Joint Research Centre

Annual Report 2020

The European Commission's science and knowledge service

Joint Research Centre

Foreword by Commissioner Mariya Gabriel

2020 was a year of unprecedented challenges for Europe and the world. But it was also a year where Europe's leading science and research shone through, helping us take decisive action to meet the challenges and continue building a positive future together.

The Joint Research Centre's excellent work has been central to these efforts, providing solid scientific evidence and tools to make our policies more effective. The JRC showed impressive adaptability in 2020, refocusing right from the start of the coronavirus crisis to strengthen the EU's response, helping to protect lives and livelihoods - from ensuring that diagnostic tests are reliable to helping forecast potential recovery scenarios.

With close to 3,000 scientists working in six sites across the EU, the JRC's wide-reaching expertise will continue to be invaluable in the future. Not only for the response to the coronavirus pandemic, or for my own portfolio, but for actions at the very heart of the Commission's ambitions to help build a greener, more digital and more resilient Europe, which will benefit all EU citizens.

This is a view shared across the Commission, other EU institutions and in the Member States. It is reflected in the political agreement reached in December 2020 on Horizon Europe, the EU's research and innovation programme. Horizon Europe will have a budget of around €95.5 billion for 2021-2027, making it the biggest and most ambitious programme of its kind in the world. It will also enable the JRC to continue providing scientific advice, technical support and dedicated research well into the future.

I have set out several EU missions under Horizon Europe – commitments to solve some of the greatest challenges facing our world like fighting cancer, adapting to climate change, protecting our oceans, living in greener cities and ensuring soil health and food. On top of supporting these missions with scientific evidence and data, the JRC is leading concrete actions that will be essential to making them a success. The first of these came in 2020 with the launch of the EU Soil Observatory to track progress on making at least 75% of all European soils healthy by 2030. Several other actions are planned for 2021.

The JRC was also instrumental in the production of the Commission's first annual Strategic Foresight Report in 2020, which reflects the Commission's strategy to integrate strategic foresight into EU policy-making and build resilience. JRC experts have already started helping policymakers to mainstream this approach in several policy areas - from customs, to the Bioeconomy, to the future of farming in the EU.

Making use of available evidence will be crucial to the success of the Commission's ambitions in the coming years. In 2020, the JRC added a new Knowledge Centre for Biodiversity to its roster of knowledge and competence centres. These centres contributed with valuable insights to help policymakers make sense of complex challenges - from employability and social inclusion to securing our digital society and protecting against cyber threats.

After a very eventful 2020, I look forward to the JRC providing its full support to Europe's recovery and to the Commission's political priorities in 2021 and beyond.

Mariya Gabriel

European Commissioner for Innovation, Research, Culture, Education and Youth

Observations from the Board of Governors

The year 2020 was extremely challenging, with profound economic, social and environmental implications. More than ever, effectively tackling these effects requires policies underpinned by robust scientific evidence. The board welcomes the role the Joint Research Centre adopted in addressing these challenges, fulfilling its science and knowledge functions through analytical, anticipatory and innovative approaches.

The board also welcomes the JRC's contribution to the work of the European Commission in confronting the coronavirus disease 2019 (COVID-19) crisis, including with the development of an early detection and monitoring system, data collection and mapping, epidemiological modelling supporting the Commission and the European Union Member States in answering the question 'when to lock down?', testing, and the analysis of socioeconomic impacts of the crisis.

The board encourages the JRC to continue to raise its profile as the science and knowledge service of the Commission. The JRC must continue to support better regulation with its knowledge and expertise, including through impact assessments and evaluations, and deepen efforts to communicate on the relevance, impacts and outcomes of its work. The board welcomes the JRC's provision of continued support to the new team of commissioners and the six priorities of President von der Leyen. Working with all Commission services, the JRC has supported a wide range of policy priorities to help achieve a more competitive, fair, sustainable and influential Europe. The board appreciates the active role of the JRC in the Horizon Europe programme's strategic planning as well as in the implementation of missions in the programme. The board considers that the work of the JRC has been instrumental to major Commission policy initiatives, including on setting new targets of the European Green Deal, digital education and skills, and the new EU security union strategy. The board also recognises the major contribution of the JRC to the first strategic foresight report published by the Commission, including on the rationale for using foresight in EU policymaking, the definition of the concept of EU resilience and the prototype resilience dashboards, to monitor the social and economic dimension of resilience, as well as the geopolitical, green and digital dimensions. The board welcomes the new synergies in the European Atomic Energy Community (Euratom) research and training programme providing more effective support to Member States, especially in the areas of nuclear knowledge management and open access to JRC nuclear facilities.

The board welcomes the strong alignment of the JRC's 2021–2022 work programme with the new priorities of the Commission and with EU Member States' priorities, including in nuclear research and training. The JRC supports a high number of initiatives across the Commission's 2021 work programme, for example the action plans aiming to preserve and protect biodiversity; the sustainable products package; the European health data space; the action plan on synergies between civil defence and space industries; the action plan on the European Pillar of Social Rights; the EU agenda to tackle organised crime; the transparency and democracy package; and the global initiative on research, innovation, education and youth.

REFLECTING ON A ONE-OF-A-KIND YEAR OF WORK AT THE JOINT RESEARCH CENTRE

An interview with the JRC's Director-General, Stephen Quest

The year 2020 will go down in history as the year the pandemic hit hard. How did the crisis affect the JRC and how did the JRC respond to the crisis?

The year 2020 is definitely going to go down in history as a very strange year, and it had a massive impact on us at the JRC, as it did on all organisations. It changed the way we work, because our colleagues were forced to work from home rather than in the office or in the laboratories. And that had a big impact on us as a scientific organisation.

At the same time, it also changed the texture and the nature of our work, because we had to respond to the crisis and deploy our scientific resources to help our policy colleagues respond in a multitude of different ways.

A lot of people have said that 2020 was a moment of science. I think it was a moment when we started to understand that it's very difficult to respond to some of these complex policy challenges, such as the challenge of responding to the crisis, which has health, social, economic and geopolitical implications; it's very difficult to respond to this sort of crisis, without solid facts, without sound science and without very strong analysis. So in that sense it provided a rewarding opportunity for us to really showcase our expertise and to show the relevance of a scientific organisation in the broader policy construct.

How did you reconcile addressing the urgency of COVID-19 with continuing to deliver on the European Commission's strategic priorities?

It was obviously a challenge for us last year to find the right balance between responding to the immediate challenges of the crisis and delivering our work in a more business-as-usual way, because we had a lot of ongoing priorities. So we had to work quite hard to find an appropriate balance to redeploy resource to respond to the crisis, without ignoring the core activities that we needed to take care of.

I think we managed to find that balance quite well, and that we proved to be adaptable and fairly resilient throughout the year. Colleagues worked very hard and found ways of working remotely and of connecting together differently.

And I think, as we look back over the year, we can be proud of the achievements and satisfied that we have managed to both deliver on our core priorities and provide a very substantial contribution to the response to the crisis.

"The new European Bauhaus is one of the very exciting projects we are going to be working on in 2021"

From a high-level perspective, what sets 2020 apart from previous years, COVID-19 crisis aside?

The year 2020 was obviously one of a kind because of the crisis, but if we put the crisis to one side it was also the first year for us in implementing the new priorities of the von der Leyen Commission.

The good news is that a lot of what we are doing is already very well matched to the von der Leyen priorities. If you look at the Green Deal, for example, we have a major contribution to make to it, whether that be our work on hydrogen, or our work on biodiversity or many, many other areas. So it was not particularly difficult for us to align our work to these new priorities, or the work on digital or the work on democracy, and so on. The other thing to mention, perhaps, is the work on the recovery, and the work that we did on strategic foresight, because in 2020 we produced the first strategic foresight report, and there we put the focus on resilience and therefore connected it with the work on the recovery, and the work we need to do to ensure that our economies are able to bounce back from the crisis and that we are able to build a more resilient and future-proof Europe and learn lessons, including the lessons of the crisis, as we go forward.

In this context, but on a more personal basis, how would you describe your first year in office?

It's clearly challenging when you come into an organisation fresh in the middle of a crisis. You have to take some quite rapid decisions. You also have to invest quite a lot in building trust with your senior management team and with your staff who are getting to know you just as you're getting to know them. I spent quite a lot of time getting to know people, working quite closely with them to try to build that trust and also put a lot of focus on ensuring high levels of transparency in the organisation. I think it is particularly important in a crisis that people know what's going on and that you're very straight with people. Because that's, for me, the key to building trust, and trust is absolutely central if you want to run an effective organisation.

It's been a very rewarding process, because I've learnt a lot and the welcome has been very, very warm. I'm extremely grateful to colleagues for the very good interactions that we have been having.

Looking ahead, what is your ambition for the JRC in 2021?

The year 2021 is a year of change for us. We obviously have a new multiannual financial framework, and new Horizon Europe and Euratom programmes to implement, and the new von der Leyen priorities to continue to implement. So we need to continue to adjust our work programme to take account of those priorities and those changes. We need to continue to deal with the consequences of the crisis and to help support efforts towards recovery, and we also need to continue to adapt and adjust internally in the JRC to these new challenges. So one part of our work is going to be about pushing for an internal transformation of the way we work together to ensure that we are fully fit for purpose going forward and that we can really deploy our scientific expertise in support of the emerging policy agenda. Another part of our work will very much involve continuing to work in partnership with policy directorates-general (DGs), to provide scientific excellence and robust science in support of the policy objectives of the European Commission.

What upcoming project would you single out as particularly exciting for the JRC in the years to come?

The new European Bauhaus is one of the very exciting projects we are going to be working on in 2021. It is an initiative launched by President von der Leyen in her State of the Union speech last September, and the JRC has been given the lead role in taking forward the design and the delivery phase of this initiative. So at the moment we are putting together a team of colleagues to set this up, and to collect ideas about how this new European Bauhaus initiative will work and how to bring this initiative to life. It's an exciting way for us to contribute our scientific knowledge but also to bring together different constituencies, from architects and engineers to scientists, artists and young people, to determine how we can really deliver sustainability with style.

STRATEGIC FORESIGHT AND RESILIENCE

The JRC has substantial experience in applying strategic foresight to enable anticipatory long-term thinking in EU policymaking. The strength of this approach is in its ability to explore issues systemically, moving away from lock-ins and silo thinking.

The **Competence Centre on Foresight (CC-Foresight)** is actively running strategic foresight projects in various fields to support Vice-President Maroš Šefčovič and the DGs in building anticipatory knowledge for policymaking and developing long-term strategies. In 2020, the issues covered were, for example, farmers, customs, distributed ledger technologies (DLTs) for the social and public good, migration and anticipatory innovation.

The foresight study **'Farmers of the future'**, commissioned by DG Agriculture and Rural Development, explores the future professional roles of farmers as we move towards the year 2040, using a people-centred approach. The aim is to raise awareness and to open up discussions about the future of farmers and farming in the EU and the policies needed to shape and support it. Twelve future farmer profiles reflect the existing and emerging realities in European agriculture in the context of megatrends. The report was presented at the 2020 Agricultural Outlook Conference.

The foresight project **'The future of customs in the EU 2040'**, run in collaboration with DG Taxation and Customs Union, gave key stakeholders a shared and strategic understanding of ways to deal with current and future challenges for customs. It generated a tool to help relevant actors and stakeholders of the EU's Customs Union engage with the foresight scenarios developed by this project. Through the project, a shared vision for customs in the EU in 2040 was co-created. The report was published in December 2020.

#DLT4Good is coordinated through CC-Foresight, in collaboration with DG Communications Network, Content and Technology. It is supported by the European Parliament (EP) as a pilot project. This project aims to envisage and test new policy strategies to support the co-creation of a robust and cooperative European ecosystem of DLT projects for the social and public good, focusing on experimental uptake through an accelerator. Major activities in 2020 included the publication of a report, the publication of #DLT4Good scanning as a tool in the Knowledge4Policy platform, and the supervision of and support for the accelerator programme coordinated by the DLT4EU consortium.

Foresight ON newsletters were another highlight in 2020. The new format, with forward-looking topics and global transformative trends that are characterised as rapid and complex changes, is presented in the College of Commissioners by Vice-President Šefčovič. In 2020, four issues were published:

1. 'Foresight on AI',
2. 'Foresight on critical raw materials',
3. 'Foresight on security',
4. 'Foresight on health'.

These newsletters show the synergies across the JRC in providing scientific information as a base for EU policymaking.

Megatrends

The Megatrends Hub is a foresight knowledge management infrastructure designed to help policymakers assess potential future opportunities, threats and potential policy implications created by the megatrends. The process of updating the trends and reviewing the format of the hub started in 2020 and will be completed in 2021.

CC-Foresight also offers an interactive megatrends workshop in which the 14 megatrends are first mapped and then analysed. This provides a systemic overview of their implications and interplay in the context of particular policy issues. In 2020, the workshop was successfully moved online and used in various workshops on topics such as next-generation platforms, intellectual property infringements, EU security and digital publishing.

The pandemic has not only thrown a sharp light on our vulnerabilities but has presented opportunities that the EU cannot afford to miss. It has also reaffirmed the need to make our policies evidence-based, future-proof and centred on resilience. We cannot expect the future to become less disruptive – new trends and shocks will continue to affect our lives. The first-ever Strategic Foresight Report therefore sets the scene for how we can make Europe more resilient – by boosting our open strategic autonomy and building a fairer, climate-neutral and digitally sovereign future.

Vice-President Maroš Šefčovič,
in charge of interinstitutional relations and foresight

The 2020 annual strategic foresight report

This first annual strategic foresight report, *Strategic Foresight – Charting the course towards a more resilient Europe*, published as a Commission communication, presents the Commission's strategy to integrate strategic foresight into EU policymaking.

The central theme of this first report is resilience, which has become a new compass for EU policies during the COVID-19 crisis. Resilience is the ability not only to withstand and cope with challenges, but also to undergo transitions in a sustainable, fair and democratic manner. The report shows how forward-looking policies supported by strategic foresight will contribute to enhancing European resilience. It analyses resilience along four interrelated dimensions – social and economic, geopolitical, green, and digital – and explains its importance for achieving our strategic long-term objectives in the context of the digital, green and fair transitions.

Strategic foresight will play a key role in helping future-proof EU policymaking by ensuring that short-term initiatives are grounded in a longer-term perspective. It can help anticipate developments that are likely to have adverse impacts, strengthen corresponding resilience through structural changes and take into account the impact of current and future crises on relevant megatrends and emerging issues. Policies benefiting from strategic foresight can better mitigate the vulnerabilities and strengthen the capacities revealed by the crisis, opening up new opportunities and making Europe more resilient.

Embedding strategic foresight into EU policymaking will enable the European Commission to:

- build and use collective intelligence to anticipate developments and prepare for new opportunities and challenges earlier and more effectively;
- ensure that strategic foresight becomes an integral part of the better regulation toolbox, including *ex ante* impact assessments, and supports the regulatory fitness and performance programme;
- undertake in-depth and participatory foresight exercises on major initiatives aimed at informing the annual State of the Union address, Commission work programmes and multiannual programming exercises;
- foster foresight cooperation and alliances with EU institutions and partners, Member States and other key stakeholders.

MANAGING KNOWLEDGE FOR EVIDENCE-INFORMED POLICY

The year just past brought science to the forefront of the policy process. Expertise was in very high demand, not only because of the health crisis but also to help design the policies needed to implement President von der Leyen's priorities and vision for the EU in the decades to come. Faced with such demand, the JRC responded promptly, not only thanks to decades of experience as a research organisation, but also by implementing its ability to leverage science around policy challenges, integrating its own capacity with externally produced knowledge.

In 2016, the Juncker Commission had already recognised data, information and knowledge as strategic assets, identifying their sound management as a cultural transformation enabler, with the potential to help the Commission function more efficiently, overcome silo mentalities and create synergies between different portfolios.

In 2020, this vision of knowledge valorisation helped the institution to maintain its efficiency during the COVID-19 pandemic and to deliver a swift response to it across the policy board, despite confinement, remote working and logistical problems. Although the Commission's data, information and knowledge management strategy had not been created in anticipation of a pandemic, it became a forerunner of information sharing, collaborative tools and new work practices, which so quickly became the 'new normal' for the institution in 2020.

Implementing the JRC strategy 2030 knowledge management objectives

Through its 2030 strategy, the JRC undertook a transformation from a traditional research organisation to a manager of worldwide scientific knowledge in support of EU policies. This transformation, now well consolidated, established new functions, specifically dedicated to the management of knowledge, either as an internal development cross-cutting function or as a set of activities aimed at supporting and informing EU policymaking.

In 2020, this culture percolated irreversibly across the JRC, as exemplified by the flourishing new series of #Facts4EUFuture reports and by the success of the knowledge and competence centres, one of which, devoted to bioeconomy, was launched in October 2020 during the EU Green Week. The guiding principle is to act as a facilitator at the interface between science and policy, gathering the best available scientific knowledge and making sense of it in response to policy demands.

By pursuing this strategy, the JRC has established itself as a reference and reliable partner for other EU institutions interested in knowledge management and innovation. This applies, for example, to data visualisation. Building on the collaboration initiated with the 2019 data visualisation conference in Luxembourg, the JRC has partnered with the Publications Office of the EU to bring together experts from different Commission DGs, institutions and agencies, to launch in October 2020 an interinstitutional community of practice, supported by a new knowledge-sharing platform. The community will become a treasure trove for EU officials wanting to integrate data visualisation into the EU policy cycle, knowing that making data available is important but that making it understandable and easy to analyse is the next priority. Ultimately, this community will help increase policymakers' and citizens' awareness of complex issues and their relevance.

In the context of the communication on data, information and knowledge management, the JRC continued to be one of the most active DGs contributing to the implementation of the Information Management Steering Board (IMSB) work programme. Participating in all the 2020–2021 programme work strands, the JRC was particularly involved in three actions, aimed at adapting working methods to Commission priorities, enhancing the use of country knowledge and operationalising the Commission data strategy action plan.

The JRC also intensified evidence-informed policymaking (EIPM) research and capacity building, to better rise to the challenges brought about by the growing demand of science for policy (see highlights). In March 2020, the JRC contributed to setting up the EU Policymaking Hub, a professional development programme for policymaking in the European Commission, featuring new capacity-building offers, including summer and autumn schools. The hub will strengthen the profession, make it fit for the future, contribute to colleagues' motivation and help the Commission to be at the forefront of excellence in policymaking in Europe and worldwide. In July 2020, the JRC released the *Science for Policy Handbook* (see next page), a book for researchers and research organisations aiming to have an impact on policy. In September 2020, it kicked off a series of 15 virtual workshops with external experts at national and subnational levels, focusing on strengthening and connecting science for policy ecosystems in Europe and supporting the EU commitment to EIPM for better regulation. Finally, yet importantly, the internal 'Evidence for Policy' training course continued to be deployed online, reaching the milestone of 500 JRC researchers trained in December 2020.

Through the various European Commission competence centres, the JRC supported better regulation initiatives, with guidance and advice on methods, modelling and analysis for *ex ante* assessments and *ex post* evaluations. It also provided input on exercises such as the better regulation stocktake and the revision of the better regulation toolbox. It helped to monitor the implementation of existing policies by providing indicators and scoreboards and by auditing existing indices.

The JRC also helped the Commission in its ambition to put strategic foresight at the heart of the EU policy process. The JRC supported several services in identifying emerging challenges and opportunities and animated a variety of strands of foresight work that will help to future-proof the EU policy process. This work will include specific foresight initiatives on specific topics and the development of shared foresight scenarios.

Smart policies should also be based on the best possible data and information. To this end, the JRC supported the Commission in its efforts to fight disinformation, applying various techniques, such as text and data mining, behavioural insights, and design and analysis of surveys.

In the framework of the EU's focus on the western Balkans as 'part of Europe' and the creation of a recovery package putting forward regional investment initiatives, the JRC supported the western Balkan regions with capacity-building activities for technology transfer and recommendations/information on state aid for research and innovation.

As the host of the European Commission's Central Intellectual Property Service, the JRC continued its work to protect and catalogue the intellectual property developed by various services. Despite COVID-19 regulations, the JRC did not stop exploiting its scientific knowledge to develop initiatives reinforcing the reciprocal links between science, policy and society. In 2020, the foundations were laid for turning the existing JRC school programme of site visits and other site-specific initiatives into a digital communication and educational experience, addressing both secondary school teachers and their pupils (see chapter: *Reaching out to stakeholders and citizens at large* - Page 26).

The JRC's *Science for Policy Handbook*: how to bring science to the attention of policymakers

Science and policy are different worlds, functioning on different timescales and aiming to achieve different goals. Even more than ever, scientific evidence is necessary to solve the challenging problems of our age.

The *Science for Policy Handbook* presents the lessons learnt by the JRC as the Commission's in-house science and knowledge service and explains how to apply them outside the EU legislative context. It is dedicated to researchers and research organisations aiming to achieve policy impact.

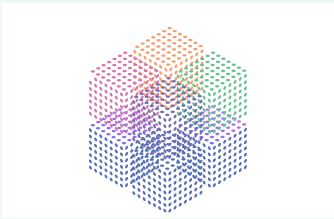
The book brings together advice on new skills and practices for individual researchers but also discusses elements of institutional change – knowledge areas (e.g. complexity science, quantitative methods, foresight, behavioural insights) and processes (e.g. place-based approaches, citizen engagement, design for policy, collaboration and communities of practice) in which to invest to create a more integrated model of the knowledge–policy relationship.

The publication of the handbook was accompanied by a summary of 10 tips for achieving policy impact for researchers and research organisations.

1. **Start with policy.** Understand how decisions are made; put yourself in the policymaker's shoes.
2. **Question the questions.** Deeply analyse the issues; do not hesitate to reframe the problems.
3. **Plan for policy impact early.** Try to embed policy impact in your research at the design stage.
4. **Policy impact is a team sport.** Prioritise collective reasoning over individual solution seeking.
5. **Become a critical friend.** Like the scientist you are, be prepared to speak inconvenient truths.
6. **Speak up in the policy debate.** Connect with policymakers and stakeholders, and learn from that connection.
7. **Become bilingual in both science and policy.** Learn to tell a story rather than giving more data.
8. **Beware of a single study.** Put your research in the context of wider knowledge; prioritise reviews.
9. **Champion diversity – no single discipline has all the answers.** Bring other experts to the room.
10. **Be clear about uncertainties and limitations.** Avoid oversimplifying to give a clearer message.

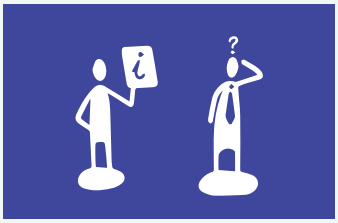
Important achievements in 2020

Launched in 2018 under the auspices of the IMSB, the **one-stop shop for collaboration** has gone from strength to strength, as recognised in the decision of the Secretariat-General to entrust it with the roll-out of Microsoft 365 in the Commission. Co-led by the JRC, the Secretariat-General, DG Human Resources and Security and DG Informatics, in 2020 the one-stop shop for collaboration continued implementing its consultancy mission, running 34 projects for various DGs and contributing to corporate policies (a hybrid way of working, a human resources strategy).

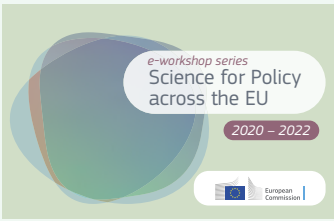


The **data catalogue** action is part of the IMSB 2020–2021 work programme. Developed from the JRC data inventory, it provides an overview of the Commission's data capital, which currently contains more than 1 200 data assets. The JRC coordinated the inventory exercise, together with Eurostat and the Publications Office. Building on this initial mapping, a permanent long-term data catalogue for the Commission will be established in collaboration with DG Informatics, becoming part of a corporate 'data platform' on which data can be analysed and visualised.

In 2020, the JRC established the Commission's **data advisory service** under the auspices of the IMSB. The service will act as a one-stop-shop for data management and data analytics, providing an end-to-end service, with requests for support dispatched to the right competencies in the Commission, covering all issues related to data management, such as data analytics, data licensing and related legal aspects, data architecture, data interoperability and data security.

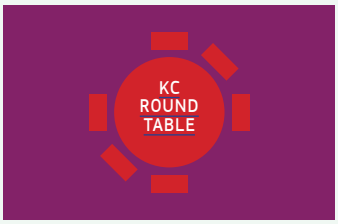


The JRC is striving to bridge the gap between science and policy. The course on **'Practice of informing policy through evidence'** is part of this effort; it focuses on the skills necessary to turn relevant and good-quality evidence into meaningful, non-biased and framed evidence for policymakers. By December 2020, more than 500 JRC scientists had attended the course. In 2020, the training programme was enriched with a new e-learning module developed for the EU Academy, targeted at early- to mid-career researchers in the EU Member States, providing them with insights into how to make their communication with policymakers more impactful.



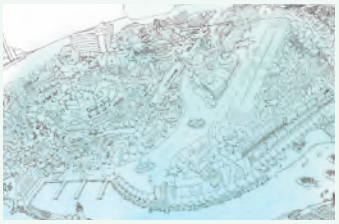
Starting in September 2020, the JRC has been organising a virtual workshop series on **strengthening and connecting science for policy ecosystems in Europe**. Overall, 15 events will take place until May 2021, each convening 50–70 experts at the national or subnational level. The threefold purpose is to build a strong community of like-minded professionals with an interest in promoting EIPM, to deepen and develop shared knowledge of what works and what does not at the science–policy interface, and to develop concrete project ideas for strengthening and connecting existing 'ecosystems'.

Connected was adopted in 2016 as the Commission-wide internal communication and knowledge-sharing platform. It currently has 40 000 registered users and 14 000 active users. The JRC provides user guidance and business support to Commission users for implementing collaborative business processes (such as the semester and country knowledge processes) and staff engagement initiatives (such as the current Together@Home) on the platform.

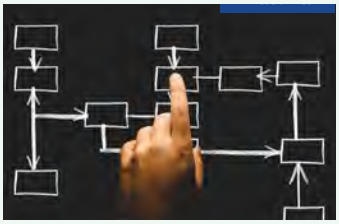


Knowledge centres bring together experts and knowledge from different sources inside and outside the Commission, creating a new flexible instrument to develop and pursue informed and evidence-based EU policies. Although each knowledge centre has its own characteristics (see pages 18-19), the opportunities for mutual learning are huge. The **knowledge centres round-table** meetings, held at regular intervals since February 2020, offer an occasion for discussion and cross-fertilisation.

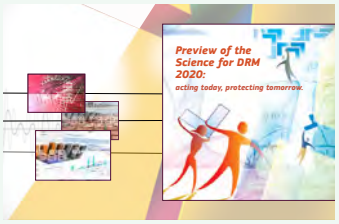
In preparation for the revision of the better regulation guidelines and its toolbox, the JRC opened the **Modelling Inventory and Knowledge Management System (MIDAS)** of the European Commission to the public. This first release, prepared with the help of 14 policy DGs, includes 35 models supporting 35 impact assessments.



In support of the Commission's ambition to devise smart future-proof policies, the report ***The future of customs in the EU 2040*** represents an outcome of a year-long foresight process to support strategic reflection on the future of the EU's Customs Union, its relevance and effectiveness in the long term. Likewise, the *Farmers of the Future* report explores who in the medium- and long-term future will face future challenges such as climate change and resource scarcity, technological change, infrastructural issues and food demand/dietary habits.



In collaboration with several experts and colleagues from DG Competition and DG Research and Innovation, the JRC published **guidelines on the application of state aid to research and innovation directed at research organisations**. The guidelines are expected to encourage collaboration between research organisations and industry, which has so far been limited by a lack of understanding of state aid legislation, in particular the distinction between economic and non-economic activities.

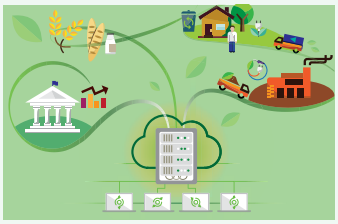


After 2 intense years of collaboration with more than 300 experts in disaster risk management, the Disaster Risk Management Knowledge Centre (DRMKC) has released ***Science for DRM 2020: Acting today, protecting tomorrow***. The report, aimed at broadening the knowledge of disaster risk in Europe, is divided into six chapters and six super case studies, drafted by 25 teams of authors, with the support of an advisory group.

In 2020, the DRMKC published the ***Recommendations for national risk assessment for disaster risk management in EU – Version 1***, the second in a series of reports bringing together a network of experts in the field. The report covers risks of natural, anthropogenic and socionatural origin, such as droughts, earthquakes, floods, biological disasters, terrorist attacks, nuclear accidents, the collapse of critical infrastructure, chemical accidents, natural disasters triggering technological disasters (Natech), volcanic eruptions, cyberattacks, hybrid threats, wildfires and the risk of biodiversity loss.

The **Knowledge Centre for Food Fraud and Quality (KC-FFQ)** developed methods to authenticate food products with protected designation of origin claims. By producing a monthly report of food fraud cases, the KC-FFQ also helps to raise awareness of the problem. Curbing food fraud will protect honest producers, reduce unfair competition and remove health hazards introduced by substandard food, thereby benefiting all stakeholders of the food value chain and restoring consumers' confidence.

The JRC, in partnership with other Commission services and external experts, developed an **EU Bioeconomy Monitoring System** to provide trustworthy data and robust indicators to policymakers and other stakeholders. The system will track progress at EU and Member State levels, in the areas of environment, society and economy, along the entire value chain and for all primary production sectors. This will help to ensure that the European bioeconomy contributes effectively to the objectives of the EU bioeconomy strategy, the European Green Deal and the Sustainable Development Goals (SDGs).



The JRC, in partnership with DG Research and Innovation, has mobilised an ad hoc network of experts to contribute their expertise to the **Knowledge Centre for Bioeconomy (KCB)**. In 2020, the network tackled key issues that are highly relevant to future transitions towards sustainable development and a climate-neutral economy. Seven of the experts focused on synthesising current knowledge from scientific literature and research projects. This work underpinned a foresight scenario-building exercise, guided by the European Commission CC-Foresight, including integrating expertise from several additional stakeholders across the bioeconomy sectors. Four other experts analysed needs and challenges to better integrate all three aspects of sustainability (economic, social, environmental) into modelling tools.

The **DRMKC Risk Data Hub** proposes facilitated access to knowledge, tools, methods and data. It adopts a comprehensive framework of policies and guidelines, data-sharing initiatives and spatial data infrastructure to lay the foundations for sharing multihazard knowledge for disaster risk management at local, national, regional and EU-wide levels.

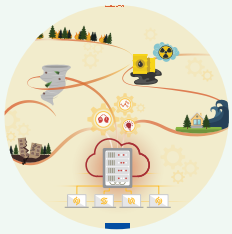
Since 2016, the European Commission has worked, together with the United Nations (UN) Office for the Coordination of Humanitarian Affairs and the wider humanitarian and development communities, to conceive a way to compare the severity of crises globally and to understand changes in crisis severity over time. The **INFORM Severity Index** seeks to contribute to improved management of humanitarian crises by providing decision-makers with a transparent, open-source and reliable summary of information about the severity of humanitarian crises, which is updated monthly.

Knowledge and competence centres

Knowledge and competence centres are integral parts of knowledge-management activities. These virtual entities bring together experts, stakeholders and knowledge from inside and outside the European Commission. Knowledge centres are built around topics, whereas competence centres focus on analytical tools. Together, they inform policymakers, stakeholders and interested citizens about the latest scientific findings relevant to their respective remits. They provide contextualised evidence, reviews, data analysis and visualisation, communicating concisely through visual and digital channels. In 2020, a new knowledge centre – on biodiversity – was launched, bringing the total operated by the JRC to 14. Emulating the JRC's initiative, the Knowledge Centre on Interpretation, (KCI) launched by DG Interpretation in 2018, consolidated its position as the single go-to space on conference interpretation and more.

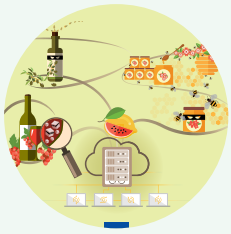
The **Knowledge Centre for Territorial Policies (KCTP)** gathers, manages and makes sense of the vast amount of knowledge available on European cities and regions to help boost their competitiveness, preserve their diversity, and improve their citizens' quality of life, while strengthening the EC's overall support for territorial development.

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 comprehensively and systematically analysing developments on a global scale and their societal impact on the EU in the medium to longer term.

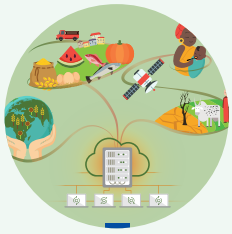


The **Knowledge Centre for Disaster Risk Management (DRMKC)** provides better knowledge, stronger evidence and a greater focus on transformative processes and innovation to improve our understanding of disaster risk, to build resilience and risk-informed approaches to policymaking, and to contribute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

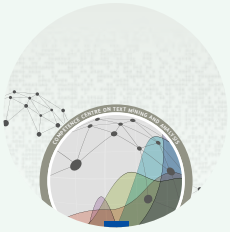


The **Knowledge Centre for Food Fraud and Quality (KC-FFQ)** aims to create a formalised science/policy interface to support initiatives for safeguarding the quality and authenticity of agri-food products and to protect the integrity of the food chain. It complements the activities of the EU Food Fraud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

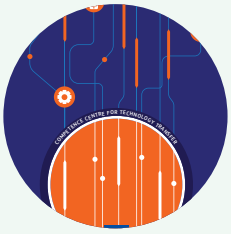


The **Knowledge Centre on Global Food and Nutrition Security (KC-FNS)** makes the existing information and tools available to EU policymakers and stakeholders, identifies priority topics to foster better knowledge and collaboration around these, and promotes the EC's role in generating new knowledge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

The **Knowledge Centre for Biodiversity** enhances the knowledge base, facilitates its sharing and fosters cross-sectoral policy dialogue for EU policymaking in biodiversity and related fields. It supports policymaking by identifying, filtering and structuring relevant information and making it accessible, in order to bring together researchers, policymakers, non-governmental organisations, industry and citizens.

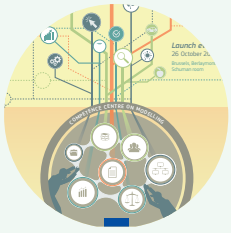


The **Competence Centre on Text Mining and Analysis (TMA)** addresses policymakers' needs for timely access to relevant information that is often buried in large amounts of textual data. TMA is relevant to virtually all policy areas and the centre provides the skills and expertise required: computational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

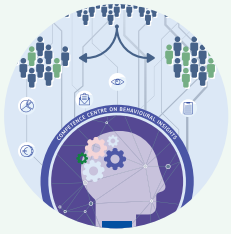


The **Competence Centre on Technology Transfer (CC-TT)** complements other JRC activities in the broader domain of support for innovation policies and makes available operational experience and understanding of the technology transfer process – for example, for the practical implementation of smart specialisation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

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 Modelling (CC-MOD)** leverages modelling capacity and competences across the EC 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 Behavioural Insights (CC-BI)** provides the competences and tools for applying behavioural evidence in policymaking, liaising with international players such as the Organisation for Economic Co-operation and Development (OECD) through a Community of Practice. It identifies behaviours and specific groups to be analysed, collecting the relevant evidence, testing alternative policy interventions and eventually informing policy decisions.

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 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 procedures. One of its most prominent outputs is the Megatrends Hub, a dynamic collective intelligence system assessing a set of 14 global megatrends relevant for the future of Europe.

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 2020, highlights included working with Spain on the digitisation of education systems; helping scale up the 'Plastic Pirates' project; supporting the Netherlands Environmental Assessment Agency in modelling CO2 emissions trends; supporting the global role of the International Atomic Energy Agency; and strengthening the European Union Chemical, Biological, Radiological and Nuclear Risk Mitigation Centres of Excellence, to name but a few.

JRC and Spain take a Selfie together

Digitisation of education systems is a political and social priority at the European and Spanish levels. The need to use digital technologies to address the disruption of education caused by the COVID-19 pandemic has made it even more relevant. In 2020, the Directorate for Growth and Innovation of the JRC and the Spanish Ministry of Education worked together on the digital capacity of primary and secondary schools in Spain.

The work was carried out using self-reflection on effective learning by fostering the use of innovative educational technologies (Selfie), a tool created by the European Commission to facilitate a self-diagnosis of the digital capacity of schools and to develop actions based on the specific needs and context of each school. A series of questionnaires to school leaders, teachers and students is the basis for the tool.

In total, 492 schools, including 27 303 individuals (1 721 school leaders, 7 934 teachers and 16 648 students) participated in the initiative. The resulting reports give an overview of the level and intensity of digitisation of Spanish schools just before their closure due to the pandemic in March 2020. They show how Spanish schools rate in using technology to prepare classes and infrastructure and equipment. They also highlight critical areas such as the use of technology for assessment practices and collaboration with the educational community and external actors. The main barriers to the use of technology are also presented.

The Spanish Ministry of Education will present the results at an event in early 2021 in which Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth, and Isabel Celaá, the Spanish Minister for Education, have been asked to participate. The studies will allow Spanish policymakers to put in place specific measures addressing the needs of schools and provide Spanish schools and educational organisations with information and expertise for further action. Moreover, the results might inspire other EU Member States to evaluate the digital capacity of their respective schools and to provide their respective ministries of education with valuable information.

The 'Plastic Pirates' project – a citizen science initiative scaled up

During the German Presidency of the Council in 2020, the JRC engaged in many presidency initiatives and events, including the 'Plastic Pirates' project. It is a citizens' science project focused on plastic in the ocean. All over Europe, young people are collecting plastic waste and uploading data on the amount of waste found to populate an online map and better identify where the plastic in the ocean is coming from. Together with the other members of the current trio Presidency, Portugal and Slovenia, Germany initiated this project and has involved the European Commission from the start. The JRC, with its experience in citizen science activities, has been able to provide strategic and methodological support for this initiative, with a view to generating good scientific results in a European context. In close collaboration with DG Research and Innovation, which has also supported the project financially, and DG Education, Youth, Sport and Culture, the JRC contributes to the strategy and conceptual design for the scaling up of the project from a national campaign to a pan-European citizen science project. It also provides guidance on common EU-wide data-gathering (and management) methodologies, as well as its scientific expertise on EU marine and ocean litter analysis.

The 'Plastic Pirates' project demonstrates the value of science, and it is also a showcase of engaging citizens and especially young people in contributing to research on an important societal issue.

Making models more accurate and consistent

Building on a Dutch initiative, the JRC and the Netherlands Environmental Assessment Agency have developed a database on trends in carbon dioxide (CO_2) emissions to help policymakers devise strategies to slow climate change. Since 2009, the JRC and the Dutch national institute for strategic policy analysis in the fields of the environment, nature and spatial planning have published the CO_2 emission trends related to fossil fuel combustion and cement production each year. Both partners formalised their cooperation in an agreement in June 2020, not only to value this existing working relationship but also to facilitate the exchange of staff and encourage additional activities. The collaboration will span the subjects of urban and regional development, climate change and energy transition, and touch on food, agriculture and nature in transformation-related subjects, such as land degradation, restoration and scenarios of future land use. The agreement will allow the JRC and its partner to review and align their models, improve their efficiency and capitalise on new approaches to work in the knowledge–policy interface. As part of the collaboration, the partners will, for instance, further increase modelling consistency and accuracy to better capture dynamics of densification and urban expansion at a global scale. The collaboration also aims to ensure strategic reflections on modelling and their quality assurance and thus contribute to the work of the JRC CC-MOD.

Pilot project in Lombardy region: data-driven knowledge to understand and predict the spread of COVID-19

In February 2020, the COVID-19 outbreak in Europe started in the Lombardy region, before spreading all over the continent. The region in northern Italy suffered significant loss during the first phase of the pandemic, and considerable stress on its health system. One of the biggest challenges for regional authorities was to base decisions on confinement measures on evidence. The same is true of the recovery phase in the aftermath of the peaks of the outbreak.

The JRC and the region have been working together for several years, and a memorandum of understanding, which encompasses, among other domains, air quality and artificial intelligence (AI), is currently under implementation. The JRC started working on the impact of COVID-19 spatial non-pharmaceutical interventions on mobility and thus naturally offered to collaborate with the region, which also hosts the JRC's largest scientific site at Ispra. The Vice-President of Lombardy, Fabrizio Sala, who is also the regional Minister for Research and Innovation, recognised the relevance of that work. JRC scientists started immediately sharing knowledge and data with Lombardy's policymakers and experts of the innovation, communications, and mobility and transport divisions. In the framework of a unique business-to-government initiative, aggregate and anonymised mobility data from mobile network operators in Europe were shared with the European Commission to support policymakers and practitioners with evidence and data-driven knowledge in understanding and predicting the spread of the disease, the effectiveness of the containment measures and their socioeconomic impacts.

The ongoing pilot, allowing mobility insights derived from mobile network operators data, has the potential to be subsequently extended to other local administrations in the EU.

Supporting the global role of the International Atomic Energy Agency in achieving safe and secure use of nuclear science

The JRC continues to be strongly engaged with the International Atomic Energy Agency (IAEA) in important activities on nuclear safety, safeguards and security, and nuclear science applications. The activities coordinated by the JRC include:

- strong support for EU and global safeguards (by coordinating the European Commission support programme and providing the secretariat for the European Safeguards Research and Development Association, among other activities);
- a role in the nuclear safety standards committees of the IAEA;
- contributing to enhancing nuclear security through the practical arrangement on nuclear security with the IAEA and the extensive activities of the European Nuclear Security Training Centre;
- an active programme of work on nuclear for medical application and nuclear science.

Establishing a new coordination instrument for nuclear decommissioning

The JRC obtained agreement from the EU Member States to include a JRC decommissioning programme in a decommissioning funding instrument, together with Bulgarian and Slovakian programmes, in the multiannual financial framework for 2021–2027 (set out in the European Commission Decision of March 2018). Since the drafting of the decommissioning programme and its adoption by the European Commission and the EP, the JRC has also reached an agreement with the Council.

Nuclear data measurements: a powerful tool to address societal challenges

Many nuclear applications that have a societal impact (fission and fusion nuclear energy, medicine, security, etc.) require reliable nuclear data for the validation of physical models on which engineering developments are based. Measuring nuclear data for these many applications is a core activity of the European Facility for innovative reactor and transmutation neutron data (EUFRAT) (GELINA, MONNET, HADES and RADMET laboratories) at the JRC Geel site. The measurements are part of dedicated nuclear data libraries that are regularly updated to respond to new societal needs. The publication *The joint evaluated fission and fusion nuclear data library, JEFF-3.3*, whose lead author, Arjan Plompen, is from the JRC, highlighted the importance of advancing in nuclear data measurements for physical modelling and was co-authored by 30 Member State organisations, the OECD Nuclear Energy Agency, the IAEA and another four international organisations. The experimental programme at JRC Geel, which is being developed with European and international partners, has given a substantial contribution to the joint evaluated fission and fusion (JEFF) nuclear data library 3.3. The JEFF library is a reference library for the development and assessment of physical models that have engineering relevance to, among other areas, the safety assessment of nuclear reactors, the development of new medical isotope production routes and the development of fusion energy devices.

Enhancing access to the JRC nuclear facilities

A new concept for easier access to the JRC nuclear facilities for the European research community was developed, through collaboration between the JRC and DG Research and Innovation,.

Under the new format, the JRC will continue hosting external users at its nuclear facilities and may provide a financial contribution to support their stay. Short- and long-term stays (between 1 and 9 months) are expected by the programme, primarily for students or young professionals at the beginning of their career.

The calls include topics in the nuclear field for energy and non-energy applications. The first call for proposals was launched in July 2020 and closed in October 2020, receiving, despite the COVID-19 pandemic, an excellent response both in the number of proposals and in their quality.

Strengthening the European Union Chemical, Biological, Radiological and Nuclear Risk Mitigation Centres of Excellence

The initiative of the EU Chemical, Biological, Radiological and Nuclear (CBRN) Risk Mitigation Centres of Excellence (CoEs) is the largest European civilian external security programme, with a budget of EUR 155 million for 2014–2020, under the Instrument contributing to Stability and Peace; 61 partner countries are grouped into eight regions with regional secretariats, covering both the immediate neighbourhood and the wider neighbourhood of the EU. Since 2010, a total of 82 projects have focused on CBRN risks, and more than 3 000 front line officers, for example in civil protection, law enforcement and medical emergency, have been trained. In the current situation, in which COVID-19 is rapidly spreading worldwide and the numbers of cases are rising with increasing pace in several affected areas, there is a need for immediate targeted actions. The EU CBRN CoEs have been actively responding to this emergency. Several partner countries have reported the importance of the CoEs' training to the COVID-19 response, and the importance of the national CBRN and regional expert networks (including the national focal points of the CoEs and the CBRN national teams) that were put in place thanks to the initiative of the EU CBRN CoEs.

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, and scientists and academics from private and public organisations alike. It also engages in outreach activities for 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 2020, activities that contributed to these core aspects of the JRC's mission included targeted initiatives, such as ensuring open access to JRC research infrastructures, engaging with the European Council and EP, the JRC school programme and citizen engagement programme, and the JRC Alumni Network.

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

Engaging with the Council and European Parliament

To put science and evidence at the heart of EU policymaking, the JRC has continued its close cooperation with the EP and the Council of the European Union.

The JRC organised several workshops and held regular informal exchanges involving members of the EP and EP bodies in relation to, for instance, its activities on foresight, AI, alternative testing and energy efficiency of buildings. Moreover, JRC scientists were invited to present their activities at EP committee meetings and to EP staff, including the EP Research Service (EPRS). The JRC's work had an important impact in the legislative process on initiatives such as the type approval of motor vehicles, for example, when a reference to JRC assessments on lowering the conformity factor was included in amendments adopted by the EP.

The JRC continued deepening its collaboration with the EPRS, the Panel for the Future of Science and Technology, the Committee on Industry, Energy and Research, and the Special Committee on Artificial Intelligence in a Digital Age. A virtual retreat with EPRS personnel also took place in October 2020 to discuss current priorities and identify areas for further cooperation.

At the initiative of the EP, the JRC is also contributing to the Renovation Wave initiative through a pilot project on integrated techniques for the seismic strengthening and energy efficiency of existing buildings.

In cooperation with the German Presidency of the Council, the JRC participated in many joint events and workshops. Important JRC input was also provided at several working group meetings under the Croatian and German Presidencies, addressing a wide range of research topics. Several joint activities planned in cooperation with the Croatian Presidency unfortunately could not take place because of the pandemic.

Under the German Presidency, the JRC organised an informal breakfast meeting with the Council's research working party, during which it had the opportunity to highlight its research activities on resilience and hydrogen. The JRC also took part in the ministerial conference on the European Research Area in Bonn and had an exchange of views with Member States. Furthermore, the JRC contributed to a mapping exercise on the Member States' green hydrogen capacities and initiatives, in cooperation with the German Federal Ministry of Education and Research.

The JRC worked closely with Member States and the EP in shaping Horizon Europe, the next EU framework programme for research and innovation, which was also adopted under the German Presidency.

Open access to JRC research infrastructures

The open access to the JRC research infrastructure programme was launched in 2017 to allow, under certain conditions, the research community, public authorities and industry in EU Member States and countries associated with Horizon 2020 to make use of its unique facilities.

The initiative is part of the JRC's strategy to enhance scientific knowledge dissemination, boost competitiveness, bridge the research–industry gap, and provide training and capacity building. Relevance-driven access is mainly granted in areas relevant to the priorities of the European Commission and the JRC's strategic priorities, and of importance to European standardisation, integration and cohesion, sustainable growth and competitiveness. It is based on a peer-review selection process following calls for proposals. The results of the access projects are openly disseminated after an 18-month embargo period. Market-driven access is granted upon payment of a fee covering the full costs of access to the JRC and is mainly targeted at industry. Projects are selected based on their strategic importance for the EU, and the results of the access projects are not openly disseminated.

In 2020, the JRC offered access on a pilot basis to 17 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 and four laboratories for environmental and mechanical materials assessment (EMMA) in Petten; four laboratories for nuclear reaction and decay data measurements (EUFRAT) in Geel; and three laboratories on actinides for the safe and secure operation of nuclear applications (ActUsLab) in Karlsruhe.

Since the start of the programme in 2017, the JRC has opened 48 calls in relation to relevance-driven access, resulting in 90 proposals having been selected, 63 signed agreements with the JRC and 40 completed projects, giving access to 224 users from 98 institutions in 17 countries, of which 6 are from industry. The programme will gradually be extended to include another 22 facilities. In 2020, the programme was revised to facilitate the access of users from institutions located in countries of the spreading excellence and widening participation work programme.

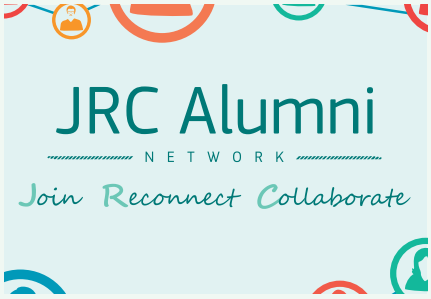
Turning JRC sites into living laboratories

A living laboratory is a modern way of creating user-centred environments that enable innovation, co-creation and start-up development. Back in summer 2019, the JRC launched its first living laboratories pilot call for expression of interest for public and private organisations that may be given access to certain JRC infrastructures in Ispra and Petten.

The aim of this pilot was, on the one hand, to turn JRC sites into a test bed for smart and sustainable cities and thus enhance the JRC's input into EU policymaking in the two selected areas (mobility and energy), and, on the other hand, to help small and medium-sized enterprises (SMEs), start-ups or other research organisations test their innovative technologies in the field of smart mobility and digital energy solutions, in real-life and controlled environments.

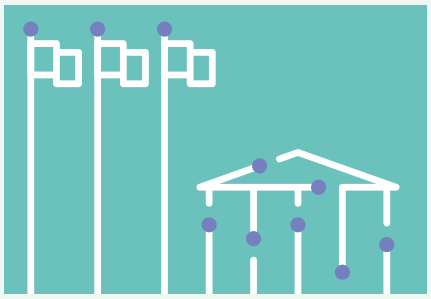
Several exciting projects are still ongoing from the first pilot call for expression of interest, ranging from co-designing and testing a new social ride-sharing service, or developing and testing an electric robotised platform for freight and passenger transport, to setting up and fine-tuning autonomous ground drones for last-mile delivery, and so on. Other initiatives pertain to testing and deploying smart charging stations for electric vehicles, using gamification for better use of energy on site, and using interactive visualisation tools to both monitor energy consumption and engage staff in a discussion on these topics.

Given the success of the living laboratories initiative so far, the pilot has been extended for another year. You can find out more about the living laboratories initiative and the ongoing open calls on the Science Hub.



JRC Alumni Network

During this unique year, the JRC's Alumni Network also continued to grow, and it now has more than 650 members. Our third annual JRC Alumni Network event could not take place as planned and was replaced by a virtual event held in February 2021. The time has come to energise the network, and a team of voluntary alumni was involved in the preparation of this event and in discussions about the future of the network. If 2020 taught us anything, it is certainly that staying in contact is essential, particularly in difficult times.



Science meets parliaments and regions: wrapping up and moving ahead

The JRC's efforts to promote EIPM go beyond the Brussels institutional context. One of the flagship initiatives in recent years has been the pilot project 'Science meets Parliaments / Science meets Regions', which was entrusted to the JRC by the EP in 2018. The year 2020 marked the end of the pilot phase but simultaneously the beginning of its consolidation and deepening.

The project consisted essentially of three components: science for policy events and innovation camps throughout Europe; studies in support of these events; and training courses for policymakers on EIPM. Although the last events and concomitant studies were largely completed in 2019, two of the three training courses – outsourced to the Hertie School (Berlin) through a call for tender – took place in 2020 and provided a rich experience to the policymakers who participated.

The year 2020 also marked the start of the next phase. The project's final report, published in September, explored several options to continue and expand the endeavour by creating a structural basis to support EIPM, especially at the local and regional levels. At the same time, the EP came forward with a proposal for 'preparatory action', as the direct successor of the pilot project, to be implemented by the JRC. The programme will be designed and launched during the first half of 2021, and it will be well under way by the time the COVID-19 pandemic subsides, supporting regions and cities in Europe in making use of the best evidence in tackling the challenges they face as we emerge from the crisis.

The preparatory action will thus further strengthen the JRC's efforts to reach out to regions and cities across Europe, in parallel with, for example, our work on smart specialisation and the urban agenda. Moreover, we are looking beyond the EU and will extend this approach to the western Balkans and the Eastern Partnership.

Institutional History Project: consolidation and re-orientation

The JRC's Institutional History Project (iHiP) was set up to develop sound, official documentation of the JRC's history. The iHiP digital library is emerging, including digitally available copies of about 200 000 pages of the JRC's legacy and numerous other digital documents. The iHiP oral history initiative, which in previous years collected over 30 interviews with experienced current and former JRC staff, basically came to a standstill because of the pandemic, but work on a legal timeline and other elements of the iHiP collection started. This collection will consist of several stand-alone yet interconnected digital documents that will allow the reader to dive deep into specific subjects of interest. Colleagues and ex-colleagues have agreed to work on specific topics, and over time the iHiP collection will provide an increasingly complete vision of the interesting and colourful history of the JRC. Knowing the past will help to envisage and create the future we want.

European Committee of the Regions

A booming collaboration with the Committee of the Regions

The Committee of the Regions has been a long-standing partner of the JRC in important fields, such as smart specialisation and territorial development. The JRC's efforts to support local and regional authorities directly are documented in the *Practical Handbook for Regional Authorities*, and the committee was also closely involved in shaping and implementing the pilot project 'Science meets Parliaments / Science meets Regions'.

The year 2020 marked a revitalisation of the formal collaborative link between the JRC and the Committee of the Regions. As the COVID-19 crisis hit, the committee approached the JRC with a request for data and evidence at the subnational level to better tackle the pandemic. The JRC's work was repeatedly quoted in the 'Regional barometer' published last autumn.

In June 2020, Commissioner Gabriel met with the Committee's recently appointed president, Mr Tzitzikostas, and the chair of the Commission for Social Policy, Education, Employment, Research and Culture (SEDEC), Ms Karjalainen. They decided to draft a joint action plan that would list the main strands of collaboration between the committee and the three DGs under the commissioner's responsibility. The plan was officially adopted and launched at the SEDEC meeting in November. For the JRC, the plan sets out the continuation of the 'Science meets Regions' programme, upgrading it to a structural level and ensuring maximal synergy with the Knowledge Exchange Platform jointly run by DG Research and Innovation and the Committee; continued and enhanced support for smart specialisation and territorial development; and the provision of data and studies at the subnational level, enabling regions to make better evidence-based policy decisions.

The implementation of all of these strands will be continuously monitored by a dedicated steering group under the Committee of the Regions and by the JRC's interinstitutional team.

The JRC school programme

Every year, the JRC welcomes almost 10 000 visitors who come to learn about it's research activities and how science affects daily lives. Many of these visitors are school students. Up to the beginning of 2020, on-site guided visits and specific interactive workshops were organised for them. Unfortunately, because of the pandemic, visits and other activities involving direct contact had to be suspended. Beyond the obvious difficulty for schools to adapt, social distancing and distance learning constraints turned out to be an opportunity to question teaching practices and develop new ones based on online solutions. This could lead to a paradigm shift in education and to new working dynamics, to which the JRC could contribute.

The JRC school programme has taken a new digital approach, aiming to exploit the JRC's scientific knowledge to the benefit of educational systems and to have a greater impact at EU level, for example as regards the European Green Deal, through which the JRC will help mobilise education communities across Europe to work towards achieving climate neutrality. By sharing its knowledge and expertise with schools digitally, the JRC will contribute to raising collective awareness of climate change and sustainable development, promoting behavioural change, bridging the gap between education and science/research, and fostering green skills development.

The main objective of the new digital programme is to provide teachers of secondary schools with scientific content through massive open online courses with a specific learning design adapted to blended learning techniques. The first pilot will focus on biodiversity and will be divided into different self-standing modules, each tackling a specific segment of the JRC's knowledge of biodiversity (invasive species, soil, water, etc.). It will involve a selection of European schools in the framework of an existing memorandum of understanding with the JRC, and schools from Italy. The method adopted is based on a co-creation process, which means creating content with teachers who best know the needs of their students and are already experimenting with new teaching approaches and techniques. It will be channelled through the EU Academy, whose mission is to provide a learning environment for professionals whose work is related to EU policies. After the pilot phase, the project is intended to be scaled up to the EU level, reaching all EU Member States schools and creating new content related to a variety of JRC scientific topics.

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 among stakeholders.

Publications

A total of 3 682 publications were produced:

1 473
science for policy, technical and training publications *

837
peer-reviewed scientific publications **

1 372
other publications ***

* Science for policy reports; whole parts of policy documents; briefs and factsheets, science for policy briefs; technical reports; contribution to standards; reference materials; validated methods; reference methods and measurements; technical systems; scientific information systems and databases; data sets; training material.
** Journal contributions (Clarivate); journal contributions (Scopus).
*** Books; non-listed journal contributions; PhD theses; oral and poster presentations; JRC-organised conference and workshop material; public information documents; external study reports; JRC contractual project management output.

Social media

In 2019, the JRC has achieved:

48.3k followers, our tweets made more than 12 million impressions and 27.5k interactions

23k followers, our posts made more than 2.27 million impressions and 9k interactions and 29.8k video views

54.9k followers, our posts made more than 1.2 million impressions and 8.2k interactions

3.3k followers, 100k views and 867 interactions

Events

Around 70 events were organised *in situ* in January and February 2020, and digitally from March onwards

Over 13 200 participants were mobilised in total, in both traditional and virtual events

Media

122 JRC news items were published on the Science Hub

5 549 news articles mentioned the JRC, representing a 26.6 % increase on the previous year

26 349 JRC newsletter subscribers were recorded

Over 300 journalist requests were dealt with and followed up

Web

The JRC's corporate website, the EU Science Hub, gathered:

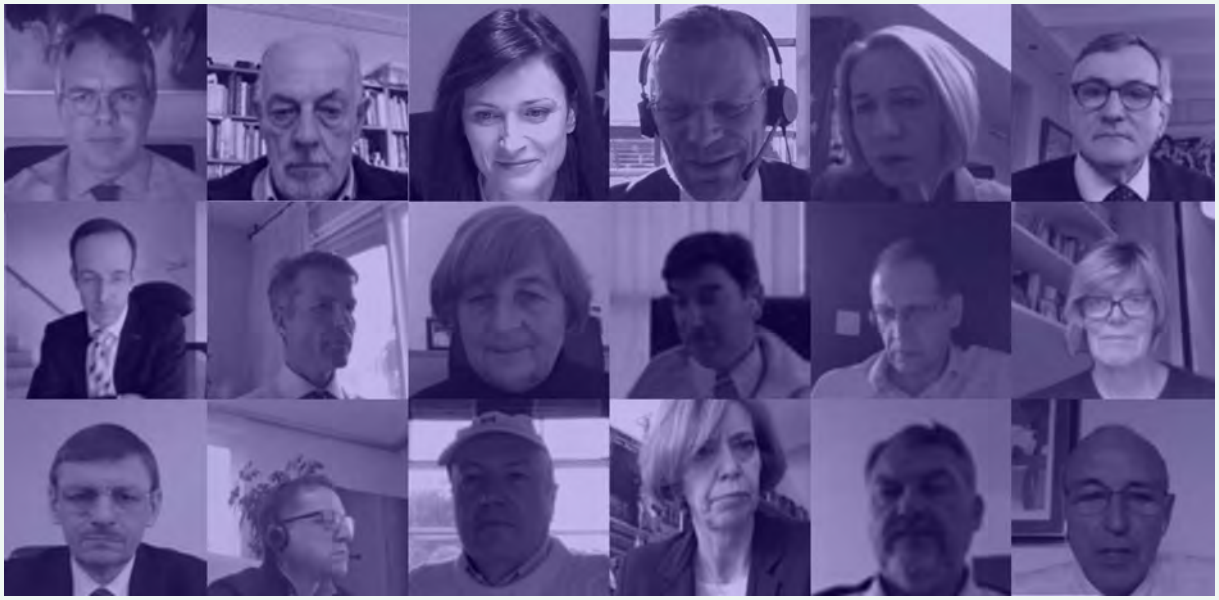
Nearly 3.5 million visits from nearly 2.7 million unique visitors

Nearly 6 million page views, including over 4.7 million unique page views

AN ENGAGED AND COLLABORATIVE BOARD OF GOVERNORS

Although it was unable to meet in person, the JRC Board of Governors carried out its proceedings remotely to ensure its mission of advising 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, 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 give advice and inform the JRC's management about relevant national developments. If justified, dedicated ad hoc working groups are created for more in-depth scrutiny and a better understanding by the board as a whole.

In 2020, ad hoc working groups on Horizon Europe and on the JRC's 2021–2022 work programme were active. The former met regularly throughout the interinstitutional negotiations on the new research framework programme, Horizon Europe, to provide advice and opinions on the matter. The Senior Appointments Selection Committee also met to help the JRC fill senior management posts. The Board of Governors met twice in 2020.



121st meeting
12 June 2020

The Board discussed the JRC's activities in Resilience, Fairness, Science for Policy 2.0, Enlightenment 2.0, the Second Report of the Critical Friends, Geel strategic site developments and Earth Observation in Agriculture. It endorsed the JRC's Site Development Vision 2030 and site development plans, following advice given by the ad-hoc working group on implementation of the Strategy 2030. The Board also met the JRC scientists involved in exploratory research projects and had the opportunity to visit the laboratories and facilities, including on aviation security, reference materials, and microplastics.

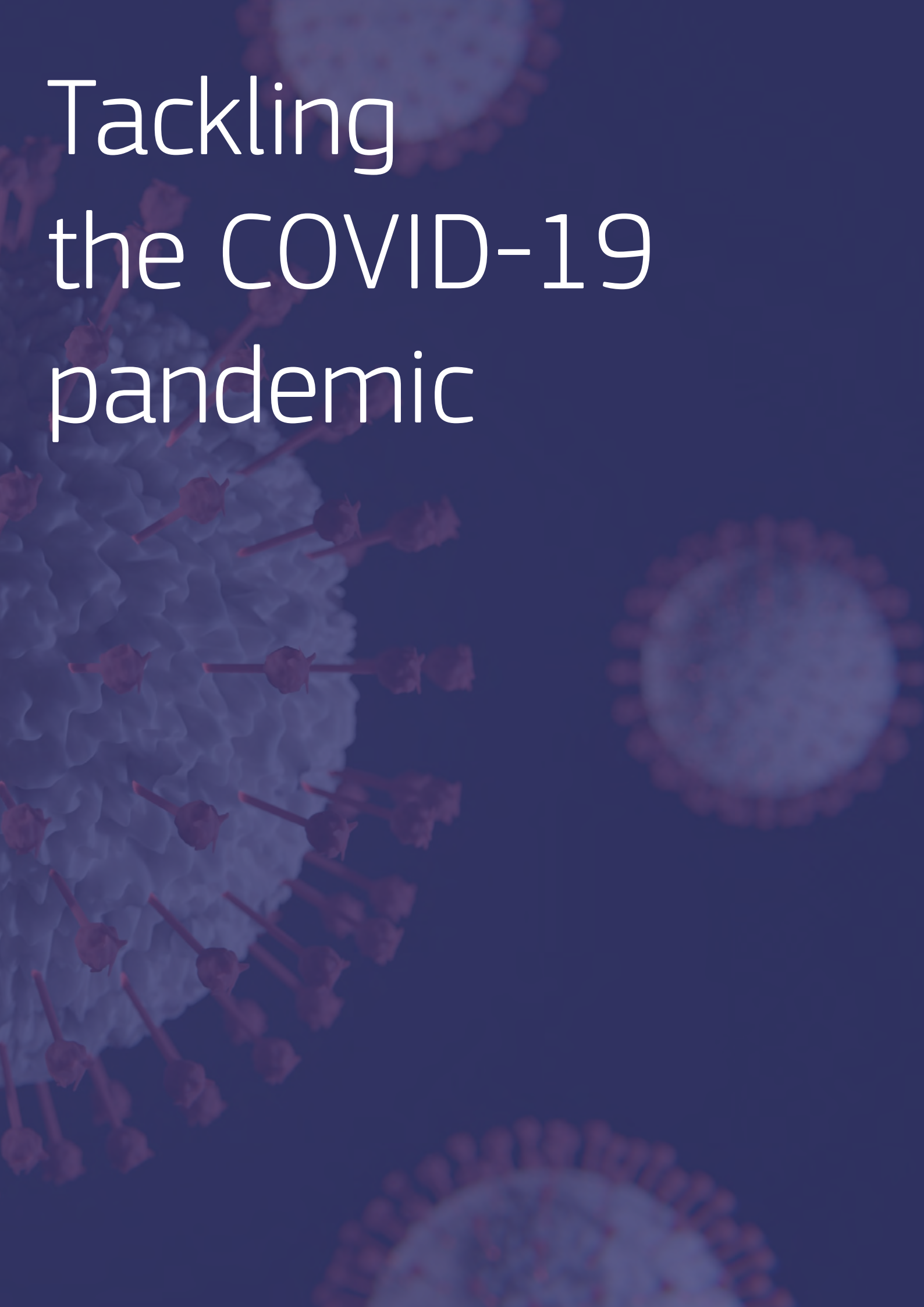
122nd meeting
25 November 2020

Board members and participants had a stimulating exchange with Mariya Gabriel, European Commissioner for Innovation, Research, Culture, Education and Youth. The board also discussed the first foresight report, key features of the JRC's 2021–2022 work programme and the JRC's draft 2021 budget, the JRC's role in the European Commission's response to the COVID-19 outbreak, and the flagship report on cybersecurity. The board was informed of the discussions held in the ad hoc meetings on Horizon Europe, Euratom and decommissioning, and on the JRC's 2021–2022 work programme.

SCIENCE FOR POLICY HIGHLIGHTS

The JRC's knowledge production and management work is carried out with a collaborative, multidisciplinary approach. This inclusive approach is self-evident as policies – to which the JRC must contribute evidence – are becoming ever more complex and intertwined. It also responds to the high-level political priorities that drive the European Commission's actions, not only those that President von der Leyen put forward at the beginning of her mandate but also those that necessity dictated, such as responding to the COVID-19 pandemic outbreak. The following chapters provide a series of examples of what the JRC has achieved in 2020, through the prism of these political priorities.

Tackling the COVID-19 pandemic



In 2020, a virus that emerged thousands of kilometres away fundamentally changed our lives. Beyond the devastating number of people who died or became seriously ill, the pandemic exposed our fragilities, locked down our communities and slowed down our economies. This had a profound impact on us as scientists, policymakers and, most of all, regular citizens. The scientific community and policymakers worked round the clock, setting out to better understand this pandemic and see how we could mitigate the adverse effects together.

Since the very beginning, research and innovation have been at the heart of the EU's response to COVID-19 in several areas. Scientists were part of President von der Leyen's COVID-19 advisory team, which helped provide robust science to inform actions to fight against the pandemic. From informing the public health response and developing guidelines and control materials for testing to performing detailed analyses on the economic impact in different sectors, scientific evidence enabled the EU to make decisions to protect lives and livelihoods.

The JRC strove to understand the situation from the citizens' perspective to help manage the social and environmental aspects of the crisis. Our scientists also launched a series of actions in solidarity with European citizens, remaining in permanent contact with local communities, hospitals and laboratories. As the virus hit Europe, JRC experts helped to develop a distribution methodology to make sure that vital medical supplies could get to where they were needed most, when they were needed most.

SINCE THE BEGINNING – A RAPID RESPONSE

As COVID-19 reached Europe, the JRC quickly mobilised its multidisciplinary expertise to monitor and model the expected epidemiologic development of the pandemic. Daily situation reports and maps of regions affected were instrumental in providing evidence on the evolution of the crisis. Many of the data were made public and helped experts predict the total number of positive cases expected in countries across Europe. The analysis also fed into the Commission's overall European roadmap to lifting COVID-19 confinement measures.

To capture the impact of the outbreak, an epidemiological analysis was coupled with a full range of assessments of social and economic consequences. The JRC continues to constantly assess the macroeconomic impacts at the national level. JRC economic analyses were used in preparing the Spring 2020 Economic Forecast, the EU's recovery plan – Next Generation EU – and the reinforced long-term budget of the EU for 2021–2027.

JRC analysts from the text- and data-mining unit were instrumental in the light of the massive wave of false or misleading information, including attempts by foreign actors to influence EU citizens and debates. By providing daily morning news briefs on COVID-19, they helped experts track the pandemic and push back on misinformation.

The JRC also worked with international partners to address the impact of the crisis globally, especially in developing countries. This included using an outbreak risk model to assess the risk of spreading contagions across the globe and contributing to a global report on food crises.

01.03
Managing the crisis with scientific evidence in late February

Right after the first positive cases of COVID-19 were detected in Italy, there was growing uncertainty about whether hospitals would be able to withstand the sudden increase in the numbers of patients. In response to this, the JRC developed a model to provide reliable daily forecasts of the demand for additional intensive care unit (ICU) beds in the Lombardy region. The results of the model were communicated to the local health authority, which activated their operations for arranging extra ICU beds. This proved valuable when the numbers of patients increased. The model was also tested in Spain, and it was confirmed that it worked for forecasting the ICU bed demand in other countries as well.

JRC modelling was also instrumental in helping Member States to forecast the supply and demand of personal protective equipment and test materials, and to take action at EU level to avoid bottlenecks in the supply chain. Epidemiological and intervention measure databases were also set up to help manage the crisis.

01.04
Developing a new control material to help prevent COVID-19 test failures

During the early stages of the COVID-19 pandemic, the lack of positive control materials was identified as one of the top three challenges for the reliable implementation of COVID-19 tests. This is why JRC scientists successfully designed a new control material that laboratories could use to check the correct functioning of their diagnostic tests and avoid false negatives. Samples were dispatched to testing laboratories across the EU, including the major reference virology centres and hospitals. In support of the global efforts to contain the spread of the novel COVID-19, the JRC also provided samples to laboratories, research centres and hospitals in more than 40 countries, including the western Balkan countries and South Africa.

15.04
Issuing new guidelines on testing methodologies

To fill the gap in the legal requirements on COVID-19-testing methodologies, the Commission presented guidelines, developed by the JRC, on how to use testing tools effectively. An analysis carried out by the JRC at the time established that the tests to detect the virus - so-called reverse transcription polymerase chain reaction (RT-PCR) tests usually perform well. The capacity to perform large-scale testing has been key to reducing the spread of the COVID-19 pandemic and remains a crucial precondition for a gradual return to our normal way of life. The JRC also set up and maintains a publicly available, structured and manually curated database on COVID-19 *in vitro* diagnostic devices and test methods, which support Member States on their national testing strategies and promote the continuous development of devices by manufacturers.

15.04
Engineering a three-dimensional printed valve for emergency ventilator masks

To respond to the sudden increase in demand for critical medical supplies by local hospitals, a technician working at the JRC's central workshop in Ispra (Italy) used a three-dimensional (3D) printer to produce valves for emergency ventilator masks. Prototypes of the valve were taken to Ospedale di Circolo in Varese (Italy) for testing and approval. On 15 April, 22 valves were delivered in person to Chief Medical Officer Lorenzo Maffioli and Operations Manager Giovanni Poggialini at the Varese hospital (Italy).

24.04
Taking part in the Commission-hosted #EUvsVirus Hackathon

The JRC hosted a webinar to kick start the social and political cohesion domain of the pan-European #EUvsVirus Hackathon, under the patronage of Mariya Gabriel, Commissioner for Innovation, Research, Culture, Education and Youth. Alexandra Balahur, IT project officer at the JRC, spoke about data as a bridge between people. The goal was to suggest open questions to think critically about the challenges derived from the COVID-19 crisis in this domain and bring forward data science-related insights.

01.05
Supporting Member States in developing effective COVID-19 contact-tracing apps

Starting in May 2020, the JRC helped the eHealth Network of EU Member States with technical analysis and a performance assessment of COVID-19 contact-tracing applications. This helped to ensure that the notification system for potential exposures on the apps could be effective, that Bluetooth proximity detection would function properly and that various apps could function with EU cross-border interoperability. On 19 October, the EU interoperability gateway for contact-tracing apps went live with the first wave of national apps in Germany, Ireland and Italy.

12.05
Monitoring people's feelings and sentiments, and the impact on vulnerable groups

In response to the lack of data on how EU citizens reacted to the COVID-19 outbreak and the measures put in place, the JRC launched an online survey in all Member States. Based on the results, the JRC could provide insights to policymakers into the impact and consequences of COVID-19 on everyday lives. This has been key to developing effective strategies to improve citizens' lives. The analyses also fed into the JRC's work on social fairness, energy and transport use, resilience, privacy and the use of modern communication.

The JRC also explored the potential impact on existing gender divides and vulnerable groups, including migrants and children.

04.06
Helping to keep culture alive during lockdown

Museums, theatres, local cultural organisations, libraries and many more cultural institutions had to close down because of the confinement measures. Some of these continued working online to keep culture alive during this difficult time. This is why the JRC's 'Cultural gems' web application was updated to include 'EU culture from home' – a hub of cultural initiatives from across Europe, from online opera performances to virtual art galleries. The 'Cultural gems' platform identifies these initiatives and organises them on interactive city maps, displaying the rich culture that Europe has to offer.

10.06
Releasing artificial intelligence technology for COVID-19 fact checkers

In the fight against COVID-19 disinformation, the JRC ensured that innovative AI text-mining software was open source and available to the fact-checking community. The technology automatically identifies and monitors

disinformation through different actions – from flagging fake news to tracking questionable sources. This helps keep the facts straight on COVID-19, which is essential to an effective public health response.

10.06
Using wastewater to track the virus

The European Commission established a pan-European umbrella study, involving 90 European wastewater treatment plants, to better understand the potential of tracking severe acute respiratory syndrome coronavirus 2 in sewers, to provide early warning of the potential re-emergence of the virus in Europe, without the need to test the population directly. The JRC and partners organised the first 'town hall meeting' of stakeholders on the issue in June 2020.

15.06
Launching 'Re-open EU' to support safe travelling and tourism

As summer approached, many citizens needed access to information to help them confidently make travel plans and stay safe during their trips. This was also important for the already hard-hit transport and tourism sectors. In response, the JRC developed the 'Re-open EU' web platform, which provides real-time information on travel restrictions and public health and safety measures (e.g. physical distancing, facemasks), as well as other information on EU and national tourism offers. It helps Europeans make responsible and well-informed decisions on how to manage continuous COVID-19-related risks while planning their holidays and travels during summer and beyond.

22.06
Exploring challenges in the prevalence of telework across the EU

As working from home became the norm for millions of workers in the EU and worldwide, JRC scientists analysed the challenges that workers, employers and states faced when adapting to the new working-from-home environment. The results give policymakers key insights when making decisions on the important role of telework in preserving jobs and production in their communities.

14.07
Mobility data provides insights into virus spread and containment to help inform future responses

Studies published by the JRC explained the relationship between human mobility and the spread of COVID-19, as well as the effectiveness of mobility restriction measures to contain the pandemic.

The findings, based on aggregated and anonymised mobile phone location data provided by mobile network operators in 22 EU Member States and Norway, served as guidance for policymakers in formulating the best data-driven approaches for ending confinement, mapping the socioeconomic effects of mobility restriction measures and informing early warning systems for potential new outbreaks. Based on a business-to-government data-sharing initiative in collaboration with DG Communications Networks, Content and Technology, the JRC developed an interactive mobility visualisation platform to deliver mobility-related insights to the Commission and Member States.

03.08
Analysing the impact on the economy and labour markets to support the European Union's response

To support policymakers in mitigating the socioeconomic consequences of the outbreak, JRC scientists carried out a territorial analysis of the economic impact of COVID-19. The results show that the economic consequences of the crisis do not necessarily mirror the epidemiological damage caused by the pandemic but largely depend on the economic characteristics of the region. Analyses also show that the most negative effects were concentrated on those who were already vulnerable before the outbreak.

26.08
Anticipating the impact of future COVID-19 waves on jobs and tourism

With the COVID-19 crisis affecting people's willingness and ability to travel and their destination preferences, JRC experts analysed survey responses and economic data to identify three potential scenarios and estimate subsequent impacts on employment across the EU. Their report maps out the regional differences within each country, to help policymakers identify those most in need of support. The experts also lay out short-, medium- and long-term actions in support of the tourism industry and people's livelihoods as they face these pressures.

11.09
Studying children's digital lives during lockdown

Because of the lockdown, children are consumers of digital media and content now more than ever. This provides opportunities for learning and sharing quality time online, but it also creates risks, such as the increased likelihood of negative experiences. This is why the JRC, in collaboration with selected European research teams, launched a study on changes in children's digital engagement during the COVID-19 lockdown, entitled 'Kids' digital lives in COVID-19 times' (KiDiCoTi). The results of this study are intended to support the EU security union strategy and its new ecosystem, as well as the European strategy for a better internet for children, which is promoted through its platform 'Better Internet for Kids'.

As part of the KiDiCoTi project, the JRC report *How families handled emergency remote schooling during the COVID-19 lockdown in spring 2020* provided a first glance at how families coped in this unprecedented situation.

19.11
JRC analysis on government support for airlines in the aftermath of the COVID-19 pandemic

A JRC report looks at if a more sustainable aviation sector could emerge from the pandemic. The report concludes that government support for the largest airlines during the COVID-19 pandemic risks distorting the level playing field, pushing out smaller companies and removing some international connections. At the same time, governments are in a position to make their support conditional on airlines taking action to be more sustainable.

07.12
New reference materials for the quality control of antibody tests

The JRC released two new reference materials, developed to function as quality assurance tools for the antibody tests used to verify if an individual has been infected with the coronavirus. They can also support research on immunity against COVID-19 and help monitor the efficiency of experimental vaccines.

LOOKING FORWARD AND PREPAREDNESS

The JRC contributes to the European comprehensive strategy to overcome the COVID-19 crisis, including through the definition of possible recovery scenarios in collaboration with the European Centre for Disease Prevention and Control. JRC experts continue to explore all aspects of these scenarios, including health, economic, agriculture, security and social.

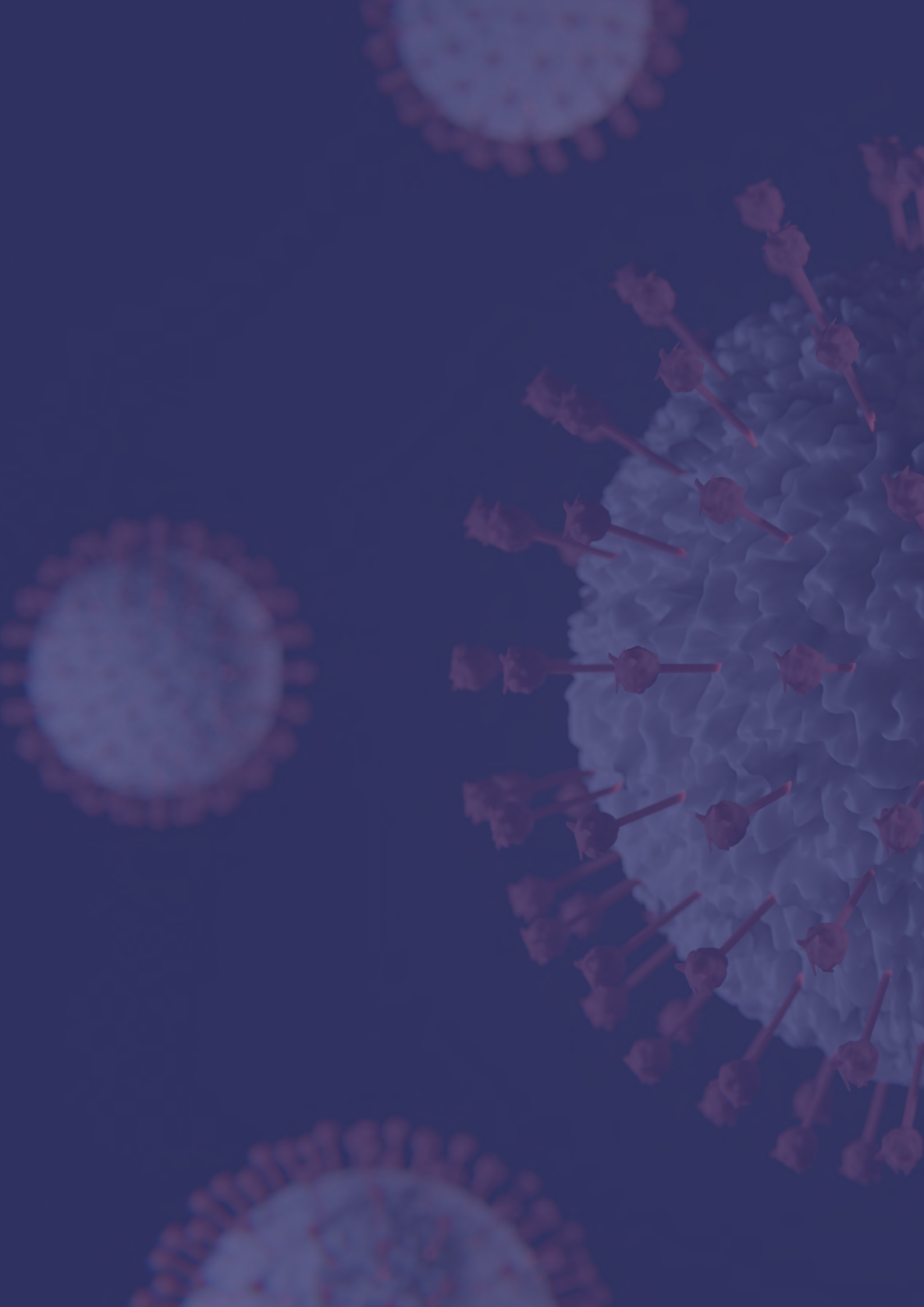
A key strand of their work is related to the **de-escalation strategy** – namely which containment measures can be relaxed safely. JRC COVID-19 de-escalation modelling helped to develop a methodology to link epidemiological and socioeconomic models, providing quantitative data supporting a transition from general to targeted containment measures. This allows for the optimisation of policy actions aimed at maximising employment and economic activity while minimising the spread of the disease. The JRC supports Member States through a series of reports that give an overview of the impact of lifting containment measures and identify synergies between ongoing and newly planned activities.

JRC analyses also reveal that **diagnostic testing** is the cornerstone of an exit strategy that responds to both short-term urgency and long-term strategic goals. The JRC has identified the adoption of a group testing protocol that significantly improves the utilisation of resources necessary for large-scale diagnostic testing as essential to an effective exit strategy. Maintaining coordination with Member States dedicated to improving the sensitivity and availability of tests at the point of care has also been identified as a key measure in the response to COVID-19.

THE COVID-19 TASK FORCE

The JRC set up a COVID-19 task force to coordinate its response to the COVID-19 pandemic. The task force helped facilitate the exchange of information and identify synergies across disciplines, thus providing more coordinated and comprehensive responses to the complexity of this unprecedented situation. To streamline the work, the JRC task force activities were categorised into six main strategic priorities:

1. epidemiological monitoring, modelling and reporting;
2. use of alternative data and digital technologies;
3. testing, genomics, diagnostics and health;
4. socioeconomic modelling and analysis;
5. travel, tourism and transport;
6. citizen pulse.



A European Green Deal

The **European Green Deal** is a strategy designed to make the EU's economy sustainable, by turning climate challenges into opportunities and making the transition just and inclusive for all. A new growth strategy for Europe is needed that will transform the EU into a modern, resource-efficient and competitive economy, in which there are no net emissions of greenhouse gases by 2050, economic growth is decoupled from resource use, and no person and no place is left behind. Policy developments implementing the strategy cover areas such as biodiversity; farm to fork; sustainable agriculture; clean energy; sustainable energy, building and renovating; sustainable mobility and eliminating pollution; and climate action.

In 2020, the JRC's contribution to making the Green Deal a reality for people living in Europe included contributing to the energy transition, climate change mitigation and adaptation efforts; looking into the blue economy, endocrine disrupters, bioeconomy, soil threats or natural radiation; contributing to the taxonomy regulation; and launching the Knowledge Centre for Biodiversity.

CONTRIBUTING TO ENERGY TRANSITION EFFORTS

As per the Green Deal's priority, decarbonising the EU's energy system is critical to reaching the EU's climate objectives. Achieving a successful transition towards sustainable energy production and consumption requires a diverse range of political and legislative actions from the Commission, to which the JRC actively contributed throughout 2020.

The latest edition of the JRC's *Global Energy and Climate Outlook* identified four technological dynamics in the energy sector that have the power to limit global warming to below 2 °C if implemented simultaneously. Replacing technologies that run on fossil fuels with alternatives that run on electricity plays a key role in the energy transition. Further electrification of key sectors such as transport will be critical to decarbonising the entire energy system. The JRC report also argues that full decarbonisation of power generation is not only technically feasible but also an economically attractive measure to combat climate change. Boosting energy efficiency in our buildings, transport and industrial sectors is also seen as a key contributor.

The transformation of the power and gas infrastructure and markets, including smart energy sector integration, will be key indeed in the energy transition. The JRC assessed the water footprint of the energy system as well as the impacts of replacing fossil fuels with renewable energy in the heating and cooling sectors. Findings from these two analyses were used in the EU energy system integration strategy, enhancing the narrative on the expected impacts of various options for energy system integration. Digitalising the energy sector is essential in this context. The JRC developed and promoted a European interoperability methodology, which is gradually being adopted by industry, and informed the implementing act of the electricity directive (Directive (EU) 2019/944) for the description of use cases. A recent JRC report also confirmed the need for

a continued European effort to develop various fit-for-purpose advanced Li-ion, post-Li and non-Li-ion battery technologies for a broad range of applications.

Contributing to the EU hydrogen strategy, the JRC published a study that examined the extent to which the currently carbon-intensive hydrogen production (grey hydrogen) in Europe could be replaced by water electrolysis using electricity from renewable energy resources, such as solar photovoltaic, onshore/offshore wind and hydropower (green hydrogen). The findings showed that 88 out of 109 hydrogen-producing regions in the 27 Member States of the EU (EU-27) and the United Kingdom have abundant renewable resources and could cover both their current electricity needs and the additional power demand for hydrogen electrolysis. Previous JRC work on hydrogen use in EU decarbonisation scenarios has also fed into the EU hydrogen strategy.

With regard to energy-efficient building renovation, a JRC report on the topic offers European and national decision-makers guidance on allocating renovation resources for maximum return while ensuring balanced regional development in the context of the Renovation Wave initiative and the national recovery and resilience plans. The study identifies the most critical European areas and quantifies, for each European region, the energy-saving potential of building renovation, as well as investment needs and impact on occupations. Further JRC analyses on heating and cooling, energy service companies and financing instruments for building renovations featured prominently in the renovation wave communication.

In support of the first competitiveness progress report (COM(2020) 953) and its related *Clean Energy Transition – Technologies and innovation* report, the JRC assessed the competitiveness of the EU clean energy sector. It focused on the impacts on macroeconomic indicators, including gross domestic product (GDP) and employment, and on various low-carbon solutions ranging from offshore wind and photovoltaics to hydrogen and batteries. The report allowed a better understanding of the state of Europe's clean energy industrial fabric, drawing on the JRC's work in the context of the Low Carbon Energy Observatory, and complementing the assessment and country-specific recommendations of the national energy and climate plans.

Zooming in on one of the fastest-growing renewable technologies in its latest photovoltaic status report, the JRC pointed to the gap between the global and European climate targets and the deployment rate of solar power, despite a 7 % increase in newly installed capacity worldwide and solar power attracting the largest share of new investments in renewable energies for the ninth year in a row. A much more rapid increase in the installation rate is needed to decarbonise the power sector by 2050. JRC scientists make their detailed knowledge of photovoltaics accessible to citizens via the JRC Photovoltaics Geographical Information System. Roughly 2.5 million people or companies access it each year to assess whether installing photovoltaics may make sense for them.

The energy transition needs to be fair and inclusive, leaving no one behind. A JRC report on clean energy technologies in coal

regions showed that the deployment of clean energy technologies in more than half of the EU coal regions could offset job losses induced by the transition by creating up to 460 000 jobs in total by 2050. It presented a concise overview of the role that clean energy technologies can play in the path to decarbonisation for the regions with coal-mining activity, whose decline is both inevitable and accelerating.

JRC'S CONTRIBUTION TO CLIMATE CHANGE MITIGATION AND ADAPTATION EFFORTS

The Commission's strategy for reducing the risks posed by climate change is both to mitigate, by reducing emissions of greenhouse gases, and to adapt, by reducing exposure and vulnerability to expected impacts.

The JRC's main activities cover cost–benefit analysis and impact assessment of mitigation and adaptation options, CO_2 emissions monitoring and verification, Earth observations from space and Earth system modelling to better formulate predictions of climate and climate impacts, and climate risk management practices.

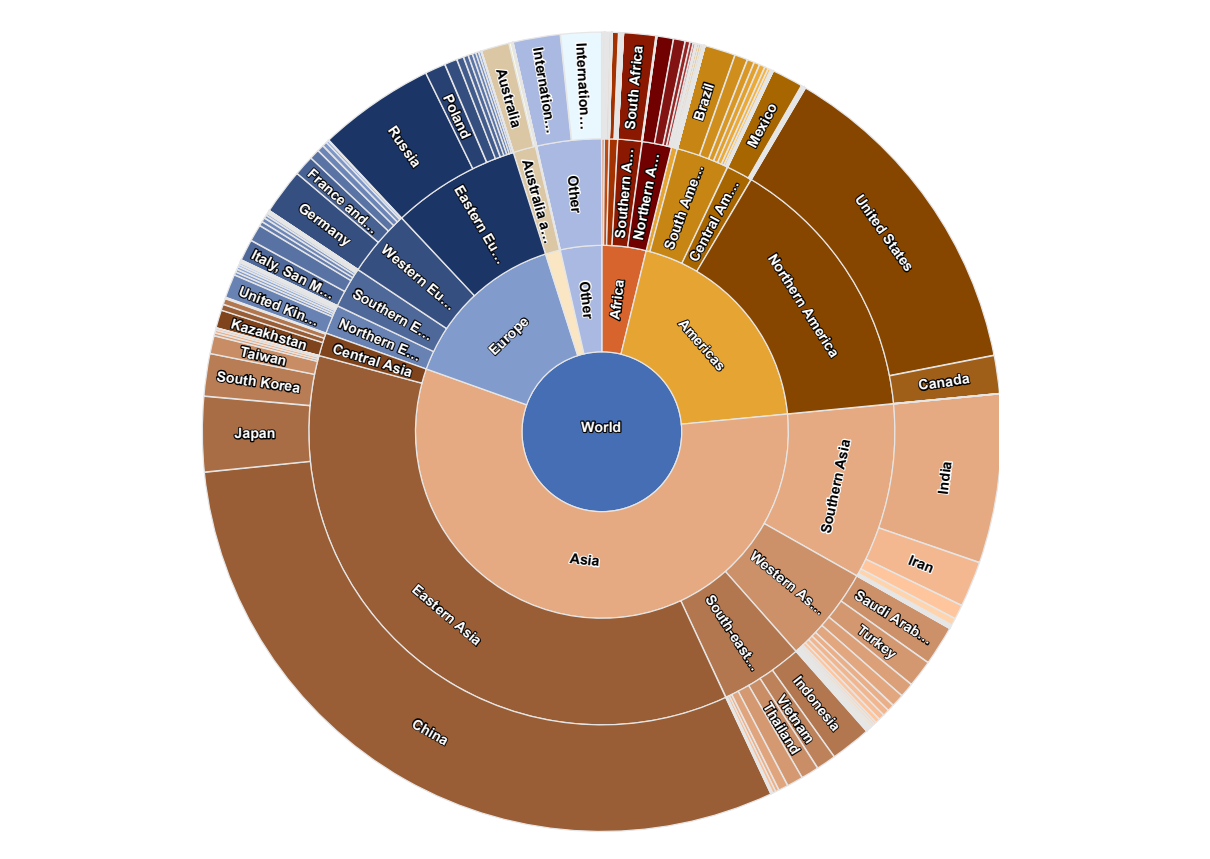
The JRC provided a quantitative insight into the economic and social consequences of reaching the increased climate targets proposed in the 2030 climate target plan, which aims to reduce EU greenhouse gas emissions by at least 55 % by 2030 compared with 1990 levels. Its studies, tools and data sets on topics ranging from non-CO_2 emissions to low-carbon technologies informed the impact assessment, which confirmed that the 2030 target is ambitious, achievable and beneficial. In its report on the impacts of the climate transition on EU households, the JRC provided a detailed exploration of the EU Household Budget Survey data in the light of its use in analysing climate policy impacts across households with heterogeneous consumption patterns. The report was recognised as a key study in showing that the transition to a climate-neutral EU is possible but needs to be done inclusively.

The JRC report on climate change impacts and adaptation highlighted the potentially devastating effects of climate change, unless mitigation measures are taken and adaptation strategies are implemented to reduce the unavoidable impacts. The report estimated that, without climate mitigation (warming of 3 °C or more above pre-industrial temperature), each year millions of citizens in the EU and the United Kingdom would be exposed to deadly heatwaves, a high level of fire danger and floods. The EU economy would also be hit by an annual welfare loss of at least EUR 175 billion (1.4 % of GDP). The JRC report also pointed to some cost-efficient adaptation strategies to reduce climate change impacts and to enhance overall resilience to climate change.

A JRC report also proposed for the first time a methodology for assessing the impacts of climate change on the thermal design of the built environment, which will serve as a stepping stone for assessing the impact of climate change on buildings across the EU and developing adaptation strategies. Another report analysed trends in the climatic parameters that provoke corrosion and reviewed the methods for a quantitative assessment of climate change-induced corrosion. The report presented a way of assessing the best adaptation measures for the existing building stock and improved design for new structures to mitigate the climate change-induced corrosion.

The devastating effects of climate change were also confirmed by a JRC study published in *Nature Communications*, which concluded that around 95 % of flood impacts could be avoided through coastal adaptation focusing on human settlements and economically important areas along the coastline. Similarly, another study, published in *Nature Climate Change*, found that half of the world's beaches could disappear by the end of the century because of coastal erosion and that effective climate action could prevent 40 % of that erosion. The findings come from the first global assessment of future sandy shoreline dynamics, combining 35 years of satellite coastal observations with 82 years of climate and sea-level rise projections from several climate models. The JRC also simulated more than 100 million storm events and measured the resulting global coastal erosion. Apart from the loss of valuable ecosystems, socioeconomic implications can be severe, especially in poorer, tourism-dependent communities and small island nations.

The latest JRC report *Fossil CO_2 Emissions of All World Countries – 2020* report, based on the JRC's Emissions Database for Global Atmospheric Research unique tool, confirmed that, globally, CO_2 emissions continued to grow in 2019, although at a slightly slower pace. However, emissions from the EU Member States and the United Kingdom decreased by 3.8 % compared with the previous year. This means the EU's and the United Kingdom's fossil CO_2 emissions were 25 % below the level in 1990. This reduction is the



2019 Fossil CO_2 Total Emissions. Source: https://edgar.jrc.ec.europa.eu/

largest among the top-emitting economic areas around the world. This shows the relevance of rigorous monitoring of CO_2 emissions, providing a benchmark against which national and global estimates can be compared.

JRC scientists showed the importance of also assessing methane (CH4) emissions in a paper published in *Science Advances*. The JRC produced a novel global estimate of wetland CH4 emissions based on observations of atmospheric CH4 concentrations and climate data. The results suggest that, by 2100 – under a business-as-usual climate scenario, in which no actions are taken to reduce anthropogenic greenhouse gas emissions – current natural CH4 emissions from wetlands may increase by 50–80 %. CH4 is a powerful greenhouse gas. Its global warming potential is estimated to be between 28 and 34 times higher than that of CO_2.

In support of the EU policy for the Arctic, a JRC report on Arctic permafrost thawing evaluated the ongoing and future warming of the Arctic permafrost and the resulting emissions of CO_2 and CH4. JRC scientists highlighted that the rising temperatures in the Arctic may lead to the thawing of permafrost, resulting in additional emissions of greenhouse gases into the atmosphere. The CO_2 emissions from the thawing permafrost already have an impact on the global warming rate, but at the moment their contribution is much smaller than that of anthropogenic emissions. In the future, the emissions from the thawing permafrost may become larger than anthropogenic emissions, and the Paris Agreement targets to reduce global warming may be exceeded sooner than expected, which would require additional reductions in anthropogenic emissions.

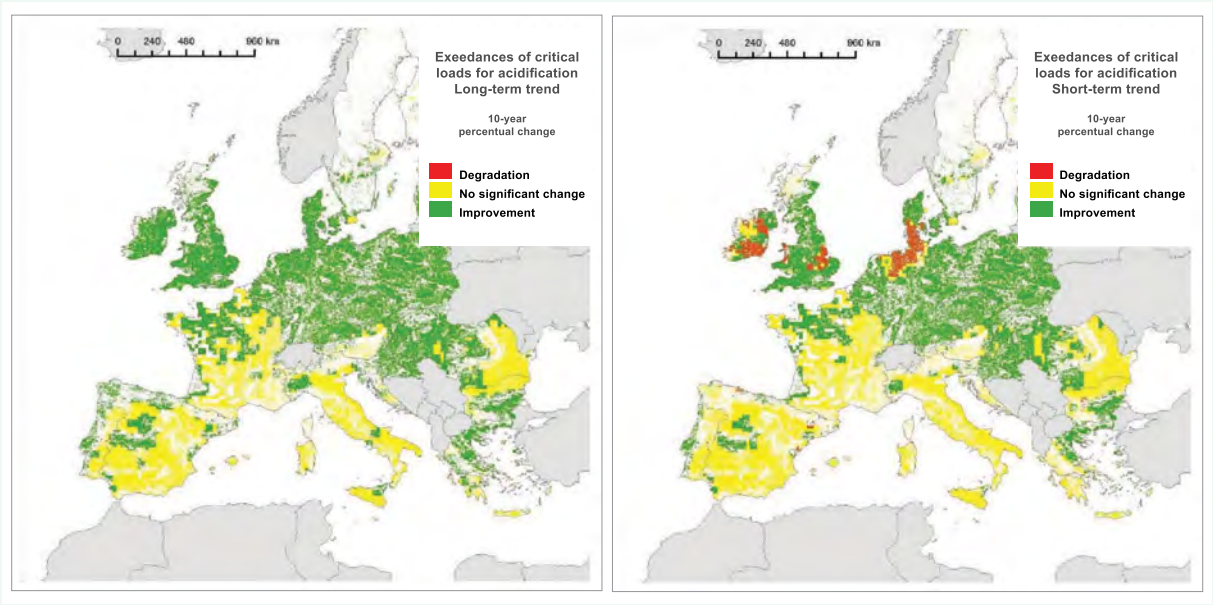
HELPING REVERSE BIODIVERSITY LOSS AND PROTECT EUROPE'S ECOSYSTEMS

The European Commission launched a new Knowledge Centre for Biodiversity: a one-stop shop for science-based evidence to protect the natural ecosystems that provide us with food, medicines, materials, recreation and well-being.

The knowledge centre makes the latest knowledge of biodiversity available to strengthen the impact of EU policies. It also helps to monitor the implementation of the EU biodiversity strategy for 2030, which aims to put Europe's biodiversity on a path to recovery by the end of the decade.

Launched during EU Green Week 2020, the knowledge centre directly addresses challenges uncovered by the first-ever EU-wide ecosystem assessment, which was produced by the JRC and released the same day. The assessment shows that Europe's natural areas – from its forests, rivers and lakes to its farmland, urban green spaces and soils – are under increasing pressure from climate change and its related impacts.

The urgency of the current situation and the inherently complex and multidimensional aspects of biodiversity



Trends of exceedances of critical loads for acidification (% change over 10 years): left: long-term trend; right: short-term trend

conservation require new ways of working. In this context, enhanced scientific support for all policymakers has a crucial role to play. This is where the Knowledge Centre for Biodiversity comes in.

Developed in close collaboration with the Commission's DG Environment and the European Environment Agency, the Knowledge Centre for Biodiversity is the eighth European Commission knowledge centre and the seventh to be launched under the leadership of the JRC. It joins those on bioeconomy, global food and nutrition security, territorial policies, migration and demography, disaster risk management, food fraud and quality, and interpretation (led by DG Interpretation).

In a separate development, a study published in *Nature Communications*, with contributions from JRC scientists, has found out that a mere 10 % of nature protection areas worldwide are connected by green corridors ensuring that wildlife can move freely from one protected area to another. This has led to the realisation that conservation strategies should not exclusively target an increase in the areas meant to be safeguarded but also allow for better connectivity among them.

Europe, with its high population density and well-developed infrastructure, has the lowest connectivity of all continents, despite ambitious conservation efforts. The study highlighted the drawbacks that such detachment can create, and the data can be useful for EU policymakers working on expanding the Natura 2000 programme.

DRIVING TOWARDS SMARTER AND MORE SUSTAINABLE MOBILITY

The EU transport system needs to achieve its green and digital transformation and become more resilient to current and future crises. Transport is a key pillar of the European industrial strategy and our economic recovery. During 2020, JRC research contributed to greening currently available transport modes while paving the way for smarter, cleaner and more resilient future mobility.

The JRC continued contributing to the reduction in CO_2 emissions from heavy-duty transport by advising and developing a methodology on CO_2 in-service verification of heavy-duty vehicles (after certification processes), and investigating its validity, accuracy and feasibility through an extensive test campaign.

In the context of the real driving emissions regulation (Regulation (EU) 2016/427), which introduced on-road testing with portable emissions measurement systems (PEMSs) complementing laboratory tests for type approving light-duty vehicles in the EU, the JRC completed a review of the uncertainty margins of PEMSs for on-road emission tests. The results of this review informed the debate in the EP on amending Regulation (EC) No 715/2007 on type approval of motor vehicles.

With regard to future mobility, JRC quantitative and qualitative analyses highlighted the potential effect of new

mobility solutions on road transport. Autonomous vehicle (AV) technology is still under development, and appropriate legislative safeguards must be established to regulate the placing on the market of such vehicles and ensuring proper road user safety. A JRC report outlined the state of play of AV active safety verification and the merits and limits of the different methodologies. In the context of the Transport Research and Innovation Monitoring and Information System, the JRC shed light on new and emerging transport technologies and trends in European research and innovation projects, including indications of current global research trends and intellectual property activity.

JRC ANALYSES AND MODELLING CONTRIBUTE TO ESTABLISHING HOW BLUE SECTORS CONTRIBUTE TO ECONOMIC RECOVERY AND PAVE THE WAY FOR THE EUROPEAN GREEN DEAL

The third edition of *The EU Blue Economy Report* was published in June 2020. Prepared by the European Commission DG Maritime Affairs and Fisheries and the JRC, it provides an overview of the performance of the EU economic sectors related to oceans and the coastal environment. In doing so, it supports policymakers and stakeholders in the quest for sustainable development of oceans and coastal resources, and, most notably, the development and implementation of policies and initiatives under the European Green Deal, in line with the new approach for a sustainable blue economy.

JRC experts in water and marine resources, territorial development and knowledge for the energy union contributed to several chapters of the report. This contribution included modelling, analysis and contributions to chapters on climate change and other human impacts on the ocean, marine natural capital and ecosystem services, status of and recent trends in established sectors, and emerging sectors.

The report examined not only established sectors (i.e. those that traditionally contribute to the blue economy) but also emerging sectors (those for which reliable data are still developing) and innovative sectors, which bring new opportunities for investment and hold huge potential for future development of coastal communities. Analyses were provided for the EU as a whole and by sector and industry for each Member State.

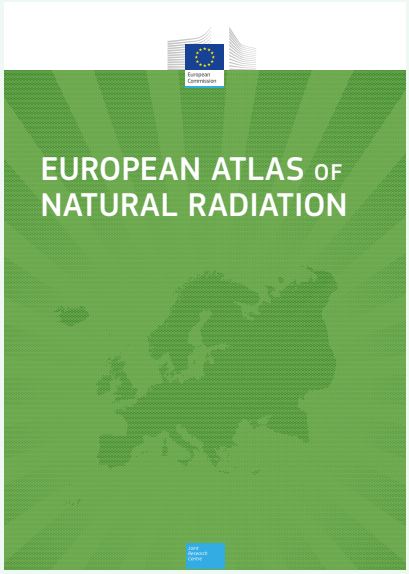
It is worth noting that, for the first time, the report addressed the environmental dimension of the blue economy in detail, thereby also contributing to achieving environmental objectives. The report also looked at the economic value of several ecosystem services provided by the ocean, including habitats for marine life, carbon sequestration, and processes that influence climate change and biodiversity.

The blue economy is linked to and affects many other economic activities. Success stories and more niche sectors or activities were also presented, for example the impacts of recreational boating, the use of multipurpose platforms to combine several sectors and how the EU blue economy compares with that of the United States.

NEW EUROPEAN ATLAS MAPS OUT NATURAL RADIATION SOURCES AND PROVIDES HARMONISED DATA SETS

We are constantly and continuously exposed to ionising radiations as natural radionuclides migrate within our environment, be it by air, water, rock or soil or through the food chain. This persistent exposure to radiation can have an impact on the health of the public and workers that varies significantly from region to region and from one working environment to another. For instance, radon, a naturally occurring, colourless, odourless and radioactive gas produced by the decay of uranium, is the most important risk factor for lung cancer after cigarette smoking, and the leading cause of lung cancer among people who have never smoked.

A quantitative analysis of the levels of radioactivity is essential to assess public dose rates and radioactive contamination, and to predict changes in environmental radioactivity caused by nuclear accidents, industrial activities and other human activities. To gain a clearer overview of the natural sources of radiation, the JRC launched, in 2020, the *European Atlas of Natural Radiation* in collaboration with over 60 institutions, including national and international organisations. Intended as an encyclopaedia of natural radioactivity, the atlas describes the different sources of this kind of radioactivity, namely cosmic and terrestrial radiation, mapping the levels of natural background radiation and providing harmonised data sets.



The scientific community, policymakers and national competent authorities have already been welcoming the atlas as the main source of reference values and harmonised data. For the public at large, the atlas also offers the possibility of becoming familiar with the radioactive part of its natural environment.

The EU Member States are responsible for monitoring the levels of radioactivity in the environment. Under the Euratom Treaty, the European Commission is mandated to collect, verify and report information on radioactivity levels in the EU Member States. The JRC operates and maintains the Radioactivity Environmental Monitoring database, which contains the monitoring data provided by the EU Member States on an annual basis.

CONTRIBUTING TO THE TAXONOMY REGULATION FOR CLIMATE MITIGATION AND ADAPTATION

The EU taxonomy is an EU-wide classification system for sustainable economic activities, with the purpose of facilitating sustainable investment. The EU taxonomy defines under which conditions activities are considered central to reaching the main EU environmental objectives (through the definition of the criteria for 'substantial contribution' to each of the six objectives set out in the taxonomy regulation), and when activities are considered an obstacle to reaching those objectives (through the definition of the 'do no significant harm' criteria). Compliance with minimum social safeguards is also required. Financial market participants and large companies are required to use the EU taxonomy to assess the green share of their financial products, portfolios and activities, and the public sector may also use the EU taxonomy to identify green activities in their budgets, programmes or plans.

The JRC has been at the heart of the development of the EU taxonomy since the Commission established the Technical Expert Group on Sustainable Finance in 2018. The JRC has substantially supported the work of the group, has been instrumental to the preparation and adoption process of the first delegated act under the taxonomy regulation (Regulation (EU) 2020/852), and guides the taxonomy technical screening criteria development work of the Platform on Sustainable Finance.

The JRC has not only contributed its in-depth technical expertise on most of the activities addressed, but also developed the methodologies for defining what is considered a substantial contribution to climate change mitigation and to the other four environmental objectives (water and marine resources, circular economy, pollution, and biodiversity and ecosystems), and how to set the technical screening criteria.

On the financial side, the JRC has developed a methodology to estimate the taxonomy alignment of financial portfolios in the absence of granular data on what fraction of activities and associated financial investments is taxonomy aligned. JRC estimates indicate that less than 5 % of EU financial markets are currently taxonomy aligned. However, the additional financial investments needed to achieve the climate targets appear to be within reach.

EUROPEAN UNION SOIL OBSERVATORY LAUNCHED TO MONITOR TRENDS IN SOIL HEALTH IN EUROPE

Life on Earth depends on healthy soils. They provide us with healthy and nutritious food, fibres, energy and clean water. Soils are also important for biodiversity and regulating the planet's climate. Simply put, healthy living soils keep us, and the world around us, alive.

'Caring for soil is caring for life', a proposed Horizon EU mission in the area of soil health and food, has the ambitious goal of ensuring that 75 % of soils are healthy and able to provide essential ecosystem services by 2030.

The JRC-hosted EU Soil Observatory was launched in 2020 to monitor the progress towards the achievement of this goal, streamline the regular reporting on the status of and trends in soil health in Europe, support citizen engagement activities and promote soil literacy to raise awareness of the societal value of soil. It is a dynamic platform that will provide European Commission services and the broader soil user community with the knowledge and data needed to safeguard soils. It features a shared soil information system that joins the ongoing soil-monitoring activities of the Commission, such as the Land Use and Coverage Area Frame Survey, with national soil-monitoring systems in EU Member States.

Based on a joint assessment by the Mission Board and the JRC, over 60 % of all European soils are in an unhealthy state. Unsustainable soil management practices, growing population pressure, changes in consumption patterns and climate change are all contributing to soil degradation.

Erosion caused by water flow wearing down soil surfaces could rise by up to two thirds compared with today, according to a JRC-led study that modelled changes until 2070. Through erosion, soils' ability to store carbon is affected as well, making them less capable of mitigating warming caused by soaring emissions. Biodiversity and ecosystem stability are also affected. Erosion makes soils less fertile and forces farmers to use more fertilisers to compensate, resulting in a heavier economic and environmental burden and aggravated food insecurity. Agriculture in Africa and South America will be hit hardest by plummeting land fertility, as these regions will have trouble compensating with phosphorus from chemical fertilisers. Rich countries with a high level of fertiliser use and moderate climates can expect erosion at a lower rate.

A study recently published in *Nature Communications* also found that between 40 and 85 % of total phosphorus losses in agricultural systems will be provoked by soil erosion caused by water. The authors of the paper, a research team from the JRC, the University of Basel, the French National Institute for Agricultural Research, the UK Centre for Ecology & Hydrology and Kangwon University, estimate that erosion by water alone will cause an average loss of phosphorus from Europe's soils of 5.9 kg per hectare every year. As 95 % of global food production relies on plants' ability to absorb nutrients, soil degradation is a major cause for concern.

EUROPEAN UNION-WIDE MONITORING SYSTEM TRACKS PROGRESS TOWARDS A SUSTAINABLE BIOECONOMY

A new monitoring system has been launched to help ensure that the European bioeconomy contributes effectively to the objectives of the European bioeconomy strategy, the European Green Deal and the SDGs.

The EU is determined to transform the European economy into a resource-efficient, low-emissions economy that reconciles

the demands for food, materials and energy with the need to reduce environmental pressures. An innovative bioeconomy is key to this complex puzzle.

In an innovative bioeconomy, paints can be made from crops, algae can be turned into fuel, and industrial by-products can be transformed into bio-based fertilisers. There can also be multiple benefits for people and the environment. For instance, the quality of life in cities would improve because of innovative waste management, more sustainable transport systems and urban agriculture.

Delivering a sustainable circular bioeconomy is a complex task. This is why the JRC, in partnership with other Commission services and external experts, developed the EU Bioeconomy Monitoring System.

Embedded in the European Commission's KCB, the system provides trustworthy data and robust indicators to policymakers.

It tracks progress towards the five societal challenges targeted by the EU bioeconomy strategy at EU and Member State levels, in the areas of the environment, society and the economy, along the entire value chain and for all primary production sectors.

The monitoring system aims to highlight synergies and trade-offs between these dimensions.

In this way, the system will make it easier to understand potential risks and pitfalls linked to policy choices, provide a basis for future policy decisions and ensure that the European bioeconomy is truly sustainable and circular.

ASSESSING IF EU LEGISLATION PROTECTING PEOPLE AND WILDLIFE FROM ENDOCRINE DISRUPTORS IS FIT FOR PURPOSE

Endocrine disruptors are chemical substances that can alter the functioning of the hormonal system and negatively affect the health of humans or animals.

Although regulatory measures have allowed protective action, stakeholders have questioned if the EU legal framework remains fit for purpose. To address these concerns, in 2019 the Commission launched a cross-cutting Fitness Check on endocrine disruptors that aimed to assess whether EU chemicals legislation was delivering on its overall objectives of protecting health and the environment.

The Fitness Check was led and carried out by the JRC, with input from other Commission services. In total, the JRC analysed about 30 regulations and directives related to the identification and control of manufactured substances used in products, as well as those found in waste and the environment. Stakeholder groups (companies and business associations, regulatory authorities, civil society organisations and academia), citizens and SMEs were also consulted.

The Fitness Check was published together with the Commission communication on chemicals strategy for sustainability, which included a number of its key findings.

Among these, differences in risk management approaches across legislation need to be addressed and better communicated to stakeholders. A horizontal approach to identifying endocrine disruptors across different sectorial legislation is also needed and should build on the World Health Organization's definition and on the criteria already developed for pesticides and biocides. Future research should focus on better health and ecosystem indicators to evaluate the effectiveness of EU laws (e.g. biomonitoring). Identification methods focusing on new approaches that minimise the use of animals (e.g. in vitro and in silico approaches) should be favoured.

Other related JRC effort includes the work on combined exposure to multiple chemicals and associated risk assessment challenges, which fed into the Commission's progress report on dealing with chemical mixtures, which was published together with the strategy.

A Europe fit for the digital age

'A Europe fit for the digital age' embodies the EU's ambition to empower people with a new generation of technologies. The pillars for the EU's digital strategy are a technology that works for the people, a fair and competitive digital economy, and an open, democratic and sustainable society.

In 2020, the JRC developed and refined a series of tools and instruments to promote the uptake of new technologies and enable digital transformation across different areas of society. We looked into cybersecurity and application programming interfaces (APIs) in governments; a new version of Selfie was released to help schools make the most of digital technologies for teaching and learning; *DigComp at Work* guidelines were developed to create a common understanding among educators, employers and recruiters about digital skills; the 'Cultural gems' application was updated to help people discover online and virtual events and visits.

CYBERSECURITY AT THE CENTRE OF SOCIETY: CONNECTING THE DOTS

Digital technologies allow us to do things that were unthinkable just 10 years ago, and they give us access to an enormous amount of knowledge. However, the more our world goes digital, the more vulnerable we are to cyberthreats.

The COVID-19 pandemic has also accelerated digitalisation, with a sudden and large-scale move to teleworking, the use of digital services in hospitals, laboratories and government services, and the explosion of online schooling.

Recognising this rapid evolution and echoing the new cybersecurity strategy adopted as part of the package 'Europe's moment: repair and prepare for the next generation', the JRC published *Cybersecurity: Our digital anchor*, a report that connects the dots to analyse cybersecurity as a societal challenge for Europe – a challenge in which everybody should be actively and continuously engaged.

It brings together knowledge from across technological, economic and social disciplines and argues for a coherent, cross-sectoral and cross-societal cybersecurity strategy that can be implemented across all layers of European society.

Cyberthreats target not only individuals, organisations and activities, but also critical infrastructure and even countries' sovereignty and democracy. Emerging new technologies such as AI, blockchain and quantum computing are opening up the digital world to new opportunities, but also new cyberthreats.

Traditionally, cybersecurity is addressed by focusing on the peculiarities of a single problem in a single sector. Action is often taken only once a vulnerability is discovered. This reactive approach is obsolete and unacceptable. A new, systemic approach means deploying cybersecurity from the start of any new digital service and moving from 'isolating to protect' to 'opening up and building resilience' to stresses and attacks. Digitalisation also means industrial sectors are

tightly interconnected, and weaknesses in one of these sectors can also hamper the others. Cybersecurity policies must be coherent and interoperable across sectors.

An EU that has a strong cybersecurity culture and strong cybersecurity technology will be in a position to guarantee digital sovereignty, support a strong online economy and keep people safe.

HELPING EDUCATORS, EMPLOYERS AND RECRUITERS ENSURE THAT EUROPEANS HAVE THE DIGITAL SKILLS TO THRIVE IN THE POST-PANDEMIC WORLD OF WORK

The realities of lockdown and social distancing over the past year have shown how invaluable digital skills are, with work, education and connecting with family and friends all happening in the digital space and with new technologies.

The European skills agenda for sustainable competitiveness, social fairness and resilience was presented in June, and notably highlights that businesses need workers with the skills required to master the green and digital transitions and that people need to access the right education and training to thrive in life.

In this context, and on behalf of the European Commission DG Employment, Social Affairs and Inclusion, the JRC produced a *DigComp at Work* report and implementation guidelines that include practical steps, key actions, tips and online resources to make the best use of the EU's digital competence framework (DigComp) along the 'employability path' – from education to sustainable employment and entrepreneurship.

The DigComp framework defines what it takes to be digitally competent. It is a reference point for identifying skills needs, assessing competences, and cataloguing, developing and delivering digital skills training.

The report also includes case studies of organisations already using the framework for their own digital upskilling. The guidelines will help to further unlock Europe's workforce potential and ensure that it has the digital skill set to succeed as the world recovers from the COVID-19 pandemic.

Up to now, DigComp has been used to collect and disseminate labour market information, design and deliver training, and assess and certify skills. It also has the potential to support activities, including career guidance, workforce development and job search support. In addition, it is a call to action for labour market actors to support the development of digital competences in the European workforce.

DigComp is unique in bringing about a common and broad view of what digital competence is. This can help stakeholders interact and build the ecosystem needed for effective upskilling actions.

EUROPE'S CULTURAL GEMS FROM YOUR SOFA

The JRC updated its 'Cultural gems' web application, which now includes 'EU culture from home' – a hub of cultural initiatives from across Europe, from online opera performances to virtual art galleries.

Throughout 2020, almost all of us were unable to travel and many cultural venues were closed. However, this does not mean that we had to miss out on all the rich culture that Europe has to offer.

Museums, theatres, local cultural organisations, libraries and many more cultural institutions have worked to keep culture alive online during these difficult times. The 'Cultural gems' platform collects initiatives and organises them on interactive city maps.

Through the web application, you can explore initiatives by city and by type. Would you like to listen to a rock concert or watch a play? Do you prefer opera or jazz? Or do you want to visit a museum or art collection in another European country?

All these online initiatives and more are searchable by city and category. Right now, there are over 350 online initiatives to browse through in categories such as online collections, virtual visits, lectures, concerts, opera, performances, social media campaigns, books and films.

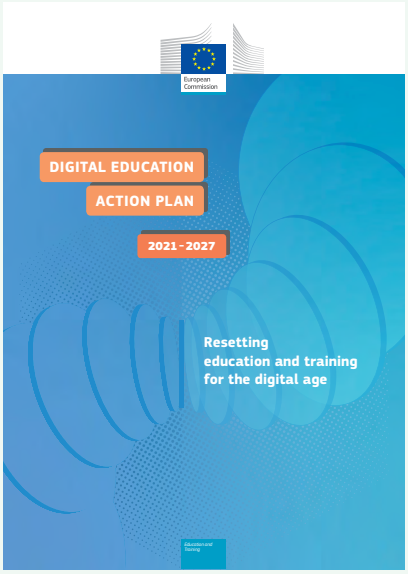
These numbers are constantly growing: 'Cultural gems' is a collaborative map where anyone can share online initiatives and help enrich the catalogue. 'Cultural gems' currently covers 236 cities in 30 European countries.

The initial collection of initiatives was made thanks to the support of the JRC's European Media Monitor.

The European Commission, to complement and support EU countries' actions, has also launched Creatives Unite, a forum for cultural and creative sectors to share ideas and initiatives and co-create solutions. 'EU culture from home' is one of the initiatives included on the platform.

Creative Europe – the EU programme supporting the cultural and creative sectors – has also launched #CreativeEuropeAtHome – a social media campaign highlighting the many cultural online offers funded by the programme.

Details on other measures being taken to respond to the COVID-19 outbreak in support of the cultural and creative sectors can be found on the Commission's website.



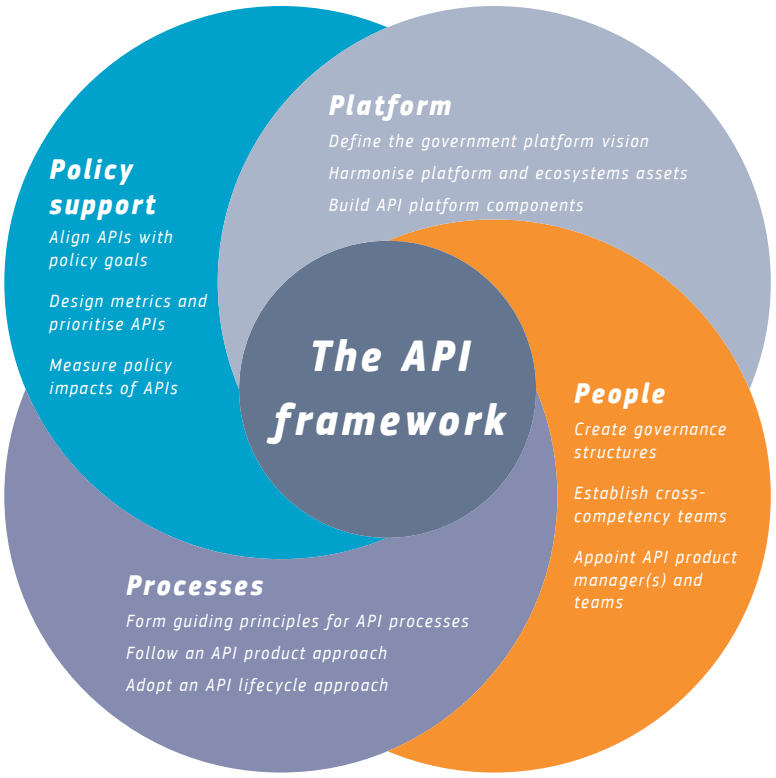
SUPPORTING SCHOOLS FACING THE REMOTE TEACHING CHALLENGE

Selfie is a free, easy-to-use, customisable tool designed to help schools embed digital technologies into teaching, learning and student assessment.

Although it launched in 2018 and is already being accessed by over 7 000 schools and nearly 700 000 users from 57 countries, Selfie was given new impetus and became more relevant with the start of the COVID-19 restriction measures. The number of users suddenly increased and more questions specific to remote teaching and learning emerged as new schools and teachers searched for guidance on tailoring their distance learning offer to the specific needs of the students, taking into account their socioeconomic backgrounds.

In response, a new release of Selfie was published that contained new questions to help schools assess students' needs beyond access to equipment, and focus on digital teaching and learning strategies that support learning autonomy and student resilience.

The tool also enables schools to reflect on how well they did during the distancing measures, in the key areas linked to the integration of digital technologies into education, from leadership and infrastructure to teaching and learning practices.



This will help them identify what worked well and what did not, and to prioritise actions based on the specific needs of the students and teachers.

The current pandemic should be looked at not only as an unprecedented challenge but also as an opportunity to rethink education. The questions in Selfie are designed not only to support the immediate needs of distance learning, but also to plan in the long term and to harness the progress made in the use of digital technologies for more equitable, inspiring and efficient education.

Selfie is a joint effort between the JRC and DG Education, Youth, Sport and Culture. It is one of the 11 actions of the current digital education action plan, which helps Member States and education and training institutions support and scale up the purposeful use of digital and innovative education practices.

IGNITING THE DIGITAL TRANSFORMATION OF GOVERNMENTS WITH APPLICATION PROGRAMMING INTERFACES

As APIs are an under-the-bonnet aspect of digitalisation, users and decision-makers often overlook their importance.

The JRC report *Application Programming Interfaces in Governments: Why, what and how* argues that they should not. APIs are machine-to-machine computing interfaces that enable one digital application to use the data and functionalities of another. They are, in a way, the connective tissue of the digital ecosystem.

APIs come with relatively low investment and substantial efficiency gains. For example, Estonia's X-Road platform got off the ground with initial financing of a mere EUR 300 000. It links public and private sector data so that citizens only have to share data with the government once, saving an estimated 800 working years every single week.

The chief advantage of APIs lies in their modularity: digital processes and data sets can be easily packaged into modules that can be reused and recombined for different applications. Moreover, APIs can be scaled with near-zero marginal costs and may also boost the efficiency of existing processes.

The JRC's *Science for Policy* report analyses in detail the relevance of APIs in governments and suggests a way to adopt them. In addition, the JRC technical report provides a detailed practical framework that organisations can use to improve their API infrastructure.

The report contains advice on API strategy, tactics and operations related to policy support, platform and ecosystems, developers, and processes. It also notes that stakeholders have acknowledged standardisation, specifications and guidelines as prime enablers of API adoption, overtaking factors such as the availability of internal funds or skilled developers.

Recommendations for governments include prioritising key areas for API deployment, such as the health sector; raising awareness of the importance of API culture among decision-makers; being a driving force behind standardisation; and ironing out the legal ownership issues that using foreign data sets entails.

SAFE AND HAPPY ONLINE WITH HAPPY ONLIFE 2

On the occasion of the Safer Internet Day, the JRC launched 'Happy Onlife 2' – a new and improved version of the popular game promoting online safety for young people.

It can be challenging for parents and teachers to keep up with the online activities of the younger generation; this is where Happy Onlife comes in. By encouraging children to reflect on their online behaviour, the game opens up a path on which adults can actively guide children towards becoming smart, responsible and respectful when using digital technologies.

It can also help both adults and children to better understand the opportunities, skills, cybersecurity risks, data protection aspects and consequences behind the decisions they make online.

Playable as a physical board game, on a web browser or through a mobile application, the game takes players on a journey through the internet.

To complete the game, players must successfully answer quiz questions designed to get them thinking about how to make the most of the opportunities of the internet while avoiding potential dangers.

The first edition of the game has already been downloaded over 9 000 times from Google Play and the App Store.

More than 3 000 copies of the physical game have been distributed to classrooms across Europe and beyond.

In addition to improved graphics, HappyOnlife 2 adds a whole host of new categories, as well as questions related to WhatsApp, Instagram, Snapchat and several other applications.

These platforms have grown in popularity since the launch of the first game, having a big impact on online habits and ways of communicating.

This brings with it new cybersecurity risks and implications for data protection.

Four new categories have been added to the game following player feedback – 'Privacy matters!', 'Is it fair!', 'Don't risk!' and 'Social life!' – along with a host of new questions exploring issues such as managing our personal data, fake news and fair communication.

HappyOnlife 2 is available on the HappyOnlife website and for free download on Google Play, and the iOS versions will soon be released on Apple's App Store.

EPROCUREMENT FOR A DIGITAL PUBLIC EUROPEAN ADMINISTRATION

The COVID-19 crisis has lent increasing impetus to the drive to digitalise for individuals, companies and institutions alike.

The European Commission is no stranger to this trend, which is why, in 2017, given its expertise in the field, the JRC was handed the role of leading the eProcurement project, aimed at rolling out a new toolset for electronic procurement to all Commission services and other EU bodies (more than 100 entities in total), in a decisive step towards harmonisation and simplification.

As a mammoth, ongoing project, involving many areas of the Commission, eProcurement is a flagship corporate IT investment, which will be a fully integrated, automated and paperless solution, covering the entire procurement process: from the preparation of the procedure to the execution, the contract implementation, and the inventory and logistics management of the material purchased.

The tools that have already been launched and developed are facilitating procurement processes across the entire institution. In 2020, for instance, the Public Procurement Management Tool, which is a part of the eProcurement suite, was rolled out not only at the DG level, but also to the entire Working Party of Foreign Relations Counsellors and executive agencies of the Commission.

As the project advances, outdated and costly local legacy procurement tools are being phased out and replaced with the eProcurement suite for a truly digital European public administration.

An economy that works for people

'An economy that works for people' aims to ensure social fairness and prosperity. A stable European economy can fully respond to the needs of the EU's citizens. SMEs are the backbone of the EU's economy; therefore, they should be strengthened, while the capital markets union should be completed and the economic and monetary union should be deepened. These objectives are pursued through a combination of stability instruments, with fairness and democratic accountability, on a deeper and fairer internal market in which investment is supported, jobs are created and youth employment receives particular attention.

In 2020, the JRC supported these efforts with several initiatives, such as assessing critical raw material (CRM) needs, reinforcing the EU's entrepreneurship competence framework (EntreComp), looking into the effects of government late payments on employment, and supporting consumer information on nutritional qualities of foods.

JRC ASSESSES CRITICAL RAW MATERIALS FOR EUROPE'S GREEN AND DIGITAL FUTURE

CRMs are of high economic importance and present a high supply risk. They are part of our daily lives. Tungsten makes phones vibrate. Gallium and indium are part of light-emitting diode technology in lamps. Beryllium is used in fire sprinkler systems installed in houses, restaurants, hospitals and offices. These materials are also used in key technologies, such as batteries, fuel cells, solar and wind energy, robotics, information and communications technology and 3D printing, to achieve a carbon-neutral and digital society.

To identify those materials that are most at risk of supply disruption and take action to secure that supply, the European Commission updates a list of CRMs for the EU every 3 years.

The 2020 list of CRMs for the EU contains 30 materials, compared with 27 in 2017, 20 in 2014 and 14 in 2011. The list is part of a communication laying out an action plan to overcome the challenges to their secure and sustainable supply.

To provide solid scientific evidence to support the communication, JRC experts completed *Study on the EU's list of critical raw materials (2020) – Final report* and two dedicated reports containing CRM and non-CRM fact sheets for all the 83 candidate raw materials that were analysed and out of which 30 made it onto the list. The assessment process included data collection, development, a dialogue with experts and stakeholders and reporting, which were done in close coordination with and under the supervision of the Commission's DG Internal Market, industry, Entrepreneurship and SMEs.

The package also included a foresight report on CRMs in strategic sectors, which translates the EU's climate-neutrality

scenarios for 2030 and 2050 into the estimated demand for raw materials. Foresight can help define the best combination of approaches to open strategic autonomy, from diversifying trading partners to strengthening the EU's own capacity.

All these reports and the updated information on the new EU 2020 list of CRMs are now available through a dedicated section in the Raw Materials Information System managed by the JRC.

NEW PRACTICAL GUIDELINES TO SUPPORT ENTREPRENEURIALISM IN THE EUROPEAN UNION

The Commission launched new guidelines to help educators, employers and recruiters ensure that Europeans are equipped with the entrepreneurial skills needed to tackle today's big challenges – from the digital and green transitions to the post-COVID-19 world of work. This guidance includes practical steps, key actions, tips and online resources to support people to become more entrepreneurial.

The EU's EntreComp defines entrepreneurship as the ability to turn ideas into actions that generate value for others. These skills can help people develop personally, increase their employability, and contribute to growth and innovation. The framework provides a common reference to help educators, recruiters and employers identify and nurture entrepreneurialism, active participation in society and value-creating initiatives.

The *EntreComp Playbook* is a toolkit for educators that offers principles, methods and tools for using the framework to facilitate entrepreneurial skills development. It sets out key principles to guide anyone in designing, implementing and monitoring that development, from planning the entrepreneurial learning experience, focusing on value creation, promoting collaboration and engaging others in empathy to assessing progress by multiple methods.

Released alongside the Playbook, the *EntreComp at Work* report includes case studies from labour market intermediaries that have been using the framework to support people in progressing on the 'employability path' towards sustainable employment and entrepreneurship.

This includes the Youth@Work partnership of national agencies across Europe, which has been using the EntreComp framework to support and develop entrepreneurship and employability across youth-work strategies and initiatives at national and EU levels. Further afield, organisations such as Startup Support South Africa use the framework to help employees at risk of redundancy develop part-time enterprises into sustainable, full-time income.

EntreComp actions support delivering on the goals of the European skills agenda for sustainable competitiveness, social fairness and resilience.

CLAMPDOWN ON DELAYED GOVERNMENT PAYMENTS PROVIDES TANGIBLE BOOST TO EUROPEAN UNION ECONOMY

Regulating late payments from governments to their suppliers in the aftermath of the 2008 financial crisis and the subsequent recession slashed bankruptcies, lifted employment levels and advanced innovation in the EU.

This is the finding of a study on government late payments and firms' survival, published in 2020 by researchers from the JRC, the University of Genoa and the Marche Polytechnic University.

The researchers looked at the impact of the EU's 2011 late payment directive, which – among other provisions – narrowed the payment window to 30 days in business relations between public bodies and their suppliers. Rules for business-to-business transactions remained lax, permitting a payment window of 60 days before sanctions kicked in.

This difference enabled the researchers to treat economic sectors dominated by such interactions as a 'control group', allowing comparisons to be made as if they had conducted a study with experimental design.

The additional rigour brought about by the directive proved to be beneficial. The rate of firms going bust declined faster in sectors providing products and services for governments than in those relying less on public purchases.

For instance, the authors of the study observed the rate of companies going out of business to be 0.32 percentage points lower in Ireland's printing industry, which is more reliant on government orders, than in the French machinery sector, in which business-to-business interactions are more common.

Since an average of 8 % of companies overall go under, this is a significant difference.

Furthermore, employment grew faster by 0.7 percentage points in branches dealing more with the public sector than in those in which transactions between private entities predominate.

Investment increased as well, by about 0.17 percentage points, although this effect is not robust enough to draw conclusions.

Such dividends can be maximised in the COVID-19-induced economic downturn. By smoothing cash flows and curbing volatility, prompt payment and repayment of arrears will contribute to stemming the tide of firms having to fold because of overdue payments.

FRONT-OF-PACK NUTRITIONAL INFORMATION HELPS CONSUMERS TO CHOOSE HEALTHIER FOOD

In support of the Commission report on front-of-pack (FOP) nutrition labelling, the JRC reviewed the scientific literature on existing and proposed FOP labelling schemes and their effects on consumers and food business operators. They concluded that FOP nutrition labelling holds potential for helping consumers make health-conscious food choices.

With a bewildering array of food products on supermarket shelves, it can be difficult for consumers to know they are making the right call when looking for the healthiest option.

A nutrition declaration is mandatory in the EU and is often provided on the back of food packaging. It provides information about the nutritional contribution that specific foods and drinks make to consumers' overall diets, including the energy value and the amounts of fat, saturates, carbohydrate, sugars, protein and salt. Increasingly, this mandatory labelling is complemented by voluntary information on the front of the packaging.

The idea behind this FOP nutrition labelling is to quickly guide consumers in the 'moment of truth' when they reach for a product on a supermarket shelf, as FOP labels attract more attention than back-of-pack nutrition information.

In the EU, six different FOP schemes are currently in use and endorsed by the public sector in various Member States. Besides these government-endorsed schemes, private FOP schemes are also present on the EU market. Evaluative FOP schemes, which employ colour coding or nutritional quality ratings, were found to improve the ability of consumers to identify healthier options more than reductive schemes, which merely reproduce parts of the mandatory information.

More importantly, studies looking at consumers' intentions to purchase show that FOP nutrition labelling, especially colour-coded labels with or without a graded indicator, can facilitate health-conscious food choices and improve the nutritional quality of shopping baskets. However, evidence is still largely missing of whether and to what extent FOP schemes have driven product reformulation and innovation by the food industry.

A stronger Europe in the world

'A stronger Europe in the world' means that Europe should reinforce its responsible global leadership. A strong, fair and open trade agenda makes Europe an attractive place for business. This is key to strengthening the EU's role as a global leader while ensuring the highest standards of climate, environmental and labour protection. European leadership also means working closely with neighbouring countries, introducing a comprehensive strategy on Africa and reaffirming the European outlook on the countries of the western Balkans.

In 2020, the JRC published a series of reports providing input from a scientific point of view about different geographical areas and global issues (Africa, tsunamis and freshwater), helping the European Commission to shape its vision and strategies. A JRC study examined the trade-offs and synergies between the SDGs for three different climate change mitigation scenarios up to 2050, and the *Atlas of the Human Planet 2020* offered a perspective on the massive urbanisation of the planet and its consequences.

GAINING INSIGHT INTO AFRICA'S YOUTH PERSPECTIVES

Africa has the youngest population structure and the fastest-growing youth population of all the continents. Understanding the opinions, concerns and aspirations of those young people is vital for future partnerships between the EU and Africa. Two JRC reports analysing data from the latest Afrobarometer public opinion survey were released in 2020; they help us to gain insight into youth perspectives in 34 African countries.

The study *Youth Perspectives in Africa: What are the most important issues for 18 to 35 year olds?* identified economic concerns, and particularly unemployment, as young Africans' primary concern.

Concerns about jobs are common for both those in employment and those who are not, suggesting that existing work positions are precarious. Although unemployment was the highest-ranked issue overall, it was not the highest-ranked in every country of the survey. Food shortages, water supply, management of the economy, health, corruption, taxes, and crime and security all ranked highest in some countries.

The report *Youth Perspectives in Africa: How young people view politics, society and the environment* suggests that Africa's young people could pave the way to a more sustainable and equal future. It notably found that 18- to 35-year-olds are more familiar with the term 'climate change' than older people are; over two thirds of young people who have heard of climate change think that it should be stopped, and half of them feel that ordinary Africans can play a part in stopping it.

The vast majority of young people in Africa also agree that women and men should enjoy equal opportunities in education and employment and have an equal chance of being elected to political office. However, they have a low level of trust in political institutions and believe that there is widespread corruption in these, which may explain why their levels of

voting and their tendency to contact the government for action or help are both lower than those of older people. Nevertheless, they more frequently engage in protest movements than older citizens and tend to trust social institutions such as religious leaders more than their political representatives.

The reports will help to develop the Africa–EU relationship and inform the EU's policies in collaborating with African partners, when youth is a cross-cutting priority.

SUSTAINABLE PATHWAYS SHOULD NOT LEAVE THE MOST VULNERABLE BEHIND

Without integrated policies, international assistance and knowledge transfer from the richer regions to the less fortunate regions, the pursuit of climate targets could make developing countries fall behind in terms of key SDGs.

That is what scientists concluded in a JRC study that looked into the trade-offs and synergies between the SDGs for three different climate change mitigation scenarios up to 2050: a non-sustainable scenario without climate targets and the two sustainable scenarios aiming to limit global temperature rise to 2 °C and 1.5 °C.

The analysis recognised that the sustainable pathways would bring indisputable benefits: lower global temperature rises; less pressure on land and water use; and improvements in ecosystem services and biodiversity. However, some climate protection measures – if ill-designed or implemented in isolation from other policies – could lead to increased food prices, poverty and higher levels of malnutrition in the poorest parts of the world.

The unsustainable scenario of no mitigation effort could increase per capita income and improve food security in the medium term, but in the long run it would inevitably lead to land degradation and water shortages, which are already particularly acute in the poorest regions, including sub-Saharan Africa.

The study calls for integrated decision-making that takes interlinkages between economic, societal and environmental factors into consideration.

Investing in education and improving access to reproductive health services are seen as important to limit population growth, which is an important driver in all scenarios.

In addition, measures aiming to increase land productivity and improve crop yields, supported by capacity building and unfettered trade access to richer markets, are important for tackling global food insecurity.

Finally, richer countries need to collectively commit to cooperative schemes, for example even greater sharing of the emissions burden, as pledged in the Paris Agreement.

The study was conducted jointly by the JRC, Wageningen Economic Research (part of Wageningen University and Research), and the research institute Fundación Agencia Aragonesa para la Investigación y el Dessarollo (ARAID) and Agrifood Research and Technology Centre of Aragón (CITA), in Saragossa, Spain, using a global economic simulation model called the Modular Applied General Equilibrium Tool (Magnet).

JRC-DESIGNED SYSTEM TO ENHANCE TSUNAMI EARLY WARNING IN INDONESIA

Indonesia has announced plans to roll out a tsunami early warning system based on the inexpensive device for sea level monitoring (IDSL) developed by the JRC with support from the Commission's DG European Civil Protection and Humanitarian Aid Operations.

The new plan for IDSL installation provided for the acquisition of 100 new units in 2020 and a more ambitious implementation of an additional 530 units over the coming years, for fisheries, ports and conservation areas across Indonesia.

The initiative is part of a collaboration between the JRC, DG European Civil Protection and Humanitarian Aid Operations and the Ministry of Maritime and Fisheries, initiated in 2019 when the JRC provided Indonesia with eight IDSL devices to quickly implement a new tsunami-warning system in the aftermath of the Anuk Krakatau volcano explosion on 22 December 2018. The event triggered a severe tsunami, killing more than 400 people in the Sunda Strait.

The IDSL has many interesting features. At around EUR 25 000, it is about 10 times less expensive than similar devices; it takes less than 5 seconds from measurement to data transmission; it is easy to install; and it can detect tsunami waves or other large sea-level variations and send email and text message alerts to a prescribed list of recipients.

Acknowledging the vulnerabilities of their vast coastlines and large number of coastal communities,

One of the IDSLs that was installed in the Mediterranean Sea (Portopalo di Capo Passero, Italy) ©European Union, 2019

the Indonesian authorities intend to roll out an ambitious yet practical tsunami mitigation regime that takes advantage of the IDSL and includes the participation of the communities in developing their preparedness and resilience to tsunamis.

IDSL has been dubbed 'PUMMA' in the Indonesian language, or *Perangkat Ukur Murah untuk Muka Air* (low-cost device for sea level measurement), which makes it easier for Indonesians to recognise and understand its functioning.

The new devices will be built with the collaboration of the European Commission and the involvement of local small-scale companies and universities. They will then be integrated with the overall monitoring network in Indonesia provided by BIG (a sea level monitoring institution) and BMKG (a tsunami service provider).

NEW TOOL TO TRACK FRESHWATER ECOSYSTEMS

Freshwater, in sufficient quantity and of sufficient quality, is essential for all aspects of life and fundamental to sustainable development. Water-related ecosystems, including lakes, rivers, wetlands and groundwater, supply water and food to billions of people, provide unique habitats for many plants and animals, and protect us from droughts and floods.

The Freshwater Ecosystems Explorer is a free and easy-to-use data platform providing up-to-date, high-resolution geospatial data showing the extent to which freshwater ecosystems change over time. It was developed through a partnership between the JRC, the UN Environment Programme and Google.

The site contains many unique, first-of-a-kind water data sets and an interactive map visualising dynamic changes to permanent and seasonal surface water, reservoirs, lake water quality, wetlands and mangroves.

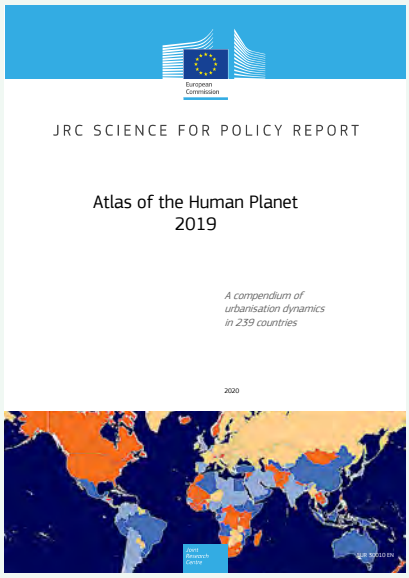
Because decisions on freshwater are made by varying levels of government (national and subnational government authorities), data on the Freshwater Ecosystems Explorer can be visualised at different scales, from whole countries right down to small individual watersheds and lakes.

JRC experts provided a synopsis of water-related ecosystems using the Global Surface Water Explorer (a JRC–Google Earth Engine tool that maps and analyses the dynamics of global surface waters over time) and the Global Reservoir data set (which provides maximum reservoir area for major reservoirs, at a global scale). They were also involved in designing and developing the indicators and interface of the new tool and the web interface.

The new tool also uses the Copernicus Global Land Service's Lake Water Quality product, which was fine-tuned to meet the SDG requirements. The JRC's Global Surface Water Explorer is the UN-endorsed official indicator for SDG 6.6.1. At the request of the UN, the JRC further developed

the analysis, refined the statistics provided and included additional data sets to provide a detailed overview of water-related ecosystems.

These coordinated efforts will now serve as essential information for the UN's 193 member states.



JRC CRUNCHES TERABYTES OF SATELLITE DATA TO ZOOM IN ON EVER-GROWING URBANISATION

Over three quarters of the world's population now live in urban areas, according to the JRC's fourth edition of its *Atlas of the Human Planet*, which officially launched on the occasion of the 10th session of the World Urban Forum in Abu Dhabi.

With data spanning four decades and nearly 240 countries and territories, the atlas shows how humans have settled all over the Earth and urbanised the planet.

The atlas includes a country brief for each of those countries and territories, and over 200 more, so that the different trajectories of urbanisation across the globe can be compared. This comparison is possible thanks to the application of the European definition of urban and rural areas to the JRC's global human settlement layer data. The definition distinguishes cities, towns, suburbs and rural areas based on population density and population size. Under the definition, a human settlement becomes 'urban' as it reaches 5 000 inhabitants.

Individual countries collect and interpret urbanisation in myriad ways, which can make it difficult to compare and obtain a global picture. By simplifying the definition of an urban area to one variable – population density – the atlas will complement national figures with new, comparable data.

To achieve this, experts used AI to process terabytes of satellite data (the JRC's own symbolic machine-learning classifier for satellite data).

Institutions that address urbanisation at the regional and global levels have all been involved in co-designing the methodology and are now using the resulting data sets.

Given the ever-increasing global population and the volatile impacts of climate change, these insights can help to inform decisions about where to build new settlements and possibly even relocate settlements most at risk from threats such as floods, fires, sea level rises and droughts.

The JRC is also providing the knowledge base to a consortium of international organisations and institutions committed to developing a harmonised global definition of urban and rural areas. The consortium's proposed definition was endorsed at the UN Statistical Commission's 51st session in March 2020.

MODERN EXPORT CONTROLS AND PREVENTING THE PROLIFERATION OF WEAPONS OF MASS DESTRUCTION

To improve global security and to curb the proliferation of nuclear and other weapons of mass destruction while facilitating peaceful trade, the dual-use regulation requires that exporters of goods listed under the EU dual-use control list first seek an export licence from customs authorities. Recently, to keep pace with the evolution of technology and threats, the regulation has been recast. The JRC robustly supported, with analyses and expertise, the 9-year-long recast process, which reached an agreement in 2020. The recast regulation is now better equipped to address future proliferation challenges and security risks. This result builds on long-standing JRC achievements.

By providing updates on technological evolution, the JRC has contributed to the annual amendments of the EU control list, and the new regulation now addresses wider threats, including those to human rights. In addition, the JRC has continuously analysed

Member States' licence requests and export denials for the annual report of the European Commission to the Parliament and the Council. This JRC effort in data collection and analysis has paved the way for more transparent procedures. Moreover, for many years the JRC has been operating the European pool of experts, providing advice on licensing and customs issues and strengthening global collaboration. Based on compliance guidance co-authored by the JRC, which draws attention to research involving dual-use items, research organisations will put in place exporters' compliance programmes.

Not least, in recent decades, the JRC has trained more than 500 trade control experts and exporters, both European and from all over the world. As a result, the JRC is the reference for export control capacity building in the recast regulation.

A well-known JRC support tool for trade analysis is the *Strategic Trade Atlas*. Prepared in collaboration with the World Customs Organization, the atlas assists analysts and officials in trade control enforcement operations and training. Essentially (and beautifully) based on graphic visualisation, it provides comprehensive views of global trade flows of strategic goods. First published as a book, the atlas has been accessible to all as an interactive tool since 2020.

NEW GLOBAL DEVELOPMENT DATA TOOL FOR AFRICAN, CARIBBEAN AND PACIFIC STATES AND OVERSEAS COUNTRIES AND TERRITORIES

The Global Development Data Tool (GDDT) contributes to the visibility of the European Commission's commitment to data-driven decision-making. The tool has been developed by the JRC and DG International Partnerships, with support from DG Economic and Financial Affairs, DG Trade and Eurostat. The GDDT supports the Commission and the European External Action Service around the globe with a wide variety of economic and social data, figures and trends for the African, Caribbean and Pacific states, as well as the overseas countries and territories, with the intention of global coverage by 2021.

The GDDT presents a high-level picture of what is and has been happening in a given country or region over 5 years. The data are updated once or twice a year depending on the frequency of the update of the source data. The tool includes 160 indicators from globally recognised data sources in 10 thematic areas, namely economy and finance; official development assistance; trade; business environment; demography; employment; human development; gender and governance; environment, climate change and energy; and fragility and resilience. It also links them to the SDGs if possible. The indicators are taken from globally recognised, publicly available data sources such as Eurostat, the Food and Agriculture Organization of the UN, the OECD, the World Bank, the UN Commodity Trade Statistics Database, the Joint UN Programme on HIV and AIDS, the UN Children's Fund, the UN Office on Drugs and Crime and the UN Statistics Division. The tool also allows the automated generation of country reports.

CHALLENGES OF THE EUROPEAN NUCLEAR SUPPLY CHAIN

Nuclear installations and their supply chain are an important component of building up strategic autonomy in the European industry. In the study *Current challenges of the European nuclear supply chain*, the JRC assessed the extent to which European operators of nuclear power plants (NPPs) are facing challenges in the supply chain of safety-classified structures, systems and components (SSC). The main challenge highlighted in the study is that virtually all NPP operators in Europe are affected by SSC obsolescence, and a majority of them have difficulties in finding new suppliers for replacements. In particular, those European countries that operate a small number of reactors, of different types and from different reactor vendors, are the most affected by these challenges. The original equipment manufacturers of the initially installed and now obsolete SSC either do not exist any more or may have left the nuclear market. Potential new suppliers may not be interested in selling to the nuclear industry, because the market for such SSC is considered too small. Moreover, producing nuclear-grade SSC normally requires that the supplier implement and maintain a dedicated and costly nuclear quality assurance programme.

A solution to the supply chain challenges that European NPP operators are currently facing is the increased use of non-nuclear industry standard components and equipment for safety-classified SSC in nuclear facilities. This solution requires, besides appropriate equipment qualification, a process that gives reasonable assurance that the equipment or component in question provides its safety function when used for safety-classified SSC in nuclear facilities. Such a process, referred to as commercial grade dedication, is already possible and even common practice in a limited number of European countries (e.g. Slovenia), and the JRC study shows that the NPP operators of those countries are far less affected by supply chain challenges.

Promoting our European way of life

'Promoting our European way of life' by protecting our citizens and our values is the priority through which the Commission wants to build a European health union; an effective response to countering terrorism and radicalisation, organised crime and cyberthreats; and common mechanisms to tackle crimes such as human trafficking, smuggling and corruption. It also means creating a European area of justice by safeguarding the rule of law and fundamental rights; better linking the different national legal systems; fighting discrimination and promoting gender equality; and protecting and empowering consumers. A new Pact on Migration and Asylum, statistics on migration to Europe and the rule of law are also elements of this priority.

In 2020, the JRC contributed to this priority by providing insight into several aspects of migration and integration, including the vulnerability of migrant workers, the perception of migration, means and tools for better integration, and of course the impact of COVID-19 on migration patterns. Other work relevant to this strategic priority included work on alternatives to animal testing and human-based methods for better breast cancer research.

THE COVID-19 PANDEMIC HIGHLIGHTS THE VULNERABILITY OF MIGRANT WORKERS IN THE EUROPEAN UNION

A recent JRC study highlighted the importance of migrant workers in the EU's COVID-19 response. The analysis showed that migrants have been on the front line performing crucial tasks to keep European citizens healthy and safe during the pandemic. And yet, according to another JRC analysis, it is migrant workers who might suffer the worst effects of the economic downturn.

Although governments across Europe are taking action to protect jobs and livelihoods, there is a risk that some migrant workers might fall short of this protection. The JRC analysis showed that migrant workers are more likely to be employed on temporary contracts, earn lower wages and carry out tasks that are not compatible with teleworking.

The study further distinguished between the migrant workers who are performing key tasks in terms of the COVID-19 response – for example nurses and other healthcare workers – and those whose jobs are less relevant to the immediate response.

It showed that, although the migrant workers employed in key occupations were not likely to lose their jobs in the middle of the pandemic, their direct exposure to the virus and possible lack of social protection made them vulnerable.

However, migrant workers who are performing tasks that are less essential to the COVID-19 response face an increased risk of losing their jobs as companies struggle with the economic effects of the crisis.

The study called for policy actions in support of migrant workers, possibly differentiating between those employed in key occupations and other migrant workers.

It also urged that existing barriers to full healthcare access for foreign nationals be removed – at least temporarily.

The study stressed that it is in the interest of governments to include migrants in the policy responses, as this will not only help protect this particularly vulnerable group during the crisis but also help sustain a workforce that will be critical to the ongoing mitigation efforts and future recovery.

PROMOTING ALTERNATIVES TO ANIMAL TESTING IN SUPPORT OF HUMAN HEALTH, THE ENVIRONMENT, EUROPEAN UNION INNOVATION AND INDUSTRIAL COMPETITIVENESS

In its annual status report, the JRC's EU Reference Laboratory for Alternatives to Animal Testing (EURL ECVAM) described research, development and validation activities, as well as initiatives that promote the regulatory use and international adoption of non-animal methods and approaches and their dissemination in the regulatory and research arenas.

EU policies and legislation call for innovative and more efficient ways of safety testing and chemical risk assessment that do not depend on animal testing. Advanced technologies, such as computational models, in vitro methods and organ-on-chip devices, are being developed, evaluated and integrated to translate a mechanistic understanding of toxicity into safety-testing strategies. The development and use of non-animal models and methods are also essential for advancing basic, applied and translational research. Education also plays an essential role in enabling a shift to non-animal methods through the introduction of the three Rs (replacement, reduction and refinement of animal use in science) into secondary school curricula and programmes of higher education.

The EURL ECVAM also issued a recommendation urging end users and other stakeholders to recognise the scientific validity of non-animal-derived antibodies and to stop using animals for antibody development and production. It also challenged misconceptions existing in the scientific community about non-animal-derived antibodies and highlighted the scientific and economic benefits of their use. Non-animal methods for generating and producing antibodies have been available for years, and one such method, based on phage display technology, received the 2018 Nobel Prize in Chemistry. Antibodies produced by phage display are already widely used across several fields including therapeutics. Besides, non-animal-derived antibodies can be reliably produced in unlimited amounts, which essentially ensures a lifetime supply of antibodies with identical performance, a critical requirement for the reproducibility of scientific experiments requiring affinity reagents. A lack of education and training is one of the major barriers to a transition to non-animal-derived antibodies, and end users need to inform themselves better about the advantages of using non-animal-derived antibodies and should specifically request them from suppliers.

FOR INTEGRATION TO WORK, WE NEED TO INTERACT

The more immigrant and host communities interact, the more positively integration is perceived, according to a joint study from the JRC-hosted KCMD, the OECD and the Migration Policy Centre.

The report is the first in-depth analysis of European perceptions of integration, based on responses to a Special Eurobarometer survey on integration of immigrants in the EU published in April 2018.

Social integration (such as speaking the language or accepting a society's values and norms) and contributing to the welfare system by paying taxes are seen by Europeans as the most important factors in integration.

There is somewhat less consensus on the barriers to integration and possible policy responses. For instance, when considering whether immigrants are doing enough to integrate, there was a wide variation in responses, not only between countries but also between different groups of respondents within countries.

In terms of policy preferences on integration, the report found variation among respondents along political lines. Making integration measures mandatory ranked highly, on average, but with relatively large variations among countries. There was also a large consensus about the importance of language courses and post-arrival integration measures, such as supporting immigrants in finding a job and fostering interaction between members of the host society and newcomers.

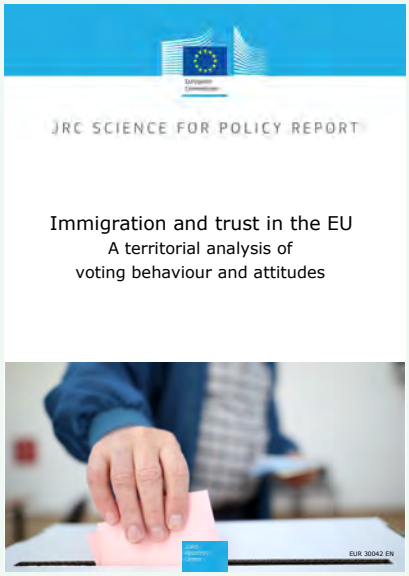
When asked if immigrants have successfully integrated at the local level, the majority of Europeans answer positively. In other words, local perception of the integration of immigrants is frequently positive.

Frequent contact with immigrants is associated with a positive perception of their integration. This suggests that, as most European countries are becoming more diverse and people interact with immigrants more frequently, the perception of local integration is likely to become gradually more positive in the future.

Immigrant integration is high on the policy agenda across EU countries. However, how EU citizens view integration is an under-studied area. The report aimed to fill this gap.

SHEDDING LIGHT ON DRIVERS OF NEGATIVE ATTITUDES TO MIGRATION AND THE EUROPEAN UNION

Low income, low level of education, low population density and old age are better predictors of people voting for parties favouring restrictive measures on migration than the share of migrants actually residing in their area, according to the JRC report on immigration and trust in the EU published this year.



The study examined the links between discontent with the EU and negative attitudes to immigration. The findings offer useful insights to improve our understanding of the complex interplay between perceived and/or actual socioeconomic realities, demographic change and migration.

The researchers analysed a long time series of Eurobarometer surveys providing information on trust in the EU and attitudes to migration.

They correlated information on voting patterns, based on EP election results, with data on locations of migrants.

The analysis found a clear association between attitudes to immigration and trust in the EU in all 27 EU countries and the United Kingdom (the data were collected before the withdrawal of the United Kingdom from the EU).

People with positive perceptions of immigration tend to have a higher level of trust in the EU. Correlatively, in all countries analysed, individuals who have negative attitudes to immigrants from outside the EU tend not to trust the EU.

The analysis also found that individuals who are better educated, as well as students, young people and people who are in employment, are more likely to trust the EU.

The study also re-evaluated the importance of the presence of migrants as a major source of discontent among citizens. It confirmed that the areas with high shares of votes for parties favouring restrictive measures on migration are associated with economic and sociodemographic factors such as an ageing population, low level of education and low income, rather than the actual presence of migrants.

In most countries, people living in low population density areas are more inclined to vote for parties favouring restrictive measures on migration.

THE COVID-19 CRISIS IS RESHAPING MIGRATION WORLDWIDE

On International Migrants Day, the European Commission KCMD launched the 2020 edition of its online, interactive atlas on migration, with updated indicators for 198 countries and territories worldwide and a new section on the impact of COVID-19 on migration.

The atlas is a reference tool guiding policymakers, practitioners and the general public through the complexities of migration and demography. It brings together harmonised, validated and updated indicators related to migration, asylum, integration, demography and development from 12 international data sources.

In the 2020 edition, JRC researchers notably suggested that the ongoing COVID-19 pandemic and government responses to it could reshape migratory movements, shift migration routes and alter the composition of migrant populations worldwide.

Mobility restrictions or fear of the virus has prevented many migrants from reaching their place of employment. Others have returned to their country of origin after losing their jobs, and some are missing opportunities to study or to reunite with family.

Some labour migration programmes have been suspended and asylum procedures have been delayed. However, many migrants have played a vital role in responding to the pandemic through their roles as key workers in essential services, or by offering their support and solidarity to those in need. Overall, 13 % of key workers in the EU-27 are migrants.

The economic crisis triggered by the pandemic is heavily affecting migrants, the countries where they live and work, and their countries of origin, to which they send remittances, a vital source of income for millions of households in developing countries. Remittances declined drastically because of the COVID-19 crisis: in 2020, the World Bank forecast an unprecedented 7 % annual reduction in the scale of global remittance flows. This decline is expected to continue, confirming that the pandemic will magnify some structural fragilities in developing countries.

The online version of the atlas is an ideal tool both for evidence-based policymaking and for supporting the implementation of those policies, such as the new Pact on Migration and Asylum. The 2020 edition also includes new continent fact sheets, supporting the country profiles with a continental perspective.

HUMAN-BASED METHODS FOR BETTER BREAST CANCER RESEARCH

Breast cancer is now estimated to be the most frequently occurring cancer, accounting for 13.3 % of all new cancer diagnoses during 2020 in the EU-27: 1 in 11 women are at risk of developing breast cancer.

Current breast cancer research is too reliant on animal models, mostly using rodents. However, rodents provide a poor model for human diseases. In breast cancer, there is a high level of heterogeneity between tumours and even within the same tumour. This has driven the development of 3D tissues, often called 'mammospheres', that reflect the different cell types present and, crucially, the interactions between them. Non-animal models will better inform therapies based on the patient and the clinical and molecular characteristics of the tumour.

Many advanced non-animal methods are already being used fruitfully for breast cancer research. However, knowledge of them is scattered across the scientific literature, limiting their diffusion and impact in the scientific community.

The JRC's EURL ECVAM conducted an extensive review of 935 scientific papers published from January 2014 to March 2019 that describe relevant non-animal models for breast cancer. The JRC has gathered all these models in a unique knowledge collection that is now freely available to the scientific community.

The JRC also published a fact sheet on breast cancer burden in 2020 for the EU-27, which notably revealed that breast cancer accounts for 28.7 % of all new cancers in women, with an estimate of 355 457 new cases and over 91 000 attributable deaths in 2020. Most new breast cancers are diagnosed in women aged 45–69 years.

Through a collaborative project with the European Network of Cancer Registries and the International Agency for Research on Cancer, the JRC also released estimates on 2020 cancer incidence and mortality in the EU-27 on the European Cancer Information System platform.

The JRC will shortly launch a new Knowledge Centre on Cancer to better align the European Commission's scientific and technical activities on cancer, and support the upcoming 'Europe's beating cancer plan' and Horizon Europe's mission on cancer.

A new push for European democracy

'A new push for European democracy' is the Commission priority that aims to nurture, protect and strengthen democracy, by tackling threats such as disinformation and online hate messages, and promoting a stronger role in the decision-making process and a more active role in setting priorities for European citizens.

In 2020, JRC activities supporting this political priority included scrutinising the influence of online technologies on political behaviour and decision-making, organising the third Citizen Engagement Festival to strengthen and widen the role of citizen engagement in all phases of policymaking at the European Commission, and revealing the models used for EU policies' impact assessments.

UNDERSTANDING FAIRNESS IN THE EUROPEAN UNION

Before the start of the COVID-19 pandemic, more than half of EU citizens considered their lives to be fair, according to a new report from the JRC.

As the Commission proposes a major plan to put the EU firmly on a sustainable, inclusive, even and fair recovery path, this report offers a snapshot of the state of fairness in Europe before the COVID-19 outbreak. Income inequality, educational inequality and incomplete coverage of social security systems are discussed from a pre-crisis perspective. The report also provides a benchmark against which some of the consequences of the current crisis can be evaluated.

There are regional and sociodemographic differences in people's perception of fairness. Northern Europeans are more likely to perceive their lives as fair than those in eastern and southern Europe. Unemployed individuals and those with low incomes also present comparatively low levels of fairness perception.

To understand how these perceptions are shaped, the report explores various measures of inequality. Inequalities in income, education or health that are too large can make people feel that life is not fair.

Although EU-wide income inequality has slightly declined since the last major crisis, in 2008, it has increased in southern Europe. Educational attainment still strongly depends on family circumstances, and there is evidence that social protection and taxation systems are increasingly challenged by digitalisation of the economy and changing work relations.

As Europe begins to emerge from this crisis, fairness and perceptions of fairness are important. They can have a real impact on happiness and how people engage

with others in society. It is also clear that the health and economic effects of the COVID-19 pandemic are being borne disproportionally by those who are less well off.

Developments and determinants of fairness, inclusive growth and solidarity in the EU were also examined in the *Employment and Social Developments in Europe 2020* annual review. The JRC will continue to support a fair recovery path with evidence of how the pandemic is shaping inequalities and perceptions of fairness across Europe.

UNDERSTANDING HYBRID THREATS BETTER AND EXPLORING WAYS TO COUNTER THEM

According to the Helsinki-based European Centre of Excellence for Countering Hybrid Threats (Hybrid CoE), the term 'hybrid threat' refers to an action conducted by state or non-state actors, whose goal is to undermine or harm a target by influencing its decision-making at the local, regional, state or institutional level. Such actions are coordinated and synchronised and deliberately target democratic states' and institutions' vulnerabilities. Activities can take place, for example, in the political, economic, military, civil or information domain. They are conducted using a wide range of means and designed to remain below the threshold of detection and attribution.

Hybrid threats and exploring ways to counter them have already been high on the political agenda for several years. Back in 2016 and 2018, the European Commission and the High Representative of the Union for Foreign Affairs and Security Policy had adopted a joint framework to counter hybrid threats and foster the resilience of the EU, its Member States and partner countries while increasing cooperation with NATO on countering hybrid threats. In July 2020, the communication on the EU security union strategy identified hybrid threats as one of the evolving threats to the EU and its Member States that must be tackled.

Throughout the year, the JRC provided essential support to European Commission policymakers and the Member States on this topic. As hostile actors took advantage of the COVID-19 pandemic to engage in hybrid threat activities, the JRC documented and structured these activities in several reports that attracted the interest of, inter alia, the Horizontal Working Party on Enhancing Resilience and Countering Hybrid Threats of the Council of the European Union.

Observing that the absence of a solid conceptual basis was hindering relevant stakeholders in improving their understanding of hybrid threats and making it more challenging to design and implement effective countermeasures at both national and international levels, the JRC and the Hybrid CoE joined forces to develop a conceptual model for characterising hybrid threats and a framework for analysis.

At a high-level event held in November, they presented their joint report *The Landscape of Hybrid Threats: A conceptual model*. The report was widely acclaimed, and in its conclusions of 15 December 2020 on strengthening resilience and countering hybrid threats, including disinformation in the context of the COVID-19 pandemic, the Council took note of the report and acknowledged 'that the conceptualisation of hybrid threats and related terminology is important for their identification with a view to improving coherence between European and national measures to enhance resilience and to counter hybrid threats in a more effective and streamlined manner'. The Council further invited the Commission and the High Representative to continue their work and to develop the conceptual model.

BRIDGING SILOS IN BIOSCIENCES

Biosciences are rich in innovation. Sophisticated methods based on new technologies are constantly emerging, such as gene editing, organ-on-chip devices and super-resolution imaging. However, compartmentalisation within biosciences is limiting the potential for new methods to translate from one domain to another. It is also hindering scientific communities from interacting and collaborating to tackle big issues such as cancer.

In the JRC report *Bridging across Methods in the Biosciences*, the authors explain that traditional disciplines can sometimes be an arbitrary separator of scientific activity and knowledge, whereas the methods are becoming more relevant in defining scientific domains.

Often the type of scientific method used by an investigator, for example based on an animal model (in vivo), a cell-based assay (in vitro) or a computer simulation (in silico), strongly influences how research problems are both formulated and addressed.

Despite considerable investment in basic and applied research, many debilitating diseases, for example Alzheimer's, still lack any effective treatment. Increasing cross-disciplinarity to avoid over-reliance on any particular method and to facilitate more integrated approaches to problem-solving should lead to more effective research strategies and hopefully to more effective treatments.

As the JRC report further suggested, cross-disciplinary is also key to bridging the gap between scientific research and clinical practice. This could be achieved, on the one hand, by putting in place social, emotion-oriented and lifestyle-related interventions and, on the other hand, by making innovation and scientific breakthroughs more tailored to patients' real needs.

However, describing methods or comparing the different types of scientific evidence they generate remains a challenge, as cross-disciplinarity lacks a common language.

We need more acknowledgement and understanding of these issues if scientific communities are to devise ways to bridge knowledge and practices, for the ultimate benefit of citizens.

The report also sets out key recommendations to better harvest the potential benefits of a more systematic cross-disciplinarity approach to biosciences.

SOCIAL MEDIA INFLUENCES OUR POLITICAL BEHAVIOUR AND PUTS PRESSURE ON OUR DEMOCRACIES

The second report from the JRC's enlightenment 2.0 multiannual research programme came out in 2020. In *Technology and Democracy: Understanding the influence of online technologies on political behaviour and decision-making*, an international team of experts takes a behavioural science approach to investigating the impact of online platforms on political behaviour.

Ongoing policy reflections have concentrated on understanding the actors and the nature of content. In the absence of behavioural reflections, policymakers may feel that they are constantly playing catch-up with technological advances. By taking a behavioural approach, the JRC report sought to help policymakers regain agency, as essential components of human behaviour are governed by relatively stable principles that remain largely static even as the technological environment changes rapidly.

The report identifies and analyses the cognitive challenges posed by four key pressure points that shape social media's impact on our democracies: attention economy, platform choice architecture, algorithmic content curation and disinformation. The report includes policy implications to assist policymakers in addressing these challenges.

The report is a state-of-the-science review based on a solid interdisciplinary critical analysis and a synthesis of the relevant peer-reviewed scientific literature. Importantly, it concludes that there is scientific evidence that social media change people's political behaviour offline.

As the European Commission's knowledge and science service, the JRC used innovative knowledge brokerage techniques to produce this report; it embedded European Commission staff in a team of international scientific experts spanning different disciplines. The JRC then shared these findings with policymaking colleagues working on many dossiers, including the European democracy action plan, the Digital Services Act and the *EU Citizenship Report 2020*, as well as those reflecting on how to legislate against disinformation and the future of political advertising.

THE THIRD CITIZEN ENGAGEMENT AND DELIBERATIVE DEMOCRACY FESTIVAL JOURNEY

The annual Citizen Engagement and Deliberative Democracy Festival contributes to public and policy discussions on the future of democracy and how to implement more participatory practices in EU policymaking. It feeds into the Commission's priority 'A new push for European democracy', which includes the upcoming Conference on the Future of Europe and the European democracy action plan. The festival in 2020 attracted many more participants than the first two editions in 2018 and 2019, with over 1 200 people registered.

The week-long festival was hosted by the new EU Academy platform. It brought politicians, practitioners, civil society and artists together to explore the following questions: How can we ensure that social distancing does not prevent the public from engaging with, co-creating or deliberating on policies that affect them? What do institutional mainstreaming and upscaling of citizen engagement require to thrive? What do citizens imagine and expect from these engagements?

During the event, it was important to hear the views of citizens and young people who have been involved in

participatory projects. They provided crucial insights and recommendations, including how the purpose of the project must be made clear from the start, and that it was imperative to provide feedback on how their participation was taken up and translated into policy.

Many participants acknowledged the significant work, at multiple scales, that was needed to see meaningful change. In relation to science, one participant said, 'Science has to get off its track of a slow death and join a broader definition for deep change'.

The festival showcased a video gallery of 54 citizen engagement activities from all over Europe. The explosion of submissions received for the initiative is a strong sign that, despite COVID-19, the citizen engagement and deliberative democracy community is more alive and diverse than ever.

BOOSTING TRANSPARENCY AND TRUST BY REVEALING THE MODELS BEHIND EUROPEAN UNION POLICIES

The JRC-hosted CC-MOD has opened MIDAS to the public, providing a user-friendly platform to better understand the evidence used by the Commission when designing and evaluating policies that address today's big challenges. Since 2019, parts of MIDAS have been open to the EP; it is now completely accessible to everyone.

MIDAS gives access to the 35 models that have been used for impact assessments since 2017. In addition to useful documents and references, it explains how each model supported the analysis carried out for each impact assessment – indicating the leading Commission department that runs the model and the impacts that it has helped to assess.

For each model, MIDAS also gives details on the modelling approach, data inputs and outputs, spatial and temporal extent and resolution; the extent to which underlying data, model results, code and documentation are available and accessible; if and how uncertainties are quantified and accounted for; if sensitivity analysis has been done; if the model has been peer reviewed or validated; and if results are published in peer-reviewed journals.

The Commission makes extensive use of models to support policymaking, from the initial design of policies to evaluating their environmental, economic and social impacts. Models are used in many policy areas, such as agriculture, the environment, transport, economics and fisheries. For example, the Commission recently used modelling to assess the feasibility of committing to EU climate neutrality by 2050, and of the 2030 climate target plan, which raises the EU's ambition on reducing greenhouse gas emissions to at least 55 % below 1990 levels by 2030.

By clearly presenting information on models that supported Commission impact assessments and making that information easy for the public to navigate, MIDAS encourages scrutiny of the quality of evidence provided by modelling and the exchange of good practices in model use.

The aim is to give everyone – whether research bodies, decision-makers or the general public – confidence in the contribution that these models make to better policy design and evaluation.

JRC ANNUAL AWARDS FOR EXCELLENCE

The JRC Annual Awards for Excellence commend outstanding work carried out at the JRC that sets examples of best practice in fulfilling the organisation's mission, vision and values.

In 2020, nine awards in seven categories were distributed to a total of 77 staff members. The Science for Policy Award recognises exceptional support to the conception, formulation, implementation or monitoring of EU policy. The Knowledge Management Award distinguishes the successful integration of new and existing knowledge from heterogeneous or multidisciplinary sources. The Excellence in Research Award acknowledges JRC scientists whose research has a high impact within the scientific community. The Young Scientist Award salutes the scientific work and achievements of a young JRC scientist. The Innovation and/or Technical Development Award acknowledges distinguished support given by JRC technical staff. The Excellence in Administration Award recognises the outstanding support given by JRC staff in the fields of administration, communication, human resources, financial management, information technologies, quality management, simplification, training provision, infrastructure development and maintenance, and site support services. The Best Team Collaboration Award celebrates the brilliant results of team collaboration efforts.

SCIENCE FOR POLICY

This award acknowledges the outstanding contribution of JRC staff in supporting the conception, formulation, implementation or monitoring of EU policy. Nominations were welcomed for scientific work across the full policy cycle, from ad hoc or short-term requests and emerging support (e.g. for communications in preparation) to longer-standing support sustained over many years. The award also serves to highlight best practice in the JRC.

Ad hoc support

Lois Brett (JRC.R.2, ex-JRC.C.1), **Natalia Lebedeva** (JRC.C.1), **Marek Bielewski** (JRC.C.1), **Antonios Marinopoulos** (JRC.C.3), **Harald Scholz** (JRC.C.4), **Elena Paffumi** (JRC.C.4), **Claudiu Pavel** (JRC.C.7), **Jaco Huisman** (JRC.D.3), **Fabrice Mathieux** (JRC.D.3) and **Fulvio Ardente** (JRC.D.3), as well as departed team member **Franco Di Persio** (ex-JRC.C.1), were given the award for providing JRC scientific expert support to the Important Project of Common European Interest on the battery value chain.

Long-standing support

Damiano Binda, **Christina Corbane**, **Daniele Ehrlich**, **Aneta J. Florczyk**, **Sergio Freire**, **Thomas Kemper**, **Martino Pesaresi**, **Marcello Schiavina**, **Donato Airaghi**, **Michele Melchiorri**, **Luca Maffenini**, **Panagiotis Politis**, **Filip Sabo**, **Pierpaolo Tommasi** (JRC.E.1) and Fincons S.p.A. were given the award for developing a method to delineate cities, urban and rural areas for international comparison.

KNOWLEDGE MANAGEMENT

This award acknowledges the outstanding contribution of JRC staff to its strategic knowledge management agenda. The award is given for successful integration of new and existing knowledge from heterogeneous or multidisciplinary sources at the service of the JRC strategic work programme, and for work that demonstrates particularly effective means employed to harness both human/tacit (knowledge, expertise, insights) and explicit (data, information) sources for strategic benefit. The award serves as an example of best practice in knowledge management at the JRC.

Strong cross-JRC interdisciplinary effort

Davide Magagna, **Ignacio Hidalgo González**, **Efstathios Peteves**, **Matteo De Felice**, **Sara Andre**, **Hrvoje Medarac** (JRC.C.7), **Giovanni Bidoglio**, **Marko Adamovic**, **Bernard Bisselink**, **Arie De Roo**, **Chiara Dorati**, **Daniele Ganora**, **Alberto Pistocchi**, **Wouter van de Bund**, **Davy Vanham** (JRC.D.2), **Robert Houghton** (JRC.G.10) and **Nicola Magnani** (RTD.03) were given the award for Water – Energy nexus in Europe.

Pragmatic, inclusive and multidisciplinary collaboration

Ine Vandecasteele, **Claudia Baranzelli**, **Alice Siragusa** and **Jean-Philippe Aurambout** (JRC.B.3) were given the award for The Future of Cities – Opportunities, challenges and the way forward.

RESEARCH EXCELLENCE

The award acknowledges top-quality research undertaken by JRC scientists that has a high impact within the scientific community. Successful awardees will demonstrate how the work has strengthened the JRC's in-house scientific competence in areas important to future JRC activities, or promoted or expanded the JRC's scientific excellence, reputation and networking capabilities.

Alessandro Cescatti, **Romain Alkama**, **Guido Ceccherini**, **Gregory Duveiller** and **Giovanni Forzieri** (JRC.D.1 ex JRC.A.5) were given the award for Land-based mitigation and adaptation to climate change.

YOUNG SCIENTIST AWARD

This award acknowledges the scientific work, achievements and contribution to the JRC work programme and mission performed by a JRC young scientist. Applicants may only receive this award once.

Davide Tonini (JRC.B.5) was given the award for his important contributions to the development of novel approaches to assessing the societal impacts of circular economy and waste management solutions.

INNOVATION AND TECHNOLOGICAL DEVELOPMENT

The award acknowledges distinguished technical support given by JRC technical staff. Awardee(s) will need to demonstrate how, for example, the work led to a major extension of the JRC's technical or experimental capabilities, to an important innovation or innovative approach, to increased efficiency of work, to a patent application, to copyrights, etc.

Enrico Ben, **Agnieszka Kinsner-Ovaskainen**, **Monica Lanzoni**, **Susanne Safkan**, **Fabrizio Zaro** and **Antonino Brunetto** (JRC.F.1) were given the award for the development of the new data management software of the European network of population-based registries for the epidemiological surveillance of congenital anomalies (Eurocat) for managing the JRC-Eurocat Central Registry and the Eurocat website on the European Platform on Rare Disease Registration.

EXCELLENCE IN ADMINISTRATION

This award acknowledges the outstanding support given by JRC staff in the fields of administration, communication, human resources, financial management, information technologies, quality management, simplification, training provision, infrastructure development and maintenance, and site support services.

Connie Biesmans (JRC.R.9) and **San Pauwels** (JRC.I.5) were given the award for the roll-out of the JRC's public procurement management tool to all DGs and executive agencies of the European Commission and associated IT developments.

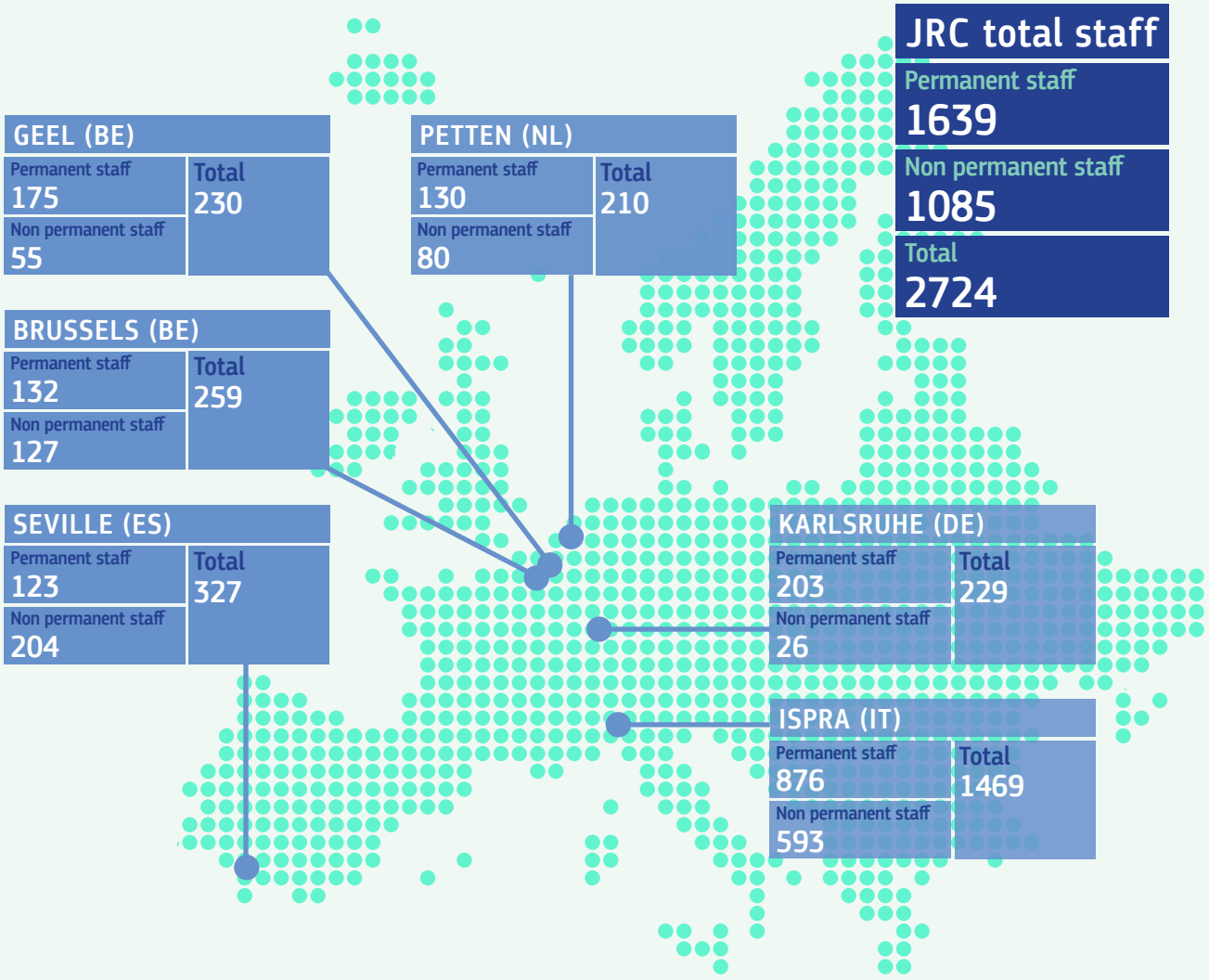
BEST TEAM COLLABORATION

This award acknowledges excellent team collaboration involving JRC staff at any level within or outside the JRC, in any area of JRC work.

Marion Bachmann, **Alena Behuncikova**, **Stephanie Clemens**, **Heike Schmidt**, **Ilja Schwarzhaupt** (JRC.R.7), **Zita van der Net**, **Dario Pardi** (JRC.R.I.3), **Angelica de Meis**, **Vanessa Schröder** (JRC.G), **Krisztina Horvath** (JRC.G.1), **Emilie Foguenne** (JRC.R.8), **Petra Strube** (JRC.G.I.3), **Krisztina Varga** (JRC.G.I.5), **Cynthia Poublan**, **Ulrike Tobisch** (JRC.G.II.6), **Anika Düennhaupt** (JRC.G.III) and **Anna Matthei-Socha** (JRC.GIII.8) were given the award for establishing the intermediate archive at the JRC Karlsruhe site.

JRC SITES MAP AND KEY FACTS AND FIGURES

(as of 31 December 2020)



* The JRC's biggest site is Ispra, where 54 % of all active staff are located, followed by Sevilla (12 %).
** The four other sites have fairly equal numbers of staff members (Brussels, 9.5 %; Geel, 8.4 %; Karlsruhe, 8.4 %; Petten, 7.7 %).

EQUAL OPPORTUNITIES

By the end of 2020, women represented 39 % of the JRC's active staff and 35 % of its administrator function group. The JRC is making a continuous effort to meet Commission targets for female staff holding management positions.

Positions (% female)	2018	2019	2020
Senior management	42 %	50 %	27 %
Middle management	16 %	28 %	26 %
Non-management administrators (AD)	25 %	35 %	35 %

JRC CONTRACTUAL INCOME

The value of contracts signed by the JRC in 2020 amounted to EUR 103 million. The table below shows a breakdown of the contracts signed by 31 December 2020. 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)	2018	2019	2020
Indirect actions (framework programme)	4.16	4.2	9.1
Support to Commission services	68.5	68.5	85.9
Third party work	10.7	10.7	7.9
Total (rounded)	83.4	83.4	103.0

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 credit is 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 below shows a breakdown of how the 2020 budget was spent (in terms of available commitment appropriations, the European Free Trade Association not included). In addition, EUR 31.6 million was made available for the programme to decommission the JRC nuclear installations and for Euratom-related waste management. An additional EUR 29 million was received in the form of contributions from countries associated with Horizon 2020 expenses.

Outgoing expenditures (in million EUR)	2018	2019	2020
Staff expenses	237.38	244.28	249.17
Means of execution	97.21	114.45	115.13
Operational appropriations (FP) €	39.06	50.26	56.66
Total (rounded)	373.65	408.99	420.96

STAFF

The total number of active staff working at the JRC on 31 December 2020 was 2 724. Of the total, about 73.9 % of staff was work programme staff and 26.1 % was 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 June 2021

STRATEGY & COORDINATION

Director-General (BRUSSELS) Stephen QUEST
- Assistant to the Director-General Valérie ENJOLRAS — BRUSSELS, ISPRA
- Assistant to the Director-General Lucia SOLDATOVA [ACTING] — BRUSSELS

Deputy Director-General (BRUSSELS) Bernard MAGENHANN
- Assistant to the Deputy Director-General Guido LANZKE — BRUSSELS
- Advider for Policy Communication Geraldine BARRY — BRUSSELS

Principal Adviser Life Sciences Elke ANKLAM — BRUSSELS

01. New European Bauhaus Xavier TROUSSARD — BRUSSELS, ISPRA

02. Communication Anne-Mette JENSEN FOREMAN [ACTING] — BRUSSELS, ISPRA

A. Strategy, Work Programme and Resources (Brussels) Delilah AL KHUDHAIRY HR Business Correspondent
- Sector HR Business Correspondent Team — BRUSSELS, ISPRA
- 1. Resource Planning Patrice LEMAITRE — BRUSSELS, ISPRA
- 2. Work Programme Margareta THEELEN * — BRUSSELS, ISPRA
- 3. Inter-institutional, International Relations and Outreach Emanuela BELLAN — BRUSSELS, ISPRA
- 4. Legal Affairs Carina Rehl SOBERG — BRUSSELS, ISPRA
- 5. Scientific Development Jutta THIELEN DEL POZO — ISPRA, OTHER SITES
- 6. Quality Assurance and Evaluation Jens OTTO — BRUSSELS, ISPRA, GEEL
- 7. Euratom Coordination Margarida GOULART [ACTING] — BRUSSELS

Deputy Director-General (BRUSSELS) Bernard MAGENHANN [ACTING]
- Assistant to the Deputy Director-General Stephen DAVIES — BRUSSELS
- Advider for Cross-Disciplinaru Knowledge Peter BOSCH — BRUSSELS

NUCLEAR DECOMMISSIONING

J.–Nuclear Decommissioning and Waste Management (ISPRA) Bernard MAGENHANN [ACTING]
- Sector 1. Management Support — ISPRA
- 1. Ispra Operational Nuclear Decommissioning & Waste Management (D&WM) Paolo PEERANI — ISPRA
- Sector 2. Ispra Decommissioning and Waste Management Safety and Security Paolo PEERANI [ACTING] — ISPRA

KNOWLEDGE PRODUCTION

B. Growth and Innovation (SEVILLE) Mikel LANDABASO ÁLVAREZ
- Adviser for Growth and Innovation – Seville Site Development Vincenzo CARDARELLI — SEVILLE
- 1. Finance and Economy Francesca CAMPOLONGO * — ISPRA
- 2. Fiscal Policy Analysis Salvador BARRIOS — SEVILLE
- 3. Territorial Development Alessandro RAINOLDI — SEVILLE, ISPRA
- 4. Human Capital and Employment Ioannis MAGHIROS — SEVILLE, ISPRA
- 5. Circular Economy and Industrial Leadership Carmen MENA ABELA — SEVILLE
- 6. Digital Economy Carlos TORRECILLA SALINAS — SEVILLE, ISPRA

C. Energy, Transport and Climate (PETTEN) Piotr SZYMANSKI *
- Adviser for site coordination and external relations Christopher HUNTER — PETTEN
- 1. Energy Storage Paul HODSON — PETTEN
- 2. Energy Efficiency and Renewables Christian THIEL — ISPRA, BRUSSELS
- 3. Energy Security, Distribution and Markets Marcelo MASERA — PETTEN, ISPRA, SEVILLE
- 4. Sustainable Transport Alois KRASENBRINK — ISPRA
- 5. Air and Climate Elisabetta VIGNATI * — ISPRA
- 6. Economics of Climate Change, Energy and Transport Antonio SORIA RAMIREZ — SEVILLE, PETTEN

D. Sustainable Resources (ISPRA) Giovanni DE SANTI
- Adviser for Environment Sustainable Resources Interactions Guido SCHMUCK — ISPRA
- 1. Bio-Economy Luisa MARELLI [ACTING] — ISPRA, BRUSSELS
- 2. Water and Marine Resources Jann MARTINSOHN — ISPRA
- 3. Land Resources Constantin CIUPAGEA — ISPRA, GEEL
- 4. Economics of Agriculture Giampiero GENOVESE — SEVILLE
- 5. Food Security Alan BELWARD * — ISPRA

E. Space, Security and Migration (ISPRA) Dan CHIRONDOJAN
- Adviser EU Strategic sovereignty Thomas BARBAS — ISPRA
- 1. Disaster Risk Management Alessandra ZAMPIERI * — ISPRA
- 2. Technology Innovation in Security Georg PETER — ISPRA
- 3. Cyber and Digital Citizens' Security Jean-Pierre NORDVIK — ISPRA
- 4. Safety and Security of Buildings Artur PINTO VIEIRA — ISPRA
- 5. Transport and Border Security Bartel MEERSMAN — GEEL, ISPRA
- 6. Demography, Migration and Governance Dessislava CHOUMELOVA — ISPRA

F. Health, Consumers and Reference Materials (GEEL) Guy VAN DEN EEDE [ACTING] *
- 1. Health in Society Ciaran NICHOLL — ISPRA
- 2. Consumer Products Safety Arnd HOEVELER — ISPRA, GEEL
- 3. Chemicals Safety and Alternative Methods Maurice WHELAN — ISPRA
- 4. Fraud Detection and Prevention Franz ULBERTH — GEEL, ISPRA
- 5. Food and Feed Compliance Hendrik EMONS * — GEEL, ISPRA
- 6. Reference Materials Robert KOEBER — GEEL

G. Nuclear Safety and Security (KARLSRUHE) Maria BETTI *
- 1. JRC Sites Radioprotection and Security Ralph MAIER — KARLSRUHE
- 2. Standards for Nuclear Safety, Security and Safeguards Arjan PLOMPEN [ACTING] — GEEL
- Dept.I – Nuclear Safety (Karlsruhe) Vincenzo RONDINELLA
  - 3. Nuclear Fuel Safety Rudy KONINGS — KARLSRUHE
  - 4. Nuclear Reactor Safety and Emergency Preparedness Concetta FAZIO * — PETTEN
  - 5. Nuclear Science and Applications Roberto CACIUFFO — KARLSRUHE
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  - 7. Nuclear Security Stefan NONNEMAN — ISPRA
  - 8. Nuclear Safeguards and Forensics Klaus LÜTZENKIRCHEN — KARLSRUHE

KNOWLEDGE MANAGEMENT

H. Knowledge Management (Ispra) Krzysztof MARUSZEWSKI
- 1. Knowledge for Policy: Concepts and Methods David MAIR — BRUSSELS, ISPRA
- 2. Knowledge Management Methodologies, Communities and Dissemination Marc WILIKENS * — ISPRA, BRUSSELS
- 7. Knowledge for Finance, Innovation and Growth Xabier GOENAGA BELDARRAIN — BRUSSELS, SEVILLE
- 7. Knowledge for the Energy Union Efstathios PETEVES — PETTEN, BRUSSELS
- 6. Knowledge for Sustainable Development and Food Security Ivan Davor KULIS — ISPRA, BRUSSELS
- 7. Knowledge for Security and Migration Paola PICCININI — ISPRA, BRUSSELS, GEEL
- 7. Knowledge for Health and Consumer Safety Guy VAN DEN EEDE — GEEL, ISPRA
- 9. Knowledge for Nuclear Safety and Decommissioning Franck WASTIN — PETTEN, KARLSRUHE, ISPRA

I. Competences * (Ispra) Matthew KING acting
- 1. Monitoring, Indicators & Impact Evaluation Michaela SAISANA — ISPRA
- 2. Foresight, Modelling, Behavioural Insight & Design for Policy Fabiana SCAPOLO acting — BRUSSELS, ISPRA, SEVILLE
- 3. Text and Data Mining Matthew KING * — ISPRA, BRUSSELS
- 4. Intellectual Property and Technology Transfer ** Giancarlo CARATTI DI LANZACCO — BRUSSELS
- 5. Advanced Computing & ICT Support Philippe BIERLAIRE — ALL SITES

SUPPORT

R. Support Services (BRUSSELS) Philippe DUPONTEIL
- 1. Support Services Seville Asuncion FERNANDEZ CARRETERO (*) — SEVILLE
- 2. Support Services Petten Lois BRETT — PETTEN
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***with administrative responsibility for decommissioning teams directly attached to the Site Directors of Geels, Petten, Karlsruhe

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