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Contents

Abstract

This report presents an evaluation of the JRC's scientific excellence from 2018 to 2022 by the dedicated Scientific Committee evaluation Panel. The assessment is based on analyses of bibliometric data, complemented with data and insights into the JRC's collaboration with other research organisations, its impact on EU policies, and the tools JRC employs to uphold scientific excellence. The findings are compared with previous reports from 2014-2018 and 2016-2020.

The main findings are:

- The number of JRC publications decreased marginally (1%) as compared to 2016-2020. However, a long-term downward trend is noted for the period 2014–2022 and totalling approximately 13%.
- JRC scientists produce on average 0.73 scholarly articles per year.
- The JRC produced more review papers than in the previous periods.
- JRC scientists are well connected to the scientific community with 82% of its publications co-authored by non-JRC colleagues. The most common countries for cooperation were (in this order) the USA, Germany, the UK, France and China.
- 'Environment and climate change' stood out as the research area where the JRC published the most articles, followed by 'Socio-economics' and 'Agriculture and food security'. Least articles are published within the field of 'Information Society'.
- JRC's publications have been cited on average 2.26 times the global average. This is the same result as in previous evaluations and places the JRC just behind IIASA and on par with Oxford University.
- As for previous reported periods, the JRC performed in the top among comparator research organisations on citation impact, with a share of 3.7% of its articles among the top 1% worldwide most highly cited.
- The share of JRC publications which are published in the top 1% and the top 10% most-cited journals are about 7% and 45% respectively, which is same as measured for 2016-2020, and puts JRC in the mid-range among comparators.
- The JRC upholds its goal of almost 100% open access to articles whose first or corresponding author is from the JRC.
- The JRC compares fairly well in terms of citations in EU policy documents to its comparator organisations. However, the relative EU impact of the JRC, considering its size, is very high compared to that of other organisations.
- The new JRC participation model for Horizon Europe has significantly reduced JRC's involvement in Horizon Europe.
- The JRC is not meeting the goals set out in the JRC 2030 strategy, which aims to allocate 5% of its research activities to exploratory research and 15% to underpinning research.
- The JRC has during the period implemented a robust framework for Scientific Integrity and Research Ethics (SIRE).
- Similar to the previously evaluated periods, the number of patent applications from the JRC is very low, with only 9 applications for the reported period.

The report concludes with a number of recommendations by the Panel on how the JRC can uphold and improve its scientific excellence.

Acknowledgements

The authors are grateful to the JRC Scientific Committee for reviewing the report.

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1. Introduction

As the European Commission's science and knowledge service, the JRC has a responsibility to ensure that its work is of high scientific quality and that it is a reliable partner in developing and translating scientific data into credible and trustworthy evidence for policy development. Scientific excellence for the JRC encompasses not only conducting research of high quality, but also effectively assessing, structuring, and communicating existing knowledge in a clear and understandable manner.

The European Council Decision on Horizon Europe[1] requires the JRC to pursue excellence in research:

> **7.2.4. Scientific Excellence**
>
> The JRC shall pursue excellence and integrity in research and extensive collaboration with top level research institutions worldwide. It will carry out research in emerging fields of science and technology and promote open science and open data as well as knowledge transfer.
>
> Broad Lines
>
> — Exploratory research programmes;
> — Dedicated collaborative and exchange programmes with research institutions and scientists;
> — Access to JRC research infrastructures;
> — Training of scientists and national experts;
> — Open science and open data.

This report presents the results of the 2023 Panel evaluation of the JRC's scientific excellence, conducted in accordance with the guidelines developed by a dedicated JRC working group[2]. The evaluation is based on data from a period of five years, spanning from 2018 to 2022. Comparisons are drawn with the two earlier reports on JRC scientific excellence, developed by

[1] COUNCIL DECISION (EU) 2021/764

[2] G. Lövestam, et.al., JRC Excellence in Science for Policy - Report by the Working Group on Scientific Excellence Ares (2020)1121264

previous panels, which covered the periods of 2014-2018[3] and 2016-2020[4], respectively. To ensure consistency in analysis, the three reports consider similar metrics and reviews, including a bibliometric study analysing JRC performance[5], in comparison to a set of comparator research organisations (see list in Annex), and an analysis of the instruments employed by the JRC to uphold scientific excellence. In addition, this report presents the results of a pilot study on defining an indicator for the impact of JRC's research on EU policy[6].

The report presents the key findings from these analyses. Based on its findings, the Panel draws conclusions and recommendations, identifying areas where the JRC has performed well and highlighting areas where further efforts may be required to maintain or enhance scientific excellence.

[3] K. Jonkers, et.al., JRC Excellence in Science for Policy - Report by the 2019 Evaluation Panel, Ares(2024)224716.

[4] G. Lövestam, et.al., JRC Scientific Excellence 2016-2020 - Report by the 2021 Evaluation Panel, Ares(2024)224774.

[5] The bibliometric data reported herein is from J. Costa Dantas Faria, M.A. Hristova, and S. Lehto, Bibliometric analysis of JRCs research performance using Scopus-Scival tools 2018-2022, European Commission, 2024, JRC136476

[6] K. Jonkers et.al., Quantitative "science for policy" evaluation: are Science for Policy Organisations operating in Pasteur's Science for Policy Quadrant?, https://publications.jrc.ec.europa.eu/repository/handle/JRC136756

2. Bibliometric study

2.1 TRENDS IN PUBLICATIONS

JRC researchers published 5468 scholarly peer-reviewed articles between 2018 and 2022[7], as shown in Figure 1. This represents a 1% decrease compared to the period of 2016-2020. Overall, there has been a long-term downward trend of about 13% over the nine-year period covering the three reported periods, i.e. 2014-2022.

FIGURE 1. **Number of JRC peer-reviewed publications in the period 2018-2022.**

TYPE OF PUBLICATION	TOTAL PUBLICATIONS		TREND 2018-2022
Overall	5468		
Article	4034	74%	
Conference paper	561	10%	
Review	352	6%	
Chapter	227	4%	
Other	294	5%	

'Other' includes for example editorials, *letters*, notes, errata and data papers.
Data and categorisation is according to Scopus.

While the total number of staff at JRC remained stable at around 2740, the number of JRC staff engaged in research[8], i.e. the staff who would be assumed to have the potential to author

[7] From Scopus database by Elsevier.

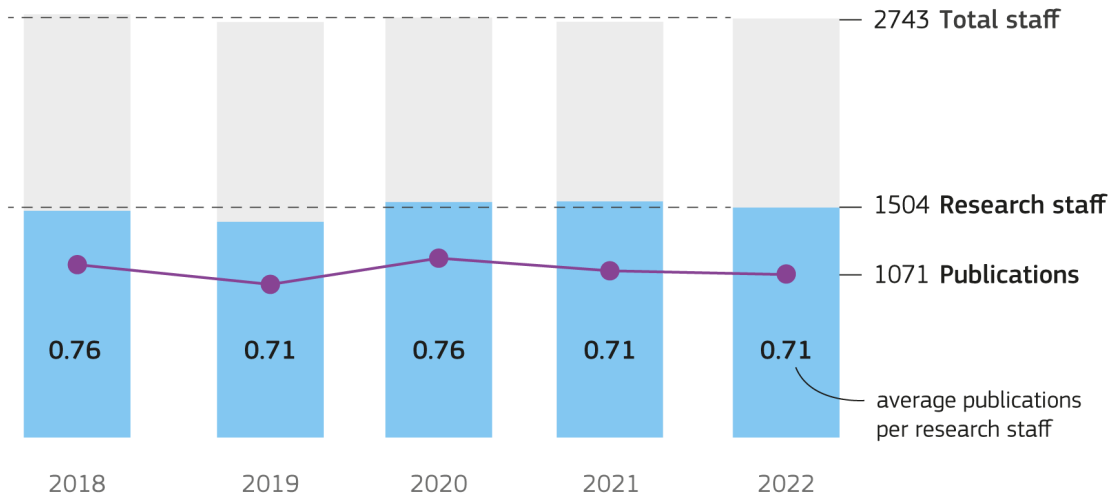
[8] JRC Administrators (AD) and Contractual Agents (CA) category VI, engaged in research.

scholarly papers, varied between 1411 in 2019 to 1544 in 2021[9], see Figure 2. This corresponds to an average annual production rate of 0.73 scholarly articles per research staff member.

JRC also houses a significant number of external staff working on JRC sites under contracts[10], with a noticeable increase during the period, from 555 individuals in 2016[11] to 915 in January 2023[12]. Such contracted personnel shall in principle be engaged for additional support for IT and data services. Yet, the abrupt increase can partly be attributed to the disappearance of grant holder contracts[13] and the lack of flexibility in the recruitment of JRC Contractual Agents (temporary staff).

It is not known to what extent, if any, this may affect the JRC's excellence in research, but it may skew the bibliometric data since such contracted staff cannot use the JRC as their affiliation on scholarly papers. As a result, the JRC's contribution may appear smaller than it is, particularly if contracted staff are solely listed on articles and no JRC staff appear as co-authors, in which case the JRC and its contribution is invisible on the papers.

FIGURE 2. **JRC total staff and AD-equivalent research staff numbers[14], and JRC peer-reviewed publication data from SciVal (May 2023), for the period 2018-2022.**



[9] During 2018-2022, a total of 2118 JRC affiliated scientists (co-)authored at least one publication. This figure corresponds to the number of registered unique names of authors and co-authors during the five-year period in the JRC Pubsy register. Thus, the figure does not correspond to the number of active JRC researchers at any one moment because a considerable number of researchers, especially those on temporary contracts, are replaced over a five-year period.

[10] Also named "intra/extra muros".

[11] Data for 2018 not available at the time of writing.

[12] Data from Sysper, ref. David Anderson.

[13] JRC Grant Holder 30 contracts.

[14] Data from J. Schwarz, J. Costa Dantas Faria and S. Lehto, JRC Productivity and Impact Evaluation Report - PRIME 2022, Ares(2023)6015741 - 15/09/2023

2.2 INTERNATIONAL COLLABORATION

Of the JRC articles authored during the period, 10% were co-authored with colleagues from other Commission services, and 82% were co-authored with non-JRC colleagues. As for the period 2016-2020, about 30% of the articles were co-authored with colleagues from outside the European Research Area (ERA) and the UK[15].

JRC scientists collaborated on articles with colleagues from more than 3200 organisations in 134 countries, including all EU Member States. The majority of these organisations were in the US (471), Germany (255), UK (217), France (198), and China (176). Over 40% of the organisations were located in the EU and the UK. The most common partners for JRC scientists were researchers from CNRS (8% of total JRC articles), CEA (5%), and University Paris-Saclay (4%), all based in France. CNR (4%) in Italy and CSIC (4%) in Spain also had significant collaboration with JRC scientists. All these organisations are large, with tens of thousands of employees, and are engaged in conducting research in various scientific fields and research networks, including those in which also the JRC is active. Consequently, the data covers not only bilateral partnerships but also participation in diverse research networks, where a greater presence of larger organisations and countries is expected.

Within EU, JRC scientists collaborated with scientists from all Member States during the period, however at varying rates. Finland, Netherlands, Luxembourg, France, and Denmark had the highest rates, with 54 to 64 co-authored articles per million population, while Latvia, Romania, Bulgaria, Poland, and Lithuania had the lowest rates, with 7 to 10 JRC co-authored articles per million population.

When adjusted for the overall scientific article production of the respective EU Member State, France was the most overrepresented, with a factor of 2.1 in co-authorship with JRC scientists, followed by Greece, Spain, and Italy, which were all overrepresented with a factor of about 1.2. On the other hand, Latvia, Lithuania, Cyprus, Poland, and Slovakia were the most underrepresented, by a factor of 0.4 or less. It is interesting to note that Denmark and Sweden, which both performed in the absolute top among EU countries in terms of the number of published scientific articles per million population, also were both considerably underrepresented, by a factor of about 0.6.[16]

These figures demonstrate that JRC scientists collaborate extensively with the international scientific community, also as research leaders. Around 45% of the articles written in collaboration with colleagues from other institutions had a JRC scientist as the first or corresponding author.

[15] The United Kingdom left the European Union and the ERA on 31 January 2020, thus in the middle of the reported period.

[16] A more detailed JRC study is under preparation on diversity in publications, including on co-authorship with research institutions and universities in different Member States.

2.3 CATEGORIES OF ARTICLES

Out of the total number of publications, 10% were conference proceedings. This is a decrease compared to the periods of 2014-2018 (15%) and 2016-2020 (13%), particularly in the years 2021 and 2022. This may be explained by reduced physical participation in conferences due to Covid restrictions. In addition, Covid restrictions made remote participation in conferences more common, which usually does not impose any requirements from the JRC hierarchy for JRC researchers to contribute a presentation, as is often the case with physical participation. When compared to other institutions, JRC's percentage of conference papers is higher than Oxbridge universities and the MPG (7-9%), but lower than RTOs[17] like FhG, VTT, TNO, AIT, and NIST (25-45%). This difference may be because of varying conference participation policies among the organisations, as well as differences in specialisation fields and type of research. The extent to which conference proceedings are listed in the Scopus database, from where the data has been retrieved, varies depending on the research area.

In contrast to conference papers, there seems to be a gradual increase in the proportion of review articles. The percentage has risen from 5% in 2014-2018 to 6% for 2016-2020 and 7% in the reported period. Review articles provide comprehensive overviews of the current state of knowledge on specific topics, written by experts in those fields, and are considered as a suitable output for a research institution focused on science for policy, such as the JRC, especially because the JRC serves as the knowledge management organisation of the European Commission. The JRC's share of review articles is similar to that of CNRS and MPG, lower than Oxbridge universities (which have a share around 7-10%), and higher than RTOs (2-4%).

2.4 TRENDS IN RESEARCH FIELDS

Figure 3 illustrates the distribution of JRC publications across different research areas for the three reported periods. The publication data has been organised[18] according to the JRC's research structure, which is also used throughout this report as well as in previous reports. It should be noted that a single publication can be associated with multiple scientific fields, so the bars in Figure 3 provide an indication of the level of JRC involvement in each research field, and not the precise number of publications.

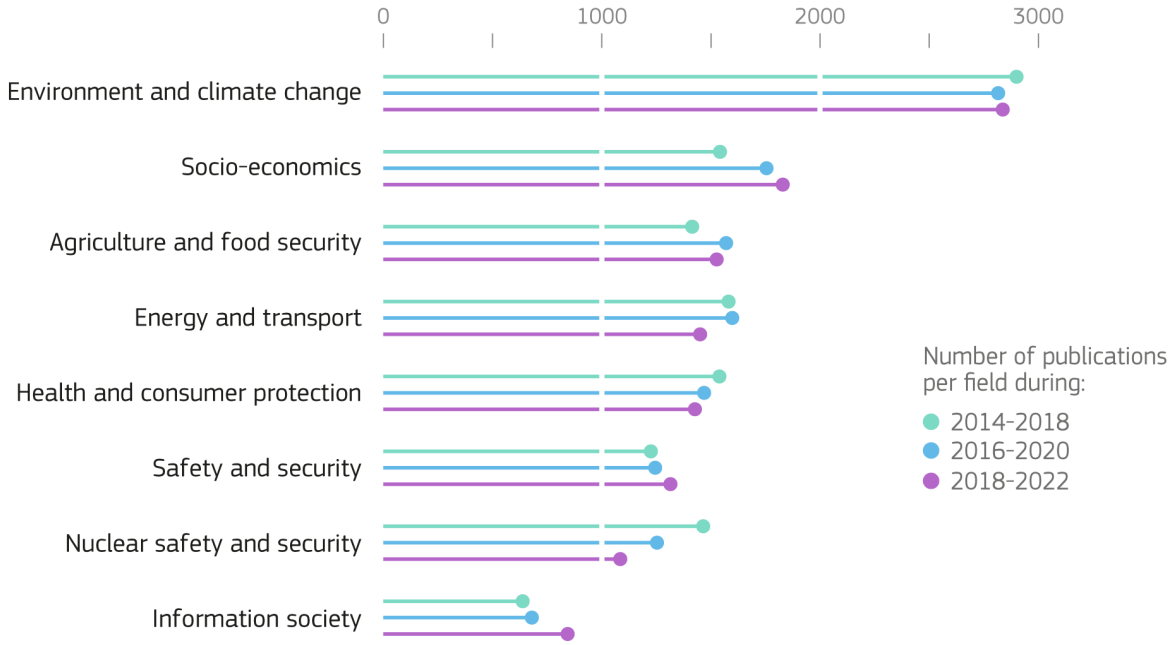
Throughout all periods, the JRC's research in the field of *Environment and climate* has consistently generated the highest number of publications. Across the three periods, the other research fields have also remained relatively stable. However, there is an observed increasing trend in publications related to *Socio-economics*, *Safety and security*, and *Information society*. On the other hand, there are decreasing trends in publications related to *Health and consumer protection*, and a more significant decrease in *Nuclear safety and security*, with a 25% decline

[17] RTO refers to Research Technology Organisations.

[18] This grouping is made on the basis of Scopus' All Science Journal Classification (ASJC) System. The ASJC classifies journals and conference proceedings under four broad subject areas which are further divided into subfields. The approach results in possible double counting both within and between JRC fields since a single publication can be attributed to several research areas.

over the three periods. The latter reflects the JRC staff reduction in the nuclear sector by approximately 20% within the last years.

FIGURE 3. **Number of JRC publications during 2014-2018, 2016-2020 and 2018-2022 attributed to respective JRC scientific fields.**



Since a single publication can be attributed to several research areas, the numbers are only indicative. For the same reason, the totals sums exceeds the total number of JRC publications for any period.

It should be noted that some JRC research is classified as sensitive, restricted or confidential and cannot be published. Thus, particularly in the area of (Nuclear) Safety and Security the share of JRC research activity is underestimated in Figure 3.

2.5 COLLABORATION WITH INDUSTRY

Collaborating with industry in research does not directly indicate scientific excellence, but it can be a valuable indicator of JRC research related to innovation. Between 2018 and 2022, the JRC co-authored approximately 7% of its publications with industry partners. This percentage remains the same as the period from 2016 to 2020, but slightly lower than the 9% recorded from 2014 to 2018. With respect to the comparator organisations used for this study, the level of collaboration is in the middle range and comparable to institutions such as NIST, RIKEN, FhG, and CEA. JRC had most co-authored publications with Électricité de France, BASF, and Procter and Gamble, each accounting for approximately 0.5% of the total number of articles.

Similar to the previous periods, the number of patent applications from the JRC is very low, with only 9 applications recorded for the reported period (12 for 2016-2020). The JRC currently lacks a clear strategy for whether patent applications should be encouraged and thus also effective means to encourage patent applications. Nonetheless, the JRC has established services and procedures to support staff who wish to apply for patents.

2.6 CITATION IMPACT ANALYSIS

Using research-field weighted citation impact (FWCI)[19], JRC publications have been cited on average 2.26 times the global average. This places JRC just behind IIASA and on par with Oxford University. The citation rate is slightly lower than during the period from 2014-2018 (2.34), but similar to the rate for 2016-2020 (2.27). The JRC maintains its top position among the comparators, as all comparators except the Chinese Academy of Sciences experienced a slight decrease between the two last periods.

A significant proportion of JRC-authored publications are among the most cited in the world. As shown in Figure 4 (research-field weighted data), 3.7% of JRC publications from 2018-2022 are among the top 1% most cited globally, and almost 25% are among the top 10%. These figures are approximately the same as those reported for the 2016-2020 period. It appears that JRC is maintaining its top position among the comparators, alongside institutions like ANL and MPG, surpassing most of the national research organisations such as TNO, NIST, and CNRS. These results suggest that despite, or perhaps partially as a consequence of, a slow, long-term decline in the JRC publication rate since 2014, the JRC is maintaining and even slightly improving the quality and impact of its publications.

It should be noted that a significant portion of JRC research has both a scientific impact and societal and policy implications. This combination often leads to a high number of citations[20]. Furthermore, JRC researchers do not face the same pressure to apply for research funding as their academic colleagues. Although the lack of possibility to raise external resources means that developing and maintaining a research group can be challenging for JRC researchers, the result is likely to be more focus on the quality of publications than on quantity. Furthermore, JRC publications are frequently co-authored with international partners and are predominantly published as open access. These factors are also known to increase the impact and visibility of publications.

Figure 4 also demonstrates that the JRC performs well compared to prestigious universities like Oxford and Cambridge, a finding also noted in the previous reports. However, it should be recognised that the figures are not directly comparable as research conducted at universities often has a different nature. While the JRC primarily focuses on applied research and research in support of policies, universities tend to prioritise fundamental research of academic character. Nevertheless, some of the other comparator institutions, such as NIST, IIASA, and NPL, share to some degree research profiles with the JRC. In comparison to these institutions, the JRC performs very well, as also highlighted in previous reports.

[19] Research-Field Weighted Citation Impact (FWCI) is the ratio of the total citations actually received by the denominator output and the total citations expected based on the average of the subject field. A FWCI of greater than 1.00 indicates that the publications have been cited more than would be expected based on the world average for similar publications.

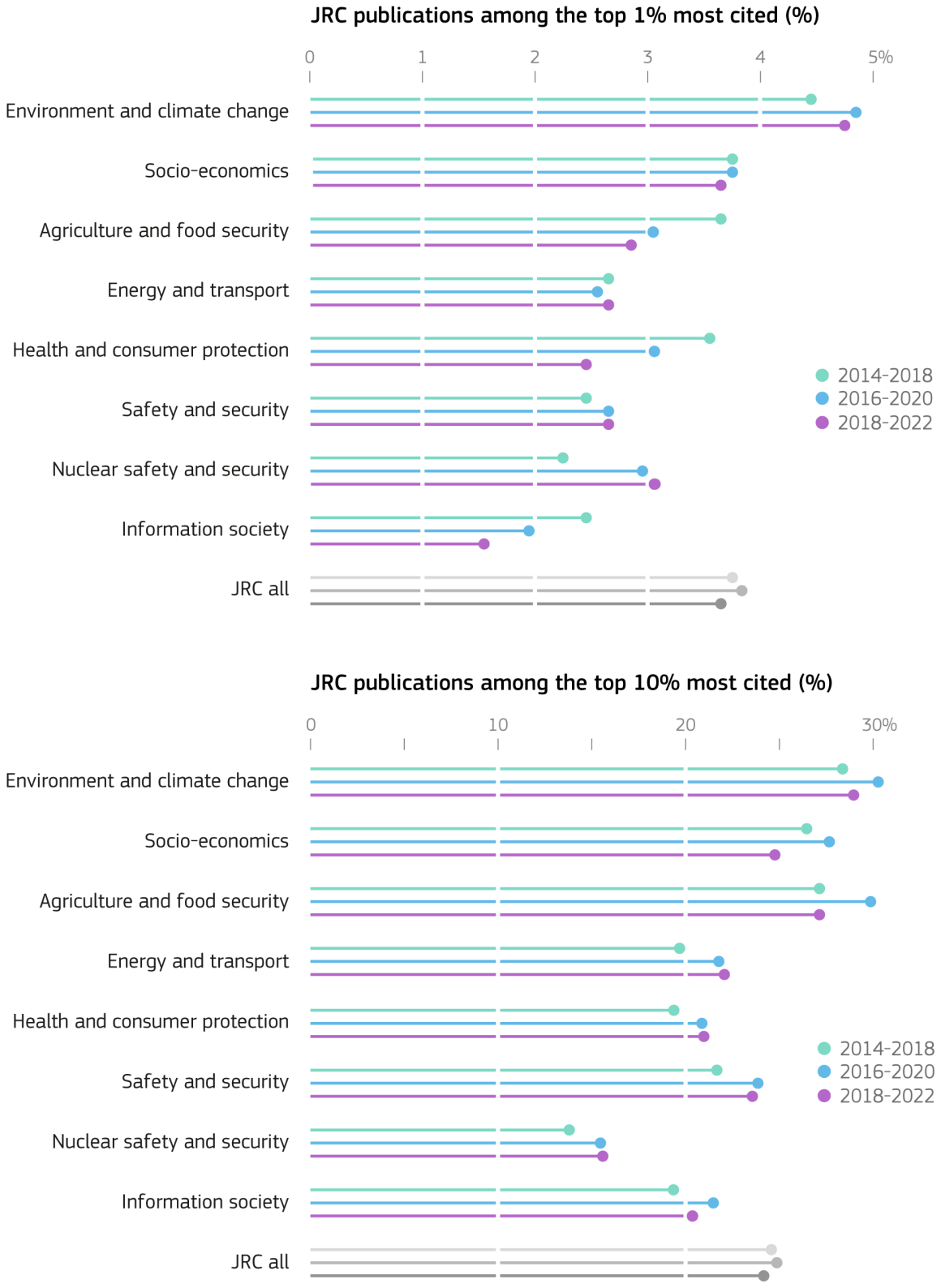
[20] Stokes, Donald E. (1997). Pasteur's Quadrant – Basic Science and Technological Innovation. Brookings Institution Press. pp. 196. ISBN 9780815781776.

FIGURE 4. **Share of top 1% and top 10% most-cited publications during 2018-2022 by the JRC and selected comparator organisations (research-field weighted data).**

Figure 5 demonstrates the JRC's research impact across its various research fields (research-field weighted data). It is evident that JRC publications exceed the global average for all research areas. JRC has shown significant improvement in the top 1% most cited publications in Nuclear Safety and Security, while performing worse in the areas of Agriculture and Food Security, Health and Consumer Protection and Information Society, the latter research field with a relative low value. Particularly noteworthy is the field of Environment and Climate Change, which stands out significantly for both the 1% and 10% most cited publications, with results far

exceeding the global average. Additionally, Agriculture and Food Security and Socio-economics perform well for the top 10% most cited papers.

FIGURE 5. **Percentage of JRC publications among the top 1% (upper) and top 10% (lower) most-cited publications by JRC research field for the three evaluated periods (research-field weighted data).**



The share of JRC publications which are published in the top 1% and the top 10% most-cited journals are about 7% and 45% respectively. This is on par with data measured for 2016-2020. JRC is still in the mid-range as compared to the comparator institutions. Encouraging JRC scientists to publish in high impact journals was one of the recommendations in both the 2014-2018 and the 2016-2020 reports.[21]

In the period of 2018-2022, about 12% of JRC publications received zero citations, which is the same percentage as in the previous period of 2016-2020. This finding reinforces the acknowledgment of JRC publications, as mentioned earlier, and positions the JRC in third place for the least number of zero-cited publications among the comparisons, closely trailing CSIRO. It is important to acknowledge that this figure carries some uncertainty due to the varying time it takes for a publication to accumulate citations, which also depends on the research field. Nevertheless, when considering only the year 2018, which should be less influenced by variations by research field, the JRC achieves a fourth-place ranking among the comparators with only about 7% of the publication non-cited.

2.7 OTHER IMPACT ANALYSIS OF THE JRC

During the reported period, JRC was recognised as one of the top 27 research organisations worldwide by REPEC[22], the largest repository for economic research, which considers citations to journal articles and reports. However, the REPEC model is limited to economics research and cannot be applied to the entire JRC.

The JRC had in 2020 two scientists listed on the Reuters list of the world's 1000 top climate scientists.

[21] Recent recommendations discourage research evaluators from evaluating researchers and research organisations on the basis of journal based metrics, see e.g. the Agreement on Reforming Research Assessment, https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/agreement-reforming-research-assessment-now-open-signature-2022-10-03_en . Nevertheless, this information can provide partial explanation for differences in article level citation impact.

[22] RePEc (Research Papers in Economics), http://repec.org/

3. JRC participation in Horizon 2020 and Horizon Europe

Starting in 2021 with the Horizon Europe Framework Programme (FP9), the JRC's method of participation in Indirect Actions has changed. Under the new rules, the JRC is excluded from participating in forming consortia and in the bidding process. However, the JRC may express interest in joining the scientific advisory board of a project if selected. Once the project selection process is complete, the JRC can join successful proposals and negotiate its participation as a research partner. This may involve either acting as a beneficiary, requesting zero funding while taking full responsibility for implementing the project, or as an associated partner participating in the action without signing the grant agreement. In both cases, the JRC is responsible for covering all costs related to its participation in the projects, including staff costs, mission costs, and other expenditures.

The initial three years of the implementation of FP9 have revealed a decrease in the JRC's participation. This decline is evidenced by the decrease in the number of projects, from 365 projects over 7 years (equivalent to 52 projects per year) for FP7, and 140 projects over 7 years (20 projects per year) for FP8 (Horizon 2020), to 43 projects over 3 years (2021-2023) for FP9 (14 projects per year). Further analysis is necessary to investigate whether this reduction in participation has impeded the JRC's involvement with the European research community and if the transition to other forms of collaboration has had negative effects on the JRC's capacity to conduct excellent or policy-relevant research. There are legitimate concerns that in the long term, this new participation model will have adverse consequences for the research environment and scientific excellence at the JRC.

Thus, it is crucial to monitor whether this negative trend continues throughout the remaining years of Horizon Europe (2021–2027). It is essential for the JRC to collaborate with research organisations across Europe, as well as with international, national, and regional experts and stakeholders. The recently completed interim evaluation of the activities of the JRC under Horizon Europe and Euratom 2021-2025[23] recommends that the JRC intensifies cooperation with institutions in the EU Member States and facilitates interaction between Euratom and Horizon Europe-financed activities. Strengthening and enhancing the JRC's involvement in Horizon Europe and Euratom remains a critical way to participate and contribute to cutting-edge and policy-relevant research in Europe. Active and continuous participation in the programme fosters a thriving research environment and scientific excellence at the JRC in the long term, while ensuring high-quality scientific output and visibility to external research communities and Member States.

[23] https://publications.jrc.ec.europa.eu/repository/handle/JRC134811

3.1 MARIE SKŁODOWSKA-CURIE ACTIONS

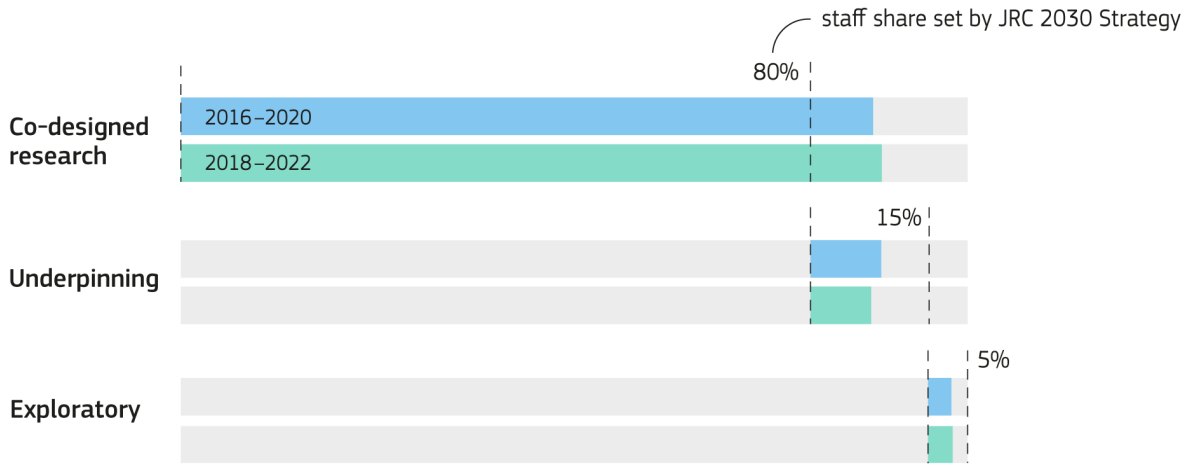
The full engagement of the JRC in the Marie Skłodowska-Curie Actions (MSCA) would enhance the JRC's scientific excellence. Presently, the JRC serves as a secondment location, where other entities can host an MSCA fellow, who can then visit the JRC under the unpaid visiting scientist scheme. However, this level of involvement with the fellows falls short of actual hosting, which was previously a valuable opportunity for the JRC, particularly in fostering connections with early-career researchers. Changes introduced with the Horizon Europe Programme have hindered the JRC from securing funding to support these researchers, resulting in a lack of MSCA fellows. Nevertheless, the JRC's eligibility for full participation in MSCA indirect actions remains justified. JRC does not influence the non-specific, broad-spectrum scientific calls for proposals, and the funding is dedicated to PhD and postdoctoral fellowships. To address this, it is recommended to explore options for JRC to host and receive funds for MSCA research fellows.

4. JRC instruments for upholding scientific excellence

4.1 EXPLORATORY RESEARCH

The JRC's research priorities are outlined in the JRC 2030 Strategy, which aligns with its role as a science-for-policy service. In agreement with the JRC Board of Governors, the Strategy aims for 80% of projects to be developed in collaboration with policy DGs, 15% to "underpinning research", and 5% to focus on exploratory research. Co-designed research involves collaborating with policy writers on policy support activities. Underpinning research focuses on new emerging areas that the JRC believes will be important for future policy. Exploratory research includes ground-breaking, blue-sky research without any necessary connection to the JRC work programme. Figure 6 illustrates that during the reported period, 89% of staff (FTE) were allocated to co-designed research, 7.7% to underpinning research, and 3.1% to exploratory research.

FIGURE 6. **Share of JRC staff allocated to co-designed, underpinning and exploratory research.**



The amount of underpinning research falls significantly below the 15% target and should be raised. Underpinning research is a crucial component of JRC's research portfolios as it bridges the gap between current in-house knowledge and knowledge identified to be required for the future. Therefore, greater emphasis should be placed on identifying JRC needs for underpinning research in different research areas. This effort could be supported by a dedicated mechanism, including the management teams of the JRC research portfolios, in conjunction with the JRC foresight studies and the exploratory research program.

Exploratory research includes in JRC the Exploratory Research Programme (ERP), the Collaborative Doctoral Partnership (CDP), and the Centre for Advanced Studies (CAS). These programs serve different purposes, fulfilling requirements set out in the Council Decision on Horizon Europe (see Introduction), and collectively contribute to invigorating the JRC's scientific

activities by introducing new, cutting-edge research. The Exploratory Research Programme (ERP) aims to engage 40 full-time employees at any given time, while the CDP initially targeted 100 PhD students in a flexible, shared arrangement with host universities, equating to hosting approximately 50 PhD students at the JRC. Although there is no exact projection for the Centre for Advanced Studies (CAS) programme, it is reasonable to assume that around 20 full-time employees should be engaged with a fully implemented programme. These efforts would together approximately meet the 5% target for exploratory research outlined in the JRC 2030 Strategy, as concluded in previous reports. However, in 2019 and 2021-2022, resources for exploratory research were temporarily redirected to address other resource gaps at the JRC, significantly reducing the exploratory research activities. It is crucial to restore the initial resources to sustain these programs.

The ERP aims to promote a bottom-up approach to exploratory research, with ideas originating from JRC scientists, while the CAS was created to facilitate a top-down approach where JRC Management identifies research topics to address specific JRC research gaps and inject new research competencies into the JRC. The Exploratory Research Programme (ERP) has been highly successful, with a total of 283 project applications submitted between 2014 and 2022, of which 107 (35%) were approved following evaluations by the JRC Scientific Committee, resulting in a wealth of internationally recognised high-quality research.

The approach of the CAS differs somewhat, as it assumes that researchers with a high level of expertise, such as university professors, would be recruited to the JRC on short-term contracts. However, this has proven to be challenging, and the program requires a revision. As an alternative to temporarily employing external specialists to introduce new knowledge and research to the JRC, the JRC could consider a more flexible approach, including sending JRC researchers to other scientific institutions, e.g. universities, to learn about novel specific research.

The CDP aims to invigorate JRC research and establish networks with EU academies, allowing the JRC to engage in cutting-edge academic research within the EU and contribute to the training of scientists and national experts. However, due to recent budget cuts in exploratory research, the program fell short of its initial goal to involve a higher number of PhD students. By the end of 2022, only 27 PhD students were participating in the program at JRC, which is significantly lower than the initial target of 50 students. It is also worth noting that this is comparable to the number of PhD students (approximately 25) present at the JRC before the program was introduced in 2017. It is important to acknowledge that the administratively burdensome arrangements for the CDP, which involve contracting Member State universities, cannot be justified with such low engagement levels. Therefore, the resources should be reinstated to their initial level, or the program should be reviewed in full.

4.2 VISITING RESEARCHER PROGRAMME

In 2018, the JRC introduced the Visiting Researcher Program, which serves as a "scientific sabbatical" for JRC researchers. The program's objective is to allow JRC scientific and technical staff to join an external research team at a university or independent institute for a dedicated

period of typically three months, focusing on specific aspects of their research. Similar to sabbatical leave programs commonly available at universities, the goal is to provide JRC scientists and technicians with an opportunity to grow professionally and personally, and to build networks while conducting top-quality research that delivers important benefits and knowledge to the Commission.

The Visiting Researcher Programme was paused in 2020 due to the Covid pandemic but was never resumed after the travel restrictions were lifted. JRC management should provide clarification on whether the program will be continued.

4.3 SCIENTIFIC INTEGRITY AND RESEARCH ETHICS

To achieve scientific excellence, it is essential to conduct research with integrity and adhere to high standards of research ethics. In 2020, the JRC implemented the Framework for Scientific Integrity and Research Ethics (SIRE) to ensure compliance with the JRC Scientific Integrity Statement. This framework demonstrates the JRC's commitment to upholding scientific integrity, which not only fosters trust but also helps manage risks within and outside of the scientific community. The SIRE Framework includes various components such as a Scientific Integrity Counsellor, the JRC Editorial Review Board, the JRC Research Ethics Board, and guidelines, information, and training on responsible research conduct. This framework is integrated into the JRC Integrated Management System and the Commission’s Internal Control Framework as part of the JRC Anti-Fraud Strategy, aiming to establish a control environment with standards of conduct, processes, and structures to ensure integrity and ethical values in JRC’s research practices. The SIRE needs to be continuously monitored and updated, not only on scientific integrity as it relates to the research process, but also on managing, communicating, and implementing research results in the policy process.

From 2018 to 2022, the JRC has revised the JRC Code of Practice for Research Fellows (RF-CoP) and developed a career development package for effective talent management. RF-CoP contributes to JRC scientific excellence by setting out the rights and obligations of JRC's temporary researchers and by ensuring that temporary researchers have access to a supervisor and mentor. However, the existence of the CoP seems to be limited among temporary researchers and better information is required, especially for newcomers.

4.4 OPEN ACCESS

Over the years, the JRC has consistently increased the proportion of open access publications, with an impressive 95% of articles where a JRC researcher was a first or corresponding author being available through open access in 2022. The remaining 5% represents articles for which a suitable open access journal could not be identified. It is worth noting that open access articles tend to receive more citations, contributing to greater scientific impact and, consequently, scientific excellence.

5. Impact on EU policy of JRC publications

The JRC regularly evaluates the impact of its research on EU policy on the basis of project reporting and case studies. To develop a new indicator for policy-impact, a pilot assessment of the policy citations specifically of JRC's published scientific articles and policy documents was made possible by a new tool developed by the company Overton. This tool can track citations to publications by the JRC and its comparator organisations in policy documents worldwide, including those published by EU institutions.

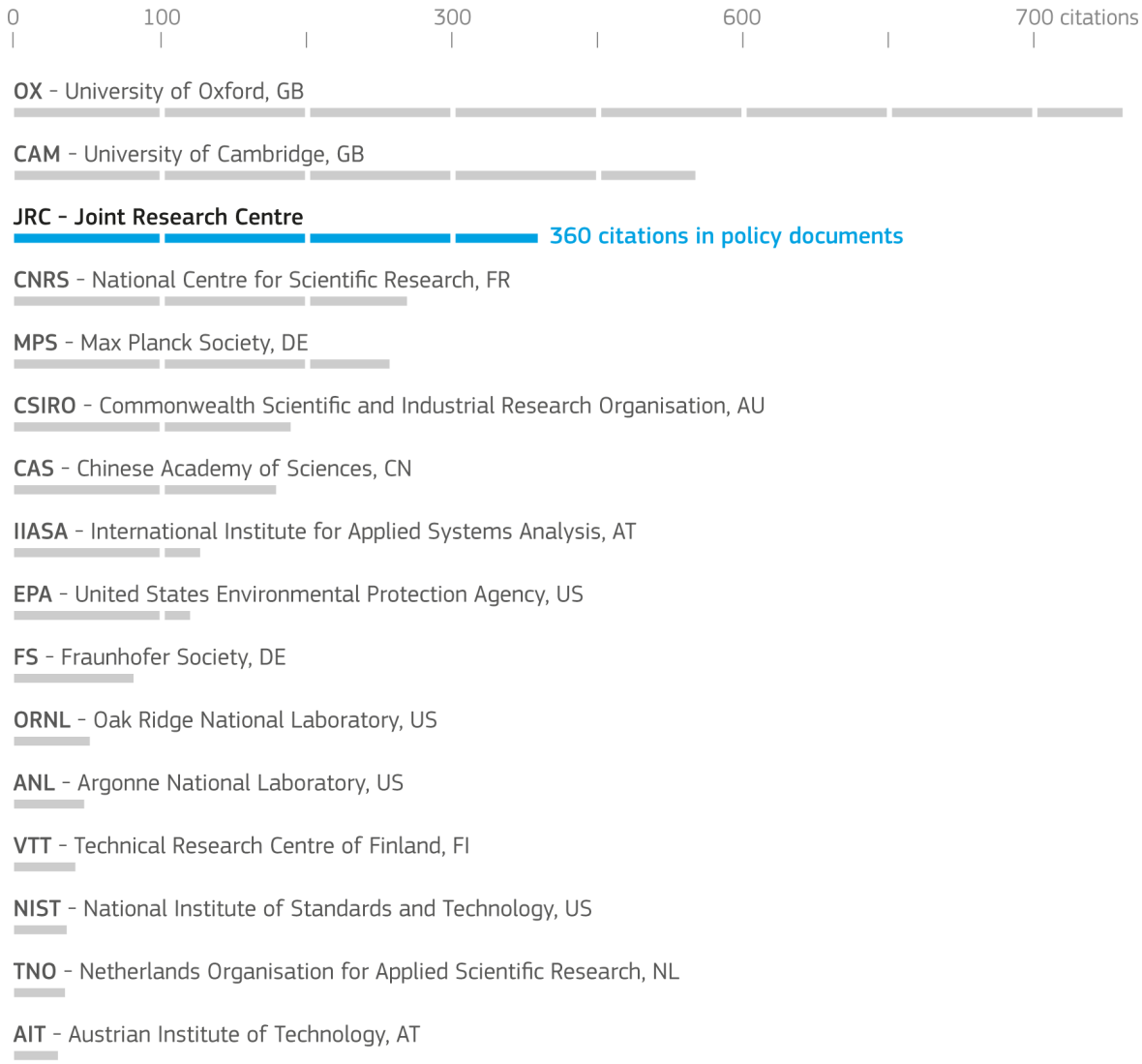
Figure 7 displays the number of citations in policy documents in 2020 from the EU and governments around the world to publications (reports and articles) from the JRC and its comparators. A policy document can refer to recent as well as older publications, and in this sense, the analysis presented in the figure differs from the bibliometric analysis described in preceding chapters.

The JRC compares fairly well in terms of citations in EU policy documents to its comparator organisations, as indicated by the absolute numbers. The analysis also show the high impact of Oxford and Cambridge University in the group of comparator organisations. In addition to their impact on science, publications from these universities are regularly cited in EU policy documents. However, there are significant variations in size among the comparator organisations. For instance, both Cambridge and Oxford Universities employ a larger number of researchers who produce a much higher volume of publications than the JRC, which may partially explain their relatively higher absolute number of citations.

To provide an indication of the relative impact of the JRC in EU policy documents and the comparators, Figure 8 shows the ratio between the number of 2020 citations and the corresponding volume of scientific articles (in Scopus) produced in 2020. This illustrates that, considering its size, the JRC's citation rate in policy documents is very high compared to that of the comparators. Two other organisations stand out: IIASA and the US Environmental Protection Agency (EPA). IIASA, though relatively small, attracts a similar relative number of citations. The US EPA attracts a high number of citations from the US government (not shown). Relative to its size, the number of citations in EU policy documents is also fairly high.

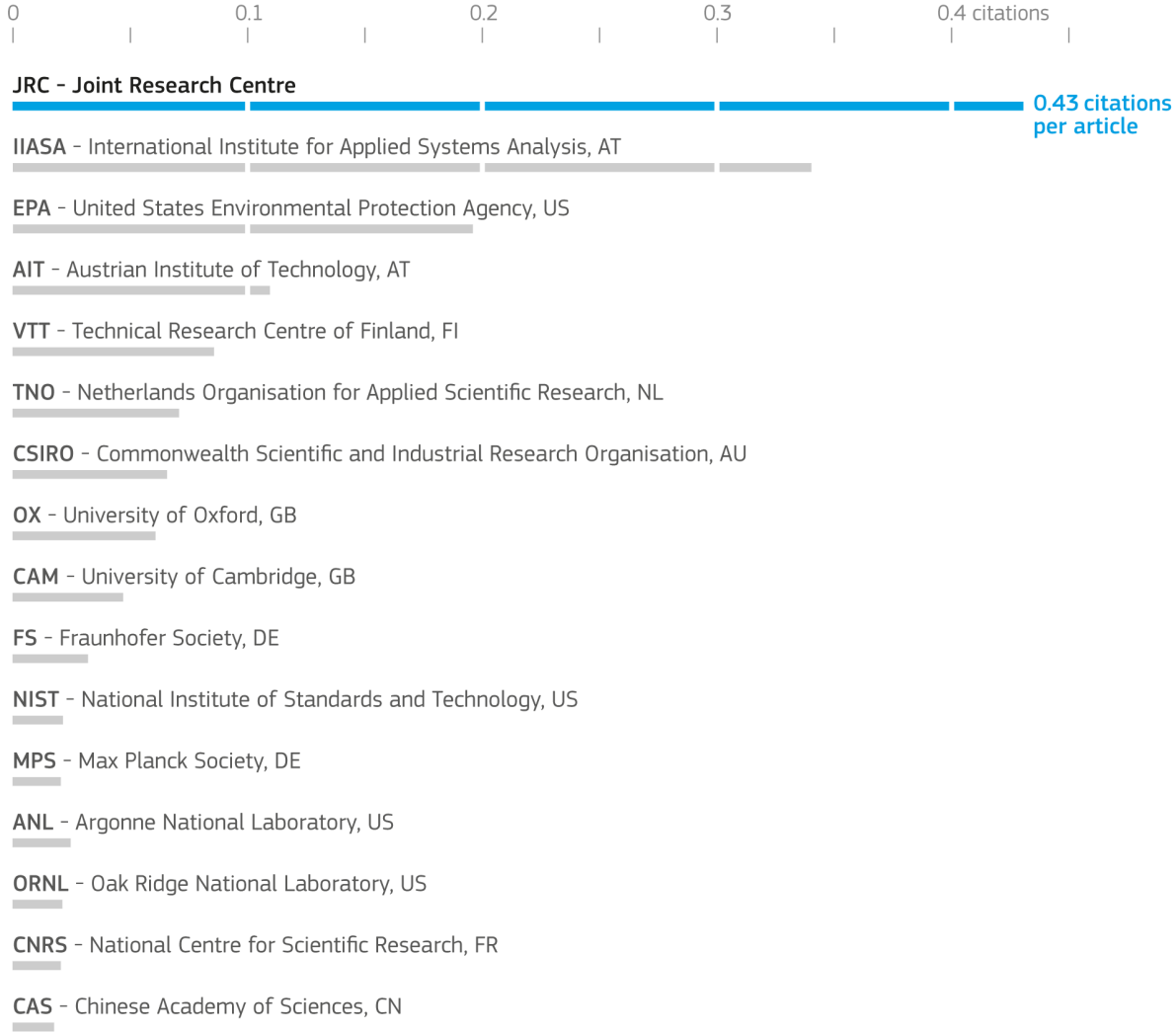
Both the absolute and relative metrics show that the JRC attracts a high number of citations in EU policy documents.

FIGURE 7. **Number of EU policy documents in 2020 referring to publications from the JRC and its comparators.**



No data could be found in Overton for: National Research Council (IT), National Physical Laboratory (UK), National Research Institute for Agriculture, Food and Environment (FR), Alternative Energies and Atomic Energy Commission (FR), and Institute of Physical and Chemical Research -- RIKEN (JP).

FIGURE 8: **The bars show the number of EU policy documents referring to publications by the JRC and comparator organisations divided by the number of scientific articles produced by these organisations in 2020 as a proxy for their size.**



No data could be found in Overton for: National Research Council (IT), National Physical Laboratory (UK), National Research Institute for Agriculture, Food and Environment (FR), Alternative Energies and Atomic Energy Commission (FR), and Institute of Physical and Chemical Research – RIKEN (JP).

6. Conclusions and Recommendations

6.1 PUBLICATIONS

The number of JRC articles published in peer-reviewed journals from 2018 to 2022 has slightly decreased by 1% compared to the period from 2016 to 2020. Although this decrease may seem small, there has been a long-term downward trend of approximately 13% over the nine-year period from 2014 to 2022. The cause of this trend needs to be investigated.

6.2 CONFERENCES AND REVIEW PAPERS

Scientific conferences are important for researchers to exchange ideas and showcase JRC to the scientific community. JRC researchers published fewer articles in conference proceedings during 2018-2022 compared to previous periods. It is important to encourage JRC researchers to participate in conferences and present their research, whether in virtual or physical formats, and for the JRC to allocate sufficient resources for conference missions.

In contrast to conference papers, there appears to be a gradual increase in the percentage of JRC published review articles. The JRC is well-positioned to develop cross-cutting review articles that may attract a large number of citations and increase JRC's impact on both science and policy. Although there is an upward trend in review articles, it is recommended that JRC's management continues to encourage staff to publish review papers.

6.3 CITATION RATE

The JRC maintains a significantly high citation rate for its published research compared to other research organisations. It is crucial to encourage JRC researchers to continue publishing high-impact research and to sustain a high level of collaboration with ERA and global peers in research.

The proportion of JRC publications appearing in the top 1% and top 10% most-cited journals remains in the mid-range compared to comparator institutions, consistent with data from the previous period. Encouraging JRC scientists to publish in high-impact journals has been a recommendation in previous reporting periods and continues to be so.

6.4 EXTERNAL CONTRACTED STAFF

The number of contracted external staff working on JRC sites has noticeably increased during the period. It is important to study the reasons for this increase and any impact on scientific excellence, particularly regarding JRC's publications. The JRC should aim to ensure that externally contracted staff are not involved in core research activities.

6.5 INTERNATIONAL COLLABORATION

The JRC has wide-ranging collaborations worldwide, but within the EU, the collaboration appears to be unbalanced between Member States. The JRC should conduct a more detailed study of the situation and endeavour to better balance its collaboration with different Member States.

6.6 INNOVATION

Engaging in research collaborations with industry serves as an indicator of the relevance of JRC research to innovation. However, the number of JRC patent applications remains very low. The JRC should strategically define whether collaboration with industry and patent applications are desired.

6.7 HORIZON EUROPE

The initial three years of Horizon Europe implementation indicate on a notable decrease in JRC participation. It is essential for JRC to collaborate with research organisations across Europe and engage in discussions on enhancing its involvement in Horizon Europe. Furthermore, the JRC should explore avenues to become eligible for full beneficiary participation in the Marie Skłodowska-Curie Actions.

6.8 CITATIONS IN POLICY DOCUMENTS

The JRC is highly cited in policy documents compared to its peer organisations and should continue to identify and develop metrics to assess the policy impact of its scientific excellence.

6.9 EXPLORATORY AND UNDERPINNING RESEARCH

More focus should be given to underpinning research. The JRC needs to guarantee that 15% of its resources are allocated as outlined in the JRC 2030 Strategy. The CAS programme should be revised. Instead of hiring external specialists on a temporary basis to bring in new knowledge and research to the JRC, the JRC could sending JRC researchers to other scientific institutions, like universities, to learn about novel specific research.

6.10 SCIENTIFIC INTEGRITY AND RESEARCH ETHICS

The JRC's framework of instruments on scientific integrity and research ethics, SIRE, needs to be continuously updated to ensure scientific excellence and integrity. Newcomers on temporary contracts should be better informed about the existence of the JRC Code of Practice for Research Fellows.

6.11 VISITING RESEARCHER PROGRAMME

The JRC Visiting Researcher Programme, VRP, was put on hold due to the Covid pandemic, and it is currently unclear whether this programme will resume. JRC's management should provide clarification on whether the programme will be continued.

6.12 OPEN ACCESS

With about 95% of its publications with first and/or corresponding author, the JRC has almost achieved its goal of 100% open access to publications. The fraction of JRC open access articles is likely to remain within the span of 95-100% until the remaining journals change their policy to open access.

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