovery in the raw materials sector, although more efforts are needed to diversify supply and increase the use of secondary materials.
  https://europa.eu/!uT73Cg

Towards a new policy for migration

In May 2015, the European Commission presented a comprehensive European Agenda on Migration intended to address immediate challenges and equip the EU with the tools to better manage migration in the medium and long term in the areas of irregular migration, borders, asylum and legal migration. The European Agenda on Migration has guided the EU's response to immediate challenges, and the work now focuses on long-term solutions to equip Europe with future-proof means of managing migration responsibly and fairly.

Contributing to this Agenda, in 2018, the JRC issued – in the context of the Knowledge Centre on Migration and Demography — the Atlas of Migration as well as the International Migration Drivers report, and together with the International Organization for Migration (IOM) launched the Big Data for Migration Alliance (BD4M).

BETTER DATA FOR EVIDENCE-INFORMED MIGRATION POLICY

A major challenge to effective migration policy is the need for a comprehensive evidence base. There are official statistics, but migration phenomena are complex and only part of them can be captured through these statistics. In addition, there is an emerging pool of potential data sources that could provide valuable, real-time insights, but which remain largely untapped at the moment.

Through the European Commission's Knowledge Centre on Migration and Demography (KCMD), the JRC is helping to ensure that policymakers are equipped with the tools they need to source and make use of existing available data and the potential of innovative data sources.

The JRC Science for Policy report 'Towards an EU Policy on Migration Data' shows where policymakers get most of their data, and where the biggest gaps are. The report also highlights approaches to make better use of existing data – such as the increasing use of administrative data – to produce more frequent and timely migration statistics. In addition, the report reflects on the opportunities presented by new sources such as Big Data.

The KCMD also launched the BD4M this year, together with IOM's Global Migration Data Analysis Centre. The Alliance promotes dialogue and collaboration among policymakers, international organisations, NGOs, data providers, national statistical offices and researchers. It aims to harness the potential of Big Data sources for migration policymaking while ensuring ethical data use and individual privacy protection. At the launch, the JRC presented a methodology to estimate the number of foreign-born people living in a given country, based on data from the Facebook advertising platform.

In December, world leaders met at the UN Intergovernmental Conference in Marrakech to adopt the Global Compact for Safe, Orderly and Regular Migration.

The JRC and the International Centre for Migration Policy Development co-organised an official side event exploring the latest evidence on the drivers and root causes of migration, as well as the latest tools and approaches available for effective migration policy design.

WHAT CAUSES PEOPLE TO MIGRATE?

A global analysis of intentions to migrate found that individuals preparing to move abroad are more likely to do so out of aspiration for a better life, economic opportunities and development of skills, rather than sheer desperation. JRC scientists analysed intentions to migrate in different forms: the desire to move abroad, actual plans, and preparations. While being dissatisfied with one's own standard of living is associated with a higher probability to desire and plan a move abroad, the link with making concrete preparations is less obvious.

Building on these and other findings, the JRC also released a Science for Policy Report which uses the best available data to quantify the relative importance of different factors that shape international migration. 'International Migration Drivers' confirms that the key drivers of international migration are mainly structural: economic development in countries of origin, migrants' social networks and demographic change. The report helps policymakers to better understand current and potential future trends across the world.

Both the European Agenda on Migration and the Global Compact for Safe, Orderly and Regular Migration, explicitly state the need to improve the management of migration by addressing the "root causes which cause people to seek a life

elsewhere" and "mitigating the drivers and structural factors … that compel [people] to seek a future elsewhere". Despite using different terms, such as drivers, root causes, determinants and push-and-pull factors, the rationale behind these statements is the same: the management of migration requires a deep understanding of what determines migration in the first place.

This research builds a bridge between the complexity emerging from research and the need for digestible answers for policy. Taking a quantitative approach, JRC scientists are addressing this complexity by exploring how multiple drivers of migration change in relation to countries' development stages and the different dimensions of migration. The study establishes anchor points built upon empirical evidence to support discussions about the future of migration. If policies are to address the structural factors driving international migration, such as poverty, unemployment and demographic trends, then a long-term approach is vital.

ILLUSTRATING THE EVIDENCE WITH A NEW ATLAS OF MIGRATION

The first issue of the Atlas of Migration provides insights on migration for all EU Member States and 44 non-EU countries. With data visualisations and maps, it gives a snapshot of migration in 2017, providing a knowledge base for use by policymakers in migration and related areas, relevant stakeholders, businesses, researchers and the general public.

The publication presents the available data on a range of migration-related fields in a format that is both easy to access and to understand – and which can help policymakers and citizens alike to get a good grasp of migration-related issues. It condenses statistics from multiple sources, including Eurostat for the EU Member States and several international statistical sources for non-EU migration profiles and thematic analysis.

The Atlas is structured around three sections, each with a distinct focus. Migration profiles of EU Member States provide an annually updated picture of demography, migrant stocks and flows, legal migration, asylum, irregular migration, naturalisation and integration. Non-EU migration profiles cover similar aspects to those of the EU country profiles for 44 key countries of migration origin and transit, with additional information on development and humanitarian aid, remittances and socio-economic characteristics. A thematic analysis presents details and trends in 2018 on forced displacement in Africa. The thematic analysis will change with each annual edition of the Atlas.

The annual publication of the Atlas gives a snapshot of the situation each year, visualising the data in an easy-to-understand format. A set of online resources accompanying the book will be made available in early 2019, enabling the interactive exploration of its data.

With better and broader global data in the future and the visual presentation approach adopted in the Atlas, the European Commission's KCMD hopes to build a more complete picture of migration around the world.

NEW PERSPECTIVES ON AFRICAN MIGRATION

The number of people in Africa moving from their home country is set to increase in line with population growth over the coming decades, according to the findings of a joint study from the JRC and the European Political Strategy Centre (EPSC).

Scientists analysed past and present migration patterns from and within Africa, as well as the drivers behind them. Their findings give insights on the potential effects of policy decisions on migratory flows, and project potential scenarios for the future, up to 2050.

Every year, some 1.4 million Africans leave their country of birth for a longer period of time or for good. This is

expected to reach 2.8 to 3.5 million per year by 2050, in line with population growth. Although 27 % of Africa's adult population would like to move to another country, only 1 % is actively preparing for such a move and only 0.12 % of all Africans actually migrate annually.

On average, Africans who take concrete measures to migrate are likely to be better educated and economically in a better position than those who want to migrate but have not taken concrete steps to do so. Factors stopping people from taking such steps may include a lack of the necessary economic means or information. More than 50 % of all those who prepare their departure have completed secondary or tertiary education.

Socio-economic development, better education, job creation and improved income opportunities contribute to higher migration. Direct investment in the continent and in general economic development will reduce population growth and improve living conditions, and will also improve the ability of people to migrate. The study finds a nonlinear relationship between GDP, income and emigration rate.

And it will take around 30-40 years until the majority of African countries reach a GDP per capita threshold whereby emigration becomes less likely.

Climate change will also remain a key determinant for migration. Its destabilising effects will potentially accelerate future migration within Africa and to neighbouring parts of the world.

DATA CHALLENGE PROVIDES INSIGHTS ON MIGRATION AND LOCAL INTEGRATION

In November, JRC scientists and researchers from across Europe presented the final results of the Data for Integration (D4I) challenge, which gave researchers access to a unique dataset on migration and diversity at the local level.

The final results include maps showing the extent to which migration is not just limited to big cities, with rural areas and small towns being increasingly characterised by high levels of social and cultural diversity.

The D4I dataset covers 8 countries and 45 000 local administrative units, with details down to street level. JRC scientists generated maps by harmonising and spatially processing official 2011 census statistics collected from national institutes in France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain and the UK.

Challenge participants explored the impact of migration and diversity on policy-relevant issues such as housing markets, the level of segregation within cities, and access to services. They also looked at the possibility that support for anti-immigrant parties might be stronger among those people who live in areas with the lowest concentration of migrants in the community.

The results provide useful information on the diverse communities living in the EU and open new windows of analysis for understanding the local impact of migration across the continent.

Insights such as these also provide policymakers with a better overall picture to develop local policies that help migrants integrate in their host countries. The project supports the Commission's aim to facilitate evidence-based migrant-integration policies.

The JRC also took part in the 5th Global Mayoral Forum, a city-led dialogue on migration and development supported by local, regional and international partners. At a breakout session organised together with the City of Athens, the JRC demonstrated how it is contributing to the implementation of the Global Compact for Migration at EU city level with data, tools, platforms and analyses – including the new insights offered by the D4I initiative.

READ MORE

- **Future of populations and migration**
  If population dynamics remain similar to the averages between 1960 and 2015, the EU population could grow to 512 million by 2035, while that of sub-Saharan Africa could double to around 2.2 billion by 2060.
  https://europa.eu/!Jd76hj

- **Migrant workers and digital transformation in the EU**
  Although digital transformation may be opportune for workers with the right skills, the tasks of others could soon be taken over by computers. Migrant workers are in a more precarious position compared to others, a JRC study finds.
  https://europa.eu/!Fk86bT

- **A gateway to knowledge on migration**
  A new web portal allows any user – whether analyst, scientist, policymaker or interested citizen – to access a wealth of information related to migration flows, trends and their impact on societies across the EU.
  https://europa.eu/!Wg33qR

A stronger global actor

Today's interconnected and interdependent societies are facing unprecedented global challenges and transnational security threats, such as climate change, extreme poverty and instability. However, this also opens up new opportunities for more sustainable development, equity and peace. For Europe, it also represents the opportunity to show leadership and promote its values and vision on current and future global challenges.

To that effect, in 2018, the JRC significantly increased its cooperation and capacity-building activities with the African continent, not least on critical themes such as food security and desertification. Improved connectivity with Asian countries is also an area where much progress has been made. The JRC is also addressing threats from chemical, biological, radiological, nuclear and explosive materials (CBRN-E) threats and emergency preparedness at a global level. Last but not least, it continues to contribute valuable climate and environmental expertise that extends way beyond EU borders.

STUDY AND ONLINE TOOL MEASURE HOW WELL EUROPE AND ASIA ARE CONNECTED

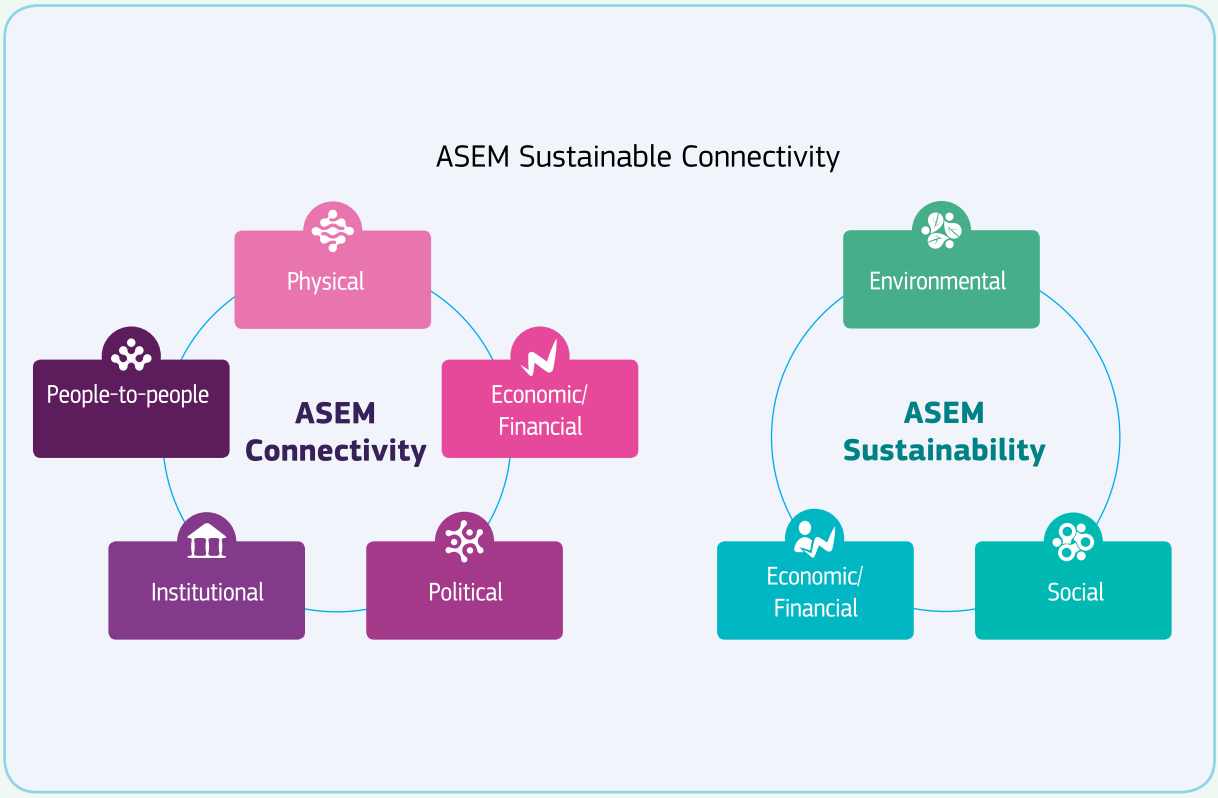
In October 2018, at the occasion of the 12th Asia-Europe Meeting (ASEM) summit in Brussels, the European Commission presented the ASEM Sustainable Connectivity Portal – a JRC-developed online tool offering a wealth of data on the political, economic and social relationship between the two continents.

The Portal and its accompanying study, Exploring ASEM sustainable connectivity. What brings Asia and Europe together? offer insights into the state of connectivity between 30 European countries, 19 Asian countries, Australia and New Zealand (together representing the ASEM countries). According to the study, connectivity inside Europe and inside Asia is currently five times stronger than connectivity between Europe and Asia.

The potential to enhance these links is substantial, not only in terms of economic gains. The study demonstrates that better connected countries have lower levels of poverty, more equal societies, more students in tertiary education, a freer press and lower levels of corruption, and better inclusion of minorities.

The Connectivity Portal is meant to help policymakers, businesses, investors and researchers to identify gaps in cooperation, and better exploit the untapped potential. It gathers in one place a wealth of connectivity-related data coming from a range of international sources and original research for the 51 ASEM countries and, for the first time, putting the spotlight on the importance of sustainable connectivity.

A total of 49 indicators – ranging from the number of border crossings, the quality of network connection, through the number of embassies, technical barriers to trade, common language users, to CO_2 emissions per capita and the proportion of youth not in education, employment or training – are grouped into two composite indicators.



Multidimensional nature of ASEM Sustainable Connectivity.

The 'connectivity index' measures cross-border connectivity in physical, economic/financial, political, institutional and people-to-people dimensions. The 'sustainability index' measures sustainability related to connectivity.

STEPPING UP COOPERATION WITH AFRICA

In 2017, the landmark publication of the JRC's Africa Report and its successful promotion during the Abidjan EU-AU Summit manifested a renewed and improved cooperation between African stakeholders and the EU in a number of scientific areas. Throughout 2018, The JRC continued to build upon this momentum, sustaining it continuously.

Noteworthy is the expansion of the JRC's territorial and urban development research focus to include African cities and territories. The JRC cooperated with the relevant Commission Directorate Generals, the Union for the Mediterranean, and United Nations-Habitat to produce simple land-use maps and indicators for African regions and cities, and future African urban scenarios until 2050.

In March, the JRC took part in the Next Einstein Forum in Kigali, Rwanda, with the aim of connecting science, society and policy, leading Africa along the path of innovation and fulfilling the potential of its youth. At the Forum, a JRC side event discussed scientific capabilities in Africa, reflected on the challenge of delivering knowledge to support decision-making, and discussed fostering innovation in Africa, notably through the smart specialisation approach.

As a follow-up to the 'Commission Communication on a new Africa-Europe Alliance for Sustainable Investment and Jobs: taking our partnership for investment and jobs to the next level', the JRC also created an internal task force on Africa. Its core objective is to support and have the desired impact on the future implementation of the Africa-EU Partnership Agenda which has been rapidly evolving away from the traditional donor-based model towards long-term cooperation on jointly identified, mutual and complementary interests.

In December in Pretoria, the JRC also organised a capacity-building seminar on evidence-informed policymaking in Africa, in cooperation with pan-African partners: the African Union Commission, African Academy of Sciences and the International Network for Government Science Advice – Africa branch, as well as UK Research and Innovation and South Africa's Department of Science and Technology.

IRAN-EU: SUPPORTING THE IMPLEMENTATION OF THE JOINT COMPREHENSIVE PLAN OF ACTION

The Joint Comprehensive Plan of Action (JCPoA) is the culmination of 12 years of diplomacy facilitated by the EU, unanimously endorsed by UN Security Council Resolution 2231. The JCPoA is a key element of the global effort for nuclear non-proliferation and crucial for the security of the region. Its successful implementation continues to ensure that Iran's nuclear programme remains exclusively peaceful.

In 2018, the JRC initiated cooperation with Iranian scientists on research and trainings (together with the Directorate General for Research and Innovation) and hosted several visits to its Ispra, Geel and Petten sites, offering training and capacity-building in areas such as safety and radiation protection. In November, nine Iranian scientists also took part in a JRC-organised seminar on radioactivity measurements and metrology. The JRC and Iran's Nuclear Science and Technology Research Institute agreed to define and implement a joint research project on 'Capability building and improvement of traceability of nuclear measurements'.

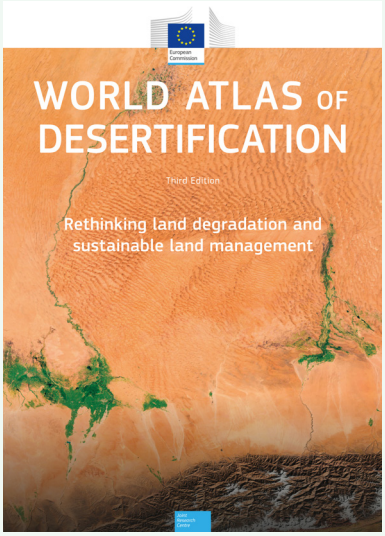
The JRC provides ongoing technical and scientific support to the European External Action Service in its role of coordination in the JCPoA implementation, be it through its participation in coordination and technical meetings of E3+3 (China, France, Germany, Russia, United Kingdom, United States) and Iran, or in the working group on the modernisation of the Arak heavy water research reactor related to its redesign and reconstruction to reduce plutonium output. The JRC is also contributing to the technical elaboration of the proposals for the Fordow facility conversion.

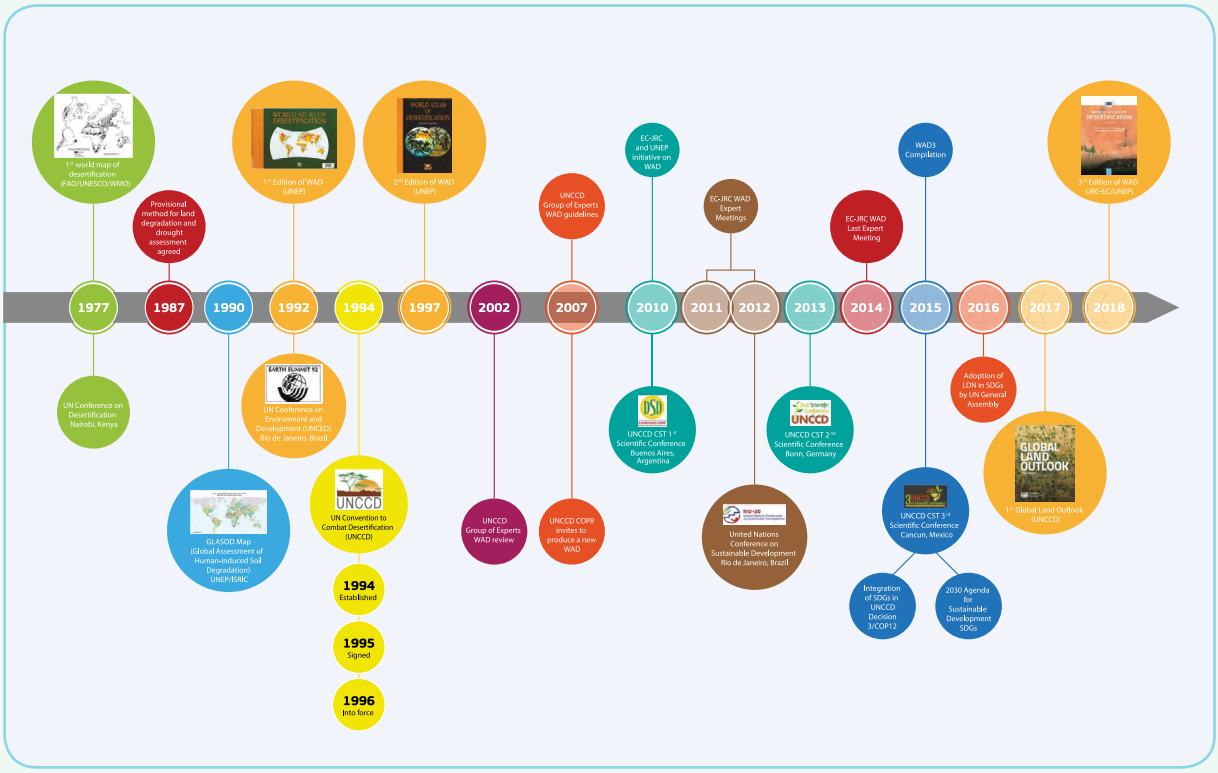
Furthermore, the JRC is supporting the implementation of technical projects funded under the EU instrument for nuclear safety cooperation under the responsibility of the Directorate General for Development and Cooperation (DG DEVCO). These include capacity-building by the Iranian nuclear regulatory authority, the design of a nuclear safety centre, and support to both the regulatory authority and the operator of the Bushehr Nuclear Power Plant to perform nuclear 'stress tests'. The JRC has also supported DG DEVCO on defining the scope of cooperation with Iran on developing export control, a key element of the JCPoA.

NEW WORLD ATLAS OF DESERTIFICATION SHOWS UNPRECEDENTED PRESSURE ON NATURAL RESOURCES

Twenty years after the last edition, the JRC published a new edition of the World Atlas of Desertification which unfortunately shows that pressures on land and soil have increased dramatically. This new and much more advanced edition of the Atlas gives policymakers comprehensive and easily accessible evidence-based insights into land degradation, its causes and potential remedies to tackle desertification and restoring degraded land.

The Atlas provides examples of how human activity drives species to extinction, threatens food security, intensifies climate change and leads to people being displaced from their homes. The main findings show that population growth





International efforts to combat desertification stretch back to 1977, with several milestones along the way.

and changes in our consumption patterns are putting unprecedented pressure on the planet's natural resources.

Over 75 % of the Earth's land area is already degraded, and over 90 % could become degraded by 2050. Globally, a total area of half the size of the EU (4.18 million km2) is degraded annually, with Africa and Asia being the most affected. The economic cost of soil degradation for the EU is estimated to be in the order of tens of billions of euros annually.

Land degradation and climate change could lead to a 10 % reduction in global crop yields by 2050. Most of this will occur in India, China and sub-Saharan Africa, where it could halve crop production.

While land degradation is a global problem, it takes place locally and requires local solutions. A greater commitment and more effective cooperation at the local level are necessary to stop land degradation and biodiversity loss. Further agricultural expansion, a leading cause of land degradation, could be limited by increasing yields on existing farmland, shifting to plant-based diets, consuming animal proteins from sustainable sources and reducing food loss and waste.

The Atlas also presents a large number of facts, forecasts and global datasets that can be used to identify important biophysical and socio-economic processes which, on their own or combined, can lead to unsustainable land use and land degradation.

JRC SHARES INSIGHT WITH THE INTERNATIONAL COMMUNITY ON EMERGENCY PREPAREDNESS AND RESPONSE

An emergency situation, whether natural or human-made, is a challenge both for political leaders and for the authorities responsible for managing the related crises. Governments need a structurally robust system to

effectively cope with the complexity, novelty, uncertainty, and social expectations inherent in modern crises.

To assess similarities in emergency preparedness and response across sectors, identify lessons learned and set out good practices for the nuclear sector, the JRC has joined forces with the Nuclear Energy Agency (NEA) and the OECD. The results of this collaboration are published in NEA's report Towards an all-hazards approach to emergency preparedness and response (OECD NEA EPR).

The JRC's contribution includes a number of recommendations based on insights related to emergency preparedness and response from in-depth analyses of chemical accidents, as well as natural hazard-triggered technological (Natech) accidents, using data from the JRC's Major Accident Reporting System (eMARS) and its Natech accident database (eNATECH).

The JRC's scientists notably recommended boosting preparedness to limit the damages and long-term impacts of a disaster. To that effect, it is vital to keep track of lessons learned from past events, identify gaps in emergency preparedness, and find innovative ways to manage both expected and unexpected parts of the response. Training and coordination between internal and external responders on site-specific scenarios is another critical element of preparedness, especially in chemical and Natech accidents.

Natech accidents pose specific challenges since several accidents can happen simultaneously and impact large areas, affecting people, the natural and built environment, as well as neighbouring industry and infrastructures. So on- and off-site emergency plans for accidents involving hazardous materials should take into account the risks from natural hazards, and on-site emergency plans should assume that off-site response resources are unavailable under natural disaster conditions.

ENHANCING THE FRAMEWORK AGAINST CBRN-E THREATS

The JRC is strengthening its support for the EU Action Plan to enhance preparedness against chemical, biological, radiological and nuclear security risk by developing cross-cutting umbrella initiatives to holistically address the threats, gaps and challenges, capacity-building (detection; dual use applications, strategic trade and export control; precursors; prevention; protection; standardisation), event cycle (anticipation; preparedness; detection; crises

management; response; recovery and forensics; adaptation; lessons learned), interoperability and harmonisation, and internal and external dimensions.

Concrete examples of JRC activities include the development of online training courses and handling new projects within the chemical, biological, radiological and nuclear risk mitigation centres of excellence (CBRN-CoE) initiative. For instance, the JRC concluded a review of detection methodology and portable devices for bio-threats and has launched a similar action for the chemical threat. It also continued its activities in the field of dual-use materials, i.e. materials with civil applications that might also be used for a military purpose, notably its support for the EU Partner-to-Partner Capacity-Building in Dual-Use Export Control. The JRC also strengthened its actions on precursors (innocent chemical compounds which, when combined, might produce a dangerous substance) and reinforced internal collaboration to handle this specific thematic.

In aviation security, the JRC has developed a test kit to verify the performance of explosive trace detection (ETD) equipment. In 2018, the test kit was made available to Member State authorities, and dedicated training courses were given at JRC Geel. The Commission's ETD test kit is now used across European airports and has become a de-facto standard for the performance assessment of deployed ETD equipment.

In general, the JRC continued to contribute to creating a more robust EU framework for reducing the threats of CBRN-E attacks and incidents, strengthening security measures, increasing resilience and preparing for an effective response in case prevention fails.

OBSERVING THE ARCTIC PROVIDES BENEFITS BEYOND CLIMATE CHANGE INSIGHTS

Accelerated warming and rapid environmental changes in the Arctic require a sustained, integrated and pan-Arctic observing system, capable of giving timely access to information and data about the Arctic, better documenting processes within key sectors and better informing decision-making. Within this context, long-term investments in research, operational infrastructure and logistical support services are essential.

The JRC produced a cost-benefits analysis of Arctic observing systems under the European Commission's Impact Assessment on a Long-Term Investment on Arctic Observations (IMOBAR) project, which makes the case for sustained, long-term Arctic observation.

Scientists assessed 10 case studies to identify the impact of insights gained from monitoring the Arctic. They concluded that the societal benefits of Arctic observation far outweigh the investment required to conduct it.

Even in a very conservative scenario, with the lowest total benefits compared with the highest total costs and considering the range of uncertainties and underestimates, annual economic benefits from the limited number of economic activities considered exceed the total annual investments in Arctic observing systems by at least 50 %. For the next decade, the report identified overall observation-linked economic benefits of between EUR 183 and 341 million per year, from the required annual investments ranging from EUR 70 to 135 million.

Additional economic returns may be expected from impacts on human health, ecosystem preservation and global benefits such as predicting global sea-level rise. While the study focused on local-to-regional benefits, the proposed analytical framework can be further developed to account for the societal benefits of Arctic observing systems beyond the Arctic region.

The study was an EU contribution to the Second Arctic Science Ministerial conference held in Berlin from 25 to 26 October 2018, which produced a joint statement signed by representatives of 26 nations on international research collaboration in the Arctic.

JRC WORK SUPPORTS REDEFINING THE QUANTITY IN THE NEW SI (SYSTEM OF UNITS)

The International system of units, SI, has been transformed from a system of manmade objects, towards the application of devices using certain selected natural constants as a base. This is the largest revision of the SI system since 1890.

Already in 1983 (at the 18th General Conference on Weights and Measures, CGPM) the unit of time (the second) and the unit of length (the metre) were defined in terms of natural constants.

At the recent, 26th, CGPM it was decided, among other things, to replace the kilogram artefact, which over time has shown to be the hardest change to make.

JRC made two important contributions to the work in introducing the explicit constant formulation of SI. First it helped determining the isotopic purity of the material Si-28 used in the Avogadro project (which was important in this redefining of kilogram as it provided accurate measurement of the Plank constant). Second, it helped determine Boltzmanns constant, k, via acoustic resonance in argon at the triple point of water, JRC contributed by determining the purity of the argon gas used.

The EU citizens will not notice anything in their daily life. Buying a kilogram of bananas or potatoes will be the same as before. The main impact is where accurate measurements are a basic prerequisite, like in science, engineering, industry, health and commerce. In addition, accurate and traceable measurements contribute to better management of resources, sustainable growth, a clean environment, and to a better world to live in.

READ MORE

- **Global Report on Food Crises sheds light on 2017 status**
  Major risks of famine were averted in the four countries declared at risk in early 2017: Yemen, Somalia, South Sudan and North Nigeria. But the severity and complexity of food crises around the world remain.
  https://europa.eu/!QX96Dr

- **JRC launches largest database on cities**
  Covering every high-density area of at least 50 000 inhabitants, i.e. 10 000 urban centres across the globe, the city centres database shows growth in population and built-up areas over the past 40 years.
  https://europa.eu/!ku33Ry

- **Global hotspots for potential water disputes**
  JRC scientists have identified the hotspots where countries compete over the use of shared water resources could lead to disputes. The study aims to support strategies to encourage cross-border cooperation.
  https://europa.eu/!ng88Rp

- **Contributing to the IAEA Symposium on International Safeguards**
  The JRC contributed broadly to the IAEA's 2018 symposium on 'Building Future Safeguards Capabilities', with no less than 11 abstracts and 3 panel chairs, 9 panel presenters, 4 round-table members, and 3 interactive-corner speakers.
  https://tinyurl.com/y9fvyg2h

- **JRC analysis assists response to Laos dam collapse**
  The JRC provided situation maps and analysis reports to the European Commission's Emergency Response and Coordination Centre, in collaboration with UN services and under the Global Disaster Alerting and Coordination System framework.
  https://europa.eu/!hU97KG

- **Carbon Offsetting and Reduction Scheme for International Aviation**
  The JRC has taken the lead on the methodology and computation of global default values for aviation alternative fuels moving towards reducing emissions and offsetting international aviation in the CORSIA scheme.
  https://europa.eu/!GU64vU

BOARD OF GOVERNORS: MEMBERS AND PARTICIPANTS

(as of 31 December 2018)

Members of the Board are high-level representatives from the EU Member States, while participants are representatives from countries associated with the Seventh Framework Programme or the subsequent Horizon 2020 Framework Programme.

Board members are nominated by the Commission upon designation by their country's authorities. They also act as JRC ambassadors in their respective countries.

Please visit: *https://ec.europa.eu/jrc/en/about/people/board-of-governors for an up-to-date list*

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Head of Department V/3, Federal Ministry of Science, Research and Economy.

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PARTICIPANTS

Dr Kirsten BROCH MATHISEN — Norway
Director, Division for Energy, Resources and the Environment, The Research Council of Norway.

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Head of EU Framework Programmes, Federal Department of Economic Affairs, Education and Research, State Secretariat for Education, Research and Innovation.

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Head of Department for Science, Ministry of Civil Affairs.

Mr Teimuraz MURGULIA — Georgia
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Prof. Viktor NEDOVIĆ — Serbia
Assistant Minister for International Cooperation and EU Integration, Ministry of Education, Science and Technological Development.

Dr Vardan SAHAKYAN — Armenia
Deputy Chairman, State Committee of Science of the Republic of Armenia.

Dr Ela STRAUSS — Israel
Director, Chemistry, Energy, Materials and Nanotechnology, Ministry of Science, Technology and Space.

Dr Arjan XHELAJ — Albania
Director-General, National Center RASH Academic Network of Albania.

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Vice-President, National Academy of Sciences of Ukraine.

Mr Mourad ZGHAL — Tunisia
Head of Doctoral Schools, Directorate-General for Scientific Research, Ministry of Higher Education and Scientific Research.

Dr Vladan BOŽOVIĆ — Montenegro
Assistant Professor in Molecular Biology and Physiology; University Donja Gorica.

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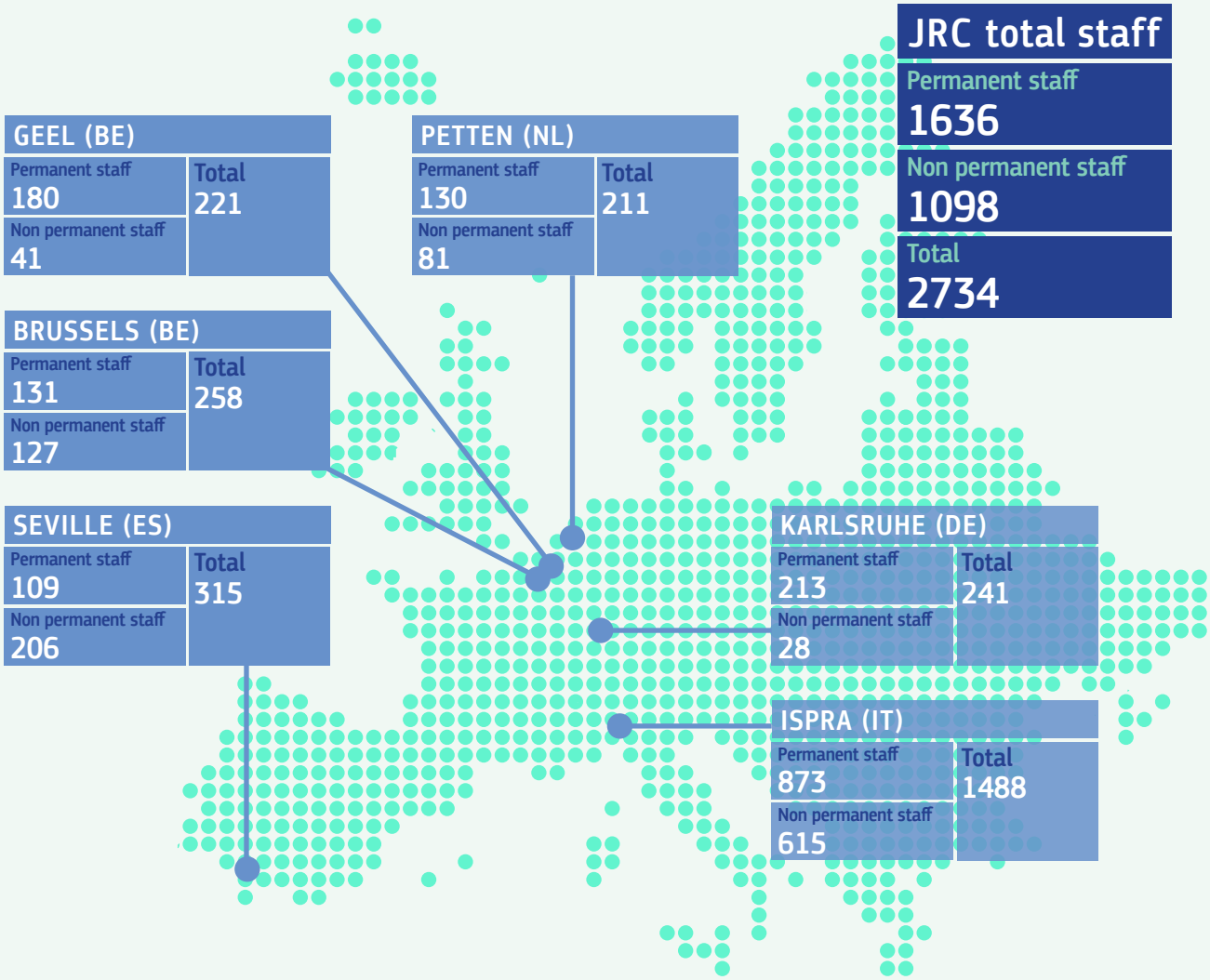
Ms Emanuela BELLAN
Head of Unit, Interinstitutional, International Relations & Outreach, European Commission, Joint Research Centre.

ASSISTANT

Ms Cynthia DENNIS
Interinstitutional, International Relations & Outreach, European Commission, Joint Research Centre.

JRC SITES MAP AND KEY FACTS AND FIGURES

(as of 31 December 2018)



* The JRC's biggest site is Ispra, where 59% of all active staff are located, followed by Sevilla (11%).
** The four other sites (Brussels, Geel, Karlsruhe and Petten) have a fairly equal number of staff (approx. 8%).

EQUAL OPPORTUNITIES

By the end of 2018, women represented 38 % of the JRC's active staff and 25 % of its administrator's (AD) function group.

The JRC is making a continuous effort to meet Commission targets for female staff holding management positions.

Positions (% female)	2016	2017	2018
Senior management	38.5 %	50 %	45 %
Middle management	14.9 %	13.6 %	17 %
Non-management administrators (AD)	24.1 %	25 %	25 %

JRC CONTRACTUAL INCOME

The value of contracts signed by the JRC in 2018 amounted to EUR 80.3 million. The table below shows the split of the contracts signed by 31 December 2018. These activities complement the tasks outlined in the JRC's work programme and are essential to acquiring and transferring expertise and know-how.

Contracts signed (in million EUR)	2017	2018
Indirect actions (framework programme)	10.9	7,8
Support to Commission services	99.7	66.3
Third party work	5.9	6.2
Total (rounded)	116.5	80.3

BUDGET

The JRC is funded by the EU's Framework Programme for research and innovation, currently Horizon 2020, and the EURATOM research and training programme. Further income is generated through additional work for Commission services and contract work for third parties.

The JRC's available credits are allocated to staff expenses, means of execution (maintenance of buildings and equipment, commodities, insurance, consumables, etc.) and specific expenses (direct scientific procurements) related to the research and innovation framework programme activities.

The table shows the breakdown of how the 2018 budget was spent (in terms of available commitment appropriations, EFTA not included). In addition, EUR 30.1 million was made available for the programme to decommission the JRC nuclear installations, and for EURATOM-related waste management. An additional EUR 28.2 million was received in the form of contributions from countries associated to Horizon 2020.

Outgoing expenditures (in million EUR)	2017	2018
Staff expenses	237.3	237.4
Means of execution	97.2	97.2
Operational appropriations (FP) €	38.0	39.1
Total (rounded)	372.5	373.7

STAFF

The total number of active staff working at the JRC on 31 December 2018 was 2734. Of the total, about 70 % of staff was work programme staff and 30 % support services staff. Work programme staff includes core research staff and technical support staff. Support services staff includes support entities and administrative support staff in scientific directorates.

European Commission

JRC – JOINT RESEARCH CENTRE
ORGANISATIONAL CHART – 1 MARCH 2019

STRATEGY & COORDINATION

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Vladimír ŠUCHA
BRUSSELS

Deputy Director-General
Maive RUTE
BRUSSELS

- Assistant to the Deputy Director-General
  .....
  BRUSSELS
- Adviser for Policy Communication
  Geraldine BARRY
  BRUSSELS

Principal Adviser for Generation IV
Thomas FANGHÄNEL
KARLSRUHE

Adviser for Policy Support
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- Adviser for Evaluation & Scientific Integrity
  Pieter VAN NES
  BRUSSELS
- Adviser for Scientific Development
  Marion DEWAR
  BRUSSELS

Assistant to the Director-General
Margarita NIKOLOVA
BRUSSELS

- Assistant to the Director-General
  Jean-Baptiste HERBOUT
  BRUSSELS

KNOWLEDGE PRODUCTION

B- Growth & Innovation
Luis DELGADO SANCHO (acting)
SEVILLE

- Adviser for Growth and Innovation - Seville Site Development
  Vicenzo CARDARELLI
  SEVILLE
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  ISPRA
- **B.2-** Fiscal Policy Analysis
  Daniel DACO
  SEVILLE
- **B.3-** Territorial Development
  Alessandro RAINOLDI
  SEVILLE - ISPRA
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  SEVILLE - ISPRA
- **B.5-** Circular Economy & Industrial Leadership
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  SEVILLE
- **B.6-** Digital Economy
  Alessandro ANNONI
  SEVILLE - ISPRA

C- Energy, Transport & Climate
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PETTEN

- Adviser site coordination and external relations
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  PETTEN
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  PETTEN
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- **C.5-** Air & Climate
  Elisabetta VIGNATI
  ISPRA
- **C.6-** Economics of Climate Change, Energy & Transport
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  SEVILLE

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  David MAIR
  BRUSSELS - ISPRA
- **H.2-** Knowledge Management Methodologies, Communities and Dissemination
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  ISPRA - BRUSSELS

B.7- Knowledge for Finance, Innovation & Growth
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C.7- Knowledge for Energy Union
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  Matthew KING
  ISPRA - BRUSSELS
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  Giancarlo CARATTI DI LANZACCO
  BRUSSELS

SUPPORT

R- Support Services Brussels
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BRUSSELS

- Adviser for Public Tendering & Compliance
  Eric FISCHER
  BRUSSELS
- **R.8-** Budget Execution
  Stanislav DRAPAL
  ISPRA - BRUSSELS
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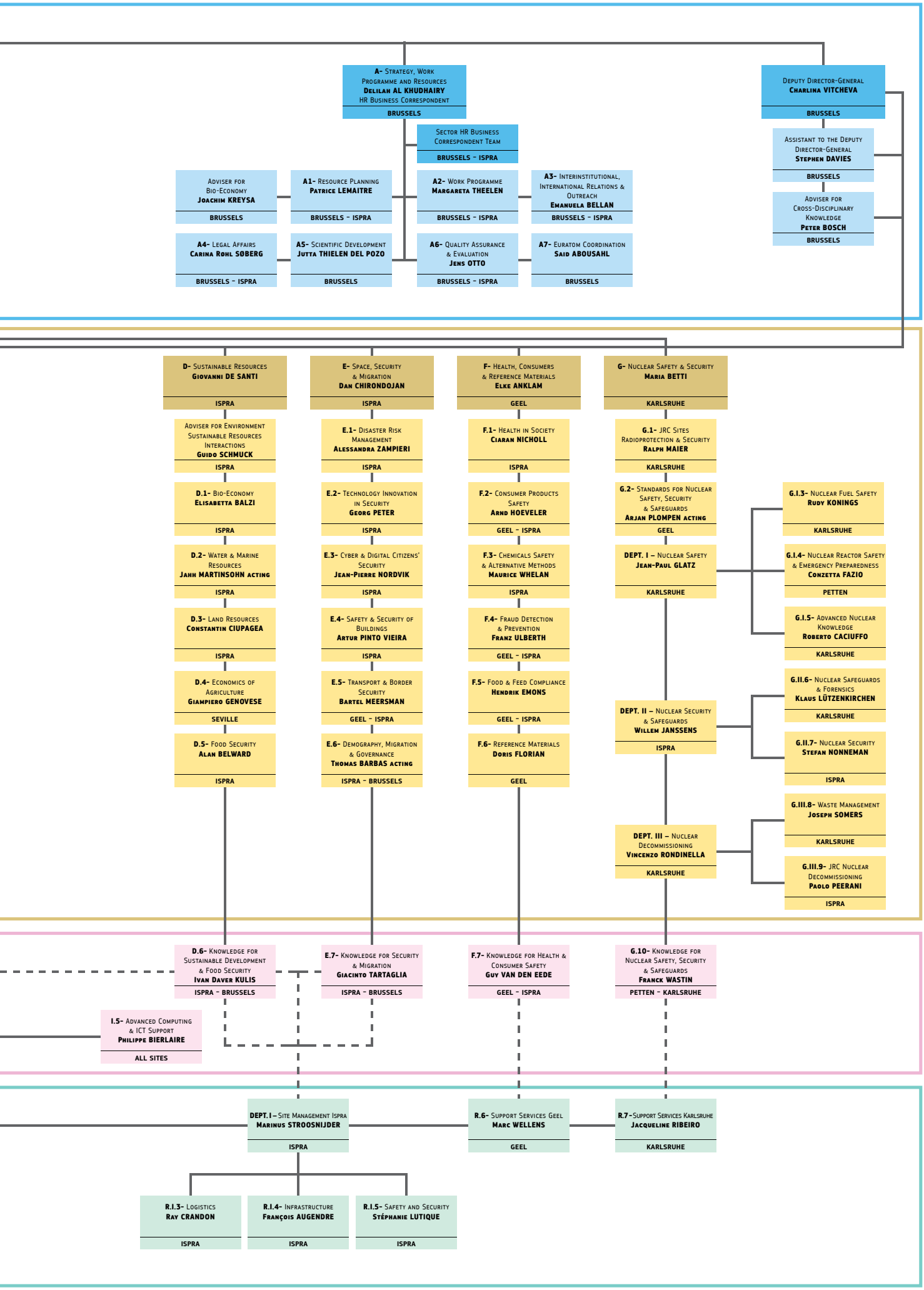
    ISPRA - BRUSSELS

R.1- Support Services Seville
Vincenzo CARDARELLI (acting)
SEVILLE

R.2- Support Services Petten
Francesco SCAFFIDI-ARGENTINA
PETTEN


A- Strategy, Work Programme and Resources
Delilah Al Khudhairy
HR Business Correspondent
Brussels
Sector HR Business Correspondent Team
Brussels - Ispra
Adviser for Bio-Economy
Joachim Kreysa
Brussels
A1- Resource Planning
Patrice Lemaitre
Brussels - Ispra
A2- Work Programme
Margareta Theelen
Brussels - Ispra
A3- Interinstitutional, International Relations & Outreach
Emanuela Bellan
Brussels - Ispra
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Brussels
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Brussels - Ispra
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Brussels
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Brussels
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Stephen Davies
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Geel
G- Nuclear Safety & Security
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Karlsruhe
Adviser for Environment Sustainable Resources Interactions
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Ispra
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Ispra
D.2- Water & Marine Resources
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Ispra
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Ispra
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Seville
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Karlsruhe
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Geel
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Ispra

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Annual Report 2018
Report on the activities, accomplishments and resources related to the JRC's work carried out in 2018. An overview is given of the scientific achievements and activities as well as of corporate initiatives.

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Contact information

European Commission
Joint Research Centre (JRC)
Interinstitutional, International Relations and Outreach
BE-1049 Brussels
Belgium

Emanuela Bellan, Head of Unit

Tel. +32 22953134

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https://ec.europa.eu/jrc

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