European Commission

Scientific Advice Mechanism (SAM)

Informing European Commission policy making with

Scientific Evidence

The Group of Chief Scientific Advisors 2015-2019

Independent Expert Report

Group of Chief Scientific Advisors

Brussels, February, 2020

Research and Innovation

Informing European Commission Policy Making with Scientific Evidence

The Group of Chief Scientific Advisors 2015-2019

European Commission
Directorate-General for Research and Innovation
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EUROPEAN COMMISSION

Chief Scientific Advisors – SAM, EGE
INDEPENDENT SCIENTIFIC ADVICE FOR POLICY MAKING

Informing European Commission Policy Making with

Scientific Evidence

The Group of Chief Scientific Advisors 2015-2019

Brussels, 5 February 2020

2020 Directorate-General for Research and Innovation

This report:

- ✓ Summarises the activities of the European Commission's Group of Chief Scientific Advisors, [2015-2019];
- ✓ Summarises our scientific advice during this period, and its impact on Commission policy making and beyond;
- ✓ Describes our place in the scientific advice system, within and beyond the European Commission.

This report is for:

- ✓ Readers wanting to understand better the work of the Group of Chief Scientific Advisors, and in particular the impact of our advice on European Union policy and legislative proposals;
- ✓ EU and worldwide policy-makers and stakeholders making use of scientific advice.

This report is produced exclusively by and reflects the views of the Group of Chief Scientific Advisors, and does not rely on any input from other experts.

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Foreword – Mariya Gabriel, Commissioner for Innovation, Research, Culture, Education and Youth

It is with great pleasure that I take over responsibility for the Group of Chief Scientific Advisors from my predecessor Carlos Moedas. In my previous role, I was aware of their excellent work to ensure that EU policy is informed by the latest scientific evidence and knowledge. Indeed, their scientific opinion on 'Cybersecurity in the European Digital Single Market' was of particular interest to me and useful for cybersecurity related policy initiatives, as you can see in this report. In my new role, I will have the pleasure to meet them on a regular basis, discuss their scientific advice with them, and be their link to President von der Leyen's College of European Commissioners.

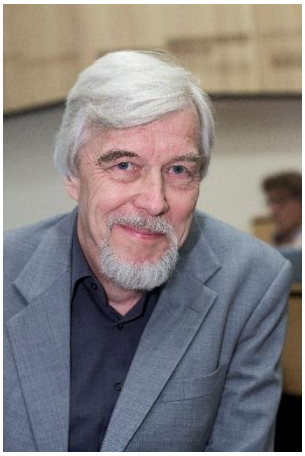
This report presents an overview of the Advisors' work since they first met in January 2016, to when I met them during their 20th plenary meeting in December 2019. With seven scientific opinions, two statements and two explanatory notes, the Advisors have informed the thinking of the Commission on some very challenging issues. Their work has improved EU legislation and the understanding of policy-makers through better-informed debate and outreach. Beyond their direct impact on policy they have rapidly become a reference for scientific advice on policy. Their experience has informed similar structures in Europe and beyond, and more broadly still, the advisors have been important in pushing back against anti-expert, anti-science, populist discourse by providing sensible, evidence-based and independent advice.

I would like to add my thanks to those of my predecessor to the current and previous Advisors for their commitment and invaluable advice. They are the Chair Professor Rolf-Dieter Heuer, the Deputy Chair Professor Pearl Dykstra, and members Professors Janusz Bujnicki, Elvira Fortunato, Nicole Grobert, Carina Keskitalo, and Sir Paul Nurse; as well as former members Dame Julia Slingo and Professor Cédric Villani, and former Chair Professor Henrik C. Wegener.

I would also like to thank the Scientific Advice for Policy by European Academies (SAPEA) project and the Presidents of the Academy networks in its Board: the previous Chairs Günter Stock and Bernard Charpentier, the outgoing Chair Sierd Cloetingh, and Professors Antonio Loprieno, Thierry Courvoisier, George Griffin and the incoming Chair Reinhard Hüttl. I also thank each and every expert who has provided valuable input and shared his or her time selflessly with the Advisors or when developing the excellent SAPEA Evidence Research Reviews informing the Advisors' opinions.

I am very much looking forward to working with the Advisors on their ongoing topics, and to developing new ones with them to support the policy objectives of this Commission. I recommend this report, alongside the Advisors' most recent scientific opinion, *Science Advice to European Policy in a Complex World*, as we endeavour to support better policy making with excellent scientific advice.

Introduction – Rolf-Dieter Heuer, Chair of the Group of Chief Scientific Advisors



With the arrival of President von der Leyen's Commission comes the fourth anniversary of the establishment of the Group of Chief Scientific Advisors. The Advisors and the Scientific Advice for Policy by European Academies (SAPEA) consortium form the Scientific Advice Mechanism, SAM, supported by European Commission staff in the Directorate General for Research and Innovation (DG RTD). We seven advisors bring together our experience and our expertise from different disciplines in the natural and social sciences, complemented by the breadth and depth of expertise represented by academies of science and learned societies across Europe in the SAPEA consortium. We are working in full independence at the science-policy interface, but closely with other science advice providers, such as the Joint Research Centre, the EU-Agencies Network on Scientific Advice (EU-ANSA), and beyond the EU.

Our work has resulted from questions received from the College of European Commissioners, whose members have requested scientific opinions on vehicular CO_2 emissions, cybersecurity, food from the oceans, carbon capture and utilisation, and plant protection products, as well as explanatory notes on new techniques in agricultural biotechnology, and on the regulatory assessment of glyphosate in plant protection products.

More recently, and in line with our mandate, we have delivered scientific advice on our own initiative concerning the environmental and health risks of microplastic pollution and on mechanisms for effective science advice for policy in a complex world. Our present work is focusing on 'own-initiative' scientific advice on adaptation to climate change related health effects and sustainable food systems, the latter emerging from previous work on plant protection products, food from the oceans and agricultural biotechnology. Similarly, and following our work on microplastic pollution we will start work related to biodegradable plastics. We also anticipate work on a scientific opinion on the energy transition in 2020.

In this report, we take stock of our work over the past four years by presenting scientific opinions and other advice provided to the European Commission, as well as the impact of these opinions on EU legislation and the views of the Commissioners and services having made use of our advice. The report also covers cooperation with similar bodies providing scientific advice, the impact of the opinions on debate and looks at broader outreach fostered by our work. Although the SAM is a broad mechanism, this report represents the views of the Group of Chief Scientific Advisors exclusively.

It is gratifying to see how our work has borne fruit, and continues to do so as evidenced by the impact of our recommendations on corresponding legislation, policy and other activities. Similarly, cooperation between the Advisors and SAPEA continues to flourish, while links with scientific advisors and other scientific advice structures within Europe and beyond grow stronger.

Membership of the Group of Chief Scientific Advisors is for a maximum of five years. As Chair, I shall step down and leave the Group in around one year's time. In my remaining year, I hope in particular to develop our ways of working according to the recommendations made in our recent opinion, Scientific Advice to European Policy in a Complex World. Beyond that, I would like to enable the Group to provide advice on more topics, more regularly, while retaining the high quality that has been the hallmark of our work to date.

I am also keen to communicate our work more effectively both to decision makers and outside the 'Brussels bubble', with plainer language and shorter documents and to ensure that the topics we consider reflect the interests and concerns of citizens in general. In turn, I hope that the Commissioners that we serve will support our efforts to strengthen evidence-based policy making within the European Union.

Before that, however, my fellow Advisors and I would very much like to thank Commissioner Moedas and former and current Research and Innovation Directors General Robert-Jan Smits and Jean-Eric Paquet for their energetic support and constructive questions, and for helping us to navigate the complexities of the European Commission. We are grateful to all the members of the outgoing College of European Commissioners and their Cabinets for their trust and to SAPEA and all the experts involved in providing the evidence reviews for our opinions for their dedication and constructive cooperation. Our ultimate goal is to deliver high quality, timely and independent advice for policy that

benefits all European citizens, and we look forward to working closely with the Commissioner for Innovation, Research, Culture, Education and Youth, Mariya Gabriel, our link to the von der Leyen Commission, to do so.

Last but not least, we thank the European Commission staff in the Directorate General for Research and Innovation, past and present, including staff from the Joint Research Centre and those seconded from Member States, for their support of our work and of us, not least in their invaluable assistance with the preparation of this report.

1. Who we are and what we do:

1.1. Who we are

The European Commission's Group of Chief Scientific Advisors first met in January 2016. Our role is to provide independent scientific advice to the College of European Commissioners to inform their decision-making and thus contribute to the quality of EU legislation. The Group gathers seven highly qualified expert members with backgrounds in various disciplines, covering both social and natural sciences: Professor Rolf-Dieter Heuer (Chair), Professor Pearl Dykstra (Deputy Chair), Professors Janusz Bujnicki, Elvira Fortunato, Nicole Grobert, Carina Keskitalo and Sir Paul Nurse. The Advisors are supported by a team in the European Commission's Directorate General for Research and Innovation (DG RTD), including staff seconded from the European Commission's Joint Research Centre (JRC), and experts from EU Member States.

We work closely with the Science Advice for Policy by European Academies consortium, SAPEA, which consists of five European Academy Networks: Academia Europaea, the European Federation of Academies of Sciences and Humanities (ALLEA), The European Academies' Science Advisory Council (EASAC), The European Council of Academies of Applied Sciences (Euro-CASE) and the Federation of European Academies of Medicine (FEAM). SAPEA brings together the outstanding knowledge and expertise of fellows from over 100 Academies, Young Academies and Learned Societies in over 40 countries across Europe, and provides the Evidence Review Reports that inform the scientific opinions of the Group of Chief Scientific Advisors. Collectively, the Group of Chief Scientific Advisors, SAPEA, and European Commission support staff are known as the Scientific Advice Mechanism (SAM).

The interdisciplinary nature of the Group broadens the boundaries of science advice and allows contributions from all relevant areas of science and research to be taken into account in our scientific advice. Furthermore, the innovative structure of the Scientific Advice Mechanism, in cooperation with SAPEA and EC staff allows the Advisors to act quickly, assembling information from Europe and beyond. It is an unprecedented system for ensuring that science advice is based on the best available knowledge at any given time.

There are two features of how we work that are particularly important for providing scientific advice to the Commission on policy issues. The first is our independence from the European Commission. This allows us to give advice independent of prevailing views and opinions within the Commission or other bodies associated with the Commission, enabling a clear focus on the science relevant for the policy issue under consideration. In line with our mandate, it also allows us to identify and analyse, from a scientific point of view, issues we consider of importance and to bring them to the attention of the Commission. The second feature is that we apply a 'dual layer system': the first layer is SAPEA's provision of a peer-reviewed comprehensive evidence synthesis based on literature reviews and workshops with experts of their networks – Evidence Review Reports. The second layer is the development of the scientific advice ourselves based on the analysis of the Evidence Review Reports by SAPEA. At this stage, we typically call upon additional experts of our own choice and consult stakeholders of all categories (though without involving them in the formulation of the scientific advice). This allows us also to consider pertinent evidence from experts involved in commercial operations or campaigning NGOs who might otherwise be excluded due to their interests. The final product is the sole responsibility of the Chief Scientific Advisors.

If any of the Chief Scientific Advisors were to have a conflict of interest concerning a topic under study, then that individual would be excluded from that particular scientific advice. This way of working gives better control of conflicts of interest issues whilst allowing access to the full range of scientific evidence necessary for good scientific advice for better policy development.

1.2. What we do

The Group of Chief Scientific Advisors' mandate is provided by a Commission Decision[1] establishing the Group. In summary, our tasks are:

"To provide the Commission with independent scientific advice on specific policy issues; that does not duplicate advice being provided by existing bodies; […] to support the Commission in identifying specific policy issues where independent scientific advice is needed; to provide recommendations for improving the

[1] C(2018) 1919 (amending C(2015) 6946)

overall interaction between Commission policy making processes and independent scientific advice".

As well as providing scientific opinions with advice for policymakers, explanatory notes that describe complex issues but without providing advice, and statements that may precipitate further, more detailed work, we also co-operate with other providers of science advice within the Commission, in Europe and beyond.

1.3. Our place in the EC science advice context

The Advisors are not the only providers of scientific advice to the European Commission. Other science advisory bodies and providers include the Joint Research Centre (JRC), the scientific committees (on Consumer Safety and on Health, Environmental and Emerging Risks), thematic expert panels and high-level groups in other Directorates-General, various decentralised agencies carrying out scientific tasks in the EU, such as the European Food Safety Authority and the European Environment Agency, and ad-hoc expert groups. We actively co-operate with many of these other bodies in order to avoid duplication, exchange best practice and improve the overall quality of advice provided to the Commission.

We are part of a broad ecosystem of scientific advice providers and are unique in our close relationship with the College of European Commissioners. This allows us to have direct access to EC policy-makers and to respond in a timely manner to their requests. We are also unique in the breadth of topics, covering most fields of science, on which we may be asked to provide advice. In this respect, the expertise represented by SAPEA whether in engineering, humanities, medicine, natural or social sciences is invaluable.

1.4. Our work so far: facts and figures

Since the Group was established in 2015, we have published seven scientific opinions, two explanatory notes and two statements. We have held 20 ordinary plenary meetings to discuss ongoing and future scientific opinions and 34 workshops and expert group meetings to discuss the opinions with stakeholders and the scientific community before publishing. The advice published so far has informed EU legislation, fostered cooperation among science advice bodies in the EU, and has had an impact on debate in and outside the scientific

community. The contribution of each scientific opinion is outlined below, presenting also the feedback from the Commissioners to whom the advice was provided and the services who made use of it in their ongoing policy work.

25 September 2019, 19th plenary meeting of the Group of Chief Scientific Advisors, Brussels. From left to right: Deputy Chair Pearl Dykstra, former Chair Henrik C. Wegener, Paul Nurse, Chair Rolf-Dieter Heuer, former European Commissioner for Research, Science and Innovation, Carlos Moedas (2014-2019), Janusz Bujnicki, Elvira Fortunato, Carina Keskitalo, Nicole Grobert.

2. Our work to date and its impact on policy:

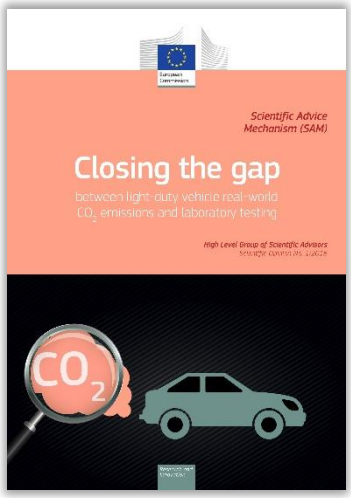
2.1. Scientific advice published to date

This section presents our scientific advice delivered to the European Commission to date. The necessity for advice is described, usually with reference to a specific Commissioner's request, and the question and consequent recommendations are summarised. Finally, the impact on EU policy so far is presented, as well as the feedback from the Commissioner to whom the scientific opinion was provided.

2.1.1. Closing the gap between light-duty vehicle real-world CO_2 emissions and laboratory testing

The scientific opinion

The first scientific opinion examined the growing gap between CO_2 emissions measured and published when putting new vehicles on the market and the real-world emissions of these vehicles. The opinion describes ways in which the gap might be reduced, and responds to two main questions:



- What is the European and worldwide scientific basis for improving the measurement of light vehicle CO_2 emissions and fuel consumption in order to produce values closer to average real-world data?
- Which approaches might be considered, what are their strengths and weaknesses, including aspects of reliability and transparency, and what additional scientific and analytical work would be needed?

The scientific opinion was based on a detailed literature review, a visit to a vehicle emissions laboratory (JRC), a scientific expert workshop and a stakeholder meeting. The main recommendations are to:

- Create a framework for the monitoring of real driving CO_2 emissions through CO_2 data obtained from real driving emissions testing using portable emissions measurement systems, a targeted ex-post real driving emissions methodology, and formal reporting of fuel consumption from on-board diagnostic systems;
- Strengthen regulatory oversight and technical capacity in Europe, and increase the transparency of the whole process;
- Design legislation on CO_2 emissions that stimulates innovation and is adapted to new technologies such as plug-in hybrid and electric vehicles;
- Develop further the Worldwide Harmonised Light Vehicle Test Procedure, WLTP, with a formal review every five years to ensure that the gap between laboratory and real-world emissions is not growing.

The opinion also recommends further research to assess the real driving emissions procedure and methodology and develop on board diagnostics, as well as to include new types of vehicles.

The outcome:

Having decided to replace the 'New European Driving Cycle' (NEDC) CO_2 emissions test process with the WLTP, the Commission anticipated further improvements to WLTP post 2020, to be informed by this scientific opinion.

Recommendations made in the opinion substantiated elements of the new Regulation on emissions performance standards for cars and light commercial vehicles, adopted on 17 April 2019 ((EU) 2019/631) by the European Parliament and the Council[2].

[2] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0631
Direct references to the opinion are made in Staff Working documents addressing CO_2 emissions COM(2017)676, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2017:0676:FIN, p.9, p.59 and 62 : Impact assessment of different policy options.

The handover of the opinion to the Commission: the Group of Chief Scientific Advisors with Commissioner Moedas, 25 November 2016 during the 5th plenary meeting of the Group, with former Advisor Cédric Villani and former Chair Henrik C. Wegener.

"Curbing CO_2 emissions and more representative measurements will support European and global efforts to decarbonise transport in view of international commitments to combat climate change. An important step has been the adoption of a new emissions testing procedure. This first opinion of the SAM High-level Group[3] will undoubtedly constitute a key reference for our work on post-2020 emission performance standards for cars and vans in the EU."[4]

Miguel Arias Cañete, Commissioner for Climate Action and Energy, speaking on receipt of the scientific opinion, 25 November 2016.

[3] The Group of Chief Scientific Advisors was known until April 2018 as the High Level Group of Scientific Advisors
[4] November 25, 2016: https://ec.europa.eu/clima/news/articles/news_2016112501_en

2.1.2. Cyber Security in the European Digital Single Market

The scientific opinion

The need for this opinion arose from citizens' and policy-makers' concerns about cybersecurity, reflecting the rapid development of new information and communications technologies (ICT) across borders. This opinion was requested in view of the revision of the EU's 2013 cybersecurity strategy in order to take into consideration the latest technological developments and to recommend ways to strengthen cybersecurity in the Digital Single Market[5]. It addresses two main elements:

- How to enable trust in transactions intermediated by ICT (e.g. backdoors, encryption and digital identities);
- Cross cutting issues such as evidence collection, risk management and the science of cybersecurity.

This Opinion was based on an extended review of existing scientific literature, evidence from the site visits (JRC laboratory) and an analysis of the specific European policy context. It focuses on people, processes and technology, and addresses technical, socio-economic, ethical and jurisdictional challenges related to cyberspace. Its main recommendations are to:

- Ensure that cryptographic standards in the EU reach and remain at state-of-the-art levels and encourage the adoption of a systems engineering approach to the totality of on-line relevant ICT developments;
- Reduce software vulnerabilities over the product life cycle, requiring duty-of-care from design to testing and verification, including formal verification, long term maintenance and fast repair;

[5] https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-market#Achievements

- Promote the development and context-tailored use of digital identity management and data-literacy education, and build European citizens' awareness and engagement on cybersecurity;
- Support the deployment of the means for user choice and control over their digital identities, footprints and personal data and the development of an EU cybersecurity industry ('Made in Europe'), including data transfer and network technologies, protection of metadata, and cloud-based data storage and processing;
- Promote cybersecurity education curricula and lifelong cybersecurity training to build talent and sustain the skills of professionals;
- Support the development of evidence collection methods, including sharing evidence and best practice between EU Member States on cybersecurity-related matters;
- Improve mutual trust between national entities;
- Promote the establishment of coherent worldwide cybersecurity governance for the digital economy, aligned with European values.

The outcome

This opinion informed the new EU cybersecurity strategy[6], JOIN (2017) 450. Its recommendations have been taken up in the Regulation on the European Union Agency for Cybersecurity, and on information and communications technology cybersecurity certification (2019/881)[7]. It is also reflected in the proposal for a Regulation establishing the European cybersecurity industry, technology and research competence centre, along with a network of national co-ordination centres COM(2018) 630[8].

[6] "Resilience, Deterrence and Defence: Building strong cybersecurity for the EU", JOIN(2017) 450, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=JOIN:2017:450:FIN&rid=3, p. 3

[7] https://eur-lex.europa.eu/eli/reg/2019/881/oj. It is also mentioned in the Staff Working Document impact assessment of the proposal for European Cybersecurity Industrial, Technology and Research Competence Centre and the Network of National Coordination Centres COM(2018) 403 final, annex 5: Taxonomy for Cybersecurity expertise centres mapping, https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1566462564115&uri=CELEX:52018SC0403 , p.6;

[8] https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2018/0630/COM_COM(2018)0630_EN.pdf, notably the Mandate of the Cybersecurity centre

Vice-President Ansip (Digital Single Market 2014-2019), Commissioner Moedas, Roberto Viola (Director General Communications Networks, Content and Technology), Johannes Klumpers (Head of Unit – Chief Scientific Advisors, SAM EGE) and Keith Sequeira (Cabinet of Commissioner Moedas) at the 6th plenary meeting of the Advisors, discussing the then forthcoming opinion on Cybersecurity, 30-31 January 2017.

"*As cyber threats are becoming increasingly sophisticated, cyber security is of major importance for the Digital Single Market. Europe's digital economy will only bring benefits to its citizens if they can be sure of its security. This Scientific Opinion is another important part of our cybersecurity policy and will feed into our work on cyber security in 2017.*"

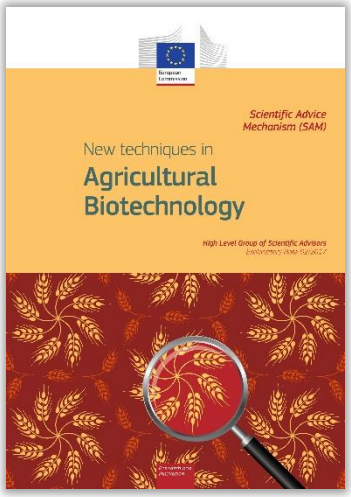
Andrus Ansip, Commission Vice-President for the Digital Single Market, speaking on receipt of the Scientific Opinion, 24 March 2017

Roberto Viola, Director-General of Directorate-General Communications Networks, Content and Technology (DG CNECT) was invited to share his views and feedback on this opinion at the 17th plenary meeting of the Group of Chief Scientific Advisors. He confirmed that the opinion also triggered other initiatives planned by DG CNECT related to research and development activities for capacity building in the area of cybersecurity, as well as policy initiatives. Important topics for further development include identity management, human-centric and environment-friendly Internet, as well as high-value data sets for society[9].

[9]Minutes of the 17th meeting of the Group: https://ec.europa.eu/research/sam/pdf/meetings/hlg_sam_022019_minutes.pdf#view=fit&pagemode=none

2.1.3. New Techniques in Agricultural Biotechnology

The explanatory note



This explanatory note was requested in order to provide a description and comparison of agricultural breeding techniques, including new techniques in agricultural biotechnology, such as gene editing, established techniques of genetic modification and conventional breeding. The comparison was made according to a range of criteria including the detectability and identification of products, as well as the speed with which the desired outcome can be obtained.

The note was based on literature reviews, scientific reports and existing published opinions. It is explanatory, and so does not take a position or make recommendations related to the techniques under discussion.

The main observations are:

- New techniques in agricultural biotechnology, which include genome editing, differ significantly from each other, and their grouping together is not optimal from a scientific and technical point of view; some resemble conventional breeding techniques, others the established techniques of genetic modification;
- New techniques are often used in combination with conventional breeding or with established techniques of genetic modification;
- New techniques are very versatile and can make different changes to plants, animals and microorganisms, including the insertion of genes from the same or other species or the precise and targeted modification of an organism's own genetic sequence, without the addition of DNA to the genome of end-products;
- Some new techniques do not make changes to genetic sequences at all;

- Precision and control over changes made is greater than with the use of conventional breeding or established techniques of genetic modification, and as a consequence, these new techniques result in fewer unintended effects;
- Assessments of the safety of the organisms produced by the new techniques in terms of environmental protection or health can only be made on a case-by-case basis taking into account factors including the specific mutation, unintended effects, the species into which the mutation is introduced, the environment in which the end product is used, the agricultural practice applied, and its planned use and precise and targeted exposure to it.

The outcome

This explanatory note provided a comparative analysis of the existing knowledge on breeding techniques and their characteristics. It was not intended to provide any recommendations or advice for policy. Instead, it was intended to support public debate with stakeholders, initiated at a high-level conference on modern biotechnologies in agriculture, organised by the Commission in Brussels on 28 September 2017.

In July 2018, the Court of Justice of the European Union decided that organisms obtained by the new techniques of directed mutagenesis are genetically modified organisms, GMOs, within the scope of the GMO Directive[10], and that they are therefore subject to the obligations laid down by that Directive. In response to this, in November 2018, the Advisors published a statement "Providing a scientific perspective on the regulatory status of products derived from gene editing". In it, and based on the explanatory note, they recommended a revision of the GMO Directive, for it to better reflect up-to-date scientific evidence, and a broad dialogue with stakeholders and with the public at large.

[10] 2001/18/EC on the release of genetically modified organisms into the environment.

Commissioner Vytenis Andriukaitis (Health and Food Safety, 2014-2019) at the high-level conference on "Modern Biotechnologies in Agriculture – Paving the way for responsible innovation" in Brussels, Belgium, on 28 September 2017, with the participation of Commissioner Phil Hogan (Agriculture and Rural Development, 2014-2019), and the Estonian Minister of Rural Affairs Tarmo Tamm.

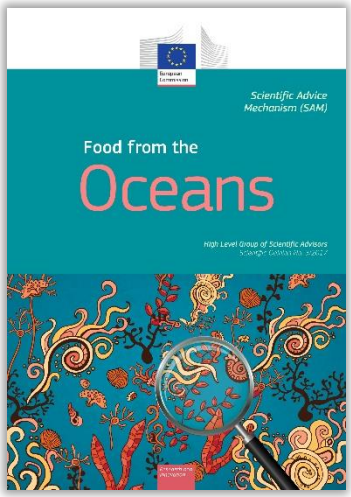
"*If we are to continue to ensure the highest health and food safety standards for our citizens we need an informed public debate among all stakeholders addressing the challenges and opportunities related to innovation in the agro-food sector. The scientific description of the full spectrum of agricultural breeding techniques published by the SAM High Level Group today will contribute to this wider debate and the discussion that I will be initiating later this year.*"[11]

Vytenis Andriukaitis, Commissioner for Health and Food Safety, speaking on receipt of the explanatory note, 28 April 2017.

[11] https://ec.europa.eu/research/index.cfm?pg=newsalert&year=2017&na=na-280417&pk_campaign=policy_newsletter

2.1.4. Food from the Oceans

The scientific opinion



The oceans account for almost half of the planet's biological production, yet provide a relatively small proportion of our food. The challenges related to a growing world population require us to optimise resources, without threatening the preservation of biodiversity.

In order to address these challenges, this opinion answers the question: "How more food and biomass can be obtained from the oceans in a way that does not deprive future generations of their benefits?".

Informed by a SAPEA Evidence Review Report, an overview of the policy context, a scientific expert workshop, ad hoc expert consultations and a stakeholder meeting, this opinion provides a number of evidence-based policy recommendations on increasing the amount of food harvested from the ocean while maintaining healthy marine and coastal ecosystems.

The main recommendations are:

- Mainstream a food from the ocean paradigm of responsible culture and capture into broad EU and global systems, prioritising the food-generating capacity of the ocean in the EU's Integrated Maritime Policy, as well as in EU contributions to UN's 2030 Agenda;
- Develop a comprehensive, concerted policy framework issuing guidance on the inclusion of mariculture requirements in the implementation of the 2014 EU Directive on Marine Spatial Planning, extending technological cooperation to mariculture under sustainable fisheries partnership agreements between the EU and southern partner countries;
- Continue to improve the implementation and enforcement of existing regulations and use of best practice for sustaining wild capture;

- Facilitate policy change by optimal use of the open method of coordination, and initiatives such as the Blue Bioeconomy Forum, to support identification and deployment of best practice, stakeholder dialogue and the acquiring of social license to operate;
- Further develop the Common Fisheries Policy science advice system[12], addressing key knowledge gaps and uncertainties identified in this opinion, and facilitating scientifically motivated pilot fishing of as-yet unexploited lower trophic-level species.

The outcome

This scientific opinion was published as part of preparations for the successor to the present European Maritime and Fisheries Fund and the development of marine policy. It has informed the Commission's proposals for the post-2020 European Maritime and Fisheries Fund (2018/390)[13], the reflection paper 'Towards a Sustainable Europe by 2030',[14] and the progress report on International Ocean Governance (JOIN(2019)4)[15]. Its recommendations were addressed in the EU's revised bio-economy strategy[16].

The opinion was also presented to the EU Council working party[17] on internal and external fisheries policy, and the delegates noted the relevance of many items in the report. It was further discussed at the "EU Aquaculture: Farmed in EU Regions" meeting[18], aiming to raise awareness of the potential of aquaculture, as well as the difficulties and opportunities facing businesses in the sector, among regional and local level decision makers. At the "Europe, the Ocean, and Feeding the World: Seas, Rivers, Islands & Coastal Areas (SEARICA)" intergroup meeting[19] at the European Parliament on 20 March 2018, the

[12] Namely the work of the Scientific, Technical and Economic Committee for Fisheries (STECF)
[13] 'Food security through competitive and sustainable aquaculture' – is one of the four main objectives in the Commission's proposal for the 2021-2027 European Marine and Fisheries Fund which was adopted on 12 June 2018.
[14] https://ec.europa.eu/commission/publications/reflection-paper-towards-sustainable-europe-2030_en
[15] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=JOIN:2019:4:FIN
[16] https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf#view=fit&pagemode=none
[17] EU Council Working Party Internal and External Fisheries Policy, held on 11 January 2018
[18] Held in Brussels on 2 February 2018
[19] Held at the European Parliament, 20 March 2018, Brussels

keynote speeches of the General Assembly highlighted the importance of this opinion in informing debate[20]. This scientific opinion has also informed the Advisors' work leading to the ongoing opinion on Sustainable Food Systems, which develops some of the aspects related to EU and global food systems.

"Europe, the Ocean, and Feeding the World: Seas, Rivers, Islands & Coastal Areas (SEARICA)" intergroup meeting at the European Parliament on 20 March 2018.

"How will we feed the global population without putting intolerable strain on our natural environment? That is why I asked the High-Level Scientists to produce the Food from the Oceans report. The answer lies in farming our seafood. Of course we must continue our work on sustainable wild fisheries, but if we are to get more seafood, it has to come from farming."[21]

Karmenu Vella, Commissioner for Environment, Maritime Affairs and Fisheries, speaking on receipt of the scientific opinion, 2 February 2018

Iain Shepherd, senior expert at the Directorate General for Maritime Affairs and Fisheries was invited to give his feedback on the opinion at the 10th plenary meeting of the Group of Chief Scientific Advisors. He confirmed that the opinion

[20] European Parliament Resolution "Towards a sustainable and competitive European aquaculture sector: current status and future challenges", adopted on 12 June 2018, CONT(2017/2118(INI), cites many of the recommendations of this opinion http://www.europarl.europa.eu/doceo/document/TA-8-2018-0248_EN.html, p.1

[21] https://ec.europa.eu/research/sam/index.cfm?pg=oceanfood

underpins several fisheries and aquaculture related aspects of the EU's revised bio-economy strategy, adopted in October 2018[22], related to its goals to alleviate or eliminate unsustainable practices in the agriculture sector and rural milieu, in particular in relation to biomass for food and feed[23].

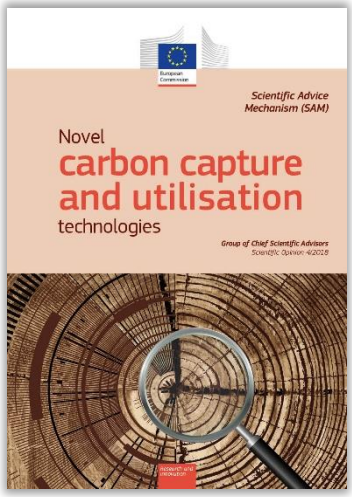
[22] https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf#view=fit&pagemode=none

[23] See minutes of the 10th meeting of the Group: https://ec.europa.eu/research/sam/pdf/meetings/hlg_sam_052017_minutes.pdf#view=fit&pagemode=none

2.1.5. Novel carbon capture and utilisation technologies

The scientific opinion

As the main challenge of the 21st century, the EU is committed to keeping global warming well below 2°C in the framework of the 2015 Paris Climate Agreement. One of the techniques that may mitigate CO_2 emissions is Carbon Capture and Utilisation, CCU.



This opinion answers two questions:

- Under what circumstances can carbon capture and utilisation for fuels, chemicals and materials deliver climate benefits and what is their total climate mitigation potential in the medium and long-term?
- How can the climate mitigation potential of CO_2 incorporated in products such as fuels, chemicals and materials be accounted for, considering that the CO_2 will remain bound for different periods of time and then may be released into the atmosphere?

This scientific opinion provides evidence-based answers informed by a SAPEA Evidence Review Report including literature review and an overview of the policy context, a scientific expert workshop, ad hoc expert consultations and a stakeholder meeting. Its main conclusions are that CCU may play a role in de-fossilising the economy and help to attain the climate change mitigation targets by leaving fossil carbon in the ground, and closing the carbon loop above the ground. The uptake of CCU will depend on the availability of abundant low carbon energy and a favourable legislative and investment environment. Introduction of CCU could start with high-density CO_2 streams from industrial processes and progressively move towards capturing CO_2 from less dense sources.

The opinion makes recommendations to:

- Develop a methodology to calculate the Climate Mitigation Potential of CCU;
- Define eligibility criteria for CCU projects;

- Assess novel CCU technologies taking into account both Technology Readiness Levels, TRLs, and Integration Readiness Levels, IRLs;
- Develop a cross-sectorial and systemic regulatory and investment framework for CCU applications;
- Advocate the methodologies of the Convention on Climate Change, the Kyoto Protocol and the Paris Agreement in international arenas.

The outcome:

This opinion addresses the climate mitigation potential of CCU technologies in view of future policy decisions in this field, including potential financial support from the European Union. The recommendations in the opinion enable the funding of CCU projects through the Innovation Fund (2019/1492)[24] for demonstrating innovative low-carbon technologies.

The opinion was presented to Commissioner Carlos Moedas on 23 May 2018 during the Mission Innovation Ministerial Meeting that took place in Malmö.

"*We are determined to meet our commitments to curb climate change, and for that we have to explore every possible avenue. This scientific opinion provides a*

[24] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM%3AC%282019%291492, p.8; The Innovation Fund is one of the world's largest funding programmes for demonstration of innovative low-carbon technologies. It provides funding for: innovative low-carbon; carbon capture and utilisation; construction and operation of carbon capture and storage; innovative renewable energy generation and energy storage.

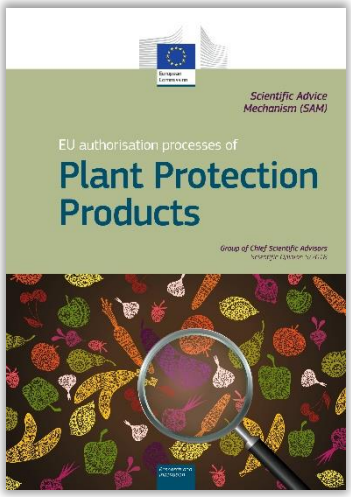
roadmap for specifying how carbon capture and utilisation can be part of this effort."[25]

Miguel Arias Cañete, Commissioner for Climate Action and Energy, speaking on receipt of the scientific opinion, 23 May 2018.

[25] https://ec.europa.eu/info/news/commissions-chief-scientific-advisors-examine-carbon-capture-and-utilisation-2018-may-23_en

2.1.6. EU authorisation processes of Plant Protection Products

The scientific opinion



Plant protection products are important for agriculture, but as is necessary for potentially hazardous substances, their approval requires strict authorisation before introducing them into the market

This opinion answers the question: "Can the current EU dual system for approval and authorisation of plant protection products, PPP, be rendered more effective, efficient and transparent, and if so, how?"

This scientific opinion provides evidence-based policy recommendations on the improvement of current authorisation processes of PPPs and their communication. It is informed by the SAPEA Evidence Review Report, an overview of the policy context, various expert workshops and consultations.

The main recommendations are to:

- Develop a shared, comprehensive and long-term vision for food production in the EU, including the role of plant protection products, while endorsing the EU's efforts to achieve a more sustainable use of pesticides;
- Clarify the protection goals of the EU PPP approval and authorisation system and improve their communication to ensure adequate functioning and to increase public trust;
- Improve the organisation and operation of the EU PPP system to increase transparency, effectiveness and efficiency in scientific assessments;
- Implement systematic post-market vigilance to ensure adequate protection is provided and to increase trust;
- Secure and strengthen scientific knowledge and capacity in risk assessment to enable excellence in protection methods;

- Improve guidance, oversight and transparency of pre-market studies to ensure the availability and quality of data to perform proper assessments;
- Re-examine the treatment of hazards, risks, costs and benefits – to provide reassurance that the system is fit-for–purpose;
- Augment mechanisms to resolve divergent scientific assessments to safeguard public trust in scientific advice

The outcome

This scientific opinion evaluates the current EU system for approval and authorisation of PPPs and provides recommendations for its further improvement. Its recommendations are explicitly referenced in the new Regulation on the transparency and sustainability of the EU risk assessment in the food chain (COM(2018)179[26], 2018/0088(COD)), and taken up in the European Parliament's Special Committee on Pesticides report on EU authorisation procedures for pesticides (2018/2153(INI)[27]. The Regulation on the transparency and sustainability of EU risk assessment was adopted by the Council on 13 June 2019. A day after the publication of the Scientific Opinion "EU authorisation processes of Plant Protection Products", the scientific journal *Nature* discussed the scientific opinion in an Editorial[28]. The opinion is related to the Advisors' earlier (2016) explanatory note on the regulatory assessment of glyphosate used in plant protection products[29].

"I will look closely at these recommendations, which contribute to our Regulatory Fitness examination of Plant Protection Products' legislation. This opinion helps us in our continued efforts to provide the highest standards of protection for human and animal health, and the environment while producing safe, nutritious and affordable food in a sustainable way".[30]

[26] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018PC0179&from=EN, p.2
[27] www.europarl.europa.eu/doceo/document/TA-8-2019-0023_EN.html?redirect, p.5
[28] https://www.nature.com/articles/d41586-018-05327-2
[29] https://ec.europa.eu/research/sam/index.cfm?pg=glyphosate
[30] https://ec.europa.eu/info/news/commissions-chief-scientific-advisors-publish-opinion-eu-authorisation-processes-plant-protection-products-2018-jun-04_en

Vytenis Andriukaitis, Commissioner for Health and Food Safety, speaking on receipt of the scientific opinion, 4 June 2018

Commissioners Moedas and Andriukaitis receiving an update on the progress with the scientific opinion on Authorisation Processes of Plant Protection Products at the 11th meeting of the Group, Brussels, 31 January and 1 February 2018.

Sir Paul Nurse speaking at the European Parliament's special committee on the Union's authorisation procedure for pesticides (PEST), chaired by Eric Andrieu, MEP, European Parliament, 7 June 2018.

Anne Bucher, Director-General for Health and Food Safety, was invited to the 14th plenary meeting of the Group of Chief

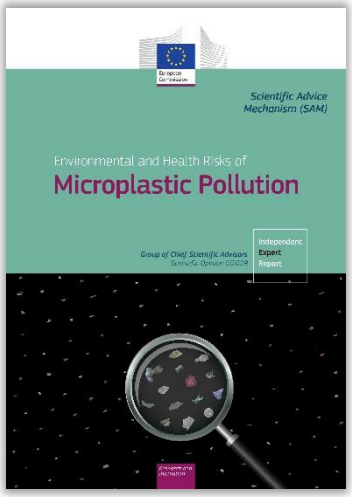
Scientific Advisors. There, she confirmed that the opinion served as a useful summary of complex issues for informing discussions and is feeding into the Regulatory Fitness and Performance, REFIT, evaluation of corresponding PPP legislation (expected 2020) and the General Food Law[31] adopted in June 2019[32].

It is also expected that relevant findings of the REFIT evaluation of PPP legislation will be incorporated in the forthcoming evaluation of the Sustainable Use of Pesticides Directive (SUD)[33] in 2020.

[31] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1381&from=EN
[32]Minutes of the 14th meeting of the Group: https://ec.europa.eu/research/sam/pdf/meetings/hlg_sam_042018_minutes.pdf#view=fit&pagemode=none
[33] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L:2009:309:TOC

2.1.7. Environment and Health Risks of Microplastic Pollution

The scientific opinion



Noting that concern about microplastic pollution and its impact on the environment and human health is increasing among scientists, policy-makers and the general public, the Advisors decided to deliver a scientific opinion on this topic on their own initiative. At present, knowledge of ecological and health risks, and the consequences of microplastic pollution is limited, but a precautionary approach might help mitigate negative impacts.

This opinion addresses the environmental and health risks of microplastic pollution.

This opinion was informed by an analysis of the European policy context, a SAPEA Evidence Review Report, and existing scientific literature on this topic.

The main recommendations are to:

- Broaden policy cover to prevent and reduce microplastic pollution in water, air and soil, and prioritise substance and context-specific measures for high-volume, high-emission sources of pollution;
- Address wider socio-economic and trade-off implications of microplastic pollution policy actions and preventative microplastic pollution measures through socioeconomic cost-benefit analyses considering environmental aspects in the design of these measures;
- Promote global cooperation, high-quality scientific exchange and policy coherence in the measures, as well as in international scientific standards and methodologies for measuring, monitoring and risk assessment.

The outcome

This opinion made recommendations on how the EU, together with other global policy actors, should respond to microplastic pollution based on state-of-the-art scientific knowledge and insights. It has informed a number of debates both within the scientific community and among policy-makers, including roundtable meetings of G7 Chief Scientific Advisors on Scientific Advice cooperation for microplastic pollution in Washington DC in February 2019[34] and in Paris on 15 October 2019, and has strengthened international cooperation between Chief Scientific Advisors. It has also informed the ECHA proposal January 2019 to restrict intentionally added microplastics. This scientific opinion originates in observations made in the Food from the Oceans scientific opinion and was delivered on the Advisors' own initiative.

The handover of the opinion to the Commissioner Moedas, April 2019, took place during the inauguration of a microplastics photographic exhibition in Brussels, in the presence of Commissioner Malmström, Commissioner for Trade (2014-2019). The photographer, Filipa Bessa (shown below), was a member of the SAPEA Expert Working Group that prepared the Evidence Review Report that informs the opinion.

[34] On 13 February 2019, in Washington DC, the Group of Chief Scientific Advisors co-hosted with Canada's Chief Science Advisor and France's G7 Presidency a round-table discussion among Chief Scientific Advisors or their equivalents from G7 members on "What meaningful and robust scientific advice to government is possible on microplastic pollution based on the current scientific evidence base".

"*These recommendations complement work already set in motion by the European Plastics Strategy. They will help us in our continued efforts to provide the highest standards of protection of public health and the environment, through sustainable management of plastics*"[35].

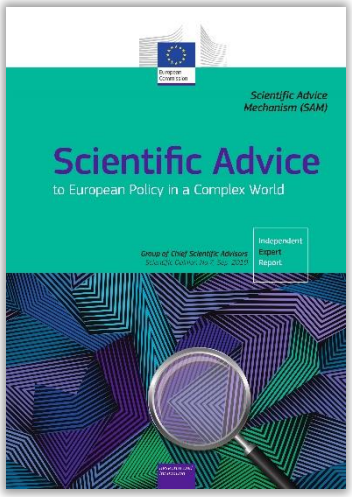
Karmenu Vella, Commissioner for Environment, Maritime Affairs and Fisheries, speaking on receipt of the scientific opinion, 30 April 2018.

On 25 April 2019 in Brussels, the EC's Group of Chief Scientific Advisors held a Stakeholder meeting regarding 'Environmental and Health Risks of Microplastic Pollution'.

[35] https://ec.europa.eu/info/news/european-commissions-chief-scientific-advisors-call-wider-evidence-based-policy-response-pre-empt-growing-risks-microplastic-pollution-2019-apr-30_en

2.1.8. Scientific Advice to European Policy in a Complex World

The scientific opinion



This opinion was developed by the Group of Chief Scientific Advisors, on their own initiative, to provide guidance to the Commission for the provision and use of scientific advice to inform policy-making in the European context. The main question was: "How to provide good science advice to EC policy-makers, based on available evidence, under conditions of scientific complexity and uncertainty?"

The main conclusions of this opinion, which was informed by a SAPEA Evidence Review Report and other contributions, notably from the JRC, focus on how to organise scientific advice for policy-makers, how to address conflicts of interest, how to ensure that the policy advice is relevant and covers all relevant fields, and how to tackle uncertainties and disagreement among scholars. It also addresses communication with stakeholders and the public, and their contribution to the debate. It concludes on the need to codify good science at European level and to streamline existing practices for the delivery of scientific advice.

As this opinion was published only very recently it is too early to discuss outcomes. It is nevertheless of considerable relevance in view of the prominence given to evidence-based policy making in the portfolios of the new Commissioners[36].

[36] Notably two Commissioners sharing responsibility for this process: the Commissioner for Innovation, Research, Culture, Education, Youth and the Vice President for Inter-Institutional Relations and Foresight.

The handover of the opinion to the Commission: Pearl Dykstra and Commissioner Carlos Moedas.

"*I am deeply concerned that the role of scientific advice in policy making is under attack at a time when good scientific evidence is so vital for well-informed policymaking. So I very much welcome this opinion, which also reflects the depth of experience the Chief Scientific Advisors have developed over the last few years.*"[37]

Carlos Moedas Commissioner for Research, Science and Innovation, 25 September 2019

[37] https://ec.europa.eu/info/news/how-can-science-better-support-eu-policymaking-2019-sep-26_en

2.2. Forthcoming scientific advice

This section presents scientific advice under preparation. It gives the policy background and the main question that each of the forthcoming opinions will focus on.

a) Transforming the Future of Ageing

The SAPEA Transforming the Future of Ageing report tackles challenges related to the ageing population that the EU will face in the near future, and the changes that this will require in the EU's health and social systems. The main question is: "*What policies at the EU level could support the Member States in achieving inclusive, fair and sustainable systems of health and social care and promote the take-up of innovation for ageing societies?*". As indicated in the Political Guidelines of President von der Leyen, the Commission aims to promote and design an inclusive, fair and prosperous society. The Group of Chief Scientific Advisors will towards the end of 2019 discuss how elements of the SAPEA report may substantiate the development of these aims in the context of ageing.

b) Towards a sustainable EU food system

Following their earlier work on New Techniques in Agricultural Biotechnology, Food from the Oceans and Authorisation Processes of Plant Protection Products, the Group of Chief Scientific Advisors will explore how food production, distribution and consumption can be made more socially, environmentally and economically sustainable, using social sciences insights. The main question this opinion will address is: "*What are workable paths to deliver an inclusive, 'just' and timely transition to an EU sustainable food system, considering 'co-benefits' for health, the environment, and socio-economic aspects, including the socio-economic situation of the farming sector, and addressing territorial imbalances, the rural-urban divide, food waste as well as responsible consumer behaviour*?"

This forthcoming scientific opinion is highly relevant in the context of the EU's commitment to the UN Sustainable Development Goals, and the new Commission's planned Green Deal and associated "Farm to Fork Strategy" for

sustainable food along the whole value chain[38], and the Sustainable Europe Investment Plan[39].

c) Adaptation to climate change-related health effects in Europe

Scientific evidence demonstrates that the global climate is changing. Emissions have largely contributed to global warming increasing negative effects to human health. This opinion will focus on the impacts of climate change on human health and will propose policy recommendations for adaptation measures at EU level. The main question to be answered is: "*Which adaptation measures could strengthen the resilience of the health sector in Europe in view of climate change?*

The opinion will give special regard to vulnerable groups, regions and the urban environment, considering specifically impacts from vector-borne infectious diseases and heat and heat waves."

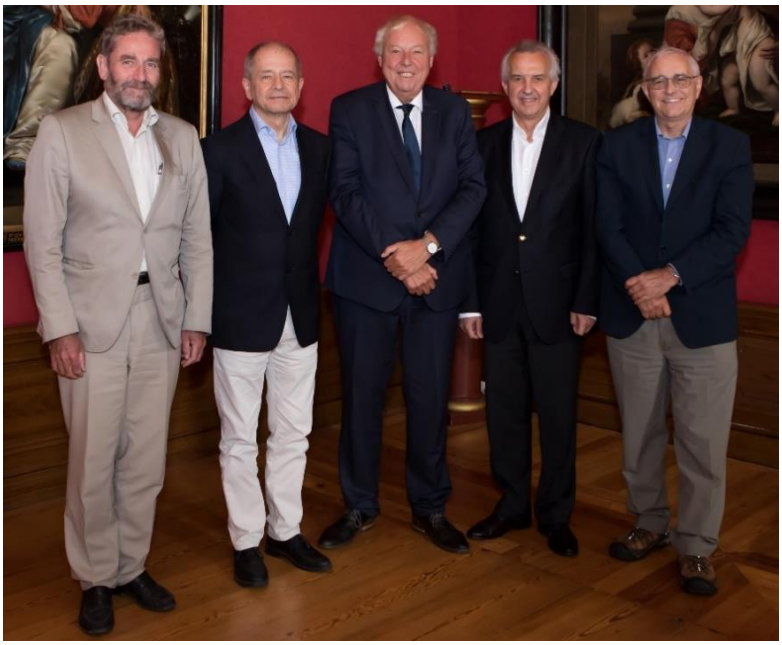
The 'EU Strategy on adaptation to climate change'[40] recognises that the consequences of climate change are a global issue of major relevance for Europe, which has been confirmed by the recent report on its implementation[41]. The opinion on Climate Change and Health will propose valuable input for policy developments and measures within the EU adaptation strategy.

The Group of Chief Scientific Advisors during a pause in their 19th plenary meeting in Brussels, 24-25 September 2019.

[38] https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf, p.7
[39] https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf, p.6; 1 trillion euro foreseen for the next decade.
[40] 'An EU Strategy on adaptation to climate change ', COM (2013)216, https://ec.europa.eu/clima/sites/clima/files/docs/eu_strategy_en.pdf
[41] Report on the implementation of the EU Strategy on adaptation to climate change, COM(2018) 738, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52018DC0738

3. Impact of our work beyond policy

3.1. Co-operation within the Scientific Advice Mechanism



SAPEA Board (in 2019): from left to right: Professors Thierry Courvoisier (EASAC), Antonio Loprieno (ALLEA), Sierd Cloetingh, outgoing Chair of SAPEA Board (Academia Europaea), Reinhard F.Hüttl (Euro-CASE), incoming Chair of SAPEA Board and George Griffin (FEAM). Image © SAPEA.

The Science Advice for Policy by European Academies consortium, SAPEA[42], consists of five European Academy Networks: Academia Europaea, ALLEA, EASAC, Euro-CASE and FEAM. SAPEA brings together the outstanding knowledge and expertise of Fellows from over 100 Academies, Young Academies and Learned Societies in over 40 countries across Europe. Its expertise covers scientific fields from engineering, humanities, medicine, natural and social sciences.

Cooperation between the Chief Scientific Advisors and SAPEA provides timely and relevant scientific input to the Advisors in the form of Evidence Review

[42] https://www.sapea.info/

Reports, which inform the Group's scientific opinions with the latest state-of-the art scientific knowledge on the topic in question. Working with SAPEA within the Scientific Advice Mechanism ensures a plurality of views, and brings an interdisciplinary approach to scoping the questions for which scientific advice is provided. The link with SAPEA also serves to strengthen cooperation between scientific networks. The regular dialogue it fosters between academies and science advisors helps to raise awareness of issues of particular interest for EU policy-making and European citizens.

To date, six SAPEA Evidence Review Reports have been provided to the Group of Chief Scientific Advisors to inform past and ongoing scientific opinions. These are:

- Food from the oceans;
- Novel carbon capture and utilisation technologies: research and climate aspects;
- Improving authorisation processes for plant protection products in Europe – a scientific perspective on the assessment of potential risks to human health;
- A scientific perspective on Microplastics in nature and society;
- Making sense of science for policy under conditions of complexity and uncertainty;
- Transforming the future of ageing.

The Evidence Review Reports outcomes were presented at seven expert workshops organised by SAPEA and European Commission staff dedicated to these topics, as well as at a large number of other debates where they were presented and discussed with the broader scientific community and stakeholders[43].

[43] For example the 'Food from the Oceans seminar' at the Annual Cardiff International Food and Drink Festival, in Cardiff, UK on 14 – 15 July 2017. One scientific and one public seminar were organised jointly by the Academia Europea Bergen Hub and SAPEA to discuss how more food and biomass be obtained from the ocean.

3.2. Cooperation with other scientific advice bodies

Our mandate includes improving the overall interaction between Commission policymaking processes and independent scientific advice. In this context, close cooperation with similar bodies, within and outside the European Commission, and regular debates are productive. Several organisations that bring together advisory bodies at the EU level have provided input at discussions on how to organise scientific advice in the EU, participated in debates and shared their expertise on the opinions developed by the Group. Overall, these debates play a key role in structuring the science advice ecosystem and strengthening further cooperation between the various bodies at national and European level, and in sharing best practice.

Cooperation with other scientific advice bodies aims to improve the process of science advice to policy-makers in the EU and ensure widespread use of evidence-based policy-making. It can help identify the best structure and processes to provide timely, relevant and efficient advice to policy-makers, and to ensure that advisors are always aware of the latest developments in the Member States. Such cooperation has taken place or is ongoing with: the European Parliament's Science and Technology Options Assessment Committee (STOA) and other Parliamentary committees; with the European Science Advisors Forum (ESAF), which brings together science advisors and science advisory structures from European Member States. Likewise, we co-operate with the EU Agencies Network for Scientific Advice, EU-ANSA, which is the network of technical and regulatory agencies providing scientific advice to EU policy-makers and with the International Network for Government Science Advice (INGSA), as well as with Member States and international Chief Scientific Advisors, in particular the Canadian Chief Scientific Advisor, Dr Mona Nemer.

3.2.1. Cooperation with the European Parliament's Science and Technology Options Assessment Panel

The Advisors maintain fruitful collaboration with the European Parliament's Science and Technology Options Assessment Panel, STOA. Its Chair Eva Kaili MEP and the Vice-Chair, Paul Rübig MEP, were invited to the 9th plenary meeting on 5 September 2017. Chair Eva Kaili MEP also attended the 20th plenary meeting of the Group.

From left to right: Elvira Fortunato, Paul Rübig MEP, Deputy Chair Pearl Dykstra, Janusz Bujnicki, Chair Rolf-Dieter Heuer, Commissioner Carlos Moedas, Carina Keskitalo, Günter Stock (ALLEA), Paul Nurse, Eva Kaili MEP and Chair of STOA, and Cédric Villani.

The Advisors were invited to present their scientific opinion on Plant Protection Products to the European Parliament's Special Committee on Pesticides, the opinion being referenced in the PEST committee's final report[44]. Likewise, the Food from the Oceans scientific opinion was presented at the "Europe, the Ocean, and Feeding the World": Seas, Rivers, Islands & Coastal Areas (SEARICA) intergroup meeting[45] at the European Parliament.

Pearl Dykstra at the seminar 'Fact Checking Science - Shaping the Governance of Scientific Advice in the EU', hosted by Julie Girling, MEP on 23 January 2018.

[44] Report on the on the Union's authorisation procedure for pesticides; http://www.europarl.europa.eu/doceo/document/A-8-2018-0475_EN.html, p.2, fn 23
[45] Held at the European Parliament, 20 March 2018, Brussels

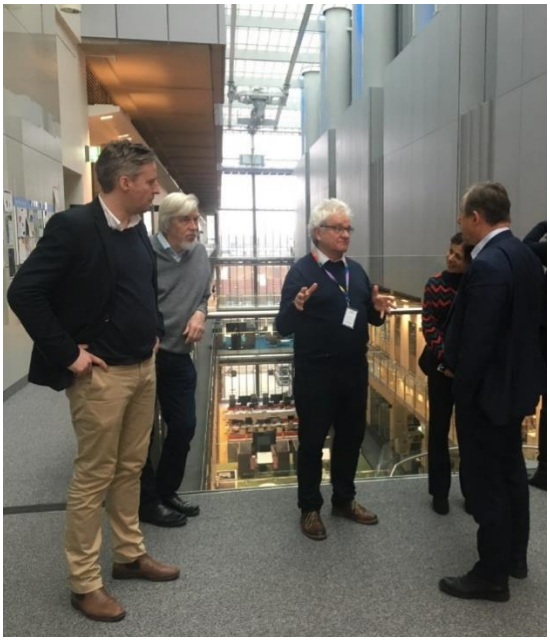
Janusz Bujnicki presenting at the workshop "Genome Editing in Agriculture – Implications for Society" on 2 April 2019, European Parliament, Brussels.

3.2.2. Cooperation with the Joint Research Centre

The Joint Research Centre, JRC, is the European Commission's internal service providing scientific evidence to inform EU policy. Throughout this period, successful cooperation with the JRC has been developed at many levels. JRC experts have shared their expertise during the evidence collection phase of different opinions, and the first two opinions, on Cybersecurity and CO_2 emission measurements, were informed by study visits to the JRC laboratory at Ispra, where the latest technological developments were discussed. The JRC supported the work of the Group with cooperation and close communication between the two services strengthening over the years. Furthermore, JRC reports have tackled some specific aspects related to the scientific opinions, which were then taken up as reference in the final reports. For example, the JRC report on 'Understanding our political nature'[46] informed some parts of the opinion on Scientific Advice to European policy in a Complex World. The Group also maintains cooperation with other advisory bodies such as the Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) at DG SANTE.

[46] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/understanding-our-political-nature-how-put-knowledge-and-reason-heart-political-decision

European Research and Innovation Days session on Science advice, Brussels 26 September 2019. From left to right: Jeremy Bray (Deputy Head of Unit, Chief Scientific Advisors, SAM EGE, DG RTD), Pearl Dykstra, Ortwin Renn (SAPEA), David Mair (Head of Unit, Knowledge for Policy: Concepts and Methods, JRC).



The Group of Chief Scientific Advisors and EC staff touring the Francis Crick Institute, London, during the 16th plenary meeting, 12 – 13 January 2019.

3.2.3. Cooperation with EU ANSA

In the wider context of science advice co-ordination, the EC staff in DG RTD supporting the advisors are part of the EU Agencies Network for Scientific Advice, EU ANSA, and host one network meeting per year in Brussels. The Network is made up of the 13 decentralised EU Agencies that carry out specific legal, technical or scientific tasks within the European Union and provide in-house scientific advice according to the needs of the Commission. Among others, meetings within this network help to coordinate scientific input provided by the agencies and the Group of Chief Scientific Advisors, to promote the scientific opinions, and gather feedback from experts in specific fields. This cooperation also helps the exchange of ideas for the organisation of scientific advice at EU level, and in identifying knowledge gaps that can be addressed by further research.

3.2.4. Cooperation with European Science Advice Forum (ESAF)

The European Science Advice Forum, ESAF, is a Europe-wide network of government science advisors first having met in June 2014, to share know-how and best practice in science advice, as well as to explore issues of common interest. Staff in DG RTD supporting the advisors are associate members of ESAF with the Advisors participating in annual ESAF meetings. Members of ESAF are invited to provide feedback on existing and future opinions, and to participate in stakeholder meetings.

3.2.5. Cooperation with INGSA

Cooperation with the International Network for Government Science Advice, INGSA, allows the Advisors to exchange ideas and best practice on scientific topics and developments, as well as the organisation of science advice to policy makers. European Commission staff supporting the Advisors have facilitated discussion between ESAF and INGSA to explore possibilities for coordination and cooperation between INGSA's European Chapter and ESAF. The Advisors

participated in the two INGSA biannual conferences in 2016 and 2018, facilitating further cooperation.

Pearl Dykstra at the Joint ESAF-INGSA meeting, Dublin, 26-27 June 2019.

Joint ESAF-INGSA meeting, Dublin, 26-27 June 2019.

3.2.6. Specific bilateral co-operation

In addition to their co-operation with Member States' Chief Scientific Advisors or Science Advisory structures in European Union Member States through ESAF, the Advisors invited the Chief Scientific Advisors of the UK – Mark Walport and

Sir Patrick Vallance[47]; Ireland- Professor Mark Ferguson and New Zealand- Sir Peter Gluckman to plenary meetings of the Group. Specific and on-going cooperation has developed with the Canadian Chief Scientific Advisor Mona Nemer who was welcomed to the 13th and 16th plenary meetings in Toulouse and London. Dr Nemer participated in discussions on the topic 'Environmental and Health Risks of Microplastic Pollution' in London and shared her experience in the provision of scientific advice with the Advisors and the European Group on Ethics in Science and New Technologies (EGE) in Toulouse.

Sir Patrick Vallance and Commissioner Moedas at the 18th plenary meeting of the Group on 14-15 May 2019.

The accumulated experience of the Group has also fostered discussion in other EU Member States, such as Spain, Luxembourg, Finland, Norway and Portugal[48], and beyond in Japan, on the development of scientific advice structures.

[47] Mark Walport and Sir Peter Gluckman were invited to the 3rd plenary meeting of the Group on 25 July 2016 in Manchester, Sir Patrick Vallance to the 18th plenary meeting of the Group on 14-15 May 2019 in Brussels.
[48] As acknowledged in the speech of Commissioner Moedas at the INGSA Joint meeting in Dublin, 27 June 2019

Nicole Grobert and Johannes Klumpers (Head of Unit, Chief Scientific Advisors, SAM EGE, DG RTD) and Sabine Pahl (Professor at Plymouth University, UK and Vice-Chair SAPEA Working Group – Microplastics) at the G7 French Presidency roundtable discussion among Chief Scientific Advisors on the issue of global biomonitoring and socio-ecological challenges of microplastics on 15 October 2019, Paris.

3.3. Outreach: impact on debate

The process for the development of our scientific advice includes the review of evidence (including through the organisation of expert workshops and the provision of SAPEA Evidence Review Reports) and the presentation of draft final scientific advice to other representatives of the scientific community, policy-makers and stakeholders. A number of events have been organised in this context, and the members of the Group have participated in many other conferences and workshops to present and discuss the results and recommendations of all the published and ongoing opinions.

Publication of our advice has resulted in a variety of invitations to present our work as well as reports from stakeholders and scientific publications. Though our primary aim remains the provision of advice to the College of European Commissioners, outreach events represent a valuable contribution to fostering further debate with experts, stakeholders and the public. A non-exhaustive list of such events is included in the annex.

Since the publication of our first scientific opinion, there have been 18 publications in peer-reviewed scientific journals and books that directly quoted

our advice. If we take into account references to SAPEA's Evidence Review Reports, the number of publications increases further. See the SAPEA website for a summary of these and other impacts. An illustrative selection of publications is presented in the annex. A more comprehensive summary of such publications will be included in future years' reports.

Annex – Impact on debate: events and scientific articles by scientific opinion

1. Closing the gap between light-duty vehicle real-world CO_2 emissions and laboratory testing

Articles:

- Cubito, C. (2017). A policy-oriented vehicle simulation approach for estimating the CO_2 emissions from Hybrid Light Duty Vehicles (Doctoral dissertation, Ph. D. Thesis, Politecnico di Torino, Torino, Italy)[49]
- Cecilia, J. M., et al.(2018), « High-Throughput Infrastructure for Advanced ITS Services: A Case Study on Air Pollution Monitoring.", IEEE Transactions on Intelligent Transportation Systems, 19(7), 2246-2257[50]

Other reports:

- ICCT briefing note: "The role of standards in reducing CO_2 emissions of passenger cars in the EU"[51]
- JRC technical report: Pavlovic, J.et al. (2017),"Characterisation of real-world CO_2 variability and implications for future policy instruments"[52]

Presentations at conferences/outreach:

There have been two events organised to discuss the Opinion- one with stakeholders and one with the scientific community; additionally, a visit to the JRC laboratory helped gather technical information on the latest developments in CO_2 emission measurement.

[49] https://core.ac.uk/download/pdf/84253270.pdf, ref 1
[50] https://www.researchgate.net/publication/324379443_High-Throughput_Infrastructure_for_Advanced_ITS_Services_A_Case_Study_on_Air_Pollution_Monitoring, ref 3
[51] February 2018: https://theicct.org/sites/default/files/publications/Role_of_EU-CO2_Standard_20180212.pdf, fn12
[52] https://www.researchgate.net/publication/322790448_Characterisation_of_realworld_CO2_variability_and_implications_for_future_policy, fn1

- Stakeholder meeting on CO_2 emissions from light-duty vehicles, held in Brussels 15 September 2016
- Scientific Workshop, held in Lisbon 7-8 June, 2016
- Technical visit to JRC laboratory, Ispra on 4 Mars, 2016

2. Cyber Security in the European Digital Single Market

Articles:

- V. A. F. Almeida, B. Goh and D. Doneda (2017), "A Principles-Based Approach to Govern the IoT Ecosystem," in *IEEE Internet Computing*, vol. 21, no. 4, pp. 78-81[53]
- Kenett, R. S., Zonnenshain, A., Fortuna, G. (2018), "A road map for applied data sciences supporting sustainability in advanced manufacturing: the information quality dimensions", *Procedia Manufacturing*, Volume 21, pp. 141-148[54]
- Domingo-Ferrer, J.et al. (2017), "Canvas White Paper 4 – Technological Challenges in Cybersecurity"[55]

Presentations at conferences/outreach:

There have been two events organised to discuss the Opinion- one with stakeholders and one gathering the scientific community; additionally, a visit to the JRC laboratory helped gather technical information on the latest developments in cybersecurity related to smart grids.

- Stakeholders Meeting on Cybersecurity, held in Brussels, 13 February 2017
- Scientific Workshop on Cybersecurity, held in Vilnius, 25-26 October 2016
- Technical visit to JRC laboratory, Ispra, 4 March, 2016

[53] doi: 10.1109/MIC.2017.2911433; https://www.researchgate.net/publication/318739178_A_Principles-Based_Approach_to_Govern_the_IoT_Ecosystem, fn 5
[54] https://doi.org/10.1016/j.promfg.2018.02.104, http://www.sciencedirect.com/science/article/pii/S2351978918301392, fn 5
[55] https://ssrn.com/abstract=3091942, http://dx.doi.org/10.2139/ssrn.3091942

3. New Techniques in Agricultural Biotechnology

Articles:

- Lassoued R., Smyth S. J., Phillips P., Hesseln H. (2018), "Regulatory Uncertainty Around New Breeding Techniques", *Frontiers in Plant Science* 9, 2018[56]
- Eriksson, D., Chatzopoulou, S. (2018), "Responsible decision-making for plant research and breeding innovations in the European Union", *GM Crops & Food*, 9:1, 39-44[57],
- De Jong, P., Bertolotto, E., De Seze, I. (2018), "From Farm to Fork: the Regulatory Status of Non-GMO Plant Innovations under Current EU Law", *Bio Science Law Review*, Vol.16, 6; p.251-252[58]
- Du Bus de Warnaffe, C. (2018), "Between Innovation and Precaution: Which Treatment for New Plant Breeding Technologies? The European Perspective" *Stanford Law School and the University of Vienna School of Law European Union Law Working Papers,* No. 28[59],
- Friedrichs, S. et al. (2019), "An overview of regulatory approaches to genome editing in agriculture", *Biotechnology Research and Innovation*,[60]

Books:

- Kuntz, M (ed.)(2018), *Transgenic Plants*, Advances in Botanical Research series, Vol 86[61],
- Dürnberger, C., Pfeilmeier, S., Schleissing, S. (2019), *Genome Editing in Agriculture: Between Precaution and Responsibility*, Nomos, Baden-Baden[62],

[56] DOI=10.3389/fpls.2018.01291, https://www.frontiersin.org/articles/10.3389/fpls.2018.01291/full, p.2
[57] DOI: 10.1080/21645698.2017.1388496, p.43
[58] https://www.altius.com/images/Publications/De%20Jong/ARTICLE_-_de_Jong_et_al._-_From_farm_to_fork_BSLR_2018.pdf,
[59] https://www-cdn.law.stanford.edu/wp-content/uploads/2018/03/dubus_eulawwp28.pdf, p.1, 15
[60] https://doi.org/10.1016/j.biori.2019.07.001, in press
[61] https://books.google.be/books?isbn=0128112344, p.285
[62] https://books.google.be/books?isbn=3845296437, p.97, fn 82

- Koporc, Z.(ed) (2019), *Ethics and Integrity in Health and Life Sciences Research*, Emerald Publishing ltd. UK[63],
- Herdegen, M., (2018) *The International Law of Biotechnology: Human Rights, Trade, Patents, Health and the Environment,* Edward Elgar, UK[64],

Presentations at conferences/outreach:

There have been two events organised to discuss the Opinion- one with stakeholders and one gathering the scientific community.

- Stakeholders Meeting- Modern Biotechnologies in Agriculture – paving the way for responsible innovation, held on 28 September 2017 in Brussels
- Scientific Workshop - 'Modern Agriculture Biotechnology Calling', part of the 5th Meeting of the World Congress for Freedom of Scientific Research, held on 12 April 2018 at the European Parliament, Brussels
- Stakeholders Meeting – Science in Society Salon 'Genome Editing in Agriculture – Implications for Society', 2 April, 2019, European Parliament, Brussels

4. Food from the Oceans

Articles:

- Schupp M. F., et al. (2019), Toward a Common Understanding of Ocean Multi-Use, *Frontiers in Marine Science*, Vol.6[65],
- Sheppard, C.(ed) (2019), *World Seas: an Environmental Evaluation* (Second Edition), Chapter 9 - European Protection of Fisheries in the North East Atlantic, Academic Press, pp. 173-182[66]

[63] https://books.emeraldinsight.com/resources/pdfs/chapters/9781787435728-TYPE23-NR2.pdf , p. 101
[64] https://books.google.be/books?isbn=1786435969, p.2, 3, 10
[65] https://www.frontiersin.org/articles/10.3389/fmars.2019.00165/full, p.2
[66] https://doi.org/10.1016/B978-0-12-805052-1.00009-7, p.181

Presentations at conferences/outreach:

There have been two events organised to discuss the Opinion- one with stakeholders and one gathering the scientific community. The opinion was presented and discussed further in numerous workshops organised by Commission services, by the European Parliament, the Committee of regions as well as national fora and exhibitions on the topic.

- 'Food from the Oceans seminar' at the Annual Cardiff International Food and Drink Festival, in Cardiff, UK on 14 - 15 July 2017
- Expert workshop on Food from the Oceans, 14 September 2017 in Brussels
- Stakeholder meeting on Food from the Oceans, 13 November 2017, Brussels
- DG MARE Aquaculture workshop: Good practice and exchange of information on EU aquaculture, held on 5 December 2017
- DG RTD 20th Standing Committee on Agricultural Research (SCAR) - Fish meeting on 12 December 2017
- EU Council Working Party Internal and External Fisheries Policy, held on 11 January 2018
- EU Aquaculture: Farmed in EU Regions Meeting, 2 February 2018, Brussels
- Blue Innovation: Oceans to feed the planet workshop on 27 February 2018, Brussels
- Workshop More Food from the Sea?, held on 14 March 2018 in Hamburg
- "Europe, the Ocean, and Feeding the World": Seas, Rivers, Islands & Coastal Areas (SEARICA) intergroup meeting at the European Parliament, 20 March 2018, Brussels
- "Food from the Oceans, a look into our future", presentation at Seafood Expo Global, held on 25 April 2018, Brussels
- Presentation of the opinion at the AQUA 2018 EU EaTiP Day on 27 August 2018 in Brussels
- Presentation at the Global Ocean Social Sciences (GLOSS) meeting - a UN Ocean Decade Event, on 6 November 2019 in Brest, France

5. Novel carbon capture and utilisation technologies

Articles:

Ghasemzadeh, K., Basile, A., & Iulianelli, A. (2019). "Progress in Modeling of Silica-Based Membranes and Membrane Reactors for Hydrogen Production and Purification", *ChemEngineering*, *3*(1), 2[67]

Presentations at conferences/outreach:

There have been three events organised to discuss the Opinion- two workshops with stakeholders and one expert workshop. The opinion was presented and discussed further at other workshops and presented at academic conferences and fora.

- Presentation at "Eurometaux conference - Immediate challenge, long-term opportunity How can we really enable Europe's low- carbon transition?" held on 19 October 2017 in Brussels
- Scientific expert workshop on the topic Novel carbon capture and utilisation technologies: research and climate aspects on 25 January 2018 in Brussels
- Novel carbon capture and utilisation technologies: research and climate aspects, stakeholder meeting, 20 February 2018, Brussels
- Carbon capture and utilization for climate change: hype or hope? Session at ESOF 2018, held on 11 July, Toulouse
- Stakeholder workshop on Carbon Capture and Utilisation Technologies - Technological status, environmental impacts, and policy developments, held on 17 September 2018, Brussels
- Presentation at "European Biomass Conferences and Exhibition", 27-30 May 2019, Lisbon

[67] p.1 fn 1; https://www.mdpi.com/2305-7084/3/1/2

6. EU authorisation processes of Plant Protection Products

Articles:

- "Europe's top science advisers send clear message on food production" (2018), *Nature,* 558, 6; editorial[68]

Presentations at conferences/outreach:

There have been four events organised to discuss the Opinion- one with stakeholders and three gathering the scientific community. The opinion was presented and discussed at the European Parliament PEST Committee hearing.

- Expert workshop on authorisation processes of PPP in Europe, held on 26 October 2017, Brussels
- Expert meeting on the environmental impacts of PPP, on 19 December 2017, Berlin
- Sounding Board meeting with experts, held on 16 February 2018, Geneva
- Stakeholder meeting on 'Authorisation processes of plant protection products (PPP) in Europe', held on 23 February 2018, Brussels
- Presentation at European Parliament PEST Committee hearing on 7 June 2018, Brussels

7. Environment and Health Risks of Microplastic Pollution

Articles:

- Koelmans, A. et al. (2019), "Microplastics in freshwaters and drinking water: Critical review and assessment of data quality", *Water Research*, 155; pp. 410–422;[69]

[68] doi:10.1038/d41586-018-05327-2, https://www.nature.com/articles/d41586-018-05327-2
[69] doi: 10.1016/j.watres.2019.02.054; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6449537 ; included in the references

- Backhaus, T., Wagner, M., (2018), "Microplastics in the environment: much ado about nothing? A debate", *Global challenges*;[70]

Presentations at conferences/outreach:

There have been three events organised to discuss the Opinion- one workshops with stakeholders and two expert workshops. The opinion was presented and discussed further at academic roundtables and public debates, see list below:

- Scoping workshop with experts on Human Health and Environment Impacts of Micro and Nano Pollution, held on 26 April 2018, in Brussels
- Environmental and Health Impacts of Microplastic Pollution – from scientific evidence to policy advice, expert workshop held on 10-11 January in Brussels
- Roundtable of G7 Chief Scientific Advisors on Scientific Advice cooperation for microplastic pollution at G7 Chief Scientific Advisors meeting, on 13 February 2019, in Washington DC
- Public debate on issues related to micro-plastic pollution at the American Association for the Advancement of Science (AAAS) annual meeting on 15 February 2019 in Washington DC
- Stakeholder meeting regarding 'Environmental and Health Risks of Microplastic Pollution' on 25 April 2019 in Brussels

Other coverage:

2018

"Microplastics: sources, effects and solutions"[71], European Parliament

[70] https://doi.org/10.7287/peerj.preprints.26507v6; ref 29

[71] www.europarl.europa.eu/news/en/headlines/society/20181116STO19217/microplastics-sources-effects-and-solutions

8. Scientific Advice to European Policy in a Complex World

Presentations at conferences/outreach:

There has been one scoping workshop with experts and one consultation meeting with stakeholders to discuss the recommendations of this opinion, as well as a presentation at the session dedicated to science advice at the European R&I Days.

- Scoping workshop with experts held on 4 June 2018 in Brussels
- Consultation Meeting with science advice practitioners and EC policy makers, held on 27 March 2019, Brussels

European R&I Days, Policy session on Scientific Advice to European Policy on 26 September 2019 in Brussels

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This report provides an overview of the work of the Group of Chief Scientific Advisors from their first plenary meeting in January 2016 to their 20th plenary meeting in December 2019. It describes the impact of their seven scientific opinions, two statements and two explanatory notes on European Union policy and legislation. The report also describes the links between the Advisors and other providers of scientific advice within the European Commission, elsewhere in the European Union and globally.

Studies and reports

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