European Commission

Publications as a measure of innovation performance in the clean energy sector: Assessment of bibliometric indicators

Provision of technical assistance and study to support the development of a composite indicator to track clean-energy innovation performance of EU members

Independent Expert Report

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Research and Innovation

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EUROPEAN COMMISSION

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In association with:

Directorate-General for Research and Innovation
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Abbreviations

CEII	Clean Energy Innovation Index
EIS	European Innovation Scoreboard
EPO	European Patent Office
EU27	European Union (and its 27 members)
$HCP_{10\%}$	Highly cited publications among the 10 % most cited
KA	Key action
MI	Mission Innovation
NSE	Natural sciences and engineering
RC	Relative citation
SCP	Share of publications cited by patents
SI	Specialisation index
SIP	Share of international co-publications
SOA	Share of open access publications
SPP	Share of public/private co-publications
SSH	Social sciences and humanities
STP	Share of transnational co-publications
UN	United Nations
USPTO	United States Patent and Trademark Office
WB	World Bank
WEC	Weighted eigenvector centrality
WIPO	World Intellectual Property Organization

1 Introduction

This report is the fourth deliverable in the Second interim data and report series designed to support the development of the Clean Energy Innovation Index (CEII). The CEII tracks the clean energy innovation performance of EU Member States (the EU27, without the United Kingdom) and Mission Innovation (MI) members (see Table 1)[1]. Trinomics, Science-Metrix and Cambridge Econometrics collectively developed the CEII as part of the First interim data and report series[2], which included data up to 2019. The Second interim data and report series is an update of the first series, with data up to and including 2020 and with minor methodological changes. The CEII contributes to the overarching aim of measuring the progress made by each of the EU27 and MI members in clean energy research and innovation by analysing output-related indicators in the Strategic Energy Technology (SET) Plan key actions (KAs). It is a composite indicator consisting of three core dimensions (scientific publications, patents and trade), each measured with multiple indicators that capture various aspects of the innovation system. This report covers the work on using publications as a measure of research performance. The other two dimensions, and the index consisting of a combination of all three dimensions, are covered in separate reports.

Table 1: List of EU27 and MI members

EU27 members		MI members	
Austria*	Italy*	Australia	Indonesia
Belgium	Latvia	Austria*	Italy*
Bulgaria	Lithuania	Brazil	Japan
Croatia	Luxembourg	Canada	Mexico
Cyprus	Malta	Chile	Norway
Czech Republic	Netherlands	China	Saudi Arabia
Denmark*	Poland	Denmark*	South Korea
Estonia	Portugal	Finland*	Sweden*
Finland*	Romania	France*	United Arab Emirates
France*	Slovakia	Germany*	United Kingdom
Germany*	Slovenia	India	United States
Greece	Spain		
Hungary	Sweden*		
Ireland			

Note: The asterisk (*) denotes countries that are members of both groups.

Science-Metrix built nine data sets of publications, one for each of the SET Plan KAs:

- KA1-2: Performant renewables / Reduced technology costs[3]
- KA3: New technologies & services for consumers

[1] Table 1 lists MI member countries as of the end of 2018, when the CEII project was designed. Morocco also became an MI member in 2019, and in September 2021, a new phase of MI (MI 2.0) was launched, in which Indonesia and Mexico are not participating. The EU27 is also a member of MI, but EU27 data are not included in the total values of indicators estimated for the MI category to avoid double counting of 7 EU Member States that are also MI members.

[2] Yearwood, J. et al. (2021). First Report on the Clean Energy Innovation Index. https://op.europa.eu/en/publication-detail/-/publication/dbcf832a-f8b9-11eb-b520-01aa75ed71a1/language-en/format-PDF/source-search

[3] The data set for KA1-2 was disaggregated into five sub-KAs specific to different renewable energy sources – solar energy, wind energy, hydroelectricity, ocean/tidal energy and geothermal energy – but they are not documented individually in this report.

- KA4: Resilience & security of the energy system
- KA5: New materials & technologies for buildings
- KA6: Energy efficiency in industry
- KA7: Competitive in the global battery sector (e-mobility)
- KA8: Renewable fuels
- KA9: Carbon capture, utilisation and storage
- KA10: Nuclear safety

The data sets were built by using an extensive list of keywords specific to the KAs and querying them in the title, abstract and author keywords of peer-reviewed publications indexed in Scopus, a bibliographic database with a broad coverage of the scientific literature. The methodology to create and assess the coverage and accuracy of these data sets was extensively documented in a separate report[4]. As part of the Second interim data and report series, the queries were reviewed, which improved coverage and recall.

Using these data sets, Science-Metrix calculated a wide range of publication-based indicators of potential relevance to the policy context surrounding the development of the CEII, two of which were ultimately chosen for inclusion in the CEII. These indicators were chosen to measure the four scientific aspects of core relevance to the policy context surrounding the development of the CEII (i.e. the SET Plan, the Energy Union and the MI initiative): the level of research output, the collaboration of research activities, the openness of research activities and the impact of research activities. The SET Plan favours research and innovation policies that create an open innovation ecosystem and capitalise on the results of research and open science. It also favours transparency and exchange of information to avoid unnecessary duplication of efforts and to stimulate cooperation and coordination between Member States. It also wishes to build synergies between European and national programmes, especially joint investment programmes in order to leverage investments from, and collaboration with, the private sector[5,6]. Keeping these priorities in mind, the indicators chosen for consideration are the following:

- Number of publications
- Specialisation index
- Share of international co-publications
- Share of transnational co-publications
- Weighted eigenvector centrality in the world's co-publication network
- Weighted eigenvector centrality in the Member States' co-publication network
- Share of open access publications

[4] This report is not publicly available but can be provided upon request to the European Commission.
[5] European Commission (2015). Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation. Brussels. https://ec.europa.eu/energy/sites/ener/files/publication/Complete-A4-setplan.pdf
[6] European Commission (2015). A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy. Brussels. https://eur-lex.europa.eu/resource.html?uri=cellar:1bd46c90-bdd4-11e4-bbe1-01aa75ed71a1.0001.03/DOC_1&format=PDF

- Share of public/private co-publications
- Share of highly cited publications (those among the 10 % most cited)
- Share of publications cited in patents

This report focuses on reassessing the pertinence and robustness of these indicators for inclusion in the CEII through a qualitative review and quantitative assessment of the data computed by country (EU27 and MI members) for each KA. For a brief summary of indicator description, relevance, comparability, availability (and data sources), quality and assessment, the reader is referred to Annex 1.

The report is structured as follows. In Section 2, we discuss the main challenges of using publications as a measure of innovation performance and lay out the methodology used to assess the soundness of each indicator for consideration in the CEII. In Section 3, we calculate the indicators, apply the methodology to assess their soundness, discuss the results and determine whether or not they are appropriate for inclusion in the CEII. Section 4 concludes by comparing the indicators that were selected.

2 Publications as a dimension for measuring innovation performance

Peer-reviewed publications are commonly used to measure research performance, especially in the natural and applied sciences, since they are commonly used to disseminate new knowledge in these areas. Scientific publications, as measured via inclusion in bibliometric databases (e.g. Scopus, Web of Science), mostly consist of three document types: journal articles, published to disseminate the results of novel research; review articles, published to aggregate and summarise the research findings published thus far in a specific topic; and conference papers, published as in-depth reports of presentations given at conferences. Conference papers are particularly relevant to the field of clean energy technologies since conferences are prominent venues to disseminate research findings in the technological and engineering fields. For example, conference papers account for 63 % of the peer-reviewed scientific output indexed in Scopus for the 2016–2020 period in Information & Communication Technologies; they account for 37 % in Engineering.

Scientific publications also provide a wealth of information on their authors that enables us to extrapolate collaboration practices at various aggregation levels (e.g. between researchers, activity sectors, countries, regions) according to their affiliation. Additionally, bibliographic data on a publication's or a patent's references to the scientific literature make it possible to track which publications, and their corresponding authors, were most credited by their peers for their intellectual contribution to the advancement of science and technology. One of the key beneficial aspects of publication statistics is that they are readily available at a high level of granularity. However, there are also some shortcomings in using publication statistics for measuring research performance, such as data availability and the coverage of bibliographic databases. In Section 2.1, we identify publication-based indicators worth considering for inclusion in the CEII and discuss potential shortcomings of using them to monitor research performance. In Section 2.2, we detail the quantitative methodology used to assess the robustness and value of each indicator for inclusion in the CEII.

2.1 Key challenges to publication-based indicators

When dealing with publication data, several issues need to be considered to properly interpret them. Some of these are merely practical challenges that require a transparent and consistent approach but do not pose challenges beyond that. Others are more fundamental in nature and cause debate around the usefulness of publication data for measuring scientific performance. Some challenges only pertain to specific indicators.

2.1.1 Data availability

The metadata of scientific publications are indexed in bibliographic databases. For this project, Scopus was used for its broad coverage of the scientific literature, which includes more regional and non-English-language journals than some competing databases, as well as its wide coverage of conference proceedings, which represent a very important dissemination media for scientific discoveries in technological and engineering fields. A comprehensive bibliometric database indexing all scientific articles published worldwide and indexing all necessary information for producing large-scale bibliometric studies does not currently exist. All databases, including Scopus, have their own biases with regard to geography (some countries are better covered than others), language (English is usually better covered than other languages) and thematic coverage (some fields of science are better covered than others).

Another database worth mentioning is 1findr, which tracks the availability of publications in open access. 1findr's coverage is wider than that of Scopus, but it lacks the necessary metadata to calculate a wide range of bibliometric indicators. The open access status of the publications it provides can nevertheless be exploited by linking its content to Scopus.

2.1.2 Practical challenges

Some peculiarities pertaining to bibliometric data need to be considered in order to interpret the indicators properly. For example, the language coverage of bibliometric databases, which is somewhat biased toward the literature written in English, can be a shortcoming. For instance, whereas research questions in the natural sciences and engineering (NSE) tend to be universal, social sciences and humanities (SSH) research subjects are often more local in orientation/focus and, as a result, the target readership is more often limited to a country or region. Consequently, SSH scholars publish somewhat more frequently in a language other than English than NSE researchers do. They also tend to publish in journals with a national distribution rather than an international distribution more than their counterparts. The uninformed or careless use of bibliometrics to benchmark SSH research can thus lead to erroneous conclusions. Notwithstanding that reality, Scopus covers a large number of relevant records for the fields of highest relevance to this study (e.g. Built Environment & Design, Earth & Environmental Sciences, Enabling & Strategic Technologies, Engineering and Information & Communication Technologies), which enables the computation of representative indicators for all EU27 and MI members covered in this study.

Bibliometric databases are also not populated in real time, meaning that it can take up to a year before a publication is indexed. The speed of indexing has historically been quite slow for conference papers, which are important to this study. However, this aspect has greatly improved in recent years and Scopus's coverage for a given publication year is estimated to be 98 % complete as early as February of the following year; this means that for publication year 2020, Scopus is 98 % complete as of February of 2021. Of course, there is some variation across countries, but nothing outstanding. Of the 42 countries covered in this study, 30 have attained the expected figures in terms of the number of publications for 2020, and only two have a coverage below 90 % of the expected figures: Indonesia (70 %) and Bulgaria (87 %). The bibliometric indicator most likely to be impacted by this is the number of publications. All other indicators are relative indices that should not be biased with these levels of completeness. Still, special care was paid to the detection of potential outliers in the most recent year of data (i.e. 2020) that could arise from such variation in country coverage. The methodology to identify outliers is detailed in Section 2.2. Based on information currently available, we expect Scopus to provide timely data, as requested in this study (i.e. data from 2016 up to 2020), for all 42 countries included in constructing the CEII.

2.1.3 Indicator-specific shortcomings

Number of publications

The number of publications is a straightforward indicator, but it does not convey information that can be used to make a direct comparison between countries, since larger countries naturally tend to publish more papers. A normalising variable that takes country size into consideration is therefore needed. The ideal denominator is population data, which are more stable than other data, such as the gross domestic product. Population data are provided by the World Bank[7] (WB). One shortcoming worth mentioning related to the WB's databank is that none of Taiwan's statistics are included, whereas Science-Metrix adds Taiwan's publications to China's total, as well as Hong Kong's and Macao's publications. Hong Kong's and Macao's data are indexed by the WB, and were added to China's population for this study, but Taiwan's population is still lacking. Science-Metrix used Taiwan's population data provided by the United Nations[8] (UN) and added them to China's total. There are small differences between the WB's and

[7] World Bank (2021). Population, total. https://data.worldbank.org/indicator/SP.POP.TOTL. Retrieved on 2 July 2021.
[8] United Nations (2021). World Population Prospects 2019. https://population.un.org/wpp/Download/Standard/Population/. Retrieved on 8 April 2021.

the UN's data, but Taiwan represents approximately 1 % of China's total population, rendering any inconsistencies between both data sources negligible for the purpose of this study.

Although the precision and recall[9] of each data set of publications that define the KAs were tested and improved until a very high level of accuracy was obtained, some relevant articles were inevitably left out of the data sets. As a result, comparing the number of publications across the KAs is problematic because precision and recall vary somewhat between them. Assuming that these variations affect each country in similar proportions, it is therefore more appropriate to compare between KAs by looking at the ranking of countries instead of their raw number of publications, whether or not they are normalised. For example, if two data sets include the same number of publications but the first data set has a recall of 80 % and the second has a recall of 85 %, the coverage of the first data set is underestimated in a larger proportion compared to the coverage of the second data set. Therefore, the raw numbers of publications are not directly comparable between them. However, a rescaling of this indicator on a uniform scale applied to all KAs, such as the one described in Section 2.2, enables comparison between KAs. Within each KA, however, the volume of publications can be compared between countries without issue.

As a last note, due to the language bias in Scopus, the scientific production of countries whose official language is not English might be underestimated. This is particularly true for China because of the incomplete coverage of Chinese journals in western databases[10].

Share of open access publications

In order to measure the extent of the scientific literature available in open access, the coverage of 1findr – the database used to flag the open access status of articles – needs to overlap with Scopus, which contains the necessary metadata to compute the share of open access publications (SOA) at the level of countries. Previously, very few conference papers were indexed in 1findr, but the overlap between both databases has recently been tremendously improved. As a result, of the 693,553 articles included in all the KA data sets combined and published between 2014 and 2018 (Table 2 below), only 1,546 are not indexed in 1findr. This means that the open access status of most publications, including conference papers, in the KA data sets can now be assessed. Lastly, to account for the embargo period – a period of time imposed by some publishers before an article can be made available in open access – the SOA was calculated for articles published between 2014 and 2018. However, beyond the embargo effect, the backfilling of older articles made available in open access is continuously ongoing as the open access movement gains traction. The growth of the SOA can therefore be underestimated depending on the version of the database we are using. To mitigate this shortcoming, the SOA is normalised by the world weighted average (like many other indicators, explained in more detail in Section 3). Despite this correction, the evolution in the relative placement of countries can nevertheless be affected, for which there is no ideal correction available.

Share of highly cited publications among the 10 % most cited

The share of highly cited publications among the 10 % most cited ($HCP_{10\%}$) is a citation-based indicator. Fundamentally, the value of a citation is at the heart of a constant

[9] The precision of a data set is defined as the share of its content that is relevant to the subject at hand, estimated based on a sample of publications, and the recall of that same data set is defined as the share of its coverage, estimated based on a selection of journals or classifications, such as SciVal's topics of prominence (https://www.elsevier.com/solutions/scival/features/topic-prominence-in-science), that are as relevant.

[10] Rousseau, R. (2015). The tip of the Chinese publication iceberg. ISSI Newsletter, 11, 100–102. https://www.issi-society.org/media/1045/newsletter44.pdf

debate within the bibliometric community and the scientific community more broadly. The assumption is that a citation reflects not only the visibility of a piece of work, but also a certain recognition of the significance of that cited work. In practice, citations can indeed reflect significance and novelty in research, but they are also used simply to give context or to voice a critique. That said, it is fair to assume the citations given for more dubious reasons do not significantly bias the impact metrics computed in large-scale studies such as this one (i.e. at the level of countries). For example, researchers have the incentive to cite their own work to boost their own citation score, which potentially creates a conflict of interest. Although researchers citing their own work is not necessarily scientific malpractice and is legitimate in most cases, the share of $HCP_{10\%}$ calculated in this study excludes self-citations as is currently done for the European Innovation Scoreboard (EIS). However, given the scale of the study at which citation-based indicators are calculated, removing self-citations from these indicators has little influence on the resulting scores. Despite these uncertainties, citations remain an easy-to-use, discrete piece of quantitative information efficiently applicable to broad-scale studies to evaluate scientific research. In this respect, citation-based indicators provide rich information on the relative value of different pieces of research that would be onerous to gather through other means.

One shortcoming that concerns citation practices within the scientific literature is the fact that they differ greatly between the different fields of science and document types. For example, a typical article of the health sciences receives far more citations than a typical article of the arts and humanities. Reviews are also cited more frequently than research articles and conference papers. To mitigate this bias, citation counts are normalised by scientific subfield and document type, as well as by publication year, to produce what are known as relative citation (RC) scores. The latter normalisation considers the fact that older articles have had more time to accumulate citations compared to articles published recently.

In general, most publications are either cited only a few times or not at all; in other words, the distribution of citations is heavily skewed toward the lower end of the distribution. This applies to all documents but is significantly more pronounced for conference papers, given that they receive far less attention than journal articles. So much so that in some subfields and years, a small number of citations can result in a very large RC score. For example, in 2016 in the subfield of Nanoscience & Nanotechnology, conference papers were cited 2.3 times on average, whereas research articles were cited 35.3 times on average. In this example, a conference paper with five citations would have an RC score of 2.17, while a research article with the same number of citations would have a score of 0.14. This significantly distorts the impact of conference papers in many subfields and greatly amplifies the impact of documents that may not be that impactful simply owing to the means by which they were published.

For this reason, no RC scores are calculated for conference papers and they are therefore excluded from the share of $HCP_{10\%}$. To assess the extent of that exclusion, Table 2 lists the KAs, the number of publications included in each of the data sets that define them and the share of those publications that are conference papers, published between 2014 and 2018. Overall, 33.2 % of all publications specific to the KAs were conference papers, which is significant. The share is above 40 % for a few KAs. However, for all KAs, the number of publications without conference papers, in the many thousands, is still sufficient to calculate citation-based indicators accurately.

Table 2: Number of publications and conference papers in each KA (2014–2018)

Key action	Number of publications	Number of conference papers	Share of conference papers
All KAs combined	693,553	230,423	33.2 %
KA1-2 - Performant renewables/Reduced technology costs	179,515	59,841	33.3 %
Geothermal energy	7,662	2,637	34.4 %
Hydroelectricity	15,304	4,992	32.6 %
Ocean/tidal energy	4,972	1,974	39.7 %
Solar energy	112,625	32,676	29.0 %
Wind energy	45,352	20,391	45.0 %
KA3 - New technologies & services for consumers	111,755	54,378	48.7 %
KA4 - Resilience & security of the energy system	178,228	75,708	42.5 %
KA5 - New materials & technologies for buildings	41,029	16,166	39.4 %
KA6 - Energy efficiency in industry	23,809	8,193	34.4 %
KA7 - Competitive in the global battery sector (e-mobility)	70,127	24,691	35.2 %
KA8 - Renewable fuels	121,291	16,682	13.8 %
KA9 - Carbon capture, utilisation and storage	38,101	6,946	18.2 %
KA10 - Nuclear safety	52,407	16,996	32.4 %

Source: These statistics were calculated using data from Scopus (Elsevier)

Another limitation pertaining to the timeliness of data as well as citations concerns the time lag necessary for new publications to accumulate citations from other publications before their scientific impact can be adequately measured. This lag is typically three years (i.e. publication year plus two years). This means that scientific impact metrics can only be computed up to 2018 by using the latest version of Scopus. To ensure consistency in the length of the period (i.e. five years) for which data are provided across all bibliometric indicators, an exception to the reference period (i.e. 2016–2020) was made for the share of $HCP_{10\%}$ (i.e. 2014–2018).

One last shortcoming worth mentioning is the fact that, by definition, the share of $HCP_{10\%}$ includes a small share of publications, which can cause important year-to-year fluctuations at the level of countries that might not capture true performance. For that reason, the share of $HCP_{10\%}$ was calculated for countries that have published at least 30 publications (with an RC score) in any given year.

Share of publications cited in patents

As a citation-based indicator, the share of publications cited in patents (SCP) was treated differently since very few publications are ever cited by patents. Instead of counting the number of citations, the number of articles cited at least once by a patent was counted. The speed of uptake of the scientific literature within the patent literature is slower than within the scientific literature itself because of the time needed to develop inventions and subsequently apply for patents; here, a minimum lag of five years (i.e. publication year plus four years) was applied. Therefore, to maintain a five-year period across all indicators, the SCP was calculated between 2012 and 2016. Conference papers were not excluded from the SCP because they are cited relatively often by patents: 5.3 % of clean energy articles published between 2012 and 2016 were cited by at least one patent, of which 4.1 % were journal articles or reviews, and the remaining 1.2 % were conference papers. The technological topics discussed at many conferences, such as those of clean energy, align well with patenting activities. A minimum of 30 publications was also applied to this indicator to mitigate yearly fluctuations.

Patent data provided by LexisNexis were used to link the references of patents to Scopus. This is different from the First interim data and report series, in which patent data were taken from the PATSTAT database. LexisNexis's patent data provide a better coverage, which enabled us to match publications to patent references more accurately. Since there is no universal patenting office, and considering the fact that this study is quite broad in terms of the countries covered, relying on a single national or regional patent office would be problematic since this would create a 'home advantage' in favour of one or a few countries, which are naturally inclined to file patent applications at their own national patent office. That said, some markets are so important that some countries patent more inventions in these key markets than in their own. Therefore, selecting a few major patenting offices is sufficient to cover a significant share of the global market of patented inventions, especially high-value inventions. The offices selected for this study were the United States Patent and Trademark Office (USPTO) and the European Patent Office (EPO). Patent applications filed through the World Intellectual Property Organization (WIPO) were also included; however, the WIPO simply facilitates the application process to multiple jurisdictions and is not a patenting office itself. Data from the First interim data and report series, which measured the references of patents filed at other patenting offices, such as the Japan Patent Office, the Korean Intellectual Property Office and the China National Intellectual Property Administration, revealed that patents filed at the USPTO and the EPO accounted for over 90 % of the scientific literature in the KA data sets cited by patents, with some of the remaining publications being cited by patents filed through the WIPO. Therefore, the USPTO, the EPO and the WIPO are sufficient to capture the performance of EU27 and MI members through this dimension.

Other indicators

The other indicators are not subject to specific shortcomings beyond those described in Sections 2.1.1 and 2.1.2. However, as a last point, conference papers tend to be less collaborative in practice. Therefore, the share of international co-publications (SIP) and the share of transnational co-publications (STP) in clean energy are expected to be lower than what would normally be expected for the whole of science, owing to the fact that conference papers play an important role in clean energy publications. However, this is not a shortcoming but rather an artefact of the subject at hand, and these two indicators are normalised to minimise its influence.

2.2 Assessing the soundness of the indicators for their inclusion in the CEII

To ensure the quality of the data across all countries and KAs, two time-series consistency tests were first applied to all indicators, for each country and KA individually. The first test identified potential non-sampling errors (e.g. processing errors such as harmonising errors, database errors, wrong denominator in normalising an indicator) that could lead to inaccurate data points. To detect aberrations in the time series, an automated test for detecting potential outliers was applied to the time series of each country in each KA, for each indicator. A linear regression model was fitted on the time series of each country. Subsequently, a statistical procedure was applied to test the null hypothesis that the studentised residual of each data point could have been generated by the fitted model; when the *p*-value of a test was smaller than 0.01, the hypothesis was rejected, implying that the data point was potentially an outlier. Subsequently, these potential outliers were inspected to assess the degree to which they may represent real variations; in other words, the potential outliers automatically identified using the above statistical test were validated manually to differentiate real outliers (bad data or incorrect definition) from false outliers (data points likely representing real fluctuations due, for example, to economic shocks). This exercise is very complex, as some outliers may naturally arise as a result of unknown conditions. The test also identified some outliers because a linear regression is simply not the best fit for some data series. Therefore, actions were taken on data points for which there was no ambiguity regarding their status. When outliers were identified, the data sources used to compute the indicator

were analysed to detect where the aberrant values might have come from. Subsequently, the problematic data points were flagged.

The second test identified breaks in time series and other possible outliers. A stepwise analysis was conducted via a script that compared the difference between two successive data points to the average difference of the same points before and after, which is defined as the expected value. This analysis highlighted undocumented breaks in time series or changes of regime that were not detected with the first test. Again, when the test failed a defined quality threshold, a manual validation was applied to each point before flagging any problematic ones.

The tests were applied not only to the indicators but to all sources of data that fed into each indicator. For example, for the number of publications per capita (Section 3.1), the tests were applied to the number of publications and to population data. Also, a longer time series (2010 to 2020) than the one used in building the CEII (e.g. 2016 to 2020) was used to enhance the capability of the implemented statistical procedures that detect problematic data points.

It is important to mention that outliers and breaks in time series are not necessarily inaccurate data points. In fact, all indicators in this study were calculated based on publication data, which are generally continuous through time. However, the publication output of smaller countries is much more prone to annual fluctuations. This was observed for some countries in many KAs, whose fluctuating trends were much more likely to fail the outlier and break in time series tests. Such fluctuations are to be expected and should be interpreted as within an acceptable range to accurately depict the situation in those countries. In those cases, the small output was sufficient justification to ignore these outliers and breaks in time series. Ultimately, no data were deemed exaggerated to the point that warranted a correction, even for countries whose publications from 2020 are still not fully indexed in Scopus. An example of the application of these tests is shown in Section 3.1.

Once outliers and breaks in time series had been investigated, and quality of the data had been assessed, the indicators were transformed to be properly included in the CEII. The bibliometric indicators listed in Section 2.1 measure different aspects of the scientific literature and are scaled differently. Also, the frequency distribution of bibliometric indicators tends to be skewed toward average and below-average countries, while a few countries obtain outstanding scores. In such cases, a transformation (either the natural logarithm plus one or the square root) was applied to the scores to bring the distribution closer to a Gaussian distribution. However, some indicators that do exhibit a Gaussian distribution were not transformed. Finally, all scores were standardised between 0 and 1, based on either the original (not transformed) or the transformed score (if the transformation was applied), to enable comparison across KAs and countries by applying this formula:

$$\frac{S_X - S_{min}}{S_{max} - S_{min}}$$

Where:

S_X Score of country *X*

S_{min} Minimum score among the distribution of countries (all EU27 and MI members)

S_{max} Maximum score among the distribution of countries (all EU27 and MI members)

This formula transforms all indicators to a comparable scale (i.e. between 0, the worst performance, and 1, the best performance, observed within the five-year period of interest) in order to aggregate them into the CEII, which contributes to a uniform contribution of all indicators to the CEII.

Section 3 includes a dashboard that lists all EU27 and MI members, and their respective score for each indicator for all KAs combined. The dashboard includes the original (not transformed) score, the score normalised by the world weighted average (when appropriate), the transformed score (when appropriate) and the standardised score (between 0 and 1). The countries are clustered according to the unweighted mean and standard deviation of the original (not transformed) or the transformed score (if the transformation was applied) of all EU27 and MI members as follows:

- Cluster 1 includes the countries whose score is above the mean plus one standard deviation.
- Cluster 2 includes the countries whose score is above the mean but below the mean plus one standard deviation.
- Cluster 3 includes the countries whose score is below the mean but above the mean minus one standard deviation.
- Cluster 4 includes the countries whose score is below the mean minus one standard deviation.

Assuming a perfectly normal distribution, Clusters 1 and 4 should include 16 % of countries each, and Clusters 2 and 3, 34 % of countries each. Annex 2 also includes a dashboard that lists all EU27 and MI members and their respective score for each indicator in each KA.

All the bibliometric indicators presented in this report measure the EU27 and MI members' performance in clean energy research through different dimensions, and they therefore all have value. However, some indicators may correlate strongly with each other. While such indicators may be designed to capture different aspects of a country's scientific outputs, the phenomena they aim to track may be strongly associated. Including indicators that strongly correlate with one another in a composite indicator such as the CEII may then increase the weight given to their related statistical dimension (i.e. statistical redundancy) at the expense of other statistical dimensions represented by single indicators. To reduce redundancy in the CEII, as a last step, the correlation between all indicators was thus calculated. If two or more indicators are shown to correlate strongly with each other, this is an indication that some of them might not add much value to the CEII; in other words, for each set of indicators that correlate strongly, choosing one of them is sufficient. For example, countries with a large share of their publications co-authored in collaboration with international partners tend to be highly impactful, as measured, for instance, by the share of $HCP_{10\%}$. For benchmarking countries, one of the two might then be left out in providing a synthetic overview of scientific performance.

3 Assessment of the potential indicators for inclusion in the CEII

This section presents the performance scores for each EU27 and MI member, and for each indicator listed in Section 2.1. It also documents the results of the outlier and break in series tests.

3.1 Number of publications

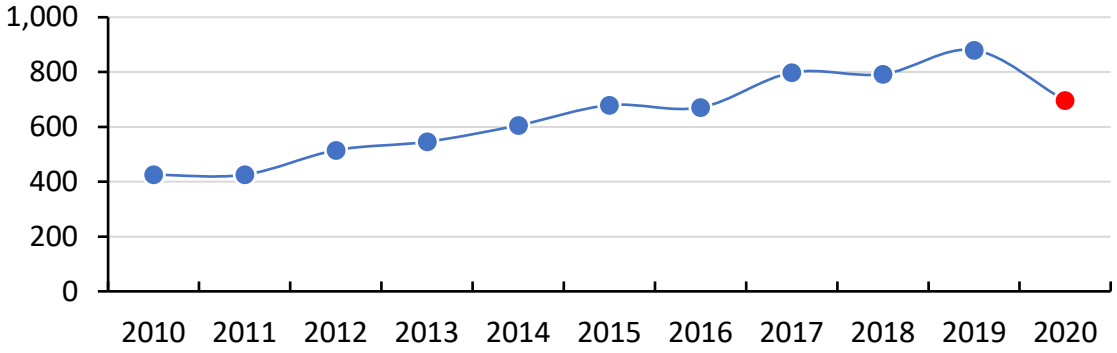
Box 3-1: Conclusion and summary

In the First interim data and report series, we concluded that the number of publications is a pertinent indicator to measure the level of research output in clean energy research and is to be included in the CEII if it is normalised per capita, and the results from this update confirms this decision.

Globally, the number of publications per capita in clean energy increased from 2016 to 2019 but decreased in 2020; a similar trend was observed for EU27 and MI members as groups. In 2020, MI members published 76.5 % of the world's publications in the field, led by China, who is responsible for almost a third of all publications. The EU27's contribution to the global output was 16.3 %. Per capita, Denmark (195 publications per 1,000,000 population) and Norway (164 publications per 1,000,000 population) were the most productive.

The first bibliometric indicator for consideration for inclusion in the CEII is the number of publications in fractional counting. As mentioned in Section 2.1, for comparison purposes, the indicator as it stands has limitations for the simple reason that larger countries naturally tend to publish more articles. Therefore, population data were used as a normalising variable that takes the size of countries into consideration.

Figure 1: The Czech Republic's number of publications (using a fractional count) for all KAs combined, 2010–2020



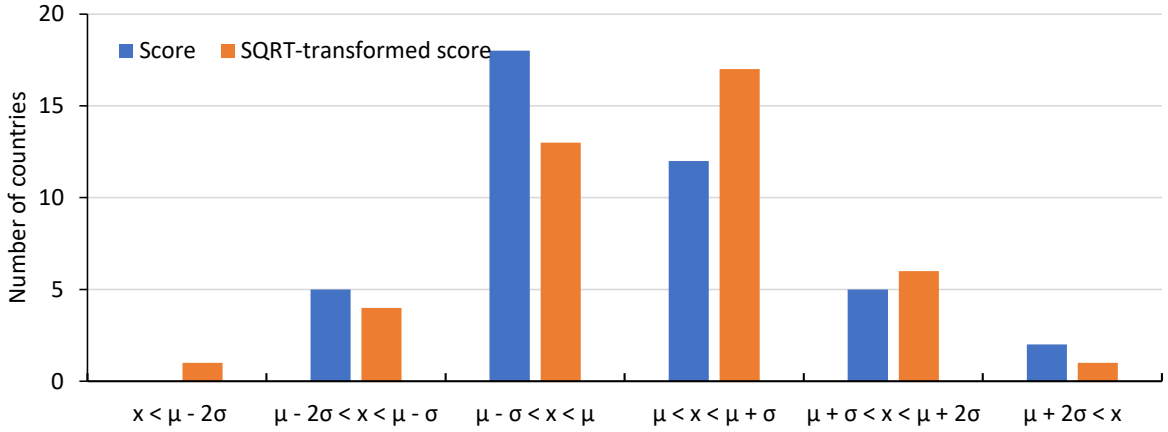
Source: These statistics were calculated using data from Scopus (Elsevier)

The outlier and break in time series tests were then applied on the number of publications. For all KAs combined, the test identified one potential outlier at the 99 % confidence level: the Czech Republic's number of publications in 2020. The Czech Republic's publication output is shown in Figure 1 with the potential outlier in red, which does appear to be an important drop from the previous year. Given that there are some yearly fluctuations in the trend and that a number of countries also experienced a drop in 2020, as did the EU27, MI and world levels, it was decided to leave this potential outlier as is without applying a correction. The number of publications in each KA is much lower

compared to the total of all KAs combined and resulted in no clear temporal trend for many countries for many KAs. Regardless, the outlier test was applied to all countries and KAs and identified a few problematic data points. After investigating each of them individually by using a similar strategy, none of them were deemed worthy of a correction. Finally, the break in time series test was applied to all countries and KAs and, after investigating potential outliers, none were considered problematic. The tests were applied to the final indicator and identified a few potential outliers, which ultimately did not raise any serious concern either.

Once the tests were run on all the data, the number of publications per 1,000,000 population was computed and is included in Table 3 further below (the 'score' column). As mentioned in Section 2.2, bibliometric indicators tend to be exponentially distributed, with a handful of entities receiving outstanding scores and the bulk of entities receiving average or below-average scores. Once normalised by population, the number of publications was much less skewed, but a positive skew still remained (Figure 2; the blue bars). In order to reduce the influence of countries that perform outstandingly well when constructing the CEII (this could lead to some indicators weighting more heavily in the CEII), some transformations were tested and the square root transformation appeared to best fit a normal distribution, albeit not perfectly. The square root-transformed score is included in Table 3, the frequency distribution of which is also shown in Figure 2 (the orange bars).

Figure 2: Distribution of countries according to the mean and standard deviation of the number of publications per 1,000,000 population and the square root-transformed equivalent (2020)



Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Looking at the results in Table 3 more closely, globally 185,000 articles related to all KAs combined were published in 2020; EU27 members contributed 30,000 articles (16.3 %) to that number, and the MI members, 142,000 articles (76.5 %). At the country level, China published the most articles (60,000 publications), followed at some distance by India and the United States (16,000 publications each). When considering population (the 'score' column), 24 articles per 1,000,000 population were published worldwide; both EU27 and MI members performed better, with 67 and 32 articles per 1,000,000 population, respectively. China is in 33rd position, despite its large publication output. The countries that performed the best, in Cluster 1, are rather small (except for South Korea in 3rd position), all of which published more than 110 articles per 1,000,000 population. There is indeed a negative but weak correlation between the number of publications per 1,000,000 population and population. Denmark, the country that performed the best, published 195 articles per 1,000,000 population.

Table 3: Number of publications (in fractional counting) per 1,000,000 population for all KAs combined

Country	Code	Number of pubs. (2020)	Score (2020)	SQRT score (2020)	Score 0-1 (2020)	CAGR		
						2016 to 2020	Lead/gap to EU27	Lead/gap to MI
World	**World**	**185,365**	**24**	**4.89**	**0.26**	**7.2%**	**5.2%**	**0.2%**
EU27	**EU27**	**30,239**	**67**	**8.21**	**0.53**	**2.0%**	**0.0%**	**-5.0%**
MI	**MI**	**141,747**	**32**	**5.69**	**0.33**	**7.0%**	**5.0%**	**0.0%**
Cluster 1								
Denmark	DK	1,158	195	13.96	0.98	1.8%	-0.2%	-5.2%
Norway	NO	880	164	12.79	0.89	4.1%	2.1%	-2.9%
Rep. of Korea	KR	7,000	135	11.63	0.80	4.2%	2.2%	-2.8%
Finland	FI	735	133	11.53	0.79	0.0%	-2.0%	-7.0%
Estonia	EE	174	130	11.42	0.78	10.3%	8.3%	3.3%
Sweden	SE	1,314	127	11.26	0.77	-0.9%	-2.9%	-7.9%
Portugal	PT	1,189	115	10.74	0.73	7.4%	5.4%	0.4%
Cluster 2								
Australia	AU	2,804	109	10.45	0.70	3.1%	1.1%	-3.9%
Cyprus	CY	131	109	10.42	0.70	9.7%	7.7%	2.7%
Slovenia	SI	194	92	9.61	0.64	2.8%	0.8%	-4.2%
Luxembourg	LU	54	85	9.23	0.61	-7.5%	-9.5%	-14.5%
Latvia	LV	158	83	9.12	0.60	-2.2%	-4.2%	-9.2%
Ireland	IE	409	82	9.04	0.59	-0.8%	-2.8%	-7.8%
Canada	CA	3,043	80	8.95	0.58	-1.2%	-3.2%	-8.2%
Greece	EL	847	79	8.89	0.58	3.5%	1.5%	-3.5%
Italy	IT	4,567	77	8.76	0.57	4.3%	2.3%	-2.7%
Lithuania	LT	206	74	8.58	0.55	9.5%	7.5%	2.5%
United Kingdom	UK	4,906	72	8.51	0.55	1.5%	-0.5%	-5.5%
Spain	ES	3,375	71	8.44	0.54	4.0%	2.0%	-3.0%
Netherlands	NL	1,240	70	8.39	0.54	1.4%	-0.6%	-5.6%
Germany	DE	5,772	69	8.33	0.53	-0.5%	-2.5%	-7.5%
Belgium	BE	785	68	8.24	0.53	1.0%	-1.0%	-6.0%
Austria	AT	588	66	8.12	0.52	-4.2%	-6.2%	-11.2%
Czech Republic	CZ	696	65	8.06	0.51	0.6%	-1.4%	-6.4%
Cluster 3								
Croatia	HR	259	64	8.00	0.51	9.8%	7.8%	2.8%
Malta	MT	24	45	6.73	0.41	-3.7%	-5.7%	-10.7%
United Arab Emirates	AE	500	51	7.11	0.44	9.3%	7.3%	2.3%
Poland	PL	1,883	50	7.04	0.43	7.7%	5.7%	0.7%
United States	US	15,717	47	6.87	0.42	-2.0%	-4.0%	-9.0%
Slovakia	SK	242	44	6.66	0.40	0.9%	-1.1%	-6.1%
France	FR	2,921	43	6.55	0.39	-2.2%	-4.2%	-9.2%
Saudi Arabia	SA	1,492	43	6.55	0.39	20.1%	18.1%	13.1%
China	CN	60,151	42	6.48	0.39	13.2%	11.2%	6.2%
Romania	RO	751	39	6.24	0.37	1.4%	-0.6%	-5.6%
Japan	JP	4,732	38	6.13	0.36	-2.0%	-4.0%	-9.0%
Bulgaria	BG	256	37	6.08	0.36	16.7%	14.7%	9.7%
Hungary	HU	312	32	5.66	0.32	8.3%	6.3%	1.3%
Cluster 4								
Chile	CL	302	16	3.98	0.19	3.7%	1.7%	-3.3%
Brazil	BR	3,052	14	3.79	0.18	7.5%	5.5%	0.5%
India	IN	16,397	12	3.45	0.15	14.6%	12.6%	7.6%
Indonesia	ID	2,664	10	3.12	0.12	41.4%	39.4%	34.4%
Mexico	MX	1,053	8	2.86	0.10	10.3%	8.3%	3.3%

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Globally, the number of publications per 1,000,000 population increased at an annual rate of 7.2 % between 2016 and 2020, mostly driven by MI members (annual increase of 7.0 %), particularly China (13.2 %) and Saudi Arabia (20.1 %). The scores of Indonesia, India and Mexico also increased substantially (by 41.4 %, 14.6 % and 10.3 % annually,

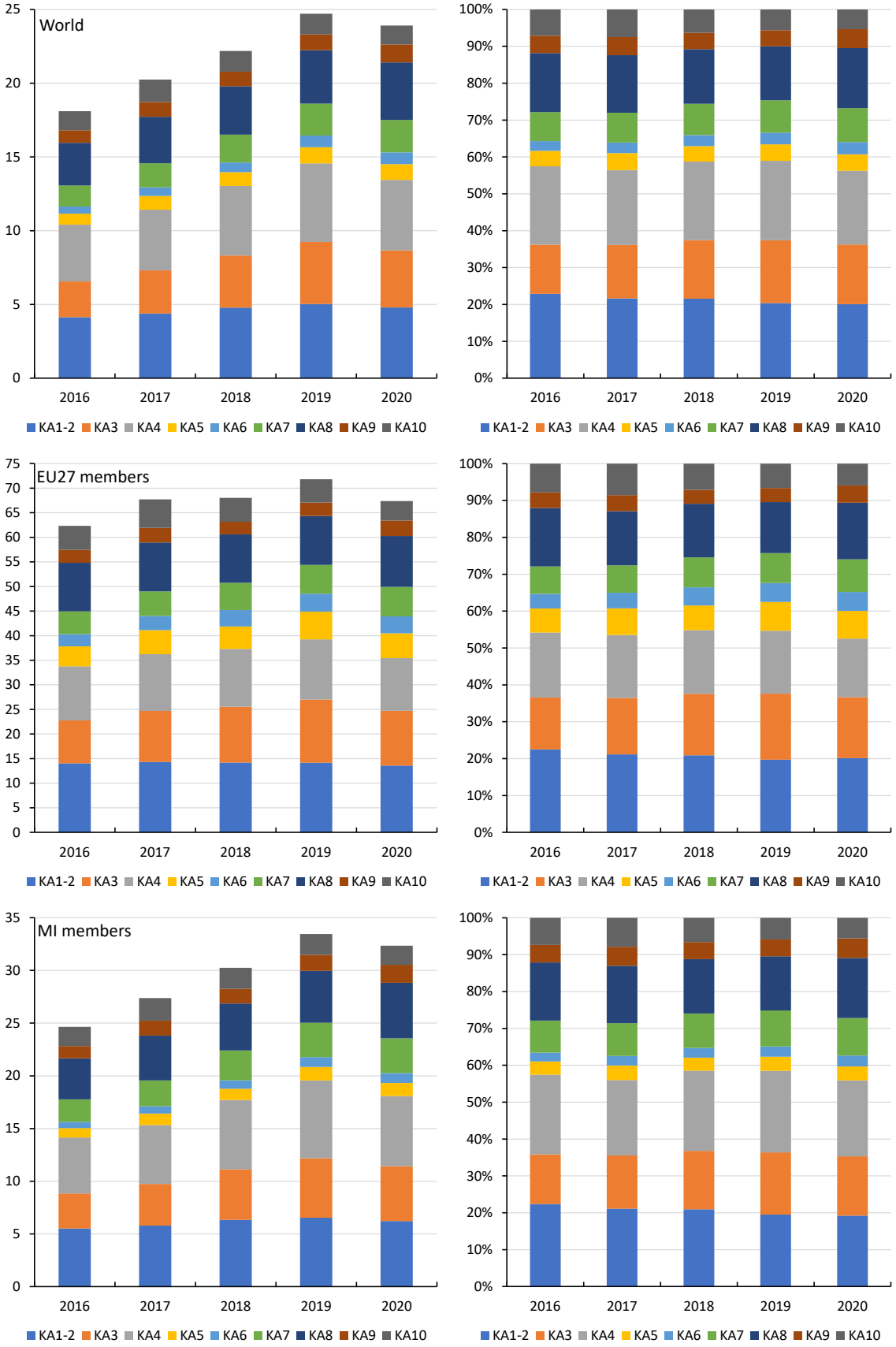
respectively), but these countries still remained in Cluster 4, indicating that their output per capita was quite low to begin with. The EU27's score during that time frame increased by 2.0 % annually. The EU27's two largest economies (Germany and France) saw their score decrease slightly during that time.

Figure 3 shows the number of publications per 1,000,000 population for the world, EU27 and MI members, by KA, between 2016 and 2020. Most of the world's publications in clean energy were focused in KA1-2 (renewables), KA3 (new technologies), KA4 (energy systems) and KA8 (renewable fuels), together accounting for 72.5 % of all publications in clean energy in 2020 (Figure 3, top right). Figure 3 (top left) shows that the number of publications per capita in clean energy increased steadily until 2019, but slightly decreased in 2020, even though the number of publications per capita continued to increase globally in all fields of science combined. The most notable decreases were observed in KA3 (new technologies), KA4 (energy systems) and KA10 (nuclear safety). At the opposite end of the scale, KA8 (renewable fuels) and KA9 (carbon capture) saw the strongest relative increases. The trend for the MI members is very similar in proportion to the global trend. The EU27 members' number of publications per capita in the field also increased until 2019, but in a smaller proportion compared to the global trend; its decrease in 2020 was proportionally larger than the global trend. The EU27's number of publications per capita still remained well above that of the MI members or the global average in all KAs, as mentioned previously.

It is worth mentioning that the observed decreases in 2020 are relative to 2019. In the First interim data and report series, an increase was observed between 2018 and 2019. This is because additional data for all publication years is continuously being added in Scopus with recent years being the most impacted. The slight decrease observed in 2020 for the world in all KAs combined might indicate that the scientific community did not further increase the yearly output in this area while in the global scientific output in Scopus kept increasing in 2020. As stated above, Scopus's 2020 coverage is 98 % complete. This may indicate stagnation in the growth of clean energy research, but it is too early to say. Research in areas not directly, or indirectly, related to the COVID-19 pandemic may have slowed down in 2020 and will likely later return to its expected level of growth.

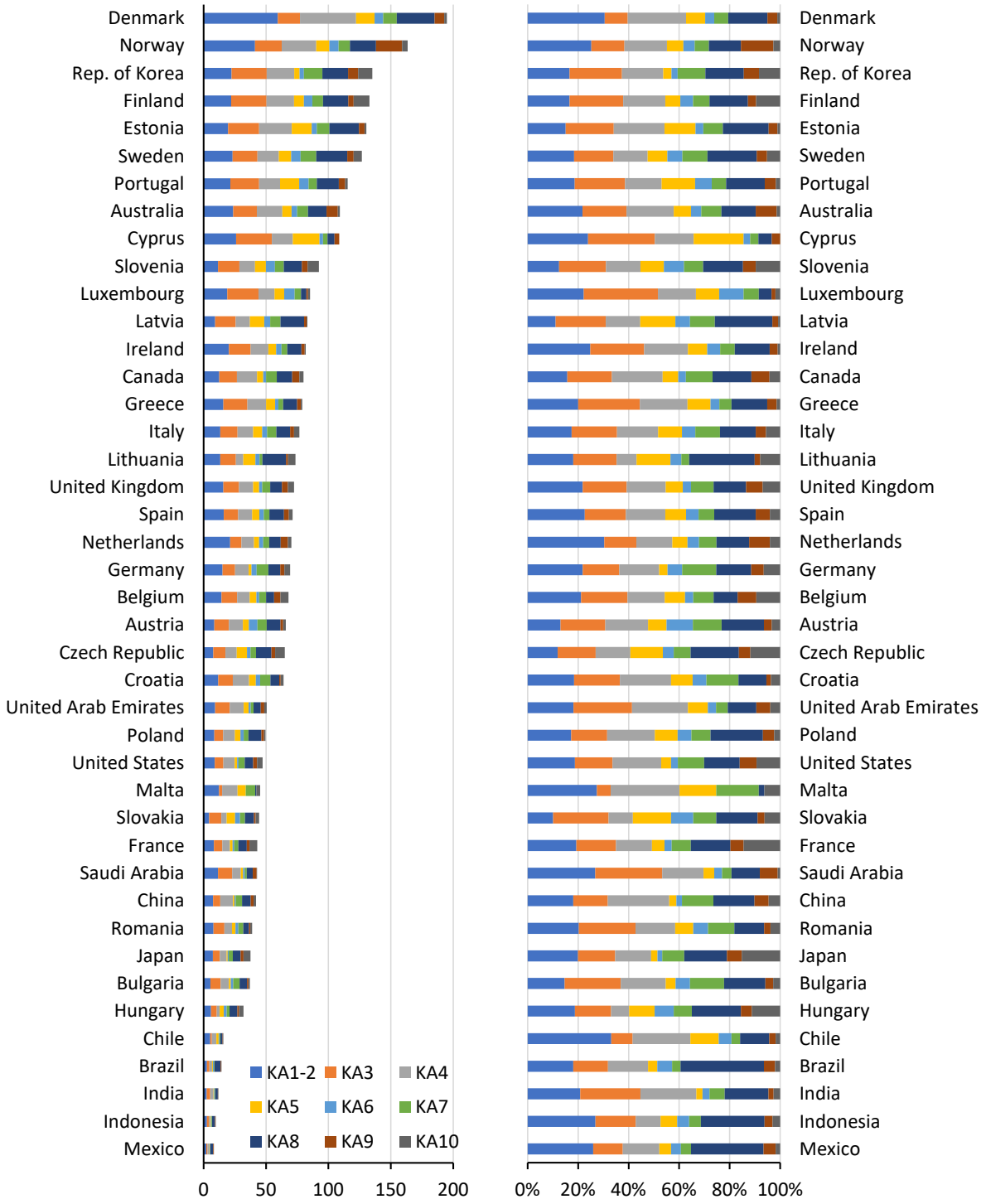
The number of publications per 1,000,000 population for each EU27 and MI member, in each KA and for 2020, is shown in Figure 4. KA1-2 (renewables) was a clear focus in clean energy research for all EU27 and MI members, comprising at least 10 % of their clean energy portfolio of publications. It was a particular focus for Chile (33.2 % of its total output in clean energy), Denmark (30.5 %) and the Netherlands (30.4 %). KA3 (new technologies) was also an important focus for many countries: it represented at least 20 % of the clean energy portfolio of 12 countries (led by Luxembourg, Saudi Arabia and Cyprus). Nine countries (led by Malta, China and Denmark) also had at least 20 % of their clean energy portfolio focused on KA4 (energy system). KA8 (renewable fuels) was also a strong focus for many countries, especially Brazil (33.0 %) and Mexico (28.7 %). No country focused more than 20 % of its clean energy portfolio of publications in any of the other KAs. The reader is referred to Annex 2 for each EU27 and MI member's performance trend, in each KA.

Figure 3: Number of publications per 1,000,000 population by KA (left) and the equivalent proportion (right) for the world, EU27 and MI members, 2016–2020



Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Figure 4: Number of publications per 1,000,000 population for each EU27 and MI member by KA (left) and the equivalent share of their total output across KAs (right) (2020)



Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

3.2 Specialisation index

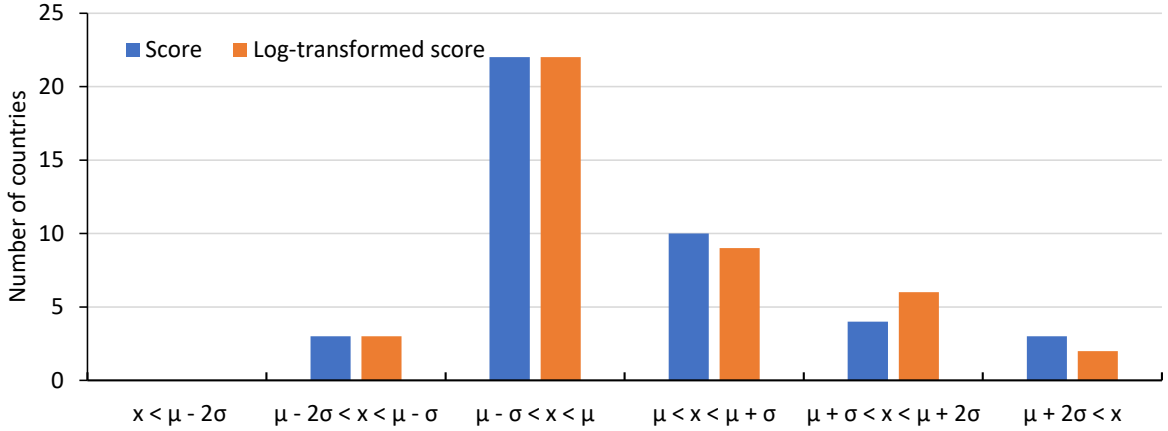
Box 3-2: Conclusion and summary

In the First interim data and report series, we concluded that the SI is a pertinent indicator to measure the level of research output in clean energy research and to be included in the CEII. However, for the CEII to focus exclusively on R&I performance in the traditional sense, the SI was excluded from the CEII. The level of research output is already well covered by the number of publications per capita.

EU27 members as a whole were not specialised in clean energy research, a trend that has worsened over the last five years, while the MI members' specialisation level was marginally better than the world level. Latvia, the United Arab Emirates, India and South Korea were the most specialised countries in clean energy research in 2020.

An entity's specialisation index (SI) is its research intensity in a given field (clean energy, in this case) relative to the world reference; for all KAs combined, it is equal to a country's share of Scopus output in clean energy (all KAs) divided by the same share at world level. In other words, when an entity is specialised in an area, it puts more emphasis, relative to the reference entity, on that area at the expense of others. It is, by definition, a normalised indicator. Therefore, it can be directly used to compare countries between themselves. The SI is calculated based on the number of fractional publications in clean energy, as well as the total number of fractional publications in Scopus. The outlier and break in time series tests were already applied to the number of fractional publications during the process described in Section 3.1; they were therefore not repeated here. The tests were applied to the total number of fractional publications in Scopus, which was substantial for all countries and as a result progressed smoothly. A few potential outliers were identified, but following a visual inspection, none of them seemed to diverge significantly away from their trend. Finally, the tests were applied to the SI itself. The outlier test identified no potential outlier for any country for all the KAs combined. It did identify potential outliers in a few KAs but for countries with a small publication output, which were ignored. The break in time series test revealed potentially problematic trends, none of which were deemed worthy of a correction.

Figure 5: Distribution of countries according to the mean and standard deviation of the specialisation index and the log-transformed equivalent (2020)



Source: These statistics were calculated using data from Scopus (Elsevier)

Table 4 further below shows the SI for 2020 and each EU27 and MI member, for all KAs combined, as well as the log-transformed and standardised (on a 0-to-1 scale) equivalents. Like the number of publications per capita, the SI is also exponentially distributed, meaning that most EU27 and MI members (25) were less specialised than the unweighted average (Figure 5). Applying the logarithm to the SI does flatten the distribution a bit, but it is still skewed toward lower-ranking countries. The log-transformed score was nevertheless used to standardise the score on a 0-to-1 scale.

It is worth mentioning that specialisation is a zero-sum game, meaning that a country cannot be specialised in all fields of research. Similarly, all countries cannot be specialised in the same field. Specialisation in any given field comes at the expense of other fields. That being said, a minority of the EU27 and MI members, 16 to be exact, were specialised in clean energy research (with a score above 1), meaning that larger shares of their publication outputs were in clean energy compared to what was observed at the world level. The EU27 as a whole was not specialised in clean energy research (score of 0.83; Table 4). Its score also decreased by 2.1 % annually between 2016 and 2020. EU27 members were in fact more specialised in fields such as psychology and cognitive sciences, economics and business, and clinical medicine, at the expense of other fields, such as information and communication technologies, and engineering. However, the most specialised country in clean energy research among all countries for which data were collected was Latvia, an EU27 member. It remained at the top in 2020 even though its SI had decreased by 6.8 % annually since 2016. The MI members were collectively more specialised in clean energy research than the EU27, but not far above the world level. Five MI members figure in Cluster 1. Three of them were in the top five for their absolute publication outputs in the field, having a significantly stronger impact than the other MI members in their collective SI; they are China (1st), India (2nd) and South Korea (4th) (Table 3). They also have a greater weighting than the EU27 members in Cluster 1 (i.e. Latvia, Estonia and Cyprus). To balance things out, the United States, which produced the 3rd largest number of publications in the field, was near last in specialisation. Like the EU27 members, the United States generally put a stronger relative focus on the fields of health science instead of those of applied science. The MI members' SI changed little between 2016 and 2020. The reader is referred to Annex 2 for a table with SI scores for each EU27 and MI member in each KA.

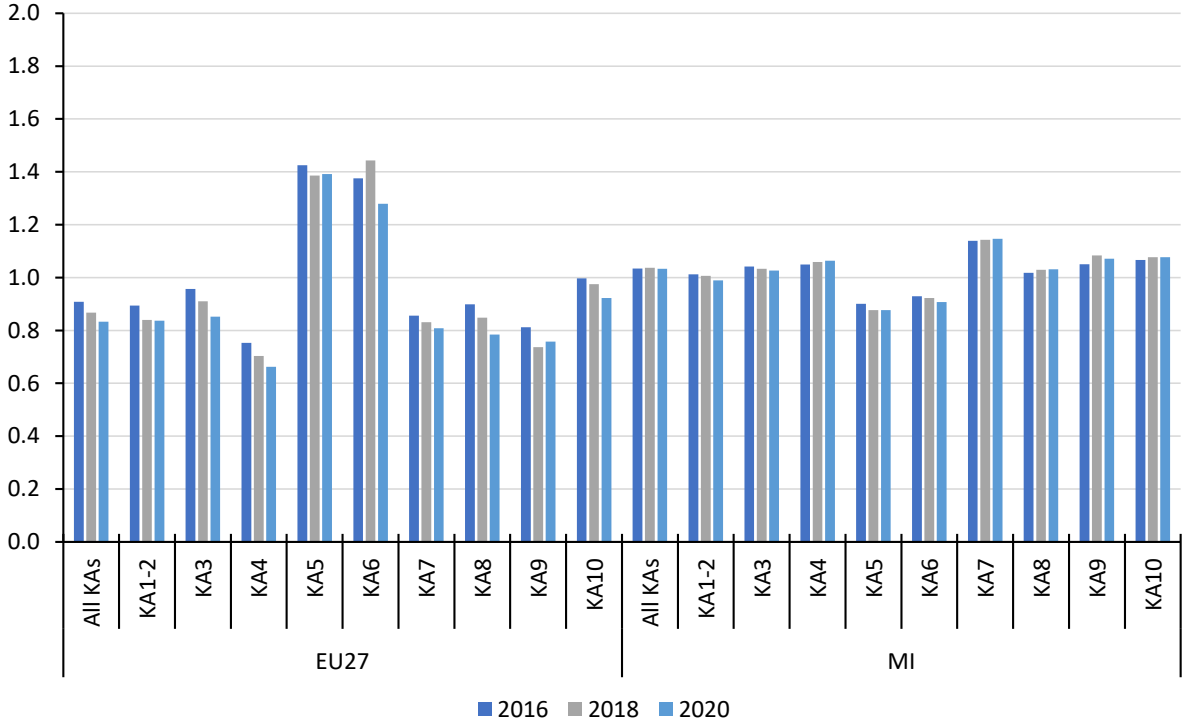
Figure 6 shows the evolution of the SI for the EU27 and MI members, in each KA, between 2016 and 2020. The world is not shown for the simple reason that the SI is benchmarked based on the global average, meaning that the SI at the world level equals one for all years and KAs. Following on from the discussion in the previous paragraph, even though the EU27 was not specialised in clean energy research, it maintained a level of specialisation above the world average in KA5 (new materials) and KA6 (energy efficiency). That said, its SI decreased in every KA from 2016 to 2020. MI members obtained a level of specialisation similar to the world average in all KAs combined and in most of them individually; collectively, its level of specialisation was slightly above the world average in KA7 but slightly below in KA5 (new materials) and KA6 (energy efficiency). The MI members' SI did not change significantly in any KA over the five-year period.

Table 4: Specialisation index for all KAs combined

Country	Code	Score (2020)	Log score (2020)	Score 0-1 (2020)	CAGR		
					2016 to 2020	Lead/gap to EU27	Lead/gap to MI
World	**World**	**1.00**	**0.69**	**0.35**	**0.0%**	**2.1%**	**0.0%**
EU27	**EU27**	**0.83**	**0.61**	**0.24**	**-2.1%**	**0.0%**	**-2.1%**
MI	**MI**	**1.03**	**0.71**	**0.37**	**0.0%**	**2.1%**	**0.0%**
Cluster 1							
Latvia	LV	1.74	1.01	0.74	-6.8%	-4.7%	-6.8%
United Arab Emirates	AE	1.68	0.99	0.71	-6.6%	-4.5%	-6.6%
India	IN	1.64	0.97	0.69	3.0%	5.1%	3.0%
Rep. of Korea	KR	1.60	0.95	0.67	-1.7%	0.4%	-1.7%
Estonia	EE	1.51	0.92	0.63	5.0%	7.1%	5.0%
China	CN	1.45	0.90	0.60	0.6%	2.7%	0.6%
Saudi Arabia	SA	1.34	0.85	0.54	1.1%	3.2%	1.1%
Cyprus	CY	1.28	0.82	0.51	-2.4%	-0.3%	-2.4%
Cluster 2							
Lithuania	LT	1.19	0.78	0.46	1.2%	3.3%	1.2%
Denmark	DK	1.19	0.78	0.46	-2.4%	-0.3%	-2.4%
Romania	RO	1.17	0.77	0.45	-0.5%	1.6%	-0.5%
Greece	EL	1.09	0.74	0.40	-1.9%	0.2%	-1.9%
Portugal	PT	1.08	0.73	0.39	-0.4%	1.7%	-0.4%
Bulgaria	BG	1.06	0.72	0.38	1.7%	3.8%	1.7%
Indonesia	ID	1.04	0.72	0.37	-8.3%	-6.2%	-8.3%
Norway	NO	1.02	0.71	0.36	-2.3%	-0.2%	-2.3%
Finland	FI	0.99	0.69	0.34	-3.0%	-0.9%	-3.0%
Cluster 3							
Sweden	SE	0.93	0.66	0.30	-3.7%	-1.6%	-3.7%
Luxembourg	LU	0.91	0.65	0.29	-9.5%	-7.4%	-9.5%
Italy	IT	0.85	0.62	0.25	-3.5%	-1.4%	-3.5%
Germany	DE	0.85	0.61	0.25	-2.9%	-0.8%	-2.9%
Mexico	MX	0.85	0.61	0.25	1.6%	3.7%	1.6%
Croatia	HR	0.83	0.60	0.23	2.8%	4.9%	2.8%
Poland	PL	0.82	0.60	0.23	3.3%	5.4%	3.3%
Spain	ES	0.79	0.58	0.21	-2.5%	-0.4%	-2.5%
Slovenia	SI	0.79	0.58	0.20	-0.7%	1.4%	-0.7%
Japan	JP	0.78	0.58	0.20	-4.4%	-2.3%	-4.4%
Czech Republic	CZ	0.75	0.56	0.18	1.0%	3.1%	1.0%
Canada	CA	0.73	0.55	0.17	-4.4%	-2.3%	-4.4%
Ireland	IE	0.73	0.55	0.17	-7.0%	-4.9%	-7.0%
Slovakia	SK	0.73	0.55	0.17	-0.2%	1.9%	-0.2%
Belgium	BE	0.73	0.55	0.16	-1.2%	0.9%	-1.2%
Brazil	BR	0.71	0.53	0.15	-0.2%	1.9%	-0.2%
Australia	AU	0.71	0.53	0.15	-1.2%	0.9%	-1.2%
France	FR	0.71	0.53	0.15	-2.4%	-0.3%	-2.4%
United Kingdom	UK	0.70	0.53	0.14	-2.0%	0.1%	-2.0%
Malta	MT	0.69	0.53	0.14	-12.0%	-9.9%	-12.0%
Austria	AT	0.67	0.52	0.12	-7.9%	-5.8%	-7.9%
Hungary	HU	0.67	0.51	0.12	2.0%	4.1%	2.0%
Cluster 4							
Netherlands	NL	0.58	0.46	0.05	-2.6%	-0.5%	-2.6%
United States	US	0.54	0.43	0.02	-5.4%	-3.3%	-5.4%
Chile	CL	0.52	0.42	0.00	-4.1%	-2.0%	-4.1%

Source: These statistics were calculated using data from Scopus (Elsevier)

Figure 6: Evolution of the SI for the EU27 and MI members, by KA, 2016–2020



Source: These statistics were calculated using data from Scopus (Elsevier)

3.3 Share of international co-publications

Box 3-3: Conclusion and summary

In the First interim data and report series, we concluded that the SIP is a pertinent indicator to measure the level of collaboration in clean energy research and to be included in the CEII. However, it was shown that smaller countries tend to collaborate relatively more frequently internationally than larger countries. For that reason and considering the fact that there was a desire for the CEII to focus exclusively on R&I performance in the traditional sense, the SIP was excluded from the CEII.

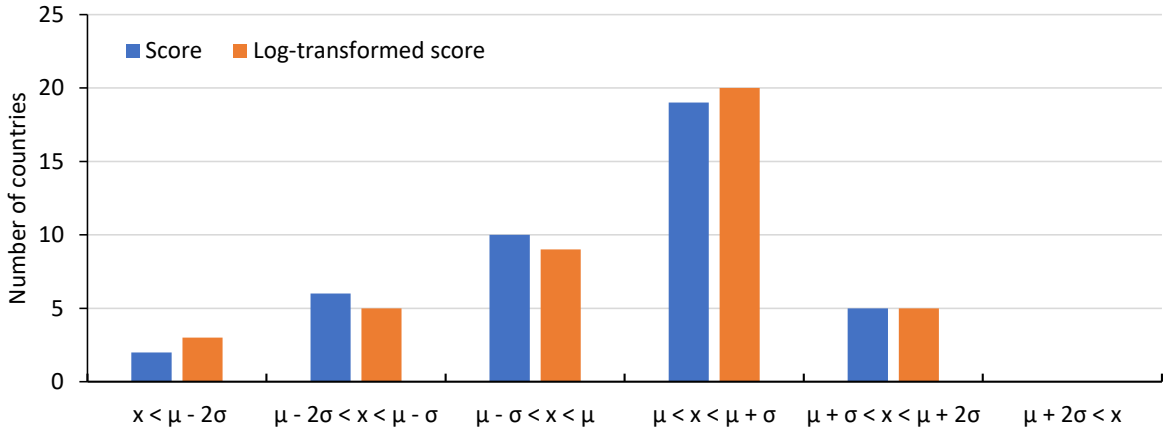
A larger share of the EU27's publications were international co-publications compared to the global average, a trend that changed little over the last five years. The MI members' share was slightly below the world average. Saudi Arabia, Luxembourg and the United Arab Emirates were the countries with the highest shares in 2020, above 75 %.

The share of international publications (SIP) is calculated based on the number of international co-publications and the total number of publications in clean energy research, both computed using a full count at country level but fractioned between KAs. The SIP is normalised by the world weighted average. The outlier and break in time series tests were first applied to the number of international co-publications, which flagged four potential outliers for all KAs combined: Denmark, South Korea, Saudi Arabia and the United States in 2020. Following an investigation, the data points were deemed to fall in line with the overall trend and were kept as is. The outlier test also identified many potential outliers in different KAs. However, the number of international co-publications at the country and KA levels is often low, and thus prone to yearly fluctuations, which was the basis to dismiss many of these flags. In other instances, the potential outliers were deemed to be in line with the overall trends. The total number of publications in clean energy research was also subjected to the test. It raised many of

the same flags that were identified in Section 3.1 for the number of publications in fractional count. In the end, all data points were deemed appropriate. The break in time series was also run on both series and found no unusual behaviour. Finally, the tests were run on the SIP itself. The outlier test identified two potential outliers for all the KAs combined: the Czech Republic and South Korea in 2020, which were not excessively out of line from the overall trend. It also identified a few potential outliers for some countries in some KAs. Following a visual inspection, it was decided to leave these data points as they were. The break in time series test identified some potential problematic breaks in the trends, none of which were deemed worthy of a correction.

The SIP does not behave like the indicators discussed so far in the sense that it is slightly skewed toward higher-ranking countries (Figure 7). Applying the logarithm to the SIP skews the distribution even more. For this reason, it was not transformed, which is why the log-transformed score is not included in Table 5. The standardisation on a 0-to-1 scale was done directly on the score.

Figure 7: Distribution of countries according to the mean and standard deviation of the share of international co-publications normalised by the world weighted average and the log-transformed equivalent (2020)



Source: These statistics were calculated using data from Scopus (Elsevier)

The SIP is shown in Table 5 for 2020 and all KAs combined and is normalised by the world weighted average (the 'score' column). Larger countries with an extensive network of universities and research centres are for the most part self-sufficient in terms of research needs and, as a result, collaborate internationally relatively less frequently than smaller countries. This dynamic is also at play among the EU27 and MI members in clean energy research, with a negative but weak correlation between publication output and the SIP. The United States, China and India, the world's largest economies based on purchasing power parity, figure among the countries that collaborated internationally proportionally the least. The fact that they are also MI members explains in large part why the MI members' collective SIP was below the world average, even though Saudi Arabia, an MI member, was the country that collaborated the most internationally relative to the world, along with the United Arab Emirates and Australia in 3rd and 5th place, respectively. The collective SIP for both the EU27 and MI members was calculated as the weighted average of all members that make up either group, and it considers co-publications shared between members of the same group as international co-publications. The EU27's collective SIP was above the world average. All EU27 members did obtain an SIP above the world average, except for Poland, Romania and Bulgaria. The EU27's and the MI members' SIP relative to the world weighted average was stable between 2016 and 2020. The reader is referred to Annex 2 for a table with SIP scores for each EU27 and MI member in each KA.

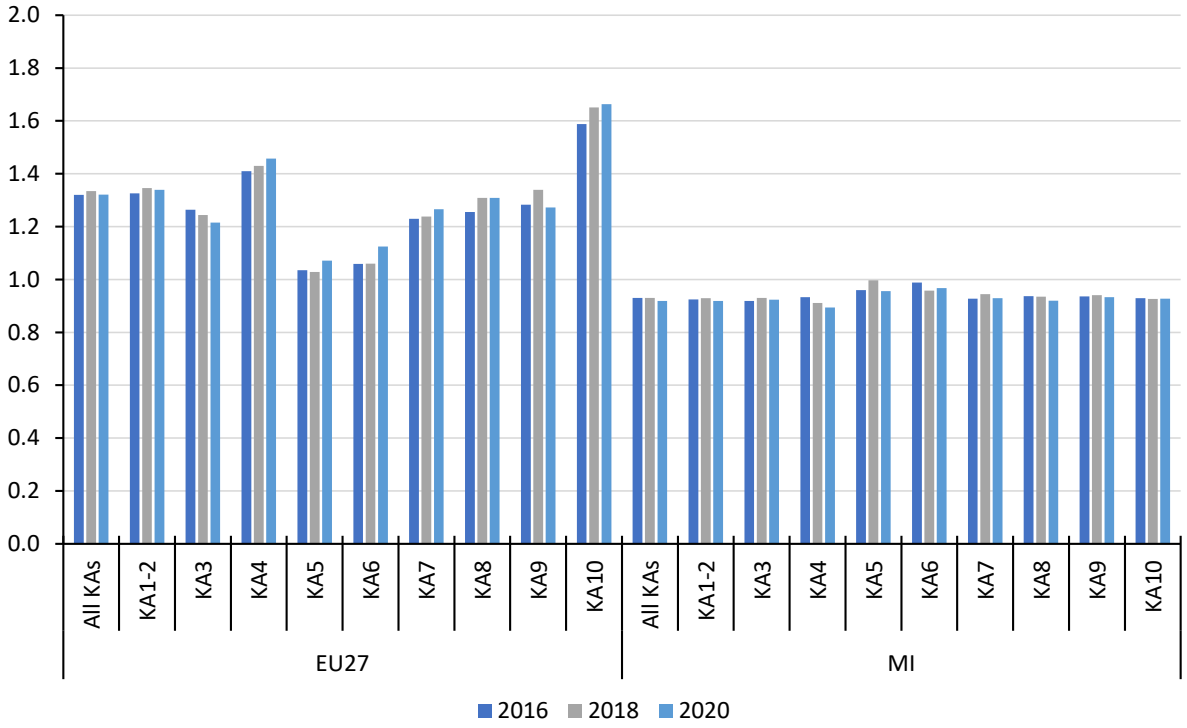
Table 5: Share of international co-publications for all KAs combined

Country	Code	SIP (2020)	Score (2020)	Score 0-1 (2020)	CAGR		
					2016 to 2020	Lead/gap to EU27	Lead/gap to MI
World	**World**	**43.0%**	**1.00**	**0.37**	**0.0%**	**0.0%**	**0.3%**
EU27	**EU27**	**56.8%**	**1.32**	**0.56**	**0.0%**	**0.0%**	**0.3%**
MI	**MI**	**39.5%**	**0.92**	**0.32**	**-0.3%**	**-0.3%**	**0.0%**
Cluster 1							
Saudi Arabia	SA	79.4%	1.85	0.88	-2.6%	-2.6%	-2.3%
Luxembourg	LU	78.4%	1.82	0.86	-0.8%	-0.8%	-0.5%
United Arab Emirates	AE	75.4%	1.75	0.82	1.4%	1.4%	1.7%
Denmark	DK	73.9%	1.72	0.80	1.0%	1.0%	1.3%
Australia	AU	72.4%	1.68	0.78	2.6%	2.6%	2.9%
Cluster 2							
Belgium	BE	70.9%	1.65	0.76	0.4%	0.4%	0.7%
Chile	CL	70.7%	1.64	0.76	-0.8%	-0.8%	-0.5%
United Kingdom	UK	70.0%	1.63	0.75	1.8%	1.8%	2.1%
Cyprus	CY	69.0%	1.60	0.73	1.4%	1.4%	1.7%
Estonia	EE	68.2%	1.58	0.72	4.7%	4.7%	5.0%
Finland	FI	67.8%	1.58	0.72	1.7%	1.7%	2.0%
Sweden	SE	67.2%	1.56	0.71	-1.1%	-1.1%	-0.8%
Netherlands	NL	67.2%	1.56	0.71	-1.3%	-1.3%	-1.0%
France	FR	67.1%	1.56	0.70	-0.2%	-0.2%	0.1%
Ireland	IE	66.6%	1.55	0.70	-0.6%	-0.6%	-0.3%
Norway	NO	63.6%	1.48	0.66	0.6%	0.6%	0.9%
Austria	AT	63.0%	1.46	0.65	0.1%	0.1%	0.4%
Malta	MT	61.5%	1.43	0.63	5.0%	5.0%	5.3%
Canada	CA	60.6%	1.41	0.61	2.9%	2.9%	3.2%
Slovenia	SI	60.1%	1.40	0.61	1.5%	1.5%	1.8%
Czech Republic	CZ	58.7%	1.36	0.59	6.2%	6.2%	6.5%
Lithuania	LT	58.0%	1.35	0.58	6.0%	6.0%	6.3%
Spain	ES	56.6%	1.32	0.56	-0.8%	-0.8%	-0.5%
Portugal	PT	55.9%	1.30	0.55	-0.4%	-0.4%	-0.1%
Cluster 3							
Slovakia	SK	54.7%	1.27	0.53	12.0%	12.0%	12.3%
Hungary	HU	52.8%	1.23	0.51	-1.6%	-1.6%	-1.3%
Germany	DE	52.3%	1.22	0.50	0.2%	0.2%	0.5%
Greece	EL	50.0%	1.16	0.47	-1.5%	-1.5%	-1.2%
United States	US	48.5%	1.13	0.45	2.0%	2.0%	2.3%
Italy	IT	47.1%	1.10	0.43	-0.6%	-0.6%	-0.3%
Latvia	LV	45.0%	1.04	0.40	13.4%	13.4%	13.7%
Croatia	HR	44.9%	1.04	0.40	0.4%	0.4%	0.7%
Mexico	MX	42.8%	0.99	0.37	-1.0%	-1.0%	-0.7%
Japan	JP	41.7%	0.97	0.35	3.9%	3.9%	4.2%
Cluster 4							
Poland	PL	37.8%	0.88	0.30	3.9%	3.9%	4.2%
Rep. of Korea	KR	34.7%	0.81	0.25	2.8%	2.8%	3.1%
Brazil	BR	34.7%	0.81	0.25	-0.6%	-0.6%	-0.3%
Romania	RO	32.8%	0.76	0.23	0.1%	0.1%	0.4%
Bulgaria	BG	30.2%	0.70	0.19	-13.4%	-13.4%	-13.1%
China	CN	24.4%	0.57	0.11	1.1%	1.1%	1.4%
Indonesia	ID	21.9%	0.51	0.08	-10.4%	-10.4%	-10.1%
India	IN	20.0%	0.47	0.05	3.2%	3.2%	3.5%

Source: These statistics were calculated using data from Scopus (Elsevier)

The evolution of the normalised SIP is shown in Figure 8 for the EU27 and MI members in each KA. The EU27's SIP was above average in all KAs. Its normalised SIP changed little between 2016 and 2020, except for a few KAs for which it slightly increased. KA10 (nuclear safety) was the KA in which the EU27 was most collaborative internationally. The MI members' SIP, on the other hand, stayed below the world weighted average in all KAs, with virtually no change over the five-year period in most of them.

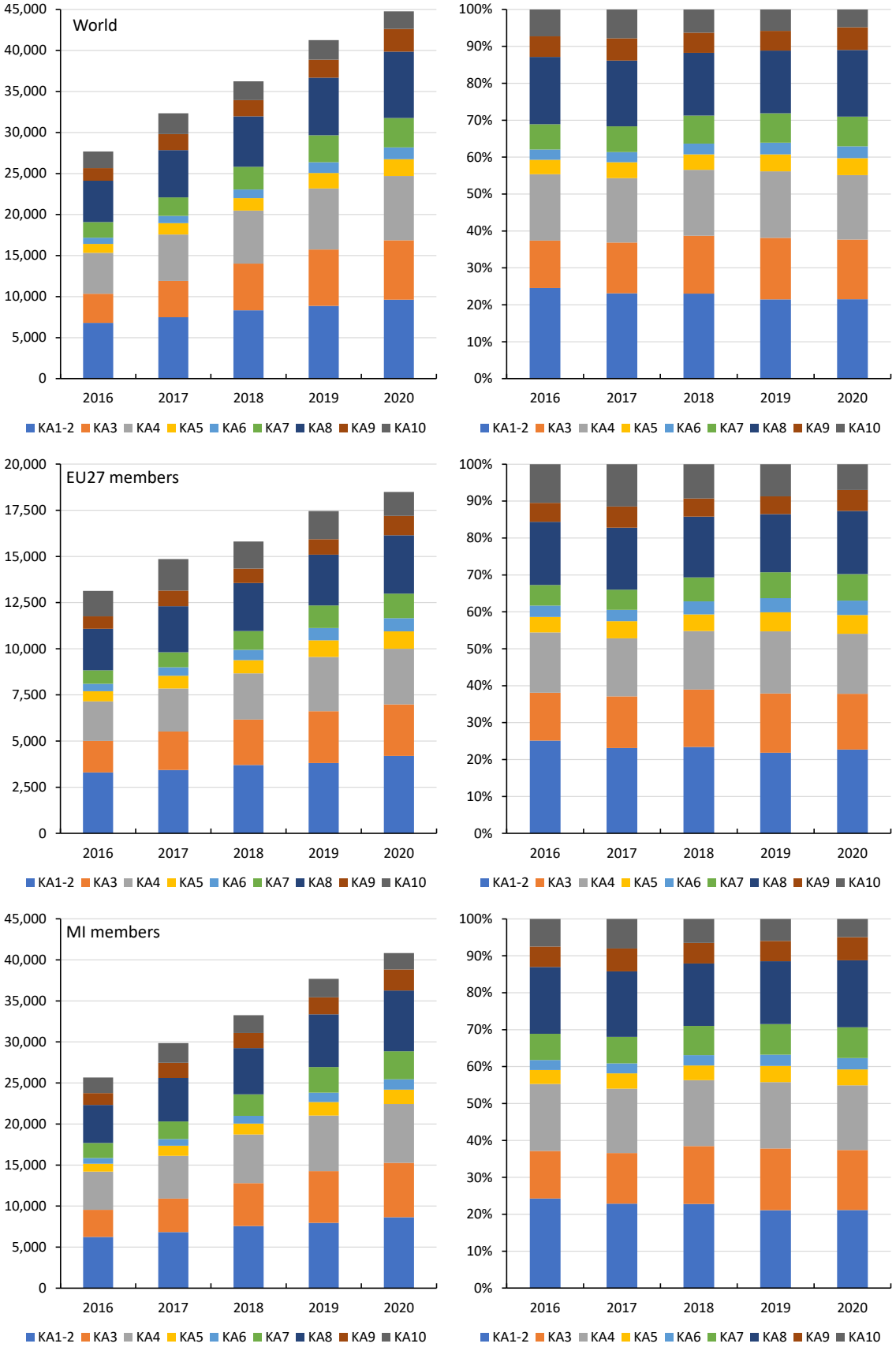
Figure 8: Evolution of the SIP normalised by the world weighted average for the EU27 and MI members, by KA, 2016–2020



Source: These statistics were calculated using data from Scopus (Elsevier)

Figure 9 shows the number of international co-publications for the world, EU27 and MI members, by KA, between 2016 and 2020. The number of international co-publications increased substantially from 2016 to 2020 (annual increase of 12.8 %), despite the total number of publications in clean energy falling worldwide in 2020. Most of the world's international co-publications in clean energy were focused in KA1-2 (renewables), KA3 (new technologies), KA4 (energy systems) and KA8 (renewable fuels), which is naturally in line with the number of publications per capita, given that the KAs with the most publications are likely to have the most international co-publications as well. All KAs experienced a substantial increase from 2016 to 2020 (i.e. above 10 % annually), except for KA1-2 (renewables; 9.1 % annual increase) and KA10 (nuclear safety; 1.6 % annual increase). MI members exhibit very similar trends, given their important contribution to the field. EU27 members also experience important increases in all KAs (except KA10), but not to the extent of MI members. Overall, emerging economies that are part of MI, such as China and India, are aggressively building their scientific networks globally, while the EU27's global networks were already well established, leaving less room for improvement.

Figure 9: Number of international co-publications by KA (left) and the equivalent proportion (right) for the world, EU27 and MI members, 2016–2020



Source: These statistics were calculated using data from Scopus (Elsevier)

3.4 Share of transnational co-publications

Box 3-4: Conclusion and summary

In the First interim data and report series, we concluded that the STP is a pertinent indicator to measure the level of collaboration in clean energy research and to be included in the CEII. However, given the fact that it is only computed for EU27 members and that it correlates well with the SIP, it was decided to exclude it from the CEII.

The weighted STP average for the EU27 in clean energy was 30.0 % in 2020. Luxembourg was the only country with an STP larger than 50 %.

The share of transnational co-publications (STP) is calculated as a member's number of transnational co-publications divided by its total number of publications in clean energy research. Contrary to the SIP, it only considers EU27 members as potential collaborators. It is normalised by the EU27's STP (calculated as a weighted average of the scores of all members). The number of transnational co-publications and the total number of publications are both computed using a full count at country level but fractioned between KAs, the latter of which was already tested for coherence in Section 3.3. The outlier test run on the number of transnational co-publications and the SIP identified no potential outlier for any EU27 member with a substantial number of publications. The break in time series test identified some potential problematic breaks in the trends, none of which were deemed worthy of a correction. The distribution of the STP (not shown) does not exhibit a clear pattern, given that it is based on a small sample of 27 countries. For that reason, it was not transformed and the standardisation on a 0-to-1 scale was done directly on the score. Both of these are shown in Table 6.

As was the case for international co-publications, larger EU27 members collaborated proportionately less frequently with other members than did smaller members. Cluster 1 is populated with three small-size and two mid-size countries. There is indeed a negative but small correlation between population and the STP. The EU27's largest economies – Germany, France and Italy – all sit at the lower end of Cluster 3. The STP is naturally smaller than the SIP, given that the STP considers a much smaller pool of countries that the EU27 members collaborated with; however, the SIP and the STP were well correlated. Luxembourg figures in Cluster 1 of both the SIP and the STP, in 2020, while Romania, Poland and Bulgaria all figure in Cluster 4 of both indicators. Denmark is somewhat of an oddity since it figures in Cluster 1 of the SIP distribution, with 73.9 % of its publications written in collaboration with an international partner. On the other hand, only 28.6 % of its publications were co-authored with at least another EU27 member, enough for a placing in Cluster 3. The reader is referred to Annex 2 for a table with STP scores for each EU27 member in each KA.

Table 6: Share of transnational co-publications for all KAs combined

Country	Code	STP (2020)	Score (2020)	Score 0-1 (2020)	CAGR	
					2016 to 2020	Lead/gap to EU27
EU27	**EU27**	**30.0%**	**1.00**	**0.32**	**0.0%**	**0.0%**
Cluster 1						
Luxembourg	LU	56.8%	1.89	0.86	-2.8%	-2.8%
Slovenia	SI	47.2%	1.57	0.67	5.0%	5.0%
Belgium	BE	46.8%	1.56	0.66	2.2%	2.2%
Malta	MT	46.2%	1.54	0.65	10.7%	10.7%
Austria	AT	44.4%	1.48	0.61	1.3%	1.3%
Cluster 2						
Estonia	EE	43.0%	1.43	0.58	0.5%	0.5%
Cyprus	CY	40.4%	1.35	0.53	-3.2%	-3.2%
Netherlands	NL	40.0%	1.33	0.52	-1.4%	-1.4%
Finland	FI	38.9%	1.30	0.50	2.3%	2.3%
Slovakia	SK	38.2%	1.27	0.48	8.2%	8.2%
Lithuania	LT	36.7%	1.22	0.45	9.0%	9.0%
Czech Republic	CZ	35.4%	1.18	0.43	6.6%	6.6%
Ireland	IE	34.9%	1.16	0.42	2.3%	2.3%
Sweden	SE	34.6%	1.15	0.41	1.1%	1.1%
Cluster 3						
Portugal	PT	31.6%	1.05	0.35	-1.6%	-1.6%
Greece	EL	29.7%	0.99	0.31	0.1%	0.1%
Hungary	HU	29.6%	0.98	0.31	1.1%	1.1%
Spain	ES	29.5%	0.98	0.31	-0.8%	-0.8%
Denmark	DK	28.6%	0.95	0.29	-2.7%	-2.7%
Croatia	HR	28.0%	0.93	0.28	0.7%	0.7%
Latvia	LV	28.0%	0.93	0.28	17.9%	17.9%
France	FR	27.3%	0.91	0.26	-1.1%	-1.1%
Italy	IT	26.4%	0.88	0.24	-0.5%	-0.5%
Germany	DE	25.5%	0.85	0.22	-0.7%	-0.7%
Cluster 4						
Romania	RO	22.0%	0.73	0.15	-0.3%	-0.3%
Poland	PL	21.5%	0.72	0.14	1.8%	1.8%
Bulgaria	BG	16.8%	0.56	0.05	-18.2%	-18.2%

Source: These statistics were calculated using data from Scopus (Elsevier)

3.5 Weighted eigenvector centrality in the world's co-publication network

Box 3-5: Conclusion and summary

In the First interim data and report series, we concluded that the WEC within the world's co-publication network was not a pertinent indicator to measure the level of collaboration in clean energy research, for the simple reason that it is highly correlated with the number of publications. Updated data from this report reaffirm this decision. Large countries tend to rank high for this indicator, even if they collaborated relatively less frequently with international partners than smaller countries. China and the United States were in fact the only countries to obtain a score above 0.5 in 2020.

The weighted eigenvector centrality (WEC)[11] was calculated twice: once for the EU27 and MI members among the world's co-publication network, discussed in this section, and once for the EU27 members among their own co-publication network, discussed in Section 3.6. The outlier and break in time series tests applied directly on the WEC flagged a few potentially problematic data points that were inspected but deemed appropriate. The WEC is heavily skewed toward lower-ranking countries, which are also the smallest. There is in fact a strong correlation between the WEC and the number of publications, which is expected given that the countries that publish many articles also tend to participate in many international co-publications, and as a result have diverse collaboration partners and play an important role in the collaboration network. Applying the logarithm does little to flatten the curve to a more normal-looking distribution (not shown), but it was log-transformed nonetheless, which was used to standardise it further on a 0-to-1 scale, shown in Table 7.

China obtained the highest WEC in 2020, with a score of 0.600, simply because it participated in 16,000 international co-publications, by far the most of any EU27 or MI member. The United States, with 11,000 international co-publications in clean energy, obtained the 2nd highest WEC of 0.519. No other country obtained a score above 0.3, and 30 of the EU27 and MI members obtained a score below 0.1. The same dynamic is at play in all the KAs, which are displayed in Annex 2.

[11] The WEC is a network indicator that measures the level of integration of an actor in a collaboration network. It integrates the number of actors to which a given actor is connected through co-authorship of publications, the intensity of those connections (number of co-publications between two actors), and the importance of the partnering actors to the network structure (connections to hubs are valued more than connections to peripheral actors). Scores for this indicator range from 0 to 1, with values close to 1 representing the most important actors in the network structure (typically major hubs with strong connections to a larger number of actors, including other influential players in the network) and 0 representing isolated entities (actors that are completely disconnected from the network).

Table 7: Weighted eigenvector centrality among the world's co-publication network

Country	Code	Eigen-vector (2020)	Log score (2020)	Score 0-1 (2020)	CAGR 2016 to 2020
Cluster 1					
China	CN	0.600	0.470	0.99	1.5%
United States	US	0.519	0.418	0.88	-2.0%
United Kingdom	UK	0.293	0.257	0.54	1.2%
Australia	AU	0.223	0.202	0.42	6.4%
Cluster 2					
Germany	DE	0.180	0.166	0.35	-5.6%
Canada	CA	0.158	0.146	0.31	1.0%
Rep. of Korea	KR	0.154	0.143	0.30	0.9%
India	IN	0.141	0.132	0.28	12.2%
Japan	JP	0.133	0.124	0.26	-4.2%
France	FR	0.121	0.114	0.24	-7.3%
Italy	IT	0.105	0.100	0.21	-5.6%
Saudi Arabia	SA	0.100	0.095	0.20	10.8%
Spain	ES	0.086	0.083	0.17	-7.7%
Denmark	DK	0.083	0.080	0.17	2.2%
Cluster 3					
Sweden	SE	0.071	0.069	0.14	-6.0%
Netherlands	NL	0.069	0.067	0.14	-4.9%
Belgium	BE	0.044	0.043	0.09	-3.6%
Norway	NO	0.040	0.039	0.08	0.8%
Brazil	BR	0.039	0.039	0.08	-3.8%
Finland	FI	0.038	0.038	0.08	-1.2%
Poland	PL	0.033	0.032	0.07	1.2%
Portugal	PT	0.032	0.031	0.07	-2.6%
United Arab Emirates	AE	0.028	0.027	0.06	9.8%
Czech Republic	CZ	0.025	0.025	0.05	4.3%
Austria	AT	0.025	0.025	0.05	-10.6%
Greece	EL	0.025	0.024	0.05	-3.9%
Ireland	IE	0.022	0.021	0.04	-6.6%
Mexico	MX	0.020	0.020	0.04	0.6%
Indonesia	ID	0.017	0.017	0.04	15.1%
Chile	CL	0.013	0.013	0.03	-1.5%
Romania	RO	0.010	0.010	0.02	-7.2%
Hungary	HU	0.008	0.008	0.02	-7.5%
Slovenia	SI	0.006	0.006	0.01	2.1%
Estonia	EE	0.006	0.006	0.01	19.8%
Cyprus	CY	0.006	0.006	0.01	11.4%
Slovakia	SK	0.006	0.006	0.01	15.4%
Lithuania	LT	0.005	0.005	0.01	5.4%
Croatia	HR	0.004	0.004	0.01	-5.9%
Luxembourg	LU	0.003	0.003	0.01	-16.3%
Bulgaria	BG	0.002	0.002	0.00	-19.0%
Latvia	LV	0.002	0.002	0.00	8.1%
Malta	MT	0.001	0.001	0.00	2.2%

Source: These statistics were calculated using data from Scopus (Elsevier)

3.6 Weighted eigenvector centrality in the Member States' co-publication network

Box 3-6: Conclusion and summary

In the First interim data and report series, we concluded that the WEC within the Member States' co-publication network was not a pertinent indicator to measure the level of collaboration in clean energy research, for the same reason discussed in Section 3.5. Updated data from this report reaffirm this decision. The EU27's largest economies – Germany, Italy, France and Spain – were the only countries to appear in Cluster 1 in 2020.

Whether the WEC was computed among the global network of countries or among EU27 members, the same conclusion can be drawn: the EU27's largest economies, those that also published the most articles, obtained the highest scores. Therefore, the distribution of the WEC within the EU27 network was also heavily skewed toward lower-ranking countries (not shown). The logarithm was applied to this indicator, which was used to standardise the indicator on a 0-to-1 scale, shown in Table 8. The outlier test identified only two possible outliers: the Netherlands' WEC in 2020 and Italy's WEC in 2018, both in KA8. Both were investigated and it was decided to leave them as they are.

Cluster 1 is composed of Germany, Italy, France and Spain, the EU27's largest economies, which are also those with the largest number of co-publications and the only countries to obtain a score above 0.3 in 2020. The WEC score for all EU27 members individually in 2020, for each KA, is tabulated in Annex 2.

Table 8: Weighted eigenvector centrality among the EU27's co-publication network

Country	Code	Eigen-vector (2020)	Log score (2020)	Score 0-1 (2020)	CAGR 2016 to 2020
Cluster 1					
Germany	DE	0.485	0.396	0.95	-1.4%
Italy	IT	0.411	0.344	0.83	0.3%
France	FR	0.390	0.329	0.79	-1.7%
Spain	ES	0.385	0.326	0.78	0.3%
Cluster 2					
Netherlands	NL	0.258	0.230	0.55	-0.1%
Belgium	BE	0.213	0.193	0.46	6.0%
Sweden	SE	0.203	0.185	0.44	0.8%
Denmark	DK	0.173	0.159	0.38	2.0%
Portugal	PT	0.156	0.145	0.35	2.4%
Finland	FI	0.136	0.128	0.30	4.6%
Austria	AT	0.133	0.125	0.30	-3.0%
Poland	PL	0.131	0.123	0.29	6.1%
Cluster 3					
Greece	EL	0.101	0.096	0.23	2.8%
Czech Republic	CZ	0.099	0.094	0.22	6.4%
Ireland	IE	0.065	0.063	0.15	1.7%
Romania	RO	0.056	0.055	0.13	-2.7%
Slovenia	SI	0.046	0.045	0.10	12.8%
Hungary	HU	0.030	0.030	0.07	-1.3%
Slovakia	SK	0.029	0.028	0.06	13.7%
Estonia	EE	0.025	0.024	0.05	19.9%
Croatia	HR	0.025	0.024	0.05	0.5%
Lithuania	LT	0.023	0.023	0.05	13.6%
Cyprus	CY	0.021	0.021	0.05	16.1%
Luxembourg	LU	0.019	0.019	0.04	-5.8%
Latvia	LV	0.014	0.014	0.03	21.7%
Bulgaria	BG	0.013	0.013	0.03	-8.1%
Malta	MT	0.007	0.007	0.01	20.5%

Source: These statistics were calculated using data from Scopus (Elsevier)

3.7 Share of open access publications

Box 3-7: Conclusion and summary

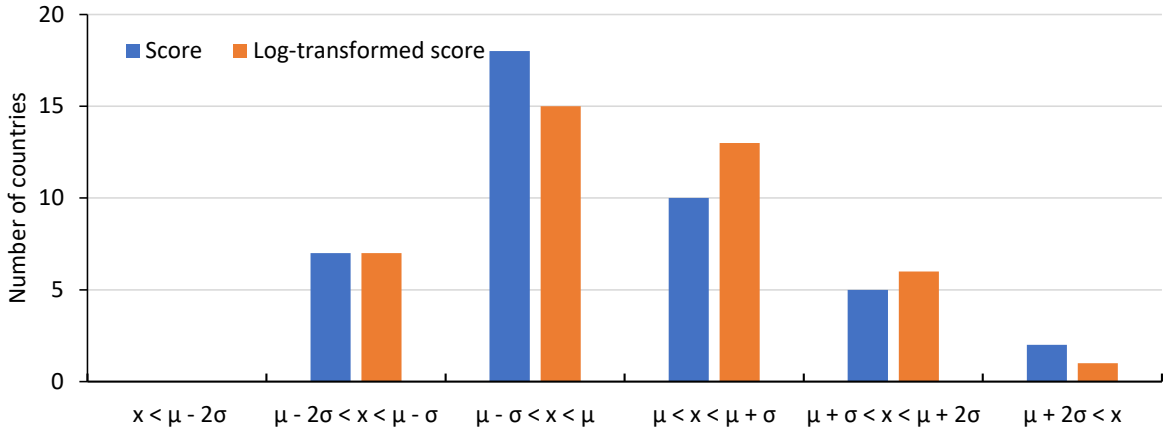
In the First interim data and report series, we concluded that the SOA is a pertinent indicator to measure the level of research accessibility in clean energy research and to be included in the CEII. However, for the CEII to focus exclusively on R&I performance in the traditional sense, the SOA was excluded from the CEII.

A larger share of the EU27's publications were available in open access compared to the global average, a trend that increased significantly over the last five years. The MI members' share was slightly below the world average. The United Kingdom, the Netherlands, Ireland and Denmark were the countries with the highest shares in 2018.

The share of open access publications (SOA) is calculated based on the number of publications available in open access and the total number of publications in clean energy research, which are both computed using a full count at country level but fractioned between KAs. The SOA is normalised by the world weighted average. As was mentioned in Section 2.1.3, the open access status of publications can only be assessed for those indexed in both Scopus and 1findr. The overlap between both databases has increased tremendously since the First interim data and report, with far more conference papers now indexed in 1findr. The outlier and break in time series tests were run on the overlapping total as well as the number of publications available in open access, and on the SOA itself. The test run on the number of open access publications flagged many potential outliers at the world, EU27 and MI levels. It also flagged potential outliers for many countries, in 2020, in many KAs, when a drop was often observed. The year 2020 is not included in the time frame of this indicator, but it is worth mentioning it given that these outliers are most likely accurate data points explained by the embargo effect discussed in Section 2.1.3, that being the period of time imposed by some publishers before an article can be made available in open access. Therefore, the drops observed in recent years justify dropping the two most recent years for this indicator; it is thus presented for the period 2014–2018 instead of the conventional period 2016–2020. Within this period of interest, two potential outliers for countries with a substantial number of publications were flagged: India's number of open access publications published in 2018 in KA3 (new technologies) and the EU27's SOA in KA5 (new materials) in 2018. Following a visual inspection, it was decided to leave these data points as they were. The break in time series test identified some potential problematic breaks in the trends, none of which were deemed worthy of a correction.

The SOA is slightly skewed toward below-average countries (Figure 10). Applying the logarithm to the SOA corrects the distribution to a more normal-looking curve. The log-transformed score is also shown in Table 9 as well as the standardised scores on a 0-to-1 scale, which was calculated based on the log-transformed score.

Figure 10: Distribution of countries according to the mean and standard deviation of the share of open access publications normalised by world weighted average and the log-transformed equivalent (2018)



Source: These statistics were calculated using data from Scopus (Elsevier) and 1findr

Table 9: Share of open access publications for all KAs combined

Country	Code	SOA (2018)	Score (2018)	Log score (2018)	Score 0-1 (2018)	CAGR		
						2014 to 2018	Lead/gap to EU27	Lead/gap to MI
World	**World**	**21.3%**	**1.00**	**0.69**	**0.38**	**0.0%**	**-4.0%**	**0.2%**
EU27	**EU27**	**28.3%**	**1.32**	**0.84**	**0.56**	**4.0%**	**0.0%**	**4.2%**
MI	**MI**	**20.2%**	**0.94**	**0.66**	**0.35**	**-0.2%**	**-4.2%**	**0.0%**
Cluster 1								
United Kingdom	UK	51.1%	2.40	1.22	1.00	8.9%	4.9%	9.1%
Netherlands	NL	46.3%	2.17	1.15	0.92	12.9%	8.9%	13.1%
Ireland	IE	41.3%	1.93	1.08	0.83	4.4%	0.4%	4.6%
Denmark	DK	40.3%	1.89	1.06	0.81	7.9%	3.9%	8.1%
Chile	CL	38.8%	1.82	1.04	0.78	4.1%	0.1%	4.3%
Hungary	HU	37.8%	1.77	1.02	0.76	-0.7%	-4.7%	-0.5%
Spain	ES	36.7%	1.72	1.00	0.74	3.0%	-1.0%	3.2%
Cluster 2								
Norway	NO	35.2%	1.65	0.97	0.71	14.3%	10.3%	14.5%
Lithuania	LT	33.6%	1.58	0.95	0.68	7.3%	3.3%	7.5%
Austria	AT	32.8%	1.54	0.93	0.66	6.5%	2.5%	6.7%
Luxembourg	LU	32.6%	1.53	0.93	0.65	2.2%	-1.8%	2.4%
Belgium	BE	32.0%	1.50	0.92	0.64	1.5%	-2.5%	1.7%
Croatia	HR	31.7%	1.49	0.91	0.64	-3.5%	-7.5%	-3.3%
Sweden	SE	31.1%	1.46	0.90	0.62	3.1%	-0.9%	3.3%
Finland	FI	29.3%	1.37	0.86	0.58	10.8%	6.8%	11.0%
Cyprus	CY	27.8%	1.30	0.83	0.54	4.4%	0.4%	4.6%
Slovenia	SI	26.5%	1.24	0.81	0.51	2.6%	-1.4%	2.8%
Portugal	PT	26.0%	1.22	0.80	0.50	-1.8%	-5.8%	-1.6%
France	FR	25.5%	1.20	0.79	0.49	2.5%	-1.5%	2.7%
Saudi Arabia	SA	25.5%	1.19	0.79	0.49	4.1%	0.1%	4.3%
Cluster 3								
Mexico	MX	25.1%	1.18	0.78	0.48	0.1%	-3.9%	0.3%
Estonia	EE	25.0%	1.17	0.78	0.48	5.4%	1.4%	5.6%
Poland	PL	24.8%	1.16	0.77	0.47	-3.5%	-7.5%	-3.3%
Germany	DE	24.3%	1.14	0.76	0.46	5.9%	1.9%	6.1%
Brazil	BR	24.0%	1.12	0.75	0.45	-3.9%	-7.9%	-3.7%
Czech Republic	CZ	23.8%	1.12	0.75	0.45	2.2%	-1.8%	2.4%
Italy	IT	23.3%	1.09	0.74	0.43	5.7%	1.7%	5.9%
Australia	AU	22.8%	1.07	0.73	0.42	-3.6%	-7.6%	-3.4%
Japan	JP	21.4%	1.00	0.69	0.38	-0.1%	-4.1%	0.1%
Greece	EL	21.2%	0.99	0.69	0.37	1.9%	-2.1%	2.1%
United States	US	20.0%	0.94	0.66	0.34	-4.1%	-8.1%	-3.9%
Slovakia	SK	19.7%	0.92	0.65	0.33	-5.5%	-9.5%	-5.3%
Rep. of Korea	KR	19.3%	0.91	0.64	0.32	0.0%	-4.0%	0.2%
Canada	CA	19.2%	0.90	0.64	0.32	-0.2%	-4.2%	0.0%
Latvia	LV	17.3%	0.81	0.59	0.26	-11.0%	-15.0%	-10.8%
Cluster 4								
United Arab Emirates	AE	16.4%	0.77	0.57	0.23	-2.0%	-6.0%	-1.8%
Indonesia	ID	15.1%	0.71	0.54	0.19	-11.4%	-15.4%	-11.2%
China	CN	14.6%	0.68	0.52	0.18	0.7%	-3.3%	0.9%
Romania	RO	12.4%	0.58	0.46	0.11	-5.0%	-9.0%	-4.8%
Bulgaria	BG	11.5%	0.54	0.43	0.07	-1.6%	-5.6%	-1.4%
Malta	MT	10.8%	0.51	0.41	0.05	-23.0%	-27.0%	-22.8%
India	IN	10.5%	0.49	0.40	0.04	-6.5%	-10.5%	-6.3%

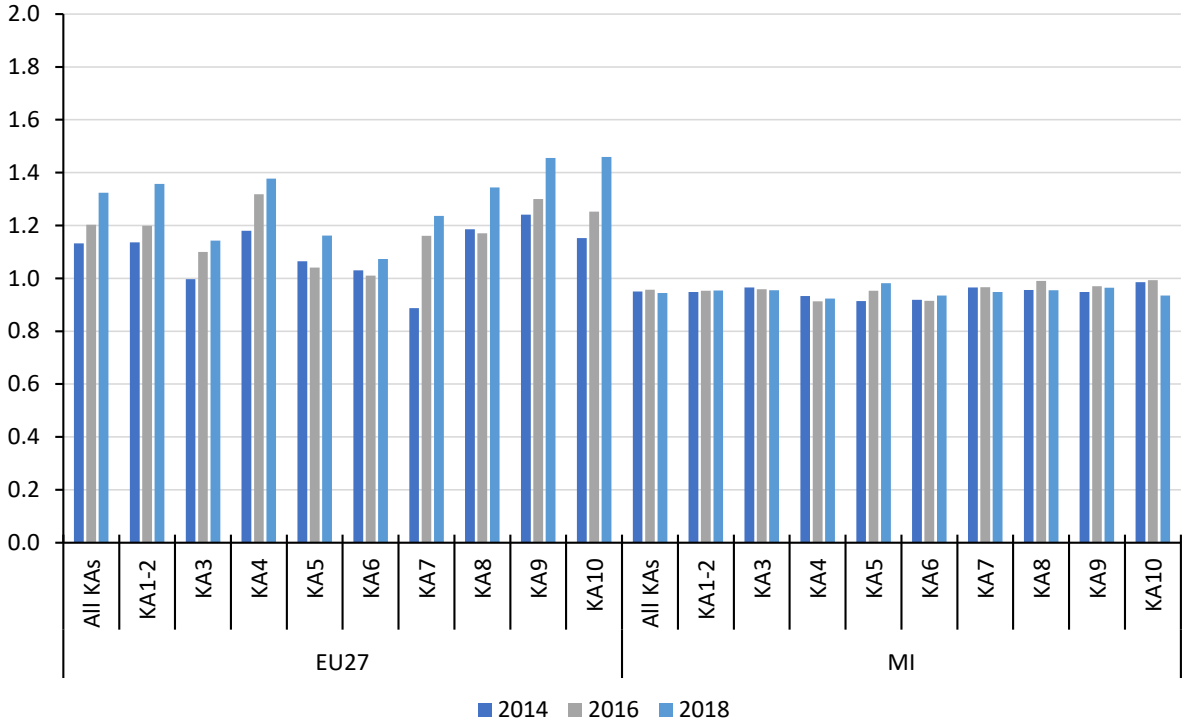
Source: These statistics were calculated using data from Scopus (Elsevier) and 1findr

The SOA is shown in Table 9 for 2018 and all KAs combined, with the SOA normalised by the world weighted average (the 'score' column). Including more conference papers resulted in a decrease of the SOA across the board compared to the one presented in the First interim data and report, given that a much smaller share of conference papers was

available in open access (3.8 % in all fields of science combined between 2014 and 2018) compared to research articles (43.5 %). It might be more challenging to retrieve conference papers online, compared to journal articles, given that conference proceedings are sometimes delivered as PDF compendiums without parsed metadata. The metadata of conference proceedings are also less uniform compared to journal articles. As a result, the SOA might be underestimated. But regardless, the normalised SOA remained comparable to the one presented in the First interim data and report. Globally, 21.3 % of clean energy publications published in 2018 were available in open access. The EU's policy on open access appears to be bearing fruit, since the EU27's SOA was higher, at 28.3 %. In fact, Slovakia, Latvia, Romania, Bulgaria and Malta were the only EU27 members to have obtained an SOA notably below the world weighted average (the SOA for Greece was also below this average, but only by 0.1 %). All countries in Cluster 1 are EU27 members, except for the United Kingdom in 1st position, which was an EU member until recently, and Chile in 5th position. Many of these countries' normalised SOA scores increased substantially between 2014 and 2018, as did the EU27's collective SOA, by 4.0 % annually. In contrast, MI members tended to have published relatively few of their clean energy publications in open access. China and India, two of the world's largest economies, published less than 15 % of their clean energy publications in open access. There was indeed a negative but weak correlation between population and SOA. The reader is referred to Annex 2 for a table with SOA scores for each EU27 and MI member in each KA.

The evolution of the normalised SOA is shown in Figure 11 for the EU27 and MI members in each KA. Not only was the EU27's SOA above average in all KAs, but it increased substantially in nearly all of them as well. The MI members' SOA, on the other hand, was below the world weighted average in all KAs. It changed little over the five-year period except for a notable increase in KA5 (new materials) counterbalanced by a notable decrease in KA10 (nuclear safety).

Figure 11: Evolution of the SOA normalised by the world weighted average for the EU27 and MI members, by KA, 2014–2018



Source: These statistics were calculated using data from Scopus (Elsevier) and 1findr

3.8 Share of public/private co-publications

Box 3-8: Conclusion and summary

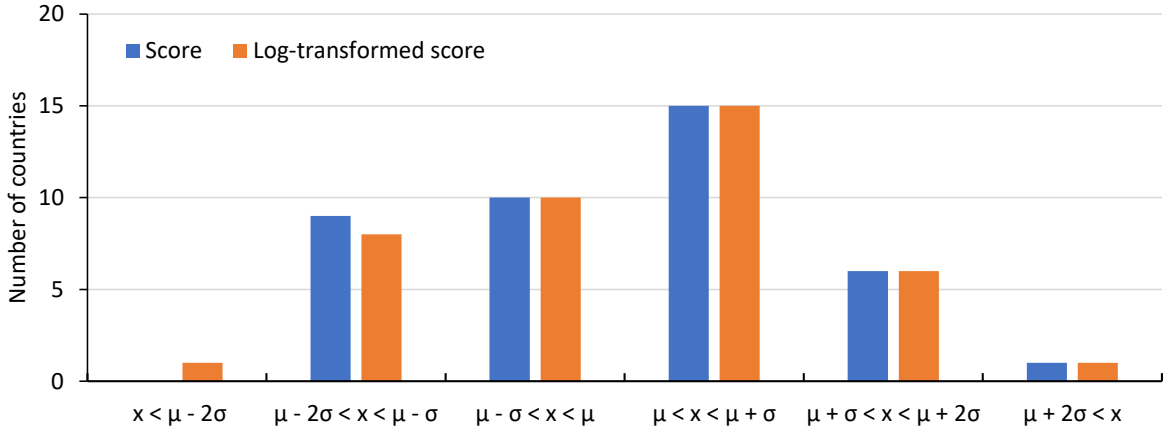
In the First interim data and report series, we concluded that the SPP is a pertinent indicator to measure the level of collaboration fuelling knowledge transfer from the public sector (particularly academia) to the private sector in clean energy research and to be included in the CEII. However, for the CEII to focus exclusively on R&I performance in the traditional sense, the SPP was excluded from the CEII.

The global weighted SPP average was 10.0 % in clean energy in 2020. Both EU27 and MI members as groups performed better than the global average for this indicator. Austria is the only country with a share above 20 %.

The share of public/private co-publications (SPP) is calculated based on the number of public/private co-publications and the total number of publications in clean energy research. It is normalised by the world weighted average. The number of public/private co-publications and the total number of publications are both computed using a full count at country level but fractioned between KAs. The total number of publications has already been tested for coherence in other indicators. The outlier and break in time series tests were therefore applied on the number of public/private co-publications and on the SPP itself. The outlier test run on the number of public/private co-publications identified a single potential outlier: Australia for all KAs combined in 2020, which fell in line with the decrease observed in clean energy output globally. In fact, the number of public/private co-publications decreased for many countries in 2020, but not significantly enough to be flagged by the outlier test. The test run on the SPP identified no potential outlier for any of the KAs. Finally, the break in time series test identified some potential problematic breaks in the trends, none of which were deemed worthy of a correction. Again, it is worth mentioning that public/private collaborations are rare occurrences. As a result, the number of public/private co-publications is often low and can fluctuate significantly from one year to the next, even for countries with a substantial number of publications.

The distribution of the SPP exhibits a somewhat normal-looking distribution with a slight skew toward above-average countries (Figure 12). Applying the logarithm to the SPP slightly reduced that skewness. The log-transformed score is included in Table 10, and the standardisation on a 0-to-1 scale was calculated based on the transformed values.

Figure 12: Distribution of countries according to the mean and standard deviation of the share of public/private co-publications normalised by the world weighted average and the log-transformed equivalent (2020)



Source: These statistics were calculated using data from Scopus (Elsevier)

Table 10: Share of public/private co-publications for all KAs combined

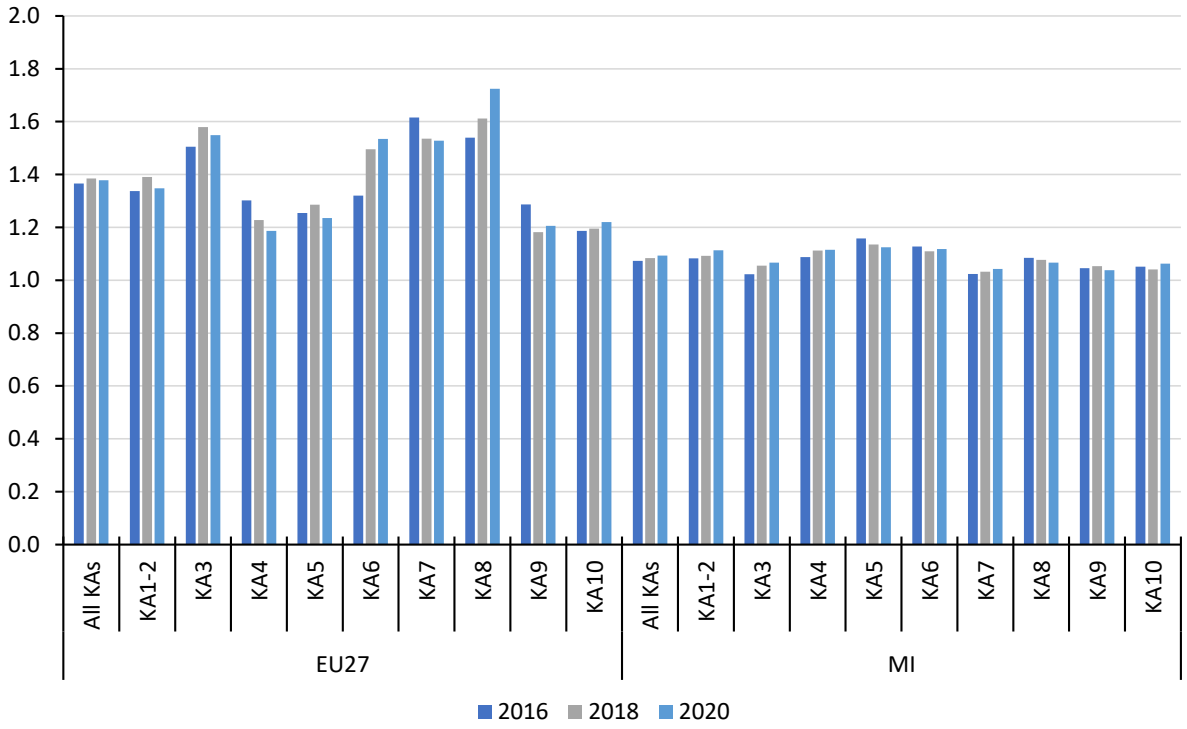
Country	Code	SPP (2020)	Score (2020)	Log score (2020)	Score 0-1 (2020)	CAGR		
						2016 to 2020	Lead/gap to EU27	Lead/gap to MI
World	**World**	**10.0%**	**1.00**	**0.69**	**0.46**	**0.0%**	**-0.2%**	**-0.4%**
EU27	**EU27**	**13.7%**	**1.38**	**0.87**	**0.60**	**0.2%**	**0.0%**	**-0.2%**
MI	**MI**	**10.9%**	**1.09**	**0.74**	**0.49**	**0.4%**	**0.2%**	**0.0%**
Cluster 1								
Austria	AT	24.6%	2.47	1.24	0.93	0.7%	0.5%	0.3%
Croatia	HR	18.5%	1.86	1.05	0.76	6.4%	6.2%	6.0%
Sweden	SE	18.4%	1.84	1.05	0.76	1.0%	0.8%	0.6%
Malta	MT	17.9%	1.80	1.03	0.74	21.7%	21.5%	21.3%
Germany	DE	17.8%	1.78	1.02	0.74	1.6%	1.4%	1.2%
Slovenia	SI	17.6%	1.76	1.02	0.73	1.8%	1.6%	1.4%
Netherlands	NL	17.3%	1.74	1.01	0.72	-1.8%	-2.0%	-2.2%
Finland	FI	16.9%	1.69	0.99	0.71	0.1%	-0.1%	-0.3%
Cluster 2								
Luxembourg	LU	16.2%	1.63	0.97	0.69	-2.2%	-2.4%	-2.6%
Cyprus	CY	15.4%	1.55	0.94	0.66	24.4%	24.2%	24.0%
Belgium	BE	15.4%	1.55	0.93	0.66	2.8%	2.6%	2.4%
Norway	NO	14.9%	1.49	0.91	0.64	-4.8%	-5.0%	-5.2%
Japan	JP	14.9%	1.49	0.91	0.64	-0.2%	-0.4%	-0.6%
Greece	EL	14.4%	1.45	0.89	0.63	11.7%	11.5%	11.3%
Denmark	DK	13.9%	1.40	0.88	0.61	-2.0%	-2.2%	-2.4%
Ireland	IE	13.2%	1.32	0.84	0.58	-3.9%	-4.1%	-4.3%
France	FR	13.0%	1.31	0.84	0.58	-2.9%	-3.1%	-3.3%
Italy	IT	12.8%	1.28	0.83	0.57	1.5%	1.3%	1.1%
Hungary	HU	12.6%	1.26	0.82	0.56	0.0%	-0.2%	-0.4%
China	CN	12.3%	1.23	0.80	0.55	6.7%	6.5%	6.3%
United Kingdom	UK	12.2%	1.23	0.80	0.55	0.1%	-0.1%	-0.3%
Canada	CA	12.0%	1.21	0.79	0.54	3.1%	2.9%	2.7%
United States	US	11.4%	1.15	0.76	0.52	-0.7%	-0.9%	-1.1%
Cluster 3								
Spain	ES	10.1%	1.01	0.70	0.46	-0.9%	-1.1%	-1.3%
Estonia	EE	10.0%	1.01	0.70	0.46	9.3%	9.1%	8.9%
Rep. of Korea	KR	9.2%	0.92	0.65	0.42	0.4%	0.2%	0.0%
Romania	RO	8.4%	0.84	0.61	0.39	5.0%	4.8%	4.6%
Czech Republic	CZ	8.2%	0.82	0.60	0.38	-0.5%	-0.7%	-0.9%
Slovakia	SK	8.1%	0.82	0.60	0.37	1.6%	1.4%	1.2%
Portugal	PT	8.0%	0.81	0.59	0.37	2.4%	2.2%	2.0%
Poland	PL	7.6%	0.76	0.56	0.35	9.7%	9.5%	9.3%
Bulgaria	BG	6.7%	0.67	0.51	0.30	3.9%	3.7%	3.5%
Australia	AU	6.0%	0.60	0.47	0.26	-3.5%	-3.7%	-3.9%
Cluster 4								
United Arab Emirates	AE	5.6%	0.56	0.44	0.24	2.4%	2.2%	2.0%
Latvia	LV	5.5%	0.55	0.44	0.24	4.0%	3.8%	3.6%
Lithuania	LT	5.2%	0.52	0.42	0.22	-6.8%	-7.0%	-7.2%
Brazil	BR	5.1%	0.51	0.41	0.21	-7.4%	-7.6%	-7.8%
Saudi Arabia	SA	4.4%	0.45	0.37	0.18	-4.6%	-4.8%	-5.0%
Chile	CL	4.2%	0.42	0.35	0.16	-4.0%	-4.2%	-4.4%
Mexico	MX	3.9%	0.39	0.33	0.14	2.9%	2.7%	2.5%
India	IN	2.6%	0.26	0.23	0.06	-5.3%	-5.5%	-5.7%
Indonesia	ID	1.7%	0.17	0.16	0.00	-7.2%	-7.4%	-7.6%

Source: These statistics were calculated using data from Scopus (Elsevier)

The SPP is shown in Table 10 for 2020 and all KAs. The 'score' column presents the values normalised by the world weighted average. The public and private sectors have different priorities regarding scientific research and publishing. It is a top priority for the public sector (particularly higher education), whereas R&D performed by the private

sector is generally more focused on higher technology readiness levels targeting economic profitability. As a result, there is a lower propensity to publish on the part of researchers in corporate R&D organisations. That being said, the private sector does participate in scientific research and publishing, particularly if it foresees a potential economic benefit from that research. Additionally, governments are emphasising the need for public/private partnerships to promote knowledge transfer toward innovation (and ultimately socioeconomic returns), as R&D is one of the core mechanisms they rely on to improve standards of living and their economic competitiveness. Data in Table 10 suggest that 10.0 % of clean energy publications were borne out of collaboration between the public and private sectors in 2020 globally. Given that such a small share of publications are public/private partnerships, to avoid excessive fluctuations and scores that are not necessarily representative of typical performance, a minimum of 30 publications was required to compute the score of any combination of country, KA and year. For all KAs combined in 2020, this did not affect any country, but for individual KAs, a few countries were affected in some years (see Annex 2). The EU27 generally scored above world level (10 %) in this regard, with 13.7 % of its publications borne out of such a public/private collaboration in clean energy research. The MI members' share of 10.9 % was also slightly higher than the world weighted average. All countries in Cluster 1 are EU27 members, and all but two countries in Cluster 4 are MI members. Both EU27 and MI members as aggregates saw little change in their score over the last five years. The reader is referred to Annex 2 for a table with SPP scores for all EU27 and MI members individually in each KA.

Figure 13: Evolution of the SPP normalised by the world weighted average for the EU27 and MI members, by KA, 2016–2020



Source: These statistics were calculated using data from Scopus (Elsevier)

The evolution of the normalised SPP is shown in Figure 13 for the EU27 and MI members in each KA. As mentioned previously, the EU27's SPP changed little over the study period in all KAs combined. However, at the KA level, there was quite a lot of movement and fluctuation, with a notable increase in KA6 (energy efficiency) and KA8 (renewable fuels),

but a notable decrease in KA4 (energy system) and KA7 (e-mobility). The MI members saw a slight increase in KA1-2 (renewables), KA3 (new technologies) and KA4 (energy system), but a slight decrease in KA5 (new materials).

3.9 Share of highly cited publications among the 10 % most cited

Box 3-9: Conclusion and summary

In the First interim data and report series, we concluded that the share of $HCP_{10\%}$ is a pertinent indicator to measure the level of research impact in clean energy research, even though some countries did not meet the 30-publication threshold in some KAs, and that it should be included in the CEII. This report reaffirms this conclusion.

In 2018, 15.0 % of clean energy publications globally were among the top 10 % most cited, indicating that clean energy is a hot research topic. The MI members collectively performed slightly better than the world level, whereas the EU27 members performed slightly worse. The EU27's trend has declined significantly over the last five years. Luxembourg, Australia, Denmark and Saudi Arabia are the only countries to have more than 20 % of their clean energy publications among the 10 % most cited.

The share of highly cited publications among the 10 % most cited ($HCP_{10\%}$) is calculated based on the number of publications among the 10 % most cited and the total number of publications in clean energy research, both computed using a fractional count. Recall that only publications with an RC score are included, which excludes conference papers. The publications that figure among the 10 % most cited are part of an elite group. At the country and KA levels, this results in a small number of publications, even for countries with a large output, which is compounded by the fact that a fractional count is used. Nevertheless, when disregarding countries that did not meet the 30-publication threshold, only a few flags were raised by the outlier and break in time series tests run on the number of publications among the 10 % most cited; they were investigated and deemed appropriate. The tests were also run on the total number of publications without conference papers, in fractional counting (the share's denominator), which also often resulted in small numbers at the country and KA levels. Again, few potential outliers were flagged, none of which were problematic. The test run on the share of $HCP_{10\%}$ flagged no potential outliers.

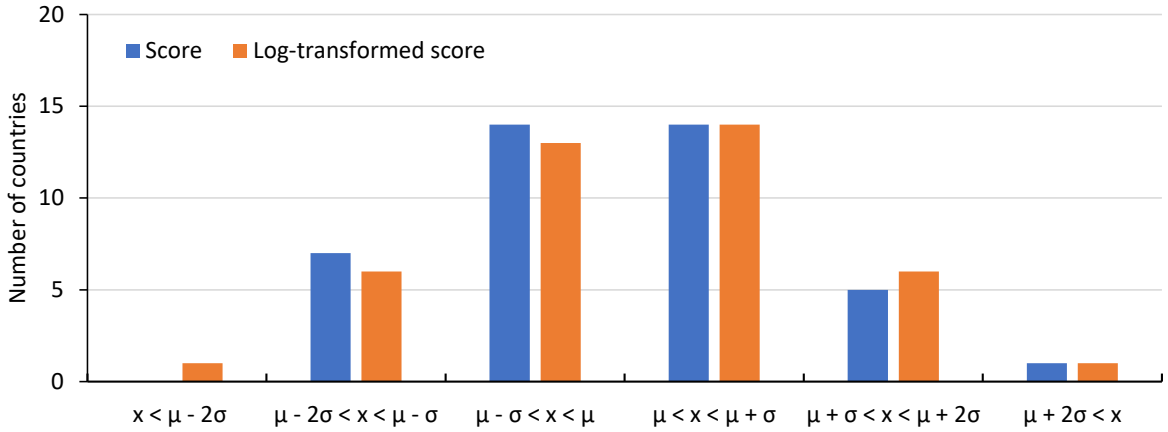
The EU27 and MI members' shares of $HCP_{10\%}$ were near normally distributed, as can be seen in

Figure 14. The logarithm slightly skews the distribution toward above-average countries; transforming the $HCP_{10\%}$ was therefore unnecessary, which is why there is no transformed score included in Table 11. The score was used to standardise this indicator on a 0-to-1 scale.

The share of $HCP_{10\%}$ is shown in Table 11 for 2018 and all KAs combined. The 'score' column is the share of $HCP_{10\%}$ multiplied by 10 to reflect an expected score centred at 1, similar to most indicators in this report; however, the RC scores of the publications in the KA data sets are based on the whole of Scopus and were not renormalised by KA, instead relying on the normalisation based on the 174 subfields of Science-Metrix's classification of science. Therefore, an $HCP_{10\%}$ share of 1.50 at the world level indicates that clean energy publications include 50 % (five percentage points) more highly cited publications than expected per the subfields in which the clean energy publications appeared. Since

the world level varies from 0.38 to 1.95 across KAs (only KA10 (nuclear safety) is markedly below expectations, see Annex 2), it is best to compare a country's performance across KAs using the rescaled scores (between 0 and 1); this provides an assessment of performance, relative to other countries, across KAs rather than on the absolute score for the share of $HCP_{10\%}$. A minimum of 30 publications was also applied to this indicator given that only a small share of publications are among the 10 % most cited. Malta is the only country that did not meet this threshold for any and all KAs combined in 2018, but a number of countries were affected by this restriction in different KAs (see Annex 2).

Figure 14: Distribution of countries according to the mean and standard deviation of the share of highly cited publications among the 10 % most cited and the log-transformed equivalent (2018)



Source: These statistics were calculated using data from Scopus (Elsevier)

Looking more closely at the results in Table 11, the EU27's collective impact was slightly below the world level, at 13.3 %, while the MI members' impact was slightly above, at 15.8 %. Luxembourg, Denmark and the Netherlands, three EU27 members, figure in Cluster 1, but all countries bar one in Cluster 4 are also EU27 members. In fact, 17 members of the EU27 obtained a score below the world level. It is worth mentioning that Luxembourg was in fact much lower in the ranking in the First interim data and report series. Its sudden thrust to the top is explained by its small publication output, highly prone to fluctuations. Many MI members obtained high scores, such as Australia in 2nd place and Saudi Arabia in 4th place, with more than 20 % of their clean energy publications being highly cited. The reader is referred to Annex 2 for a table with $HCP_{10\%}$ shares for each EU27 and MI member in each KA.

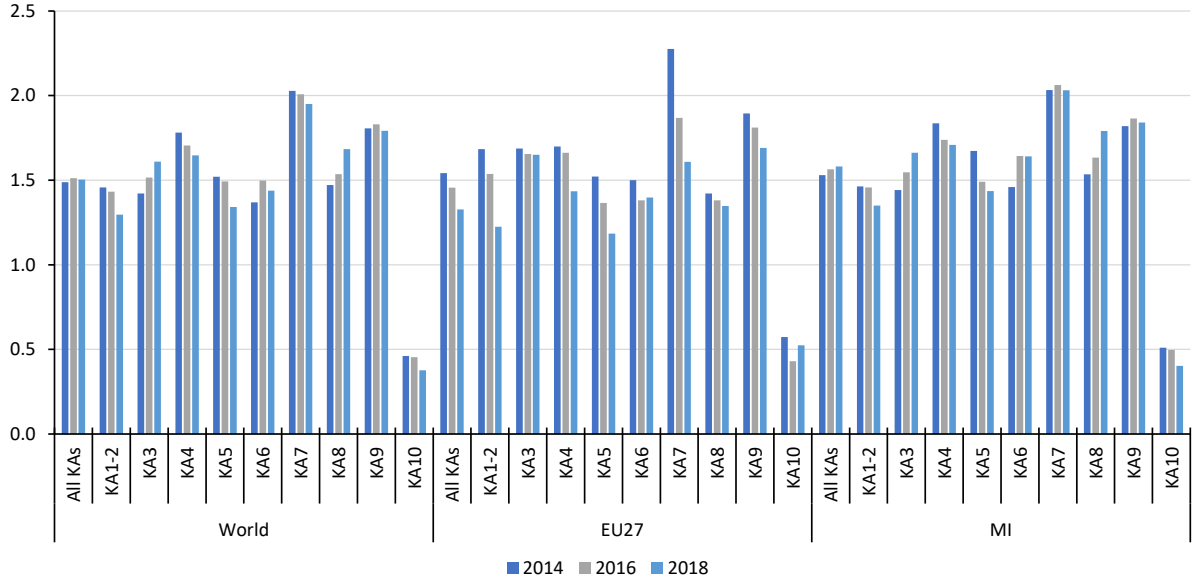
The evolution of the share of $HCP_{10\%}$ is shown in Figure 15 for the world, the EU27 and MI members in each KA. As mentioned previously, this indicator was not normalised by KA, which is why the world level is not static from year to year, but it did remain stable over the study period, at around 1.50, indicating that clean energy research is generally more impactful than all fields of research combined, which is also the case for every KA except KA10 (nuclear safety). However, this stability is the result of diverging trends between KAs: an important increase in KA3 (new technologies), KA6 (energy efficiency) and KA8 (renewable fuels) counterbalanced by an important decrease in KA1-2 (renewables), KA4 (energy systems), KA5 (new materials) and KA10 (nuclear safety).

Table 11: Share of highly cited publications among the 10 % most cited for all KAs combined

Country	Code	Share of $HCP_{10\%}$ (2018)	Score (2018)	Score 0-1 (2018)	CAGR		
					2014 to 2018	Lead/gap to EU27	Lead/gap to MI
World	**World**	**15.0%**	**1.50**	**0.45**	**0.2%**	**3.9%**	**-0.6%**
EU27	**EU27**	**13.3%**	**1.33**	**0.40**	**-3.7%**	**0.0%**	**-4.5%**
MI	**MI**	**15.8%**	**1.58**	**0.48**	**0.8%**	**4.5%**	**0.0%**
Cluster 1							
Luxembourg	LU	32.2%	3.22	1.00	6.5%	10.2%	5.7%
Australia	AU	22.7%	2.27	0.70	2.8%	6.5%	2.0%
Denmark	DK	21.9%	2.19	0.67	-1.1%	2.6%	-1.9%
Saudi Arabia	SA	21.1%	2.11	0.65	1.6%	5.3%	0.8%
Netherlands	NL	19.4%	1.94	0.59	-2.2%	1.5%	-3.0%
Cluster 2							
United Kingdom	UK	18.8%	1.88	0.58	-2.3%	1.4%	-3.1%
United States	US	18.7%	1.87	0.57	-4.5%	-0.8%	-5.3%
China	CN	17.8%	1.78	0.54	8.4%	12.1%	7.6%
Canada	CA	16.7%	1.67	0.51	-4.4%	-0.7%	-5.2%
Greece	EL	16.6%	1.66	0.50	10.5%	14.2%	9.7%
Estonia	EE	16.3%	1.63	0.49	17.4%	21.1%	16.6%
Belgium	BE	15.6%	1.56	0.47	-7.4%	-3.7%	-8.2%
United Arab Emirates	AE	15.4%	1.54	0.47	-13.6%	-9.9%	-14.4%
Italy	IT	15.4%	1.54	0.46	-3.0%	0.7%	-3.8%
Norway	NO	15.0%	1.50	0.45	-2.3%	1.4%	-3.1%
Sweden	SE	15.0%	1.50	0.45	-5.7%	-2.0%	-6.5%
Finland	FI	15.0%	1.50	0.45	2.2%	5.9%	1.4%
Germany	DE	13.8%	1.38	0.41	-5.6%	-1.9%	-6.4%
Spain	ES	13.6%	1.36	0.41	-3.4%	0.3%	-4.2%
Ireland	IE	13.3%	1.33	0.40	-11.7%	-8.0%	-12.5%
Cluster 3							
Portugal	PT	12.1%	1.21	0.36	-8.5%	-4.8%	-9.3%
Rep. of Korea	KR	11.4%	1.14	0.34	0.0%	3.7%	-0.8%
Cyprus	CY	11.3%	1.13	0.33	-7.1%	-3.4%	-7.9%
France	FR	11.2%	1.12	0.33	-6.0%	-2.3%	-6.8%
India	IN	10.6%	1.06	0.31	-1.7%	2.0%	-2.5%
Austria	AT	10.2%	1.02	0.30	-6.1%	-2.4%	-6.9%
Slovenia	SI	9.8%	0.98	0.29	-7.7%	-4.0%	-8.5%
Brazil	BR	9.1%	0.91	0.26	8.0%	11.7%	7.2%
Chile	CL	8.5%	0.85	0.25	-10.4%	-6.7%	-11.2%
Japan	JP	8.1%	0.81	0.23	-6.4%	-2.7%	-7.2%
Lithuania	LT	8.0%	0.80	0.23	2.2%	5.9%	1.4%
Croatia	HR	7.3%	0.73	0.21	8.3%	12.0%	7.5%
Romania	RO	7.0%	0.70	0.20	6.3%	10.0%	5.5%
Hungary	HU	6.9%	0.69	0.19	18.5%	22.2%	17.7%
Mexico	MX	6.4%	0.64	0.18	4.2%	7.9%	3.4%
Cluster 4							
Poland	PL	5.5%	0.55	0.15	4.9%	8.6%	4.1%
Czech Republic	CZ	5.4%	0.54	0.15	-1.6%	2.1%	-2.4%
Latvia	LV	5.3%	0.53	0.14	59.1%	62.8%	58.3%
Indonesia	ID	3.7%	0.37	0.09	-15.7%	-12.0%	-16.5%
Slovakia	SK	3.6%	0.36	0.09	9.2%	12.9%	8.4%
Bulgaria	BG	0.9%	0.09	0.00	-31.8%	-28.1%	-32.6%
Not calculated							
Malta	MT	N/C	N/C	N/C	N/C	N/C	N/C

Source: These statistics were calculated using data from Scopus (Elsevier)

Figure 15: Evolution of the normalised share of $HCP_{10\%}$ for the world, the EU27 and MI members, by KA, 2014–2018



Source: These statistics were calculated using data from Scopus (Elsevier)

The EU27's impact decreased by 3.7 % annually between 2014 and 2018 in all KAs combined, accompanied by important drops in many KAs (e.g. KA1-2, KA4, KA5, KA7). In no KA did its impact increase over the study period. Its impact in 2018 was also below the world level in every KA, except KA3 (new technologies) and KA10 (nuclear safety; see Annex 2). On the other hand, the MI members' impact trend fluctuated much less and increased by 0.8 % annually over the same time frame, improving significantly in KA3 (new technologies), KA6 (energy efficiency) and KA8 (renewable fuels).

3.10 Share of publications cited by patents

Box 3-10: Conclusion and summary

In the First interim data and report series, we concluded that the SCP is a pertinent indicator to measure the level of knowledge transfer from scientific research to innovation in clean energy; however, citations of publications by patents are quite rare, resulting in many EU27 and MI members in many KAs with none of their publications cited by a single patent. For this reason, it was not included in the CEII.

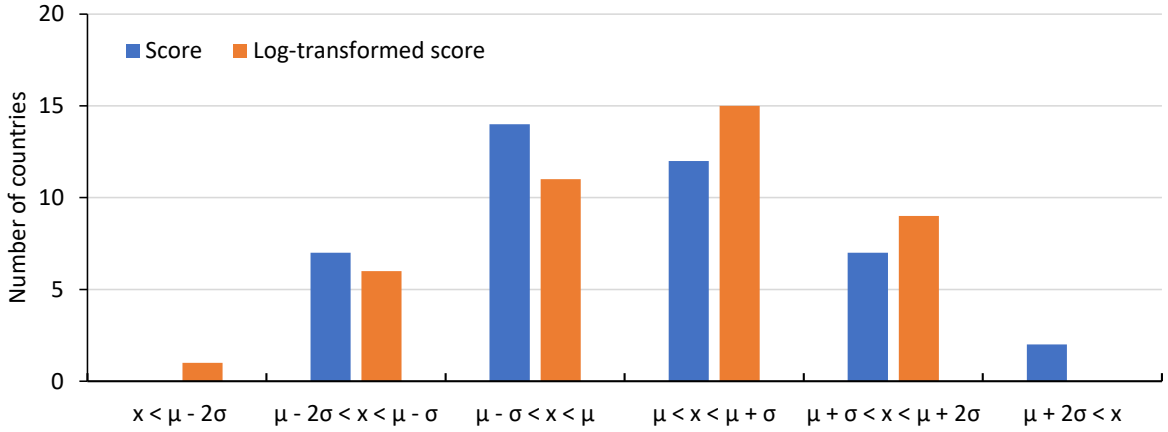
Globally, 3.3 % (weighted average) of clean energy publications were cited by patents in 2016. MI members collectively performed slightly better than this figure, and EU27 members slightly worse. The United States, Luxembourg and South Korea were the only countries to have more than 5 % of their clean energy publications cited by patents.

The share of publication cited by patents (SCP) is calculated based on the number of publications cited by a patent and the total number of publications in clean energy research. The number of publications cited by a patent and the total number of publications are both computed using a full count at country level but fractioned between KAs. The trend of the total number of publications was already tested in other indicators, which is why these tests are not repeated here. The outlier and break in time series tests were applied on the number of publications cited by a patent and on the SCP. Very few clean energy publications were cited by a patent. At the country and KA levels, the

numbers are quite small and tended to fluctuate, even for countries with a substantial output of publications. The tests identified some potential outliers and breaks in time series, all of which were investigated and deemed accurate given the small number of cited publications. The outlier test run on the SCP itself flagged quite a few potential outliers in 2010, followed by a sharp decline during the following years. The year 2010 is outside the period of interest but this is still worth mentioning because such a behaviour is actually expected for this indicator. The number of publications tends to increase over time, but publications at the beginning of the time series have had the chance to be cited for 11 years, and naturally more of them had been cited than articles published recently. As a result, the SCP naturally decreases over time, which is why it is normalised by the world weighted average in each corresponding year. The tests run on the SCP normalised by the world weighted average identified very few potential outliers and breaks in time series between 2012 and 2016, which were ultimately rationalised by the small number of publications cited by patents. As a reminder, this indicator is computed for the 2012–2016 period to allow sufficient time for publications to be cited by patents, which integrates the scientific literature at a much slower pace than the scientific literature itself.

The SCP exhibits a fairly normal-looking distribution (Figure 16). Applying the logarithm to the SCP skews the distribution in favour of above-average countries; it was therefore decided not to transform the SCP and to standardise the score directly on a 0-to-1 scale.

Figure 16: Distribution of countries according to the mean and standard deviation of the share of publications cited by patents normalised by the world weighted average and the log-transformed equivalent (2016)



Source: These statistics were calculated using data from Scopus (Elsevier) and LexisNexis

The SCP is shown in Table 12 for 2016 and all KAs combined and is normalised by the world weighted average (the 'score' column). A fairly small share of 3.3 % of clean energy articles published in 2016 were cited by a patent, which is why a minimum of 30 publications was imposed to calculate this indicator for a specific country or aggregation of countries. All EU27 and MI members met that threshold in 2016 for all KAs combined. The SCP was slightly lower for EU27 members, with 3.1 %, and slightly higher for MI members, with 3.6 %. The United States and Luxembourg were virtually tied in 1st place, with 5.9 % of their publications cited by patents. The EU27's normalised SCP increased by 1.4 % annually between 2012 and 2016, while the MI members' trend changed little, but the trends at the national level were very volatile given the nature of this indicator. None of Malta's publications in 2016, in any KA, were cited by a single patent. It is important to mention that the United States and European countries possibly enjoy a bias in their favour given that the references are measured for patent applications filed at the USPTO and the EPO, in addition to the WIPO.

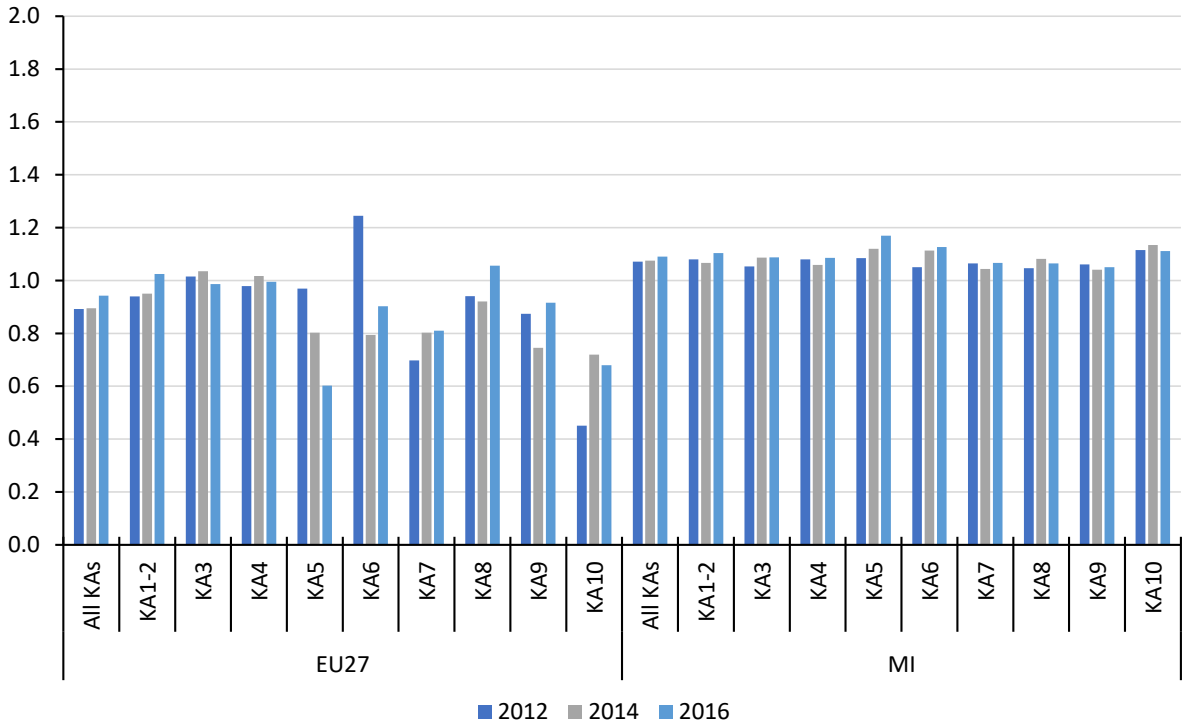
Table 12: Share of publications cited by patents for all KAs combined

Country	Code	SCP (2016)	Score (2016)	Score 0-1 (2016)	CAGR		
					2012 to 2016	Lead/gap to EU27	Lead/gap to MI
World	**World**	**3.3%**	**1.00**	**0.47**	**0.0%**	**-1.4%**	**-0.4%**
EU27	**EU27**	**3.1%**	**0.94**	**0.44**	**1.4%**	**0.0%**	**1.0%**
MI	**MI**	**3.6%**	**1.09**	**0.51**	**0.4%**	**-1.0%**	**0.0%**
Cluster 1							
United States	US	5.9%	1.82	0.86	2.5%	1.1%	2.1%
Luxembourg	LU	5.9%	1.82	0.86	8.9%	7.5%	8.5%
Rep. of Korea	KR	5.1%	1.56	0.74	3.5%	2.1%	3.1%
Belgium	BE	4.3%	1.32	0.62	6.2%	4.8%	5.8%
Ireland	IE	4.2%	1.30	0.61	-0.5%	-1.9%	-0.9%
Denmark	DK	4.2%	1.29	0.61	-3.2%	-4.6%	-3.6%
Cluster 2							
Finland	FI	4.1%	1.26	0.60	5.8%	4.4%	5.4%
Saudi Arabia	SA	4.1%	1.26	0.59	2.0%	0.6%	1.6%
Sweden	SE	4.1%	1.25	0.59	5.7%	4.3%	5.3%
Canada	CA	4.0%	1.22	0.58	0.7%	-0.7%	0.3%
Netherlands	NL	3.9%	1.18	0.56	2.9%	1.5%	2.5%
Australia	AU	3.7%	1.13	0.53	0.8%	-0.6%	0.4%
Germany	DE	3.7%	1.12	0.53	2.1%	0.7%	1.7%
Japan	JP	3.6%	1.11	0.52	3.6%	2.2%	3.2%
United Kingdom	UK	3.6%	1.09	0.51	2.3%	0.9%	1.9%
Austria	AT	3.4%	1.06	0.50	2.2%	0.8%	1.8%
France	FR	3.2%	0.98	0.46	3.3%	1.9%	2.9%
Spain	ES	3.2%	0.97	0.46	-0.8%	-2.2%	-1.2%
Hungary	HU	3.1%	0.94	0.44	18.8%	17.4%	18.4%
Cyprus	CY	3.0%	0.91	0.43	10.5%	9.1%	10.1%
China	CN	2.8%	0.86	0.41	1.5%	0.1%	1.1%
Cluster 3							
United Arab Emirates	AE	2.5%	0.78	0.37	-3.7%	-5.1%	-4.1%
Slovenia	SI	2.4%	0.75	0.35	6.1%	4.7%	5.7%
Italy	IT	2.4%	0.75	0.35	-1.8%	-3.2%	-2.2%
Norway	NO	2.1%	0.65	0.31	0.7%	-0.7%	0.3%
Czech Republic	CZ	1.8%	0.56	0.27	17.1%	15.7%	16.7%
Greece	EL	1.8%	0.54	0.26	-8.8%	-10.2%	-9.2%
Brazil	BR	1.7%	0.52	0.25	5.6%	4.2%	5.2%
India	IN	1.7%	0.52	0.24	-2.6%	-4.0%	-3.0%
Croatia	HR	1.7%	0.51	0.24	4.0%	2.6%	3.6%
Poland	PL	1.6%	0.50	0.24	10.0%	8.6%	9.6%
Portugal	PT	1.6%	0.49	0.23	-12.2%	-13.6%	-12.6%
Lithuania	LT	1.6%	0.49	0.23	-12.4%	-13.8%	-12.8%
Chile	CL	1.3%	0.39	0.18	-8.5%	-9.9%	-8.9%
Estonia	EE	1.2%	0.38	0.18	-4.6%	-6.0%	-5.0%
Cluster 4							
Indonesia	ID	0.9%	0.27	0.13	-11.0%	-12.4%	-11.4%
Slovakia	SK	0.7%	0.21	0.10	N/C	N/C	N/C
Romania	RO	0.6%	0.18	0.08	-7.5%	-8.9%	-7.9%
Bulgaria	BG	0.5%	0.15	0.07	-26.5%	-27.9%	-26.9%
Latvia	LV	0.5%	0.15	0.07	-3.4%	-4.8%	-3.8%
Mexico	MX	0.5%	0.14	0.07	-32.7%	-34.1%	-33.1%
Malta	MT	0.0%	0.00	0.00	N/C	N/C	N/C

Source: These statistics were calculated using data from Scopus (Elsevier) and LexisNexis

The evolution of the normalised SCP is shown in Figure 17 for the EU27 and MI members in each KA. The EU27's SPP slightly increased between 2012 and 2016 in all KAs combined, fuelled by increases in KA1-2 (renewables), KA7 (e-mobility), KA8 (renewable fuels) and KA10 (nuclear safety); however, there are quite a lot of fluctuations at the KA level, including in these four, and scores are usually below world level. The MI members' performance was slightly above world level in all KAs and fluctuated much less. An improvement is noticeable in KA5 (new materials) and to a smaller extent in KA1-2 (renewables), KA3 (new technologies) and KA8 (renewable fuels). The reader is referred to Annex 2 for a table with SCP scores for each EU27 and MI member in each KA; however, at the KA level, there are many instances for which countries had none of their publications cited by a single patent or for which they failed to meet the 30-publication threshold, resulting in a score of 0 or not computed at all, making a comparison between them impractical.

Figure 17: Evolution of the normalised SCP for the EU27 and MI members, by KA, 2012–2016



Source: These statistics were calculated using data from Scopus (Elsevier) and LexisNexis

4 Conclusion

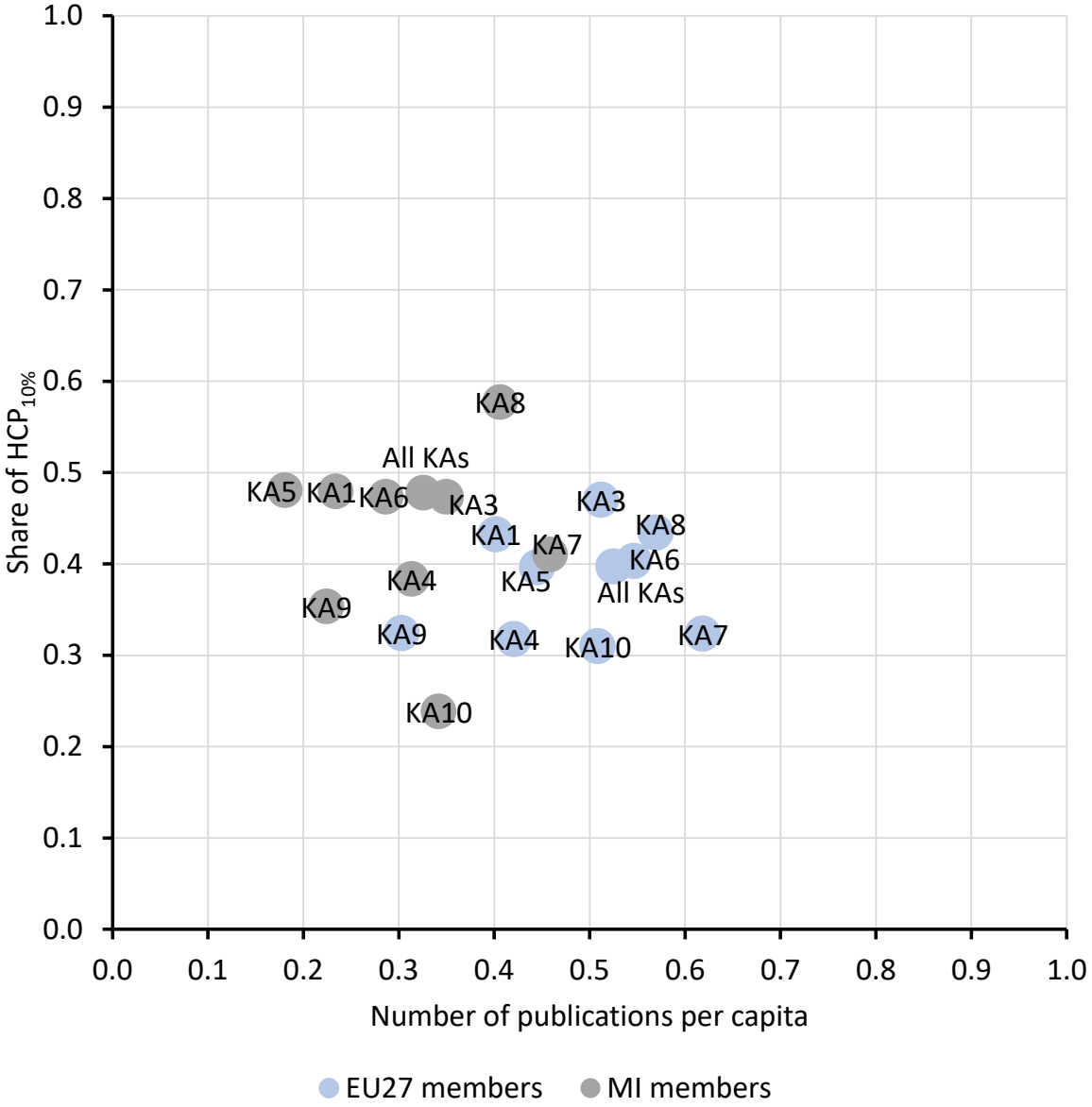
In the First interim data and report series, Science-Metrix proposed 10 bibliometric indicators as candidates for inclusion in the CEII. The indicators are designed to measure four scientific aspects – output, collaboration, open access and impact – which are of high relevance to the policy context surrounding the development of the CEII (i.e. the SET Plan, the Energy Union and the MI initiative). All the indicators were calculated for each EU27 and MI member, except for two indicators that were designed specifically for EU27 members. Ultimately, two indicators were selected for inclusion in the CEII: the number of publications per capita and the share of publications among the 10 % most cited. This report repeated this exercise with updated data and came to the same conclusion regarding the indicators to include in the CEII.

The number of publications is a simple and easy-to-understand way to communicate the level of research intensity of each EU27 and MI member in clean energy, one of the scientific aspects of interest to the Commission, as well as several other research funding organisations, in tracking scientific performance. It is normalised per capita to take into consideration the size of each member and for comparison purposes. Globally, the number of publications increased steadily from 2016 to 2019 but decreased slightly in 2020 in all KAs combined. The EU27 and MI members' performance, as groups, progressed in a similar fashion. Although the EU27's performance has consistently been above that of the MI members', its increase from 2016 to 2019 was more modest and its decline in 2020 was more pronounced; it sent the EU27 back to where it was in 2017.

The share of publications among the 10 % most cited is a citation indicator and reflects excellence in scientific research, which is a core aspect typically tracked by the Commission and several other organisations in tracking scientific performance. It is a normalised indicator that enables comparison between countries. The global performance in all KAs combined changed little between 2014 and 2018, but the EU27's share decreased by two percentage points during the same time frame and has been trending below the world level since 2015. The MI members' share increased by half a percentage point during that time, and it consistently maintained a slight edge over the world level. A 30-publication threshold was applied to this indicator, which many countries failed to meet in many KAs. The data for both indicators are presented in Annex 2, for all EU27 and MI members, KAs, and years of interest.

Figure 18 shows the relative performance of EU27 and MI members collectively for both indicators in each KA, transformed on a 0-to-1 scale based on the member that performed the worst (equivalent to 0) and the member that performed the best (equivalent to 1) over the five-year period under review. It should be noted that this might give the impression that most members, as well as EU27 and MI members as groups, performed poorly if one country performed outstandingly well. This is the case for Luxembourg's share of $HCP_{10\%}$ in all KAs combined in 2020, which set a high bar that no other member came close to matching. However, this does not prevent us from comparing members between them. The takeaway message from Figure 18 is that EU27 members published more publications per capita in clean energy research in every KA than MI members, but the MI members' publications were more impactful, except in KA3, in which both groups' impact was similar, and in KA10.

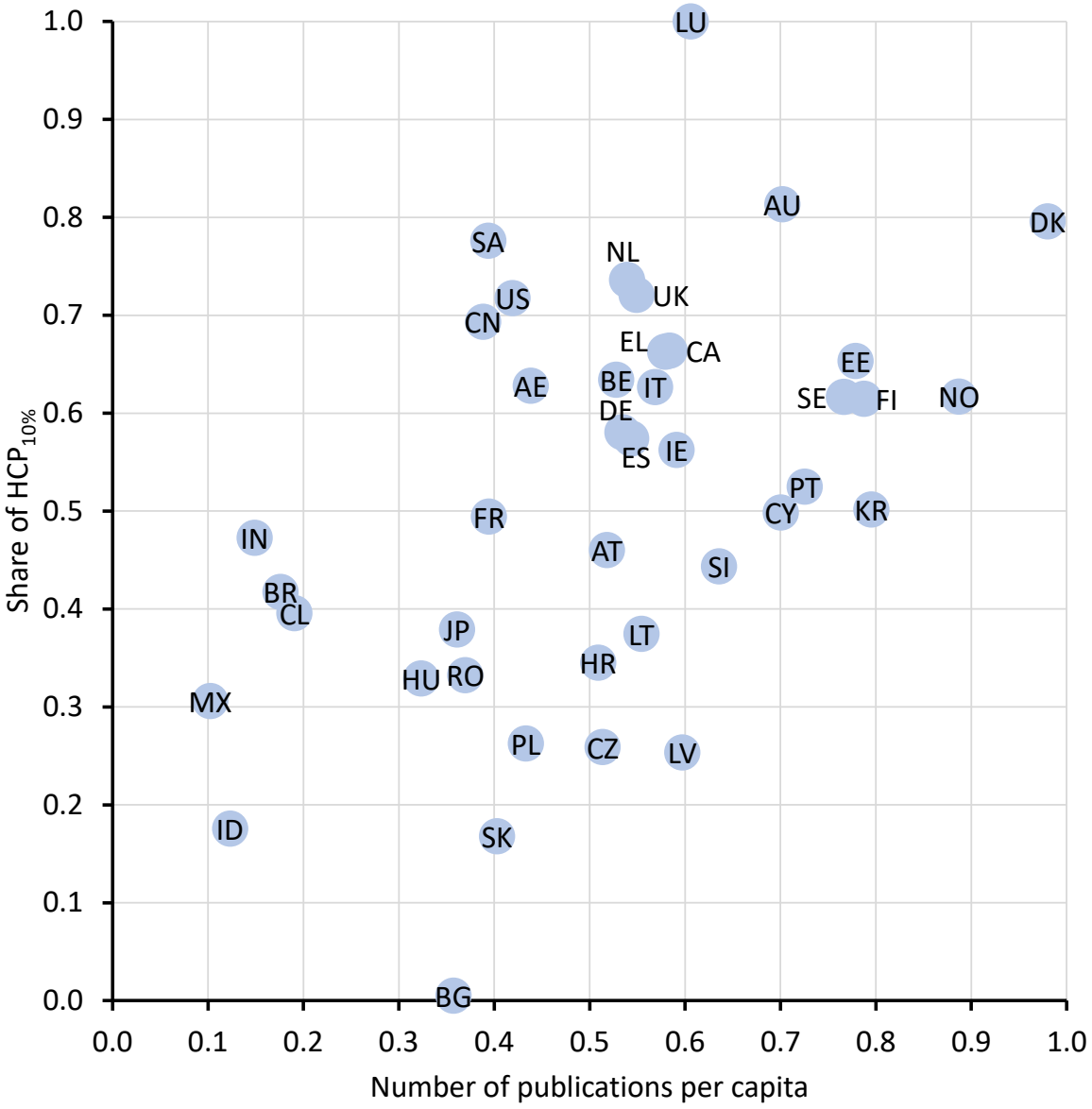
Figure 18: Positional chart of EU27 and MI members in each KA according to the number of publications per capita (square root transformed; 2020) and the share of $HCP_{10\%}$ (2018), both transformed on a 0-to-1 scale based on the equation in Section 2.2.



Source: These statistics were calculated using data from Scopus (Elsevier)

Figure 19 shows the relative performance of each EU27 and MI member in all KAs combined, which gives a preliminary indication of how each of them will perform in the CEII. A fair share of EU27 members are positioned in the upper-right portion of the graph, indicating relatively higher output and impact, along with a few MI members (Australia, the United Kingdom, Canada and Norway). Luxembourg and Denmark clearly stand out, the former for its impact and the latter for its relative production, but Denmark's impact is also noteworthy. In the lower-left portion of the graph, there are many MI members and a few of the EU27's smaller members. China and the United States are located in the upper-left portion of the graph, along with Saudi Arabia and the United Arab Emirates, indicating a lower level of output but a higher level of impact. Figure 19 also displays a positive correlation between relative output and impact, indicating that the members that produced more publications per capita also tended to have been more impactful; however, the correlation is weak. This suggests that the number of publications per capita and the share of $HCP_{10\%}$ are two indicators that complement each other and, as a result, are appropriate for inclusion in the CEII.

Figure 19: Positional chart of each EU27 and MI member in all KAs combined according to the number of publications per capita (square root transformed; 2020) and the share of $HCP_{10\%}$ (2018), both transformed on a 0-to-1 scale based on the equation in Section 2.2.



Source: These statistics were calculated using data from Scopus (Elsevier)

ANNEX 1 SUMMARY OF INDICATORS

Indicator 1: Number of scientific publications

Aspect	Description
Indicator	Number of scientific publications
Description	The number of scientific publications, also referred to as output, is measured for each EU27 and MI member. It is fractioned across authors and KAs, and normalised by capita.
Rationale/ relevance	The number of scientific publications is a proxy for the level of research intensity among the EU27 and MI members in the energy sector.
Comparability	The number of scientific publications per capita enables comparison among all EU27 members and MI members.
Data availability	The number of scientific publications is measured by using the Scopus database. Publication and population data are available for all countries and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way. Note that variation in the completeness of Scopus in the most recent publication year could lead to comparability issues. However, tests have shown that the latest year is complete or near complete for all countries of interest.
Assessment	The number of scientific publications is a simple and an easy-to-understand way to communicate the level of research intensity of countries. However, it is proportional to the size of countries, which makes a comparison between them possible but not particularly insightful without a normalising metric, such as population. The number of publications per capita is recommended for inclusion in the CEII.

Indicator 2: Specialisation index

Aspect	Description
Indicator	Specialisation index
Description	The specialisation index represents the scientific output of a given entity (e.g. a Member State) in a given research area (e.g. nuclear safety) relative to the intensity in a reference entity (e.g. the world) in the same research area. In other words, when an entity is specialised in an area, it puts more emphasis, relative to the reference entity, on that area at the expense of others. Specialisation is therefore said to be a zero-sum game: the more an entity specialises in an area, the less it does in another. Fractional counting of publications across authors and KAs is used to ensure a true zero-sum game. It is calculated as follows: $$SI = \frac{X_S/X_T}{N_S/N_T}$$ Where: X_S Number of publications in for entity *X* in a given research area (e.g. Belgium publications in nuclear safety) X_T Total number of publications for entity *X* (e.g. all Belgium publications) N_S Number of publications for reference entity *N* in a given research area (e.g. world publications in nuclear safety) N_T Total number of publications for reference entity *N* (e.g. all world publications)
Rationale/ relevance	The specialisation index is used as a proxy to identify the countries among the EU27 and MI members that allocate a significant portion of their resources to the SET Plan KAs, relative to the world. It also helps track those KAs in which they do not allocate resources relatively as much as expected at the world level.
Comparability	The specialisation index enables comparison among all EU27 members and MI members.
Data availability	The specialisation index is calculated based on the number of scientific publications by using the Scopus database. Data are available for all countries and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The specialisation index is normalised to 1 and is therefore easy to interpret. A score above 1 indicates a level of specialisation above that of the reference entity, and a score below 1 indicates the opposite. The specialisation index is recommended for inclusion in the CEII.

Indicator 3: Share of international scientific co-publications

Aspect	Description
Indicator	Share of international scientific co-publications
Description	The number of international scientific co-publications is the number of publications that include at least two authors affiliated to different countries. The share is the number of international scientific co-publications proportional to the total number of scientific publications. Publications are fractioned across KAs but not authors. It is calculated for each EU27 and MI member as follows: $$SIP = \frac{X_I}{X_T}$$ Where: X_I Number of publications for entity *X* (e.g. Belgium) that include at least one author affiliated to another country X_T Total number of publications for entity *X*
Rationale/ relevance	In the implementation plan of the SET Plan KAs, the EC details at great length the need for Member States to collaborate among themselves, as well as outside the EU, to fulfil the goals of the SET Plan. The share of international scientific co-publications is a proportional measure of that collaboration between countries.
Comparability	The share of international scientific co-publications enables comparison among all EU27 and MI members.
Data availability	The share of international scientific co-publications is calculated based on the number of co-publications and the total number of publications by using the Scopus database. Data are available for all countries and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The share of international scientific co-publications is a simple and easy-to-understand way to communicate the proportional level of research collaboration between countries internationally. However, publications are flagged as international co-publications in a binary way if at least two different countries are represented by their authors, no matter how many countries they might represent. Therefore, this indicator does not portray the diversity and relative importance of partners. Larger countries also tend to have more opportunities to collaborate internally than smaller countries and, as a result, are more self-sufficient and less likely to collaborate outside their own borders. In this respect, a relatively small share of international co-publications does not necessarily equate to an unwillingness to collaborate. The share of international co-publications is recommended for inclusion in the CEII.

Indicator 4: Share of transnational scientific co-publications

Aspect	Description
Indicator	Share of transnational scientific co-publications
Description	The number of transnational scientific co-publications is the number of publications that include at least two authors affiliated to different EU Member States. The share of transnational scientific co-publications is the number of transnational scientific co-publications proportional to the total number of scientific publications. Publications are fractioned across KAs but not authors. It is calculated for each EU27 member as follows: $$STP = \frac{X_I}{X_T}$$ Where: X_I Number of publications for entity X (e.g. Belgium) that include at least one author affiliated to another Member State X_T Total number of publications for entity X
Rationale/ relevance	In the implementation plan of the SET Plan KAs, the EC details at great length the need for Member States to collaborate among themselves to fulfil the goals of the SET Plan. The share of transnational scientific co-publications is a proportional measure of that collaboration between Member States.
Comparability	The share of transnational scientific co-publications enables comparison among all Member States, but not between MI members.
Data availability	The share of transnational scientific co-publications is calculated based on the number of co-publications and the number of publications by using the Scopus database. Data are available for Member States and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The share of transnational scientific co-publications is a simple and easy-to-understand way to communicate the proportional level of research collaboration between Member States. However, publications are flagged in a binary way as transnational co-publications if at least two different Member States are represented by their authors, no matter how many Member States they might represent. Therefore, this indicator does not portray the diversity and the extent of the collaborations. Larger countries also tend to have more opportunities to collaborate internally than smaller countries and, as a result, are more self-sufficient and less likely to collaborate outside their own borders. In this respect, a relatively small share of transnational co-publications does not necessarily indicate an unwillingness to collaborate. The share of transnational co-publications is not recommended for inclusion in the CEII, chiefly for the simple reason that it is not calculated for MI members, but also because it strongly correlates with the share of international co-publications, making it redundant.

Indicator 5: Weighted eigenvector centrality in the world's co-publication network

Aspect	Description
Indicator	Weighted eigenvector centrality in the world's co-publication network
Description	The weighted eigenvector centrality is a network indicator that measures the level of integration of an actor in a collaboration network. It integrates the number of actors to which a given actor is connected (through co-authorship of publications), the intensity of those connections (number of co-publications between two actors), and the importance of the partnering actors to the network structure (connections to hubs are valued more than connections to peripheral actors). Scores for this indicator range from 0 to 1, with 1 representing the most important actor to the network structure (typically a major hub with strong connections to a larger number of actors including other influential players in the network) and 0 representing isolated entities (actors which are disconnected from the network). This indicator is calculated for each of the EU27 and MI members using the world's collaboration network (i.e. using all countries). Full counting of co-publications is used.
Rationale/ relevance	In the implementation plan of the SET Plan KAs, the EC details at great length the need for Member States to collaborate among themselves, as well as outside the EU, to fulfil the goals of the SET Plan. The weighted eigenvector centrality is proposed as a possible alternative to the share of international co-publications, which was requested in the terms of reference. The former indicator captures, by design, a broader range of aspects underpinning international collaboration than the latter. While the latter indicator simply tracks the frequency of publications by a given country that were produced with at least one international partner, the former indicator additionally captures the diversity of involved partners and their relative importance to the network structure in a given research area.
Comparability	The weighted eigenvector centrality enables comparison among all EU27 members and MI members.
Data availability	The weighted eigenvector centrality is calculated using co-publication data as indexed in the Scopus database. Data are available for all countries and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The weighted eigenvector centrality of actors in a network is benchmarked against the most central actor in the network, no matter how connected or fragmented the network might be. This has to be accounted for in interpreting differences in the centrality of a given country across KAs. A greater score in a given KA compared to another KA could in theory be associated with a smaller share of international co-publications in the former KA if the overall level of international cooperation is also smaller in the former KA. Larger countries also tend to have more opportunities to collaborate internally than smaller countries and, as a result, are more self-sufficient and less likely to collaborate outside their own borders. However, given their sheer size, they tend to be the most frequent collaboration partners of every other country and usually have a high score. For this reason, the weighted eigenvector centrality is not recommended for inclusion in the CEII. The analyses have indeed shown that it correlates strongly with the number of publications.

Indicator 6: Weighted eigenvector centrality in the Member States' co-publication network

Aspect	Description
Indicator	Weighted eigenvector centrality in the Member States co-publication network
Description	Same as Indicator 5 except that the centrality is computed using a network in which only the 27 Member States are included as actors.
Rationale/ relevance	In the implementation plan of the SET Plan KAs, the EC details at great length the need for Member States to collaborate among themselves to fulfil the goals of the SET Plan. The weighted eigenvector centrality within the co-publication network of the Member State is proposed as a possible alternative to the share of transnational co-publications. The former indicator captures, by design, a broader range of aspects underpinning transnational collaboration than the latter. While the latter indicator simply tracks the frequency of publications by a given Member State that were produced with at least one other Member State, the former indicator additionally captures the diversity of involved Member State and their relative importance to the network structure in a given research area.
Comparability	The weighted eigenvector centrality enables comparison among the EU27 but not the MI members.
Data availability	The weighted eigenvector centrality is calculated using co-publication data as indexed in the Scopus database. Data are available for all 27 Member States and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The weighted eigenvector centrality of actors in a network is benchmarked against the most central actor in the network, no matter how connected or fragmented the network might be. This has to be accounted for in interpreting differences in the centrality of a given Member State across KAs. A greater score in a given KA compared to another KA could, in theory, be associated with a smaller share of transnational co-publications in the former KA if the overall level of transnational cooperation is also smaller in the former KA. Larger Member States also tend to have more opportunities to collaborate internally than smaller Member States and, as a result, are more self-sufficient and less likely to collaborate outside their own borders. However, given their sheer size, they tend to be the most frequent collaboration partners of every other Member State and usually have a high score. Again, for the same reason given for Indicator 5, but also because it is not calculated for MI members, the weighted eigenvector centrality in the Member States co-publication network is not recommended for inclusion in the CEII.

Indicator 7: Share of open access scientific publications

Aspect	Description
Indicator	Share of open access scientific publications
Description	The number of open access scientific publications is the number of publications that are publicly and freely available online without any barriers, either through the publisher (known as gold open access), or through a repository or a personal website (known as green open access). The share of open access scientific publications is the number of open access scientific publications proportional to the total number of scientific publications. Publications are fractioned across KAs but not authors. It is calculated for each EU27 and MI member, as follows: $$SOA = \frac{X_{OA}}{X_T}$$ Where: X_{OA} Number of publications for entity *X* (e.g. Belgium) that are available in open access X_T Total number of publications for entity *X*
Rationale/ relevance	The SET Plan prides itself on being a platform for sharing knowledge between key actors. The EC also favours transparency and exchange of information to avoid unnecessary duplication of efforts and to stimulate cooperation and coordination in order to achieve the goals of the SET Plan. Open access facilitates the distribution and circulation of knowledge and discoveries, particularly among actors with restricted financial resources. The share of open access scientific publications is a proportional measure of the openness in research.
Comparability	The share of open access scientific publications enables comparison among all EU27 and MI members.
Data availability	The share of open access scientific publications is calculated based on the number of publications by using the Scopus and the 1findr databases; the latter provides the open access status of publications. Data are available for all countries. However, there are restrictions for recent years. As stated above, we recommend applying an exception to the reference year for this indicator due to embargo periods on releasing publications in open access.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way. Scopus and 1findr do not perfectly overlap. 1findr is particularly deficient with respect to its coverage of conference papers. Therefore, the open access status is not defined for some publications, which are not used in computing this indicator.
Assessment	The share of open access scientific publications is a simple and easy-to-understand way to communicate the proportional level of openness in research. The share of open access publications is recommended for inclusion in the CEII.

Indicator 8: Share of public/private scientific co-publications

Aspect	Description
Indicator	Share of public/private scientific co-publications
Description	The number of public/private scientific co-publications is the number of publications that include at least one author affiliated to the public sector (academic, government) and one author affiliated to the private sector (for-profit firms, corporations). The share of public/private scientific co-publications is the number of public/private scientific co-publications proportional to the total number of scientific publications. Publications are fractioned across KAs but not authors. It is calculated for each EU27 and MI member as follows: $$SPP = \frac{X_{PP}}{X_T}$$ Where: X_{PP} Number of publications for entity *X* (e.g. Belgium) that include at least one author affiliated to the public sector and one author affiliated to the private sector X_T Total number of publications for entity *X*
Rationale/ relevance	In the implementation plan of the SET Plan KAs, the EC details at great length the need for the public and private sectors to collaborate during all stages of innovation, from funding and conducting research to commercialisation, to fulfil the goals of the SET Plan. The share of public/private scientific co-publications is a proportional measure of that collaboration between both sectors.
Comparability	The share of public/private scientific co-publications enables comparison among all EU27 and MI members.
Data availability	The share of public/private scientific co-publications is calculated based on the number of publications by using the Scopus database. Data are available for all countries and for all years relevant to this study.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The share of public/private scientific co-publications is a simple and an easy-to-understand way to communicate the proportional level of research collaboration between both sectors. The share of public/private co-publications is recommended for inclusion in the CEII.

Indicator 9: Share of scientific publications among the 10 % most cited

Aspect	Description
Indicator	Share of scientific publications among the 10 % most cited
Description	The number of citations received by publications is a proxy for measuring contributions to subsequent knowledge generation; however, because citation practices vary between the disciplines of science, a simple count inevitably creates biases. To correct this shortcoming, the number of citations of each publication is normalised by field, publication type and publication year. This measure is known as the relative citation (RC) score. The 10 % most cited articles are determined by their RC scores instead of their raw number of citations. The share of scientific publications among the 10 % most cited is the number of scientific publications among the 10 % most cited proportional to the total number of scientific publications. Fractional counting across authors and KAs is used, and self-citations are excluded. It is calculated for each Member State and country with MI membership as follows: $$\textit{Share of pubs. among } 10\% \textit{ most cited} = \frac{X_{10\%}}{X_T}$$ Where: $X_{10\%}$ Number of publications for entity *X* (e.g. Belgium) that are among the 10 % most cited according to their RC scores X_T Total number of publications for entity *X*
Rationale/ relevance	Output and collaboration indicators do not inform on the visibility and impact of publications. The share of scientific publications among the 10 % most cited is a publication-to-publication citation indicator and reflects excellence in scientific publishing. The fifth pillar of the Energy Union on research, innovation and competitiveness aims to support the emergence of scientific breakthroughs in low-carbon and clean energy technologies. This indicator is a proxy for identifying such scientific breakthroughs.
Comparability	The share of scientific publications among the 10 % most cited enables a comparison among all EU27 and MI members.
Data availability	The share of scientific publications among the 10 % most cited is calculated by using the Scopus database. Data are available for all countries relevant to this study. However, there are restrictions for recent years.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The RC score is not calculated for articles published in recent years. Publications need some time to accumulate citations before their impact can be reliably assessed. Typically, three years (the publication year plus the two following years) is granted to publications before their RC score is calculated. Given that conference papers also enjoy far less visibility than journal articles, and are cited far fewer times as a result, the RC score is not calculated for conference papers. A score above 10 % indicates a level of impact above that of the world average, and a score below 10 % indicates the opposite. The share of publications among the 10 % most cited is recommended for inclusion in the CEII.

Indicator 10: Share of scientific publications cited by patents

Aspect	Description
Indicator	Share of scientific publications cited by patents
Description	The number of scientific publications cited by at least one patent is measured for each EU27 and MI member. The share of scientific publications cited by at least one patent is the number of scientific publications cited by a patent proportional to the total number of scientific publications. Publications are fractioned across KAs but not authors. It is calculated for each EU27 and MI member as follows: $$SCP = \frac{X_{Pat}}{X_T}$$ Where: X_{Pat} Number of publications for entity *X* (e.g. Belgium) that were cited in at least one patent application X_T Total number of publications for entity *X*
Rationale/ relevance	The share of scientific publications cited in patents is a publication-to-patent citation indicator. Therefore, it crosses the boundaries of scientific publishing by measuring the direct translation of scientific research into innovation. The share of scientific publications cited by patents is a proportional measure of the translation of scientific research into innovation, which is one of the goals of the SET Plan.
Comparability	The share of scientific publications cited in patents enables comparison among all EU27 and MI members.
Data availability	The share of scientific publications cited in patents is measured by using and linking the Scopus and the PATSTAT databases, and patents filed at the USPTO, and the EPO. Data are available for all countries relevant to this study. However, there are restrictions for recent years.
Quality	Scopus contains some errors with respect to the authors' country affiliation; however, these errors are few and far between and do not compromise the quality of this indicator in any significant way.
Assessment	The share of scientific publications cited in patents is a simple and easy-to-understand way to communicate the relative level of uptake of scientific research into innovation. Citation practices of the technometric literature are also heavily biased toward the technological fields of science. Furthermore, the technometric literature absorbs the scientific literature at a very slow pace compared to the scientific literature itself. A large amount of time is therefore necessary to adequately track the uptake of scientific knowledge in patents. A minimum of five years is usually used. This indicator is therefore not calculated for articles published recently. The share of scientific publications cited in patents is not recommended for inclusion in the CEII for the reason that it correlates well with the share of publications among the 10 % most cited, but specifically because very few publications are ever cited by a patent. This resulted in many EU27 and MI members in many KAs with none of their publications cited by a single patent, which makes a comparison between them impractical.

ANNEX 2 ADDITIONAL TABLES

Table 13: Number of publications (in fractional counting) for all KAs combined, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**134,402**	**152,003**	**168,448**	**189,572**	**185,365**	
EU27	**EU27**	**27,819**	**30,269**	**30,463**	**32,184**	**30,239**	
MI	**MI**	**105,037**	**117,627**	**130,898**	**145,663**	**141,747**	
China	CN	36,040	41,617	49,061	58,864	60,151	
India	IN	9,110	11,316	15,278	16,484	16,397	
United States	US	16,753	17,575	17,572	17,662	15,717	
Rep. of Korea	KR	5,873	6,112	6,616	7,181	7,000	
Germany	DE	5,821	6,240	6,248	6,188	5,772	
United Kingdom	UK	4,516	5,017	4,784	5,268	4,906	
Japan	JP	5,176	5,631	5,454	5,481	4,732	
Italy	IT	3,924	4,455	4,362	4,793	4,567	
Spain	ES	2,836	2,894	3,119	3,179	3,375	
Brazil	BR	2,219	2,689	2,876	3,399	3,052	
Canada	CA	3,034	2,892	3,172	3,278	3,043	
France	FR	3,159	3,332	3,272	3,217	2,921	
Australia	AU	2,338	2,496	2,729	3,001	2,804	
Indonesia	ID	638	1,293	2,246	2,711	2,664	
Poland	PL	1,400	1,668	1,853	1,866	1,883	
Saudi Arabia	SA	669	772	958	1,179	1,492	
Sweden	SE	1,303	1,408	1,341	1,384	1,314	
Netherlands	NL	1,146	1,250	1,206	1,223	1,240	
Portugal	PT	896	939	987	1,206	1,189	
Denmark	DK	1,058	1,073	1,130	1,196	1,158	
Mexico	MX	681	827	909	1,064	1,053	
Norway	NO	728	823	774	896	880	
Greece	EL	742	757	759	850	847	
Belgium	BE	740	811	786	802	785	
Romania	RO	727	1,033	905	1,202	751	
Finland	FI	731	718	766	810	735	
Czech Republic	CZ	671	798	792	880	696	
Austria	AT	685	666	641	732	588	
United Arab Emirates	AE	331	407	412	545	500	
Ireland	IE	401	411	415	474	409	
Hungary	HU	228	287	308	315	312	
Chile	CL	249	269	296	329	302	
Croatia	HR	184	201	250	234	259	
Bulgaria	BG	142	168	209	292	256	
Slovakia	SK	232	277	271	379	242	
Lithuania	LT	147	168	173	149	206	
Slovenia	SI	171	182	177	243	194	
Estonia	EE	116	123	125	152	174	
Latvia	LV	178	237	186	199	158	
Cyprus	CY	88	95	114	142	131	
Luxembourg	LU	68	61	48	60	54	
Malta	MT	24	17	20	18	24	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 14: Number of publications (in fractional counting) in KA1-2, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**30,745**	**32,897**	**36,330**	**38,576**	**37,201**	
EU27	**EU27**	**6,263**	**6,398**	**6,363**	**6,347**	**6,091**	
MI	**MI**	**23,517**	**24,845**	**27,400**	**28,431**	**27,264**	
China	CN	7,810	8,513	9,722	11,107	10,878	
India	IN	2,111	2,645	3,569	3,413	3,414	
United States	US	3,798	3,618	3,557	3,269	2,950	
Rep. of Korea	KR	1,216	1,110	1,188	1,226	1,160	
Germany	DE	1,462	1,422	1,449	1,318	1,260	
United Kingdom	UK	1,099	1,106	1,073	1,140	1,070	
Japan	JP	1,121	1,275	1,264	1,091	942	
Italy	IT	821	804	740	767	794	
Spain	ES	703	701	789	790	764	
Brazil	BR	395	477	552	643	551	
Canada	CA	561	514	561	545	477	
France	FR	615	659	639	591	563	
Australia	AU	645	621	692	665	610	
Indonesia	ID	180	343	624	745	716	
Poland	PL	267	320	312	320	324	
Saudi Arabia	SA	215	224	248	329	399	
Sweden	SE	269	296	261	253	241	
Netherlands	NL	306	330	328	297	376	
Portugal	PT	218	182	197	261	221	
Denmark	DK	367	327	354	341	353	
Mexico	MX	189	239	249	297	274	
Norway	NO	260	236	254	275	222	
Greece	EL	192	174	167	159	170	
Belgium	BE	163	168	160	165	166	
Romania	RO	209	251	219	286	152	
Finland	FI	100	111	110	105	122	
Czech Republic	CZ	79	95	90	96	83	
Austria	AT	102	117	93	109	76	
United Arab Emirates	AE	87	99	98	105	91	
Ireland	IE	110	103	114	106	101	
Hungary	HU	23	42	42	46	58	
Chile	CL	92	89	102	98	100	
Croatia	HR	36	46	55	55	48	
Bulgaria	BG	30	33	38	54	38	
Slovakia	SK	31	46	47	53	24	
Lithuania	LT	25	29	36	25	37	
Slovenia	SI	27	39	27	41	24	
Estonia	EE	22	26	20	28	26	
Latvia	LV	29	32	22	23	17	
Cyprus	CY	21	24	32	38	31	
Luxembourg	LU	19	18	13	12	12	
Malta	MT	16	5	7	9	7	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 15: Number of publications (in fractional counting) in KA3, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**17,925**	**21,990**	**26,764**	**32,330**	**29,969**	
EU27	**EU27**	**3,908**	**4,641**	**5,079**	**5,751**	**4,998**	
MI	**MI**	**14,117**	**16,969**	**20,731**	**24,585**	**22,782**	
China	CN	4,437	5,200	6,502	7,998	8,198	
India	IN	1,707	2,277	3,523	4,354	3,917	
United States	US	1,926	2,414	2,642	2,881	2,330	
Rep. of Korea	KR	1,207	1,340	1,474	1,535	1,457	
Germany	DE	706	850	895	991	833	
United Kingdom	UK	609	755	815	941	852	
Japan	JP	628	692	729	842	698	
Italy	IT	653	809	825	928	822	
Spain	ES	345	406	472	547	547	
Brazil	BR	272	334	405	500	419	
Canada	CA	338	360	464	584	537	
France	FR	457	454	545	565	459	
Australia	AU	260	328	390	514	488	
Indonesia	ID	70	185	340	488	424	
Poland	PL	138	189	232	233	269	
Saudi Arabia	SA	125	153	247	328	396	
Sweden	SE	175	199	201	211	205	
Netherlands	NL	159	185	200	191	158	
Portugal	PT	122	200	197	255	238	
Denmark	DK	89	87	112	126	106	
Mexico	MX	63	74	102	148	124	
Norway	NO	68	83	102	115	115	
Greece	EL	131	159	194	237	207	
Belgium	BE	100	122	154	169	144	
Romania	RO	122	183	167	240	168	
Finland	FI	141	143	185	193	156	
Czech Republic	CZ	100	103	107	137	105	
Austria	AT	118	140	133	166	104	
United Arab Emirates	AE	55	73	78	139	116	
Ireland	IE	89	105	103	138	87	
Hungary	HU	36	50	67	49	45	
Chile	CL	15	20	22	38	25	
Croatia	HR	43	36	47	41	47	
Bulgaria	BG	17	31	51	66	57	
Slovakia	SK	43	44	51	74	53	
Lithuania	LT	28	31	30	31	35	
Slovenia	SI	24	28	24	41	36	
Estonia	EE	12	15	21	29	33	
Latvia	LV	20	34	31	32	31	
Cyprus	CY	24	19	16	33	35	
Luxembourg	LU	17	19	13	26	16	
Malta	MT	1	0	4	1	1	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 16: Number of publications (in fractional counting) in KA4, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**28,581**	**30,893**	**35,869**	**40,809**	**37,054**	
EU27	**EU27**	**4,904**	**5,159**	**5,261**	**5,495**	**4,806**	
MI	**MI**	**22,679**	**24,036**	**28,470**	**32,175**	**29,184**	
China	CN	9,585	10,184	12,700	15,828	14,619	
India	IN	2,438	2,922	3,905	3,827	3,618	
United States	US	3,109	3,090	3,409	3,403	3,027	
Rep. of Korea	KR	883	973	1,083	1,245	1,143	
Germany	DE	985	990	1,087	1,006	910	
United Kingdom	UK	809	869	824	870	761	
Japan	JP	807	802	795	871	675	
Italy	IT	691	734	759	841	744	
Spain	ES	491	519	522	540	528	
Brazil	BR	463	553	614	764	483	
Canada	CA	706	624	720	684	612	
France	FR	485	503	447	500	416	
Australia	AU	506	446	588	639	524	
Indonesia	ID	81	175	252	329	262	
Poland	PL	314	368	388	360	356	
Saudi Arabia	SA	93	110	150	169	243	
Sweden	SE	196	224	207	193	178	
Netherlands	NL	194	192	191	201	177	
Portugal	PT	179	180	182	200	171	
Denmark	DK	240	255	285	291	267	
Mexico	MX	98	118	138	142	152	
Norway	NO	103	107	97	120	148	
Greece	EL	150	133	122	170	160	
Belgium	BE	136	129	128	133	116	
Romania	RO	152	202	174	219	118	
Finland	FI	136	113	126	129	122	
Czech Republic	CZ	115	138	123	122	96	
Austria	AT	124	107	129	125	100	
United Arab Emirates	AE	79	84	96	102	111	
Ireland	IE	67	67	74	84	71	
Hungary	HU	22	36	33	39	22	
Chile	CL	62	51	61	97	69	
Croatia	HR	47	57	65	58	53	
Bulgaria	BG	30	39	39	64	46	
Slovakia	SK	29	35	38	49	23	
Lithuania	LT	8	15	13	14	16	
Slovenia	SI	30	29	14	36	26	
Estonia	EE	26	18	34	36	35	
Latvia	LV	29	41	43	41	22	
Cyprus	CY	14	19	29	32	20	
Luxembourg	LU	11	10	7	7	8	
Malta	MT	4	5	4	7	6	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 17: Number of publications (in fractional counting) in KA5, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**5,603**	**7,023**	**7,066**	**8,487**	**8,316**	
EU27	**EU27**	**1,819**	**2,189**	**2,041**	**2,519**	**2,266**	
MI	**MI**	**3,816**	**4,658**	**4,643**	**5,575**	**5,400**	
China	CN	852	1,159	1,229	1,496	1,731	
India	IN	204	300	351	399	408	
United States	US	737	699	653	754	624	
Rep. of Korea	KR	160	172	217	262	225	
Germany	DE	190	199	186	237	197	
United Kingdom	UK	285	378	314	358	331	
Japan	JP	124	134	139	185	118	
Italy	IT	348	512	418	466	431	
Spain	ES	173	208	221	247	277	
Brazil	BR	68	98	81	93	114	
Canada	CA	160	155	167	216	189	
France	FR	120	136	164	176	146	
Australia	AU	139	216	184	223	190	
Indonesia	ID	29	62	122	126	176	
Poland	PL	85	141	183	190	170	
Saudi Arabia	SA	26	40	36	55	63	
Sweden	SE	87	79	76	119	103	
Netherlands	NL	69	95	63	92	74	
Portugal	PT	94	105	94	126	158	
Denmark	DK	62	76	77	97	88	
Mexico	MX	22	30	30	34	50	
Norway	NO	45	59	43	83	57	
Greece	EL	65	81	54	68	77	
Belgium	BE	51	60	56	68	63	
Romania	RO	50	89	63	98	53	
Finland	FI	49	40	38	54	44	
Czech Republic	CZ	97	91	88	144	90	
Austria	AT	63	46	45	64	43	
United Arab Emirates	AE	31	42	35	53	39	
Ireland	IE	34	40	26	31	31	
Hungary	HU	20	19	24	36	31	
Chile	CL	15	26	37	22	34	
Croatia	HR	14	12	14	13	22	
Bulgaria	BG	5	5	8	13	10	
Slovakia	SK	35	45	37	59	37	
Lithuania	LT	19	18	19	13	28	
Slovenia	SI	21	13	26	32	18	
Estonia	EE	21	16	15	26	21	
Latvia	LV	25	34	26	26	22	
Cyprus	CY	13	20	18	17	26	
Luxembourg	LU	5	2	3	5	5	
Malta	MT	3	6	1	1	3	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 18: Number of publications (in fractional counting) in KA6, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**3,539**	**4,358**	**5,002**	**6,003**	**6,172**	
EU27	**EU27**	**1,109**	**1,288**	**1,506**	**1,642**	**1,546**	
MI	**MI**	**2,486**	**3,021**	**3,458**	**4,045**	**4,148**	
China	CN	579	786	869	1,172	1,328	
India	IN	187	255	389	411	443	
United States	US	358	401	374	435	414	
Rep. of Korea	KR	87	101	151	184	175	
Germany	DE	292	327	382	378	330	
United Kingdom	UK	139	183	169	185	160	
Japan	JP	59	81	79	94	90	
Italy	IT	167	197	233	248	240	
Spain	ES	87	97	128	121	167	
Brazil	BR	114	132	135	156	179	
Canada	CA	74	65	76	84	91	
France	FR	76	84	82	89	83	
Australia	AU	74	97	73	83	114	
Indonesia	ID	18	32	109	111	125	
Poland	PL	67	89	112	108	103	
Saudi Arabia	SA	19	21	29	37	47	
Sweden	SE	63	68	87	83	78	
Netherlands	NL	32	45	54	42	57	
Portugal	PT	31	51	51	86	78	
Denmark	DK	20	27	36	45	42	
Mexico	MX	28	40	42	53	41	
Norway	NO	25	22	34	36	39	
Greece	EL	25	23	31	35	29	
Belgium	BE	23	30	30	25	25	
Romania	RO	25	58	54	66	44	
Finland	FI	43	48	44	64	37	
Czech Republic	CZ	23	21	33	35	30	
Austria	AT	40	34	45	56	61	
United Arab Emirates	AE	18	11	13	26	16	
Ireland	IE	11	9	16	32	21	
Hungary	HU	17	11	12	24	23	
Chile	CL	6	11	9	14	15	
Croatia	HR	10	9	11	11	14	
Bulgaria	BG	7	8	8	13	15	
Slovakia	SK	14	11	17	31	21	
Lithuania	LT	5	5	6	7	9	
Slovenia	SI	8	9	13	15	15	
Estonia	EE	4	5	5	6	5	
Latvia	LV	12	16	7	16	9	
Cyprus	CY	3	4	4	5	3	
Luxembourg	LU	1	3	3	2	5	
Malta	MT	0	1	1	0	0	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 19: Number of publications (in fractional counting) in KA7, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**10,590**	**12,257**	**14,298**	**16,673**	**16,999**	
EU27	**EU27**	**2,064**	**2,238**	**2,477**	**2,613**	**2,690**	
MI	**MI**	**9,121**	**10,478**	**12,244**	**14,228**	**14,438**	
China	CN	3,908	4,888	5,789	7,114	7,488	
India	IN	337	478	809	937	992	
United States	US	1,380	1,576	1,636	1,713	1,639	
Rep. of Korea	KR	599	607	695	810	765	
Germany	DE	670	739	719	744	781	
United Kingdom	UK	339	326	333	434	437	
Japan	JP	505	448	538	517	410	
Italy	IT	264	290	342	414	445	
Spain	ES	135	137	166	180	211	
Brazil	BR	61	88	87	130	101	
Canada	CA	270	238	302	322	322	
France	FR	255	236	278	253	221	
Australia	AU	168	165	205	219	225	
Indonesia	ID	55	69	118	174	123	
Poland	PL	87	109	161	127	143	
Saudi Arabia	SA	15	16	24	34	55	
Sweden	SE	91	106	115	126	130	
Netherlands	NL	74	95	83	83	85	
Portugal	PT	66	41	50	48	68	
Denmark	DK	51	57	63	70	64	
Mexico	MX	16	20	31	29	42	
Norway	NO	31	31	30	40	49	
Greece	EL	35	41	37	43	41	
Belgium	BE	51	59	73	67	64	
Romania	RO	50	81	69	106	78	
Finland	FI	33	28	48	49	48	
Czech Republic	CZ	33	47	62	58	46	
Austria	AT	60	46	52	59	67	
United Arab Emirates	AE	8	15	18	29	23	
Ireland	IE	25	23	27	17	24	
Hungary	HU	13	21	22	28	22	
Chile	CL	7	11	11	12	10	
Croatia	HR	12	12	21	17	33	
Bulgaria	BG	9	19	22	33	35	
Slovakia	SK	19	18	20	37	22	
Lithuania	LT	3	4	6	6	6	
Slovenia	SI	9	10	14	16	15	
Estonia	EE	3	3	6	6	13	
Latvia	LV	9	12	13	16	16	
Cyprus	CY	1	0	2	4	4	
Luxembourg	LU	6	3	4	4	3	
Malta	MT	0	1	1	0	4	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 20: Number of publications (in fractional counting) in KA8, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**21,536**	**23,696**	**24,982**	**27,763**	**30,231**	
EU27	**EU27**	**4,409**	**4,446**	**4,419**	**4,457**	**4,641**	
MI	**MI**	**16,572**	**18,294**	**19,275**	**21,414**	**23,077**	
China	CN	5,170	6,174	7,158	8,660	9,776	
India	IN	1,563	1,738	2,075	2,446	2,839	
United States	US	2,773	2,777	2,512	2,343	2,210	
Rep. of Korea	KR	853	855	906	1,000	1,069	
Germany	DE	813	852	802	787	798	
United Kingdom	UK	596	621	547	653	630	
Japan	JP	824	900	808	857	800	
Italy	IT	614	614	630	656	648	
Spain	ES	550	462	464	466	552	
Brazil	BR	723	860	850	935	1,008	
Canada	CA	557	521	485	480	467	
France	FR	480	466	452	423	459	
Australia	AU	318	342	352	406	381	
Indonesia	ID	167	326	535	549	671	
Poland	PL	269	289	327	372	390	
Saudi Arabia	SA	99	130	105	129	168	
Sweden	SE	257	279	257	236	257	
Netherlands	NL	180	175	171	184	161	
Portugal	PT	131	117	154	160	182	
Denmark	DK	181	187	169	175	180	
Mexico	MX	200	245	254	280	302	
Norway	NO	71	89	75	88	112	
Greece	EL	98	108	120	108	120	
Belgium	BE	84	81	78	71	75	
Romania	RO	67	91	99	123	88	
Finland	FI	134	122	122	116	112	
Czech Republic	CZ	112	129	139	141	133	
Austria	AT	118	116	100	106	98	
United Arab Emirates	AE	21	37	38	50	57	
Ireland	IE	49	54	44	51	56	
Hungary	HU	44	55	63	39	60	
Chile	CL	41	44	43	40	35	
Croatia	HR	18	22	22	28	29	
Bulgaria	BG	26	16	27	34	42	
Slovakia	SK	30	39	44	49	40	
Lithuania	LT	40	41	41	33	53	
Slovenia	SI	28	29	29	30	31	
Estonia	EE	22	30	19	19	32	
Latvia	LV	50	60	36	37	36	
Cyprus	CY	7	8	7	10	7	
Luxembourg	LU	6	5	3	3	3	
Malta	MT	0	0	1	0	1	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 21: Number of publications (in fractional counting) in KA9, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**6,306**	**7,515**	**7,450**	**8,211**	**9,493**	
EU27	**EU27**	**1,167**	**1,325**	**1,144**	**1,226**	**1,408**	
MI	**MI**	**5,007**	**6,086**	**6,049**	**6,645**	**7,532**	
China	CN	1,708	2,051	2,480	2,848	3,397	
India	IN	190	229	240	296	334	
United States	US	909	1,156	978	992	1,047	
Rep. of Korea	KR	319	336	311	331	417	
Germany	DE	247	241	240	270	285	
United Kingdom	UK	314	375	322	311	325	
Japan	JP	226	281	240	230	279	
Italy	IT	131	188	153	183	187	
Spain	ES	175	171	179	154	190	
Brazil	BR	71	82	83	129	133	
Canada	CA	181	207	187	220	218	
France	FR	121	162	122	110	151	
Australia	AU	187	244	204	220	231	
Indonesia	ID	18	45	58	71	84	
Poland	PL	87	98	63	82	83	
Saudi Arabia	SA	63	68	109	82	105	
Sweden	SE	61	51	52	65	53	
Netherlands	NL	80	76	65	74	102	
Portugal	PT	32	27	34	39	53	
Denmark	DK	33	46	26	34	46	
Mexico	MX	42	30	42	51	50	
Norway	NO	104	180	124	126	113	
Greece	EL	33	23	22	19	32	
Belgium	BE	41	66	43	47	58	
Romania	RO	12	24	20	22	19	
Finland	FI	22	28	19	20	24	
Czech Republic	CZ	16	35	24	24	32	
Austria	AT	28	34	28	21	18	
United Arab Emirates	AE	24	40	23	29	28	
Ireland	IE	13	6	7	13	13	
Hungary	HU	10	17	9	16	13	
Chile	CL	7	11	7	6	8	
Croatia	HR	3	4	9	4	5	
Bulgaria	BG	4	4	2	6	8	
Slovakia	SK	2	5	4	6	7	
Lithuania	LT	1	1	6	4	5	
Slovenia	SI	4	8	9	6	10	
Estonia	EE	4	5	2	1	6	
Latvia	LV	2	5	2	4	4	
Cyprus	CY	4	0	5	3	4	
Luxembourg	LU	0	1	0	0	1	
Malta	MT	0	0	0	0	0	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 22: Number of publications (in fractional counting) in KA10, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**9,578**	**11,374**	**10,686**	**10,720**	**9,930**	
EU27	**EU27**	**2,176**	**2,584**	**2,172**	**2,133**	**1,793**	
MI	**MI**	**7,723**	**9,241**	**8,629**	**8,564**	**7,921**	
China	CN	1,992	2,662	2,613	2,641	2,736	
India	IN	373	471	419	400	433	
United States	US	1,763	1,842	1,810	1,872	1,474	
Rep. of Korea	KR	550	619	592	588	590	
Germany	DE	456	620	490	456	378	
United Kingdom	UK	326	406	388	377	339	
Japan	JP	882	1,018	861	794	720	
Italy	IT	236	309	263	291	256	
Spain	ES	176	193	177	133	138	
Brazil	BR	53	65	69	49	63	
Canada	CA	187	207	210	143	129	
France	FR	550	632	544	511	424	
Australia	AU	39	38	39	32	41	
Indonesia	ID	21	56	87	117	82	
Poland	PL	86	65	73	74	45	
Saudi Arabia	SA	13	9	11	15	16	
Sweden	SE	105	107	85	99	69	
Netherlands	NL	52	58	52	59	50	
Portugal	PT	23	36	29	30	20	
Denmark	DK	14	11	9	19	13	
Mexico	MX	25	30	21	29	19	
Norway	NO	20	15	15	12	24	
Greece	EL	13	15	11	13	12	
Belgium	BE	92	96	65	57	74	
Romania	RO	39	54	40	42	29	
Finland	FI	73	85	73	79	70	
Czech Republic	CZ	96	140	126	121	82	
Austria	AT	33	27	15	26	20	
United Arab Emirates	AE	9	6	12	12	20	
Ireland	IE	3	2	5	2	4	
Hungary	HU	42	36	36	37	35	
Chile	CL	4	6	3	3	5	
Croatia	HR	2	3	5	6	10	
Bulgaria	BG	14	12	15	8	7	
Slovakia	SK	29	33	12	22	15	
Lithuania	LT	17	22	16	16	16	
Slovenia	SI	18	18	21	25	19	
Estonia	EE	3	4	3	3	2	
Latvia	LV	3	3	6	4	1	
Cyprus	CY	0	1	1	0	0	
Luxembourg	LU	2	2	2	1	1	
Malta	MT	0	0	0	0	2	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 23: Number of publications (in fractional counting) per 1,000,000 population for all KAs, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**18.1**	**20.2**	**22.2**	**24.7**	**23.9**	
EU27	**EU27**	**62.3**	**67.7**	**68.0**	**71.8**	**67.4**	
MI	**MI**	**24.6**	**27.4**	**30.3**	**33.4**	**32.3**	
Denmark	DK	181.5	182.9	191.6	202.1	195.0	
Norway	NO	139.0	155.9	145.7	167.5	163.5	
Rep. of Korea	KR	114.7	119.0	128.2	138.9	135.2	
Finland	FI	133.0	130.3	138.9	146.7	132.9	
Estonia	EE	88.2	93.2	94.3	114.9	130.4	
Sweden	SE	131.3	140.0	131.8	134.6	126.9	
Portugal	PT	86.8	91.2	96.0	117.2	115.4	
Australia	AU	96.6	101.5	109.2	118.3	109.1	
Cyprus	CY	75.0	80.6	96.2	118.1	108.7	
Slovenia	SI	82.6	88.0	85.4	116.1	92.3	
Luxembourg	LU	116.5	102.8	78.9	96.5	85.2	
Latvia	LV	91.1	121.8	96.6	103.7	83.2	
Ireland	IE	84.4	85.5	85.2	96.1	81.8	
Canada	CA	84.0	79.1	85.6	87.2	80.1	
Greece	EL	68.9	70.4	70.7	79.3	79.1	
Italy	IT	64.7	73.6	72.2	80.3	76.7	
Lithuania	LT	51.1	59.2	61.7	53.5	73.6	
United Kingdom	UK	68.4	75.4	71.5	78.3	72.5	
Spain	ES	61.0	62.1	66.6	67.4	71.3	
Netherlands	NL	66.5	72.1	69.2	69.7	70.3	
Germany	DE	70.7	75.5	75.4	74.5	69.3	
Belgium	BE	65.3	71.3	68.7	69.8	68.0	
Austria	AT	78.4	75.8	72.6	82.4	65.9	
Czech Republic	CZ	63.5	75.3	74.5	82.4	65.0	
Croatia	HR	44.1	48.7	61.1	57.6	64.1	
Malta	MT	52.6	36.0	41.3	35.6	45.2	
United Arab Emirates	AE	35.4	42.8	42.8	55.8	50.5	
Poland	PL	36.9	43.9	48.8	49.2	49.6	
United States	US	51.3	53.4	53.2	53.2	47.2	
Slovakia	SK	42.8	50.9	49.7	69.5	44.4	
France	FR	46.9	49.4	48.3	47.4	43.0	
Saudi Arabia	SA	20.6	23.3	28.4	34.4	42.9	
China	CN	25.6	29.3	34.4	41.2	41.9	
Romania	RO	36.9	52.8	46.5	62.1	38.9	
Japan	JP	40.8	44.4	43.1	43.4	37.6	
Bulgaria	BG	20.0	23.8	29.8	41.8	37.0	
Hungary	HU	23.2	29.3	31.5	32.3	32.0	
Chile	CL	13.7	14.6	15.8	17.4	15.8	
Brazil	BR	10.8	12.9	13.7	16.1	14.4	
India	IN	6.9	8.5	11.3	12.1	11.9	
Indonesia	ID	2.4	4.9	8.4	10.0	9.7	
Mexico	MX	5.5	6.6	7.2	8.3	8.2	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 24: Number of publications (in fractional counting) per 1,000,000 population in KA1-2, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**4.1**	**4.4**	**4.8**	**5.0**	**4.8**	
EU27	**EU27**	**14.0**	**14.3**	**14.2**	**14.2**	**13.6**	
MI	**MI**	**5.5**	**5.8**	**6.3**	**6.5**	**6.2**	
Denmark	DK	63.0	55.8	60.0	57.5	59.5	
Norway	NO	49.8	44.8	47.9	51.4	41.2	
Rep. of Korea	KR	23.7	21.6	23.0	23.7	22.4	
Finland	FI	18.3	20.1	19.9	19.0	22.0	
Estonia	EE	16.5	19.4	15.1	20.8	19.6	
Sweden	SE	27.1	29.4	25.7	24.6	23.3	
Portugal	PT	21.1	17.6	19.1	25.4	21.5	
Australia	AU	26.7	25.2	27.7	26.2	23.7	
Cyprus	CY	17.6	20.3	27.3	31.6	26.0	
Slovenia	SI	13.2	18.6	13.2	19.4	11.5	
Luxembourg	LU	32.8	30.2	21.2	19.4	19.0	
Latvia	LV	14.7	16.3	11.2	12.0	9.2	
Ireland	IE	23.2	21.4	23.4	21.5	20.3	
Canada	CA	15.5	14.1	15.1	14.5	12.6	
Greece	EL	17.8	16.2	15.6	14.8	15.9	
Italy	IT	13.5	13.3	12.2	12.8	13.3	
Lithuania	LT	8.8	10.4	12.8	8.8	13.3	
United Kingdom	UK	16.6	16.6	16.0	16.9	15.8	
Spain	ES	15.1	15.0	16.9	16.8	16.1	
Netherlands	NL	17.8	19.0	18.8	16.9	21.3	
Germany	DE	17.8	17.2	17.5	15.9	15.1	
Belgium	BE	14.4	14.8	14.0	14.4	14.4	
Austria	AT	11.6	13.3	10.5	12.2	8.6	
Czech Republic	CZ	7.5	8.9	8.5	9.0	7.7	
Croatia	HR	8.5	11.3	13.5	13.6	11.8	
Malta	MT	34.3	10.8	15.3	17.5	12.4	
United Arab Emirates	AE	9.3	10.4	10.2	10.7	9.2	
Poland	PL	7.0	8.4	8.2	8.4	8.5	
United States	US	11.6	11.0	10.8	9.8	8.9	
Slovakia	SK	5.8	8.5	8.6	9.7	4.5	
France	FR	9.1	9.8	9.4	8.7	8.3	
Saudi Arabia	SA	6.6	6.8	7.4	9.6	11.5	
China	CN	5.5	6.0	6.8	7.8	7.6	
Romania	RO	10.6	12.8	11.3	14.8	7.9	
Japan	JP	8.8	10.1	10.0	8.6	7.5	
Bulgaria	BG	4.3	4.7	5.4	7.8	5.4	
Hungary	HU	2.4	4.3	4.3	4.7	6.0	
Chile	CL	5.1	4.8	5.5	5.2	5.2	
Brazil	BR	1.9	2.3	2.6	3.0	2.6	
India	IN	1.6	2.0	2.6	2.5	2.5	
Indonesia	ID	0.7	1.3	2.3	2.8	2.6	
Mexico	MX	1.5	1.9	2.0	2.3	2.1	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 25: Number of publications (in fractional counting) per 1,000,000 population in KA3, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**2.4**	**2.9**	**3.5**	**4.2**	**3.9**	
EU27	**EU27**	**8.8**	**10.4**	**11.3**	**12.8**	**11.1**	
MI	**MI**	**3.3**	**3.9**	**4.8**	**5.6**	**5.2**	
Denmark	DK	15.3	14.9	19.0	21.3	17.8	
Norway	NO	13.0	15.8	19.2	21.6	21.4	
Rep. of Korea	KR	23.6	26.1	28.6	29.7	28.1	
Finland	FI	25.7	25.9	33.6	35.0	28.3	
Estonia	EE	9.3	11.4	16.2	21.9	24.9	
Sweden	SE	17.6	19.8	19.7	20.5	19.8	
Portugal	PT	11.8	19.4	19.2	24.8	23.1	
Australia	AU	10.8	13.3	15.6	20.3	19.0	
Cyprus	CY	20.7	16.5	13.3	27.2	28.7	
Slovenia	SI	11.8	13.5	11.5	19.5	17.1	
Luxembourg	LU	28.5	31.4	21.0	42.5	25.0	
Latvia	LV	10.2	17.4	15.9	17.0	16.5	
Ireland	IE	18.6	21.9	21.2	28.0	17.5	
Canada	CA	9.3	9.8	12.5	15.5	14.1	
Greece	EL	12.2	14.8	18.1	22.1	19.3	
Italy	IT	10.8	13.4	13.7	15.5	13.8	
Lithuania	LT	9.6	10.9	10.6	11.3	12.6	
United Kingdom	UK	9.2	11.4	12.2	14.0	12.6	
Spain	ES	7.4	8.7	10.1	11.6	11.6	
Netherlands	NL	9.2	10.7	11.5	10.9	9.0	
Germany	DE	8.6	10.3	10.8	11.9	10.0	
Belgium	BE	8.8	10.7	13.5	14.7	12.5	
Austria	AT	13.5	15.9	15.1	18.7	11.7	
Czech Republic	CZ	9.5	9.7	10.1	12.9	9.8	
Croatia	HR	10.2	8.6	11.6	10.1	11.6	
Malta	MT	2.7	0.0	9.0	2.6	2.5	
United Arab Emirates	AE	5.8	7.7	8.1	14.2	11.7	
Poland	PL	3.6	5.0	6.1	6.1	7.1	
United States	US	5.9	7.3	8.0	8.7	7.0	
Slovakia	SK	8.0	8.1	9.3	13.5	9.8	
France	FR	6.8	6.7	8.0	8.3	6.7	
Saudi Arabia	SA	3.8	4.6	7.3	9.6	11.4	
China	CN	3.1	3.7	4.6	5.6	5.7	
Romania	RO	6.2	9.4	8.6	12.4	8.7	
Japan	JP	4.9	5.5	5.8	6.7	5.6	
Bulgaria	BG	2.4	4.4	7.3	9.5	8.2	
Hungary	HU	3.7	5.1	6.8	5.0	4.6	
Chile	CL	0.8	1.1	1.1	2.0	1.3	
Brazil	BR	1.3	1.6	1.9	2.4	2.0	
India	IN	1.3	1.7	2.6	3.2	2.8	
Indonesia	ID	0.3	0.7	1.3	1.8	1.6	
Mexico	MX	0.5	0.6	0.8	1.2	1.0	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 26: Number of publications (in fractional counting) per 1,000,000 population in KA4, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**3.8**	**4.1**	**4.7**	**5.3**	**4.8**	
EU27	**EU27**	**11.0**	**11.5**	**11.7**	**12.3**	**10.7**	
MI	**MI**	**5.3**	**5.6**	**6.6**	**7.4**	**6.7**	
Denmark	DK	41.2	43.5	48.2	49.1	45.0	
Norway	NO	19.6	20.3	18.3	22.5	27.5	
Rep. of Korea	KR	17.2	18.9	21.0	24.1	22.1	
Finland	FI	24.7	20.5	22.8	23.4	22.1	
Estonia	EE	19.4	13.8	25.6	26.9	26.1	
Sweden	SE	19.7	22.3	20.3	18.7	17.2	
Portugal	PT	17.3	17.5	17.7	19.4	16.6	
Australia	AU	20.9	18.1	23.5	25.2	20.4	
Cyprus	CY	12.1	16.2	24.5	26.5	16.7	
Slovenia	SI	14.4	14.1	7.0	17.4	12.6	
Luxembourg	LU	19.8	16.4	11.1	10.9	12.8	
Latvia	LV	14.9	21.1	22.1	21.6	11.4	
Ireland	IE	14.1	14.0	15.1	16.9	14.1	
Canada	CA	19.6	17.1	19.4	18.2	16.1	
Greece	EL	13.9	12.3	11.4	15.8	14.9	
Italy	IT	11.4	12.1	12.6	14.1	12.5	
Lithuania	LT	2.7	5.4	4.7	5.0	5.8	
United Kingdom	UK	12.2	13.1	12.3	12.9	11.2	
Spain	ES	10.6	11.1	11.1	11.4	11.2	
Netherlands	NL	11.3	11.1	10.9	11.5	10.0	
Germany	DE	12.0	12.0	13.1	12.1	10.9	
Belgium	BE	12.0	11.3	11.2	11.6	10.0	
Austria	AT	14.2	12.2	14.6	14.0	11.2	
Czech Republic	CZ	10.9	13.0	11.5	11.4	8.9	
Croatia	HR	11.2	13.8	15.9	14.4	13.0	
Malta	MT	8.3	10.2	9.1	13.8	12.3	
United Arab Emirates	AE	8.4	8.9	9.9	10.5	11.2	
Poland	PL	8.3	9.7	10.2	9.5	9.4	
United States	US	9.5	9.4	10.3	10.3	9.1	
Slovakia	SK	5.3	6.5	6.9	9.0	4.3	
France	FR	7.2	7.5	6.6	7.4	6.1	
Saudi Arabia	SA	2.9	3.3	4.4	4.9	7.0	
China	CN	6.8	7.2	8.9	11.1	10.2	
Romania	RO	7.7	10.3	8.9	11.3	6.1	
Japan	JP	6.4	6.3	6.3	6.9	5.4	
Bulgaria	BG	4.3	5.6	5.5	9.1	6.6	
Hungary	HU	2.2	3.7	3.4	4.0	2.3	
Chile	CL	3.4	2.7	3.3	5.1	3.6	
Brazil	BR	2.2	2.7	2.9	3.6	2.3	
India	IN	1.8	2.2	2.9	2.8	2.6	
Indonesia	ID	0.3	0.7	0.9	1.2	1.0	
Mexico	MX	0.8	0.9	1.1	1.1	1.2	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 27: Number of publications (in fractional counting) per 1,000,000 population in KA5, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**0.8**	**0.9**	**0.9**	**1.1**	**1.1**	
EU27	**EU27**	**4.1**	**4.9**	**4.6**	**5.6**	**5.1**	
MI	**MI**	**0.9**	**1.1**	**1.1**	**1.3**	**1.2**	
Denmark	DK	10.7	12.9	13.1	16.4	14.7	
Norway	NO	8.6	11.1	8.0	15.5	10.7	
Rep. of Korea	KR	3.1	3.3	4.2	5.1	4.4	
Finland	FI	8.9	7.3	6.9	9.7	7.9	
Estonia	EE	15.6	12.2	11.3	19.4	16.0	
Sweden	SE	8.7	7.9	7.5	11.6	9.9	
Portugal	PT	9.1	10.2	9.1	12.3	15.3	
Australia	AU	5.8	8.8	7.4	8.8	7.4	
Cyprus	CY	11.4	16.6	15.0	14.0	21.5	
Slovenia	SI	10.4	6.2	12.4	15.4	8.6	
Luxembourg	LU	9.0	2.8	4.3	7.4	7.9	
Latvia	LV	12.9	17.7	13.5	13.4	11.5	
Ireland	IE	7.2	8.3	5.3	6.3	6.3	
Canada	CA	4.4	4.3	4.5	5.8	5.0	
Greece	EL	6.0	7.5	5.0	6.3	7.2	
Italy	IT	5.7	8.5	6.9	7.8	7.2	
Lithuania	LT	6.7	6.5	6.6	4.6	9.8	
United Kingdom	UK	4.3	5.7	4.7	5.3	4.9	
Spain	ES	3.7	4.5	4.7	5.2	5.8	
Netherlands	NL	4.0	5.5	3.6	5.3	4.2	
Germany	DE	2.3	2.4	2.2	2.9	2.4	
Belgium	BE	4.5	5.2	4.9	5.9	5.5	
Austria	AT	7.2	5.2	5.1	7.2	4.8	
Czech Republic	CZ	9.1	8.6	8.3	13.5	8.4	
Croatia	HR	3.3	3.0	3.5	3.1	5.4	
Malta	MT	7.3	12.4	2.5	1.0	6.6	
United Arab Emirates	AE	3.3	4.4	3.6	5.5	4.0	
Poland	PL	2.2	3.7	4.8	5.0	4.5	
United States	US	2.3	2.1	2.0	2.3	1.9	
Slovakia	SK	6.5	8.3	6.8	10.9	6.7	
France	FR	1.8	2.0	2.4	2.6	2.1	
Saudi Arabia	SA	0.8	1.2	1.1	1.6	1.8	
China	CN	0.6	0.8	0.9	1.0	1.2	
Romania	RO	2.5	4.5	3.2	5.1	2.8	
Japan	JP	1.0	1.1	1.1	1.5	0.9	
Bulgaria	BG	0.7	0.7	1.1	1.9	1.4	
Hungary	HU	2.0	2.0	2.5	3.7	3.2	
Chile	CL	0.8	1.4	2.0	1.2	1.8	
Brazil	BR	0.3	0.5	0.4	0.4	0.5	
India	IN	0.2	0.2	0.3	0.3	0.3	
Indonesia	ID	0.1	0.2	0.5	0.5	0.6	
Mexico	MX	0.2	0.2	0.2	0.3	0.4	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 28: Number of publications (in fractional counting) per 1,000,000 population in KA6, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**0.5**	**0.6**	**0.7**	**0.8**	**0.8**	
EU27	**EU27**	**2.5**	**2.9**	**3.4**	**3.7**	**3.4**	
MI	**MI**	**0.6**	**0.7**	**0.8**	**0.9**	**0.9**	
Denmark	DK	3.5	4.5	6.1	7.7	7.0	
Norway	NO	4.7	4.2	6.4	6.7	7.3	
Rep. of Korea	KR	1.7	2.0	2.9	3.6	3.4	
Finland	FI	7.7	8.8	8.0	11.5	6.7	
Estonia	EE	3.0	4.0	3.7	4.3	4.1	
Sweden	SE	6.4	6.7	8.6	8.0	7.5	
Portugal	PT	3.0	5.0	5.0	8.4	7.6	
Australia	AU	3.1	3.9	2.9	3.3	4.4	
Cyprus	CY	2.9	3.0	3.4	4.5	2.8	
Slovenia	SI	4.0	4.1	6.2	7.1	7.4	
Luxembourg	LU	2.2	5.4	5.0	3.7	8.2	
Latvia	LV	5.9	8.1	3.8	8.3	4.8	
Ireland	IE	2.2	2.0	3.3	6.4	4.2	
Canada	CA	2.0	1.8	2.0	2.2	2.4	
Greece	EL	2.3	2.1	2.9	3.2	2.7	
Italy	IT	2.8	3.2	3.9	4.2	4.0	
Lithuania	LT	1.9	1.7	2.2	2.5	3.2	
United Kingdom	UK	2.1	2.7	2.5	2.8	2.4	
Spain	ES	1.9	2.1	2.7	2.6	3.5	
Netherlands	NL	1.9	2.6	3.1	2.4	3.2	
Germany	DE	3.6	4.0	4.6	4.6	4.0	
Belgium	BE	2.0	2.6	2.6	2.2	2.2	
Austria	AT	4.6	3.9	5.1	6.3	6.9	
Czech Republic	CZ	2.2	2.0	3.1	3.3	2.8	
Croatia	HR	2.4	2.1	2.7	2.8	3.5	
Malta	MT	0.0	1.4	1.0	0.0	0.0	
United Arab Emirates	AE	1.9	1.1	1.4	2.7	1.7	
Poland	PL	1.8	2.3	2.9	2.8	2.7	
United States	US	1.1	1.2	1.1	1.3	1.2	
Slovakia	SK	2.7	1.9	3.2	5.6	3.9	
France	FR	1.1	1.2	1.2	1.3	1.2	
Saudi Arabia	SA	0.6	0.6	0.9	1.1	1.3	
China	CN	0.4	0.6	0.6	0.8	0.9	
Romania	RO	1.3	2.9	2.7	3.4	2.3	
Japan	JP	0.5	0.6	0.6	0.7	0.7	
Bulgaria	BG	1.0	1.2	1.2	1.8	2.1	
Hungary	HU	1.7	1.1	1.2	2.5	2.4	
Chile	CL	0.3	0.6	0.5	0.7	0.8	
Brazil	BR	0.6	0.6	0.6	0.7	0.8	
India	IN	0.1	0.2	0.3	0.3	0.3	
Indonesia	ID	0.1	0.1	0.4	0.4	0.5	
Mexico	MX	0.2	0.3	0.3	0.4	0.3	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 29: Number of publications (in fractional counting) per 1,000,000 population in KA7, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**1.4**	**1.6**	**1.9**	**2.2**	**2.2**	
EU27	**EU27**	**4.6**	**5.0**	**5.5**	**5.8**	**6.0**	
MI	**MI**	**2.1**	**2.4**	**2.8**	**3.3**	**3.3**	
Denmark	DK	8.7	9.6	10.6	11.7	10.8	
Norway	NO	6.0	5.8	5.7	7.5	9.1	
Rep. of Korea	KR	11.7	11.8	13.5	15.7	14.8	
Finland	FI	6.0	5.1	8.8	8.9	8.6	
Estonia	EE	2.6	2.2	4.6	4.3	10.0	
Sweden	SE	9.2	10.5	11.3	12.2	12.6	
Portugal	PT	6.4	4.0	4.8	4.7	6.6	
Australia	AU	6.9	6.7	8.2	8.6	8.7	
Cyprus	CY	0.8	0.3	1.9	3.0	3.6	
Slovenia	SI	4.6	4.9	7.0	7.9	7.0	
Luxembourg	LU	10.8	4.2	7.1	6.8	5.2	
Latvia	LV	4.3	6.2	6.9	8.5	8.2	
Ireland	IE	5.2	4.9	5.5	3.5	4.8	
Canada	CA	7.5	6.5	8.2	8.6	8.5	
Greece	EL	3.3	3.8	3.4	4.0	3.8	
Italy	IT	4.4	4.8	5.7	6.9	7.5	
Lithuania	LT	1.0	1.6	2.2	2.3	2.3	
United Kingdom	UK	5.1	4.9	5.0	6.4	6.5	
Spain	ES	2.9	2.9	3.5	3.8	4.5	
Netherlands	NL	4.3	5.5	4.8	4.7	4.8	
Germany	DE	8.1	8.9	8.7	9.0	9.4	
Belgium	BE	4.5	5.2	6.4	5.8	5.5	
Austria	AT	6.9	5.2	5.9	6.6	7.5	
Czech Republic	CZ	3.2	4.4	5.8	5.5	4.3	
Croatia	HR	2.9	2.9	5.2	4.3	8.1	
Malta	MT	0.0	1.1	2.8	0.7	7.6	
United Arab Emirates	AE	0.8	1.6	1.9	2.9	2.3	
Poland	PL	2.3	2.9	4.2	3.3	3.8	
United States	US	4.2	4.8	5.0	5.2	4.9	
Slovakia	SK	3.5	3.4	3.7	6.8	4.1	
France	FR	3.8	3.5	4.1	3.7	3.3	
Saudi Arabia	SA	0.5	0.5	0.7	1.0	1.6	
China	CN	2.8	3.4	4.1	5.0	5.2	
Romania	RO	2.5	4.2	3.5	5.5	4.0	
Japan	JP	4.0	3.5	4.3	4.1	3.3	
Bulgaria	BG	1.2	2.7	3.1	4.8	5.0	
Hungary	HU	1.3	2.1	2.2	2.9	2.3	
Chile	CL	0.4	0.6	0.6	0.7	0.5	
Brazil	BR	0.3	0.4	0.4	0.6	0.5	
India	IN	0.3	0.4	0.6	0.7	0.7	
Indonesia	ID	0.2	0.3	0.4	0.6	0.4	
Mexico	MX	0.1	0.2	0.2	0.2	0.3	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 30: Number of publications (in fractional counting) per 1,000,000 population in KA8, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**2.9**	**3.2**	**3.3**	**3.6**	**3.9**	
EU27	**EU27**	**9.9**	**9.9**	**9.9**	**9.9**	**10.3**	
MI	**MI**	**3.9**	**4.3**	**4.5**	**4.9**	**5.3**	
Denmark	DK	31.0	31.9	28.6	29.5	30.3	
Norway	NO	13.6	16.9	14.1	16.5	20.8	
Rep. of Korea	KR	16.7	16.7	17.6	19.3	20.6	
Finland	FI	24.3	22.1	22.2	21.0	20.2	
Estonia	EE	16.6	22.8	14.0	14.3	23.7	
Sweden	SE	25.9	27.7	25.3	22.9	24.8	
Portugal	PT	12.7	11.3	15.0	15.6	17.6	
Australia	AU	13.2	13.9	14.1	16.0	14.8	
Cyprus	CY	6.3	6.9	6.2	8.4	5.7	
Slovenia	SI	13.5	13.9	13.9	14.5	14.6	
Luxembourg	LU	10.9	7.8	5.5	4.8	4.3	
Latvia	LV	25.4	31.1	18.8	19.2	19.0	
Ireland	IE	10.4	11.3	9.0	10.4	11.3	
Canada	CA	15.4	14.3	13.1	12.8	12.3	
Greece	EL	9.1	10.0	11.1	10.0	11.2	
Italy	IT	10.1	10.1	10.4	11.0	10.9	
Lithuania	LT	14.1	14.6	14.7	11.9	19.1	
United Kingdom	UK	9.0	9.3	8.2	9.7	9.3	
Spain	ES	11.8	9.9	9.9	9.9	11.7	
Netherlands	NL	10.4	10.1	9.8	10.5	9.1	
Germany	DE	9.9	10.3	9.7	9.5	9.6	
Belgium	BE	7.4	7.1	6.8	6.2	6.5	
Austria	AT	13.5	13.2	11.3	12.0	11.0	
Czech Republic	CZ	10.6	12.2	13.1	13.2	12.4	
Croatia	HR	4.4	5.3	5.4	7.0	7.0	
Malta	MT	0.0	0.1	1.5	0.0	1.0	
United Arab Emirates	AE	2.3	3.9	4.0	5.1	5.7	
Poland	PL	7.1	7.6	8.6	9.8	10.3	
United States	US	8.5	8.4	7.6	7.1	6.6	
Slovakia	SK	5.5	7.2	8.1	8.9	7.3	
France	FR	7.1	6.9	6.7	6.2	6.8	
Saudi Arabia	SA	3.0	3.9	3.1	3.8	4.8	
China	CN	3.7	4.4	5.0	6.1	6.8	
Romania	RO	3.4	4.7	5.1	6.4	4.6	
Japan	JP	6.5	7.1	6.4	6.8	6.4	
Bulgaria	BG	3.7	2.3	3.8	4.9	6.0	
Hungary	HU	4.5	5.6	6.4	4.0	6.2	
Chile	CL	2.2	2.4	2.3	2.1	1.8	
Brazil	BR	3.5	4.1	4.1	4.4	4.7	
India	IN	1.2	1.3	1.5	1.8	2.1	
Indonesia	ID	0.6	1.2	2.0	2.0	2.5	
Mexico	MX	1.6	2.0	2.0	2.2	2.3	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 31: Number of publications (in fractional counting) per 1,000,000 population in KA9, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**0.8**	**1.0**	**1.0**	**1.1**	**1.2**	
EU27	**EU27**	**2.6**	**3.0**	**2.6**	**2.7**	**3.1**	
MI	**MI**	**1.2**	**1.4**	**1.4**	**1.5**	**1.7**	
Denmark	DK	5.6	7.9	4.3	5.7	7.7	
Norway	NO	19.9	34.2	23.3	23.5	21.0	
Rep. of Korea	KR	6.2	6.5	6.0	6.4	8.0	
Finland	FI	4.1	5.2	3.5	3.7	4.3	
Estonia	EE	2.9	4.1	1.8	0.7	4.6	
Sweden	SE	6.2	5.0	5.1	6.4	5.1	
Portugal	PT	3.1	2.6	3.3	3.8	5.1	
Australia	AU	7.7	9.9	8.2	8.7	9.0	
Cyprus	CY	3.3	0.3	4.1	2.6	3.7	
Slovenia	SI	1.9	3.8	4.2	2.8	4.7	
Luxembourg	LU	0.0	1.2	0.6	0.0	1.3	
Latvia	LV	1.2	2.3	1.2	1.9	1.9	
Ireland	IE	2.7	1.2	1.4	2.6	2.6	
Canada	CA	5.0	5.7	5.0	5.8	5.7	
Greece	EL	3.1	2.1	2.1	1.8	3.0	
Italy	IT	2.2	3.1	2.5	3.1	3.1	
Lithuania	LT	0.4	0.4	2.1	1.3	1.7	
United Kingdom	UK	4.8	5.6	4.8	4.6	4.8	
Spain	ES	3.8	3.7	3.8	3.3	4.0	
Netherlands	NL	4.7	4.4	3.7	4.2	5.8	
Germany	DE	3.0	2.9	2.9	3.3	3.4	
Belgium	BE	3.6	5.8	3.7	4.1	5.0	
Austria	AT	3.2	3.8	3.2	2.4	2.1	
Czech Republic	CZ	1.5	3.3	2.3	2.3	3.0	
Croatia	HR	0.7	0.9	2.1	1.0	1.2	
Malta	MT	0.0	0.0	0.0	0.0	0.0	
United Arab Emirates	AE	2.6	4.2	2.4	3.0	2.8	
Poland	PL	2.3	2.6	1.7	2.2	2.2	
United States	US	2.8	3.5	3.0	3.0	3.1	
Slovakia	SK	0.3	0.9	0.7	1.1	1.2	
France	FR	1.8	2.4	1.8	1.6	2.2	
Saudi Arabia	SA	1.9	2.1	3.2	2.4	3.0	
China	CN	1.2	1.4	1.7	2.0	2.4	
Romania	RO	0.6	1.2	1.0	1.1	1.0	
Japan	JP	1.8	2.2	1.9	1.8	2.2	
Bulgaria	BG	0.6	0.5	0.3	0.9	1.1	
Hungary	HU	1.1	1.7	0.9	1.7	1.4	
Chile	CL	0.4	0.6	0.4	0.3	0.4	
Brazil	BR	0.3	0.4	0.4	0.6	0.6	
India	IN	0.1	0.2	0.2	0.2	0.2	
Indonesia	ID	0.1	0.2	0.2	0.3	0.3	
Mexico	MX	0.3	0.2	0.3	0.4	0.4	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 32: Number of publications (in fractional counting) per 1,000,000 population in KA10, 2016–2020

Country	Code	2016	2017	2018	2019	2020	Trend
World	**World**	**1.3**	**1.5**	**1.4**	**1.4**	**1.3**	
EU27	**EU27**	**4.9**	**5.8**	**4.9**	**4.8**	**4.0**	
MI	**MI**	**1.8**	**2.2**	**2.0**	**2.0**	**1.8**	
Denmark	DK	2.5	1.9	1.5	3.2	2.2	
Norway	NO	3.8	2.9	2.8	2.3	4.4	
Rep. of Korea	KR	10.7	12.1	11.5	11.4	11.4	
Finland	FI	13.3	15.5	13.2	14.4	12.7	
Estonia	EE	2.3	3.2	2.0	2.4	1.4	
Sweden	SE	10.5	10.7	8.4	9.6	6.6	
Portugal	PT	2.2	3.5	2.8	2.9	2.0	
Australia	AU	1.6	1.5	1.6	1.3	1.6	
Cyprus	CY	0.0	0.4	0.5	0.4	0.0	
Slovenia	SI	8.8	8.8	10.0	12.1	8.9	
Luxembourg	LU	2.6	3.2	3.2	1.0	1.6	
Latvia	LV	1.4	1.6	3.2	1.9	0.7	
Ireland	IE	0.7	0.5	0.9	0.4	0.8	
Canada	CA	5.2	5.7	5.7	3.8	3.4	
Greece	EL	1.2	1.4	1.1	1.2	1.1	
Italy	IT	3.9	5.1	4.3	4.9	4.3	
Lithuania	LT	5.9	7.7	5.6	5.8	5.8	
United Kingdom	UK	4.9	6.1	5.8	5.6	5.0	
Spain	ES	3.8	4.1	3.8	2.8	2.9	
Netherlands	NL	3.0	3.3	3.0	3.4	2.9	
Germany	DE	5.5	7.5	5.9	5.5	4.5	
Belgium	BE	8.1	8.4	5.7	4.9	6.4	
Austria	AT	3.8	3.1	1.7	3.0	2.2	
Czech Republic	CZ	9.0	13.2	11.8	11.4	7.7	
Croatia	HR	0.6	0.8	1.3	1.4	2.3	
Malta	MT	0.0	0.0	0.0	0.0	2.9	
United Arab Emirates	AE	0.9	0.7	1.2	1.2	2.0	
Poland	PL	2.3	1.7	1.9	2.0	1.2	
United States	US	5.4	5.6	5.5	5.6	4.4	
Slovakia	SK	5.3	6.1	2.3	4.0	2.8	
France	FR	8.2	9.4	8.0	7.5	6.2	
Saudi Arabia	SA	0.4	0.3	0.3	0.4	0.4	
China	CN	1.4	1.9	1.8	1.8	1.9	
Romania	RO	2.0	2.7	2.0	2.2	1.5	
Japan	JP	6.9	8.0	6.8	6.3	5.7	
Bulgaria	BG	1.9	1.7	2.2	1.2	1.0	
Hungary	HU	4.3	3.7	3.7	3.8	3.6	
Chile	CL	0.2	0.3	0.2	0.1	0.3	
Brazil	BR	0.3	0.3	0.3	0.2	0.3	
India	IN	0.3	0.4	0.3	0.3	0.3	
Indonesia	ID	0.1	0.2	0.3	0.4	0.3	
Mexico	MX	0.2	0.2	0.2	0.2	0.2	

Source: These statistics were calculated using data from Scopus (Elsevier) and the World Bank

Table 33: Specialisation index for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
World	**World**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
EU27	**EU27**	**0.83**	**0.84**	**0.85**	**0.66**	**1.39**	**1.28**	**0.81**	**0.78**	**0.76**	**0.92**
MI	**MI**	**1.03**	**0.99**	**1.03**	**1.06**	**0.88**	**0.91**	**1.15**	**1.03**	**1.07**	**1.08**
Latvia	LV	1.74	0.96	2.14	1.19	5.38	3.01	1.87	2.43	0.77	0.28
United Arab Emirates	AE	1.68	1.52	2.40	1.86	2.93	1.65	0.84	1.17	1.81	1.23
India	IN	1.64	1.70	2.42	1.81	0.91	1.33	1.08	1.74	0.65	0.81
Rep. of Korea	KR	1.60	1.32	2.06	1.30	1.15	1.20	1.90	1.50	1.86	2.51
Estonia	EE	1.51	1.13	1.78	1.51	4.12	1.42	1.27	1.68	1.03	0.30
China	CN	1.45	1.31	1.22	1.76	0.93	0.96	1.97	1.45	1.60	1.23
Saudi Arabia	SA	1.34	1.78	2.20	1.09	1.27	1.26	0.54	0.92	1.83	0.26
Cyprus	CY	1.28	1.53	2.09	0.98	5.63	0.99	0.46	0.41	0.85	0.00
Lithuania	LT	1.19	1.07	1.27	0.47	3.55	1.55	0.40	1.89	0.52	1.75
Denmark	DK	1.19	1.80	0.67	1.37	2.00	1.28	0.72	1.13	0.92	0.25
Romania	RO	1.17	1.18	1.62	0.92	1.85	2.07	1.32	0.84	0.59	0.83
Greece	EL	1.09	1.09	1.64	1.03	2.21	1.14	0.57	0.95	0.80	0.28
Portugal	PT	1.08	1.00	1.33	0.78	3.18	2.12	0.67	1.01	0.93	0.34
Bulgaria	BG	1.06	0.78	1.45	0.95	0.91	1.82	1.56	1.06	0.64	0.55
Indonesia	ID	1.04	1.40	1.03	0.51	1.54	1.48	0.53	1.61	0.64	0.60
Norway	NO	1.02	1.29	0.83	0.86	1.49	1.38	0.62	0.80	2.56	0.52
Finland	FI	0.99	0.82	1.30	0.82	1.31	1.49	0.70	0.92	0.62	1.76
Sweden	SE	0.93	0.86	0.90	0.63	1.63	1.67	1.01	1.12	0.74	0.91
Luxembourg	LU	0.91	1.01	1.66	0.69	1.88	2.65	0.60	0.28	0.28	0.32
Italy	IT	0.85	0.74	0.95	0.69	1.79	1.34	0.90	0.74	0.68	0.89
Germany	DE	0.85	0.92	0.76	0.67	0.64	1.46	1.25	0.72	0.82	1.04
Mexico	MX	0.85	1.10	0.62	0.61	0.89	0.99	0.37	1.49	0.79	0.29
Croatia	HR	0.83	0.76	0.93	0.84	1.57	1.37	1.15	0.56	0.30	0.57
Poland	PL	0.82	0.71	0.72	0.78	1.65	1.34	0.68	1.04	0.71	0.37
Spain	ES	0.79	0.89	0.79	0.62	1.44	1.17	0.54	0.79	0.87	0.60
Slovenia	SI	0.79	0.49	0.90	0.54	1.64	1.88	0.65	0.76	0.78	1.42
Japan	JP	0.78	0.78	0.71	0.56	0.43	0.45	0.74	0.81	0.90	2.22
Czech Republic	CZ	0.75	0.44	0.70	0.52	2.16	0.97	0.55	0.88	0.67	1.65
Canada	CA	0.73	0.57	0.80	0.74	1.01	0.66	0.85	0.69	1.03	0.58
Ireland	IE	0.73	0.91	0.97	0.63	1.25	1.13	0.46	0.62	0.46	0.13
Slovakia	SK	0.73	0.37	0.99	0.35	2.46	1.92	0.73	0.73	0.39	0.85
Belgium	BE	0.73	0.77	0.83	0.54	1.30	0.70	0.64	0.42	1.05	1.28
Brazil	BR	0.71	0.64	0.60	0.56	0.59	1.25	0.26	1.43	0.60	0.27
Australia	AU	0.71	0.77	0.76	0.66	1.07	0.86	0.62	0.59	1.14	0.19
France	FR	0.71	0.68	0.69	0.50	0.78	0.60	0.58	0.68	0.71	1.91
United Kingdom	UK	0.70	0.76	0.75	0.54	1.05	0.68	0.68	0.55	0.90	0.90
Malta	MT	0.69	0.95	0.23	0.95	2.25	0.00	1.27	0.09	0.00	0.82
Austria	AT	0.67	0.44	0.74	0.57	1.10	2.12	0.84	0.69	0.41	0.42
Hungary	HU	0.67	0.63	0.59	0.24	1.51	1.52	0.52	0.80	0.57	1.41
Netherlands	NL	0.58	0.87	0.45	0.41	0.77	0.79	0.43	0.46	0.93	0.44
United States	US	0.54	0.51	0.50	0.52	0.48	0.43	0.62	0.47	0.71	0.95
Chile	CL	0.52	0.85	0.27	0.59	1.29	0.79	0.19	0.36	0.25	0.17

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 34: Share of international co-publications normalised by the world weighted average for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
World	**World**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
EU27	**EU27**	**1.32**	**1.34**	**1.22**	**1.46**	**1.07**	**1.13**	**1.27**	**1.31**	**1.27**	**1.66**
MI	**MI**	**0.92**	**0.92**	**0.92**	**0.89**	**0.96**	**0.97**	**0.93**	**0.92**	**0.93**	**0.93**
Saudi Arabia	SA	1.85	1.84	1.66	2.12	1.73	1.60	2.27	1.91	1.38	2.03
Luxembourg	LU	1.82	1.85	1.66	1.99	1.99	0.85	2.64	2.16	2.02	0.79
United Arab Emirates	AE	1.75	1.72	1.68	2.12	1.24	1.77	1.76	1.81	1.44	1.41
Denmark	DK	1.72	1.55	1.75	2.16	1.30	1.58	2.03	1.57	1.38	1.93
Australia	AU	1.68	1.52	1.55	1.88	1.49	1.49	2.17	1.77	1.45	1.82
Belgium	BE	1.65	1.66	1.39	1.78	1.39	1.71	1.45	1.78	1.47	1.98
Chile	CL	1.64	1.56	1.46	1.93	1.36	1.38	2.44	1.50	1.77	1.66
United Kingdom	UK	1.63	1.57	1.64	1.88	1.37	1.70	1.72	1.59	1.45	1.55
Cyprus	CY	1.60	1.62	1.56	1.99	1.22	1.36	1.98	1.72	1.31	N/C
Estonia	EE	1.58	1.64	1.45	1.64	1.62	1.43	1.96	1.61	1.07	1.78
Finland	FI	1.58	1.44	1.60	1.75	1.56	1.49	1.75	1.47	1.46	1.69
Sweden	SE	1.56	1.64	1.47	1.69	1.10	1.28	1.55	1.51	1.63	1.91
Netherlands	NL	1.56	1.44	1.53	1.66	1.40	1.67	1.56	1.64	1.33	1.87
France	FR	1.56	1.52	1.53	1.71	1.37	1.57	1.74	1.54	1.53	1.48
Ireland	IE	1.55	1.47	1.54	1.64	0.73	1.64	1.68	1.60	1.82	2.03
Norway	NO	1.48	1.35	1.48	1.69	1.49	1.33	1.57	1.51	1.26	1.61
Austria	AT	1.46	1.53	1.40	1.54	1.26	1.10	1.22	1.58	1.69	1.97
Malta	MT	1.43	1.54	2.11	1.40	1.29	N/C	0.59	2.16	N/C	1.19
Canada	CA	1.41	1.37	1.43	1.51	1.19	1.33	1.65	1.34	1.34	1.31
Slovenia	SI	1.40	1.41	1.25	1.31	1.13	1.05	1.71	1.36	1.21	1.89
Czech Republic	CZ	1.36	1.33	1.29	1.53	0.81	1.34	1.37	1.45	1.40	1.56
Lithuania	LT	1.35	1.47	1.45	1.07	1.64	0.99	1.55	1.16	1.40	0.71
Spain	ES	1.32	1.26	1.18	1.52	1.06	1.29	1.41	1.30	1.19	1.70
Portugal	PT	1.30	1.28	1.28	1.60	0.88	0.85	1.68	1.24	1.22	2.01
Slovakia	SK	1.27	1.55	1.14	1.48	1.12	0.94	1.17	1.12	1.70	1.67
Hungary	HU	1.23	1.41	1.17	1.30	0.93	0.68	1.05	1.28	1.19	1.29
Germany	DE	1.22	1.25	1.09	1.22	1.19	0.86	1.03	1.25	1.12	1.78
Greece	EL	1.16	1.28	0.99	1.28	0.96	1.00	1.41	1.11	1.15	1.69
United States	US	1.13	1.10	1.19	1.20	1.06	1.26	1.17	1.17	1.02	0.92
Italy	IT	1.10	1.20	0.92	1.24	0.87	0.92	1.05	1.09	1.05	1.48
Latvia	LV	1.04	1.16	0.84	0.95	0.87	1.71	1.35	0.89	1.10	1.78
Croatia	HR	1.04	1.21	0.93	0.91	1.33	1.11	0.38	1.17	0.97	1.71
Mexico	MX	0.99	0.99	0.94	1.32	0.77	1.31	0.93	0.81	0.79	1.35
Japan	JP	0.97	0.97	0.92	1.03	1.10	1.05	1.03	1.02	1.02	0.75
Poland	PL	0.88	0.88	0.94	0.88	0.67	0.81	0.71	0.81	0.91	1.75
Rep. of Korea	KR	0.81	0.85	0.74	0.91	0.73	0.91	0.79	0.87	0.81	0.53
Brazil	BR	0.81	0.75	0.94	0.86	0.85	0.76	0.86	0.71	0.91	0.63
Romania	RO	0.76	0.87	0.59	0.80	0.71	0.73	0.57	0.82	0.81	1.23
Bulgaria	BG	0.70	0.90	0.52	0.67	0.22	0.55	0.47	0.59	1.64	1.54
China	CN	0.57	0.56	0.65	0.48	0.65	0.66	0.60	0.61	0.61	0.43
Indonesia	ID	0.51	0.42	0.50	0.57	0.44	0.47	0.49	0.55	0.65	0.40
India	IN	0.47	0.42	0.42	0.45	0.50	0.45	0.52	0.55	0.70	0.40

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 35: Share of transnational co-publications normalised by the EU27 weighted average for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
EU27	**EU27**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
Luxembourg	LU	1.89	2.07	1.39	2.60	2.32	1.13	2.97	2.22	3.15	0.65
Slovenia	SI	1.57	1.91	1.13	1.50	1.38	1.37	1.84	1.75	0.63	1.47
Belgium	BE	1.56	1.66	1.28	1.65	1.53	1.67	1.70	1.38	1.54	1.32
Malta	MT	1.54	1.74	2.52	0.80	1.98	N/C	0.95	3.21	N/C	0.98
Austria	AT	1.48	1.48	1.85	1.54	1.57	1.13	1.29	1.58	1.70	1.33
Estonia	EE	1.43	1.50	1.20	1.27	2.26	1.81	2.15	1.56	0.56	1.47
Cyprus	CY	1.35	1.12	1.58	1.90	1.22	2.26	1.86	1.58	0.74	N/C
Netherlands	NL	1.33	1.34	1.38	1.35	1.30	1.35	1.69	1.25	1.28	1.17
Finland	FI	1.30	1.05	1.42	1.48	1.53	1.46	1.39	1.28	1.20	1.02
Slovakia	SK	1.27	1.64	1.13	1.28	1.37	0.96	1.39	1.25	1.36	1.16
Lithuania	LT	1.22	1.44	1.10	0.81	1.80	1.33	2.19	1.12	0.48	0.49
Czech Republic	CZ	1.18	1.13	1.35	1.06	0.97	1.06	1.05	1.29	1.09	0.99
Ireland	IE	1.16	1.26	1.26	1.10	0.32	2.07	1.03	1.38	0.79	1.40
Sweden	SE	1.15	1.15	1.26	1.22	0.89	1.13	1.32	1.16	1.08	1.03
Portugal	PT	1.05	1.18	0.81	1.31	0.84	0.82	1.67	0.97	1.22	1.41
Greece	EL	0.99	0.81	0.91	1.27	1.03	1.31	1.37	1.12	0.95	1.08
Hungary	HU	0.98	1.22	1.21	0.75	0.96	0.55	1.06	0.92	0.81	0.66
Spain	ES	0.98	0.87	1.03	1.00	0.94	1.12	1.18	0.97	0.90	1.18
Denmark	DK	0.95	0.97	1.22	0.84	1.03	1.30	1.16	0.98	0.92	1.21
Croatia	HR	0.93	1.17	1.04	0.62	1.51	0.96	0.23	0.84	1.40	1.20
Latvia	LV	0.93	1.12	0.83	0.57	0.89	1.49	0.96	1.06	1.72	0.98
France	FR	0.91	0.84	0.77	0.91	0.69	1.12	1.15	0.90	1.12	0.74
Italy	IT	0.88	0.96	0.70	0.92	0.86	0.85	0.80	0.98	0.84	0.96
Germany	DE	0.85	0.84	0.98	0.79	1.08	0.72	0.66	0.81	0.71	1.00
Romania	RO	0.73	0.77	0.65	0.75	0.87	0.46	0.48	0.91	0.92	0.97
Poland	PL	0.72	0.77	0.79	0.68	0.63	0.66	0.69	0.62	0.86	1.23
Bulgaria	BG	0.56	0.61	0.60	0.45	0.00	0.32	0.32	0.66	2.32	0.28

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 36: Weighted eigenvector centrality among the world's co-publication network for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
China	CN	0.60	0.57	0.60	0.61	0.57	0.55	0.65	0.61	0.61	0.30
United States	US	0.52	0.48	0.51	0.52	0.45	0.49	0.54	0.50	0.54	0.41
United Kingdom	UK	0.29	0.32	0.31	0.27	0.37	0.35	0.25	0.24	0.29	0.32
Australia	AU	0.22	0.22	0.20	0.24	0.28	0.19	0.26	0.24	0.23	0.05
Germany	DE	0.18	0.22	0.11	0.13	0.13	0.18	0.15	0.16	0.18	0.41
Canada	CA	0.16	0.13	0.18	0.15	0.17	0.14	0.18	0.15	0.18	0.08
Rep. of Korea	KR	0.15	0.14	0.18	0.13	0.11	0.14	0.13	0.17	0.15	0.11
India	IN	0.14	0.14	0.20	0.14	0.12	0.14	0.09	0.18	0.08	0.03
Japan	JP	0.13	0.13	0.11	0.10	0.09	0.08	0.12	0.15	0.15	0.19
France	FR	0.12	0.11	0.09	0.09	0.10	0.12	0.07	0.10	0.11	0.38
Italy	IT	0.11	0.12	0.09	0.10	0.16	0.18	0.06	0.09	0.07	0.25
Saudi Arabia	SA	0.10	0.14	0.14	0.11	0.09	0.10	0.07	0.10	0.06	0.01
Spain	ES	0.09	0.10	0.07	0.08	0.10	0.12	0.05	0.09	0.07	0.21
Denmark	DK	0.08	0.13	0.05	0.14	0.11	0.08	0.05	0.07	0.04	0.03
Sweden	SE	0.07	0.09	0.06	0.05	0.08	0.10	0.04	0.08	0.05	0.11
Netherlands	NL	0.07	0.10	0.05	0.05	0.10	0.13	0.04	0.06	0.09	0.11
Belgium	BE	0.04	0.05	0.03	0.03	0.06	0.05	0.02	0.03	0.05	0.16
Norway	NO	0.04	0.05	0.04	0.04	0.09	0.06	0.02	0.04	0.06	0.02
Brazil	BR	0.04	0.04	0.04	0.03	0.04	0.06	0.01	0.06	0.03	0.01
Finland	FI	0.04	0.03	0.04	0.03	0.05	0.06	0.02	0.03	0.02	0.13
Poland	PL	0.03	0.04	0.03	0.03	0.04	0.06	0.02	0.03	0.02	0.06
Portugal	PT	0.03	0.04	0.04	0.03	0.06	0.03	0.01	0.02	0.02	0.08
United Arab Emirates	AE	0.03	0.03	0.04	0.04	0.04	0.05	0.01	0.03	0.02	0.01
Czech Republic	CZ	0.03	0.02	0.02	0.02	0.02	0.03	0.01	0.03	0.03	0.08
Austria	AT	0.03	0.02	0.02	0.02	0.04	0.07	0.01	0.02	0.03	0.05
Greece	EL	0.02	0.03	0.03	0.03	0.04	0.03	0.01	0.02	0.01	0.03
Ireland	IE	0.02	0.03	0.03	0.02	0.02	0.05	0.01	0.02	0.02	0.01
Mexico	MX	0.02	0.03	0.01	0.02	0.01	0.04	0.00	0.02	0.02	0.01
Indonesia	ID	0.02	0.02	0.02	0.01	0.02	0.03	0.01	0.03	0.01	0.00
Chile	CL	0.01	0.02	0.00	0.02	0.02	0.01	0.01	0.01	0.01	0.00
Romania	RO	0.01	0.01	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.04
Hungary	HU	0.01	0.01	0.01	0.00	0.03	0.01	0.00	0.01	0.01	0.02
Slovenia	SI	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.04
Estonia	EE	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00
Cyprus	CY	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	N/C
Slovakia	SK	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.01
Lithuania	LT	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01
Croatia	HR	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01
Luxembourg	LU	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Bulgaria	BG	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Latvia	LV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Malta	MT	0.00	0.00	0.00	0.00	0.00	N/C	0.00	0.00	N/C	0.00

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 37: Weighted eigenvector centrality among the EU27's co-publication network for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
Germany	DE	0.49	0.50	0.48	0.45	0.37	0.47	0.48	0.46	0.42	0.53
Italy	IT	0.41	0.40	0.41	0.45	0.49	0.45	0.41	0.42	0.36	0.39
France	FR	0.39	0.33	0.30	0.35	0.22	0.29	0.41	0.38	0.43	0.49
Spain	ES	0.39	0.37	0.41	0.41	0.40	0.40	0.38	0.40	0.37	0.35
Netherlands	NL	0.26	0.33	0.23	0.24	0.26	0.29	0.26	0.25	0.40	0.16
Belgium	BE	0.21	0.22	0.17	0.18	0.24	0.16	0.16	0.14	0.30	0.26
Sweden	SE	0.20	0.22	0.24	0.18	0.19	0.21	0.27	0.24	0.11	0.14
Denmark	DK	0.17	0.25	0.16	0.23	0.25	0.18	0.20	0.18	0.10	0.04
Portugal	PT	0.16	0.15	0.18	0.17	0.25	0.15	0.14	0.14	0.15	0.12
Finland	FI	0.14	0.09	0.19	0.14	0.12	0.13	0.09	0.13	0.08	0.18
Austria	AT	0.13	0.08	0.19	0.14	0.16	0.25	0.14	0.17	0.18	0.07
Poland	PL	0.13	0.13	0.12	0.15	0.13	0.15	0.10	0.16	0.13	0.11
Greece	EL	0.10	0.09	0.14	0.16	0.17	0.07	0.11	0.12	0.08	0.05
Czech Republic	CZ	0.10	0.05	0.08	0.07	0.09	0.07	0.06	0.13	0.11	0.13
Ireland	IE	0.07	0.09	0.09	0.07	0.02	0.11	0.03	0.08	0.06	0.02
Romania	RO	0.06	0.04	0.06	0.07	0.07	0.02	0.06	0.05	0.02	0.07
Slovenia	SI	0.05	0.04	0.03	0.03	0.03	0.03	0.05	0.04	0.01	0.07
Hungary	HU	0.03	0.03	0.03	0.01	0.08	0.02	0.01	0.03	0.04	0.03
Slovakia	SK	0.03	0.03	0.03	0.03	0.06	0.01	0.03	0.02	0.02	0.03
Estonia	EE	0.02	0.02	0.03	0.03	0.07	0.02	0.02	0.04	0.00	0.00
Croatia	HR	0.02	0.03	0.03	0.02	0.06	0.03	0.01	0.02	0.01	0.02
Lithuania	LT	0.02	0.03	0.02	0.01	0.06	0.01	0.02	0.03	0.00	0.01
Cyprus	CY	0.02	0.02	0.04	0.05	0.05	0.02	0.03	0.02	0.01	N/C
Luxembourg	LU	0.02	0.03	0.02	0.02	0.04	0.02	0.03	0.01	0.01	0.00
Latvia	LV	0.01	0.02	0.01	0.00	0.02	0.02	0.01	0.03	0.00	0.00
Bulgaria	BG	0.01	0.01	0.03	0.01	N/C	0.01	0.02	0.01	0.05	0.00
Malta	MT	0.01	0.01	0.00	0.00	0.01	N/C	0.00	0.01	N/C	0.00

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 38: Share of open access publications normalised by the world weighted average for each KA (2018)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
World	**World**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
EU27	**EU27**	**1.32**	**1.36**	**1.14**	**1.38**	**1.16**	**1.07**	**1.24**	**1.34**	**1.46**	**1.46**
MI	**MI**	**0.94**	**0.95**	**0.96**	**0.92**	**0.98**	**0.93**	**0.95**	**0.96**	**0.96**	**0.93**
United Kingdom	UK	2.40	2.50	2.18	2.69	2.08	2.20	2.50	2.33	2.52	2.08
Netherlands	NL	2.17	2.12	1.76	2.52	2.11	2.28	2.29	2.01	2.04	2.37
Ireland	IE	1.93	2.03	1.78	1.95	1.77	1.06	2.30	1.98	2.99	2.35
Denmark	DK	1.89	1.76	1.56	1.93	1.54	1.99	2.45	2.14	1.60	2.99
Chile	CL	1.82	1.75	1.69	2.13	1.46	1.58	2.09	1.65	2.28	1.79
Hungary	HU	1.77	2.02	1.35	1.71	1.63	1.77	1.42	1.79	2.82	1.40
Spain	ES	1.72	1.63	2.03	1.98	1.68	1.75	1.86	1.43	1.54	1.40
Norway	NO	1.65	1.63	1.29	1.66	1.91	2.14	1.36	1.66	1.38	1.78
Lithuania	LT	1.58	1.90	1.22	2.34	1.48	1.50	0.98	0.85	1.63	2.11
Austria	AT	1.54	1.75	0.82	1.74	1.12	1.22	1.49	1.70	2.29	2.07
Luxembourg	LU	1.53	2.85	0.79	0.82	1.69	0.85	1.30	1.17	2.09	1.10
Belgium	BE	1.50	1.59	1.64	1.47	1.26	1.32	1.28	1.33	1.40	1.68
Croatia	HR	1.49	1.86	1.01	1.21	1.08	2.42	1.45	1.79	1.13	2.60
Sweden	SE	1.46	1.73	1.16	1.35	1.37	1.22	1.42	1.34	1.48	1.43
Finland	FI	1.37	1.47	1.28	1.45	1.58	0.76	1.52	1.35	1.40	1.38
Cyprus	CY	1.30	0.96	1.44	1.72	1.30	0.36	2.87	1.21	1.39	0.00
Slovenia	SI	1.24	1.12	0.98	1.75	0.67	2.26	1.51	1.11	0.82	1.10
Portugal	PT	1.22	1.24	1.09	1.03	1.09	0.98	1.46	1.29	1.05	1.84
France	FR	1.20	1.15	0.96	1.41	0.96	1.12	0.95	1.26	1.47	1.25
Saudi Arabia	SA	1.19	1.01	1.39	1.44	1.22	1.06	1.46	1.16	0.95	1.00
Mexico	MX	1.18	0.95	1.25	1.18	1.28	0.72	1.68	1.28	1.10	0.17
Estonia	EE	1.17	0.78	0.81	1.42	1.27	1.28	1.19	1.25	2.69	1.47
Poland	PL	1.16	1.08	1.14	1.12	1.00	1.03	1.02	1.28	1.01	1.37
Germany	DE	1.14	1.07	0.85	1.10	1.00	0.67	1.01	1.27	1.41	1.70
Brazil	BR	1.12	1.23	0.78	0.78	1.24	0.84	1.11	1.27	1.17	1.13
Czech Republic	CZ	1.12	1.17	0.99	1.34	0.53	1.14	1.09	1.27	0.97	1.01
Italy	IT	1.09	1.19	0.95	1.05	0.99	0.75	1.04	1.14	1.33	1.17
Australia	AU	1.07	0.98	1.21	1.05	1.07	1.40	1.08	1.10	0.86	1.08
Japan	JP	1.00	0.97	0.92	0.98	1.14	1.08	1.04	0.95	1.05	1.03
Greece	EL	0.99	1.08	0.98	0.88	0.97	0.79	1.12	0.96	0.62	1.44
United States	US	0.94	0.93	0.88	0.86	0.77	0.96	0.91	1.19	0.93	0.78
Slovakia	SK	0.92	1.01	0.72	0.62	0.89	0.83	1.21	1.18	0.00	0.65
Rep. of Korea	KR	0.91	0.82	1.22	1.00	1.15	0.84	0.87	0.75	0.71	0.68
Canada	CA	0.90	0.93	0.97	0.74	0.99	0.99	0.87	1.03	0.93	0.69
Latvia	LV	0.81	0.92	0.85	0.80	0.80	1.01	0.38	0.48	1.05	1.47
United Arab Emirates	AE	0.77	0.41	0.87	0.92	0.96	0.70	0.68	1.06	0.68	0.55
Indonesia	ID	0.71	0.68	0.77	0.94	0.45	0.83	0.67	0.59	0.74	0.56
China	CN	0.68	0.70	0.87	0.73	0.68	0.69	0.83	0.59	0.56	0.45
Romania	RO	0.58	0.71	0.44	0.51	0.34	0.32	0.45	0.61	0.80	1.17
Bulgaria	BG	0.54	0.20	0.17	1.06	0.95	0.74	0.70	0.52	1.48	0.57
Malta	MT	0.51	0.55	0.76	0.00	0.46	4.25	0.00	0.00	N/C	N/C
India	IN	0.49	0.46	0.54	0.55	0.37	0.55	0.39	0.53	0.51	0.39

Source: These statistics were calculated using data from Scopus (Elsevier) and 1findr

Table 39: Share of public/private co-publications normalised by the world weighted average for each KA (2020)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
World	**World**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
EU27	**EU27**	**1.38**	**1.35**	**1.55**	**1.19**	**1.23**	**1.53**	**1.53**	**1.72**	**1.21**	**1.22**
MI	**MI**	**1.09**	**1.11**	**1.07**	**1.12**	**1.12**	**1.12**	**1.04**	**1.07**	**1.04**	**1.06**
Austria	AT	2.47	2.16	2.71	2.30	3.32	2.63	2.40	3.97	1.57	1.04
Croatia	HR	1.86	2.04	1.42	2.36	2.23	N/C	0.43	2.23	N/C	N/C
Sweden	SE	1.84	1.39	1.52	1.70	2.31	2.78	2.30	2.39	1.51	2.14
Malta	MT	1.80	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Germany	DE	1.78	1.65	2.12	1.43	2.29	2.22	2.05	2.35	1.38	1.06
Slovenia	SI	1.76	1.88	1.86	2.29	0.48	N/C	3.11	1.41	N/C	1.20
Netherlands	NL	1.74	1.57	2.15	1.59	1.46	1.47	1.54	3.02	1.74	1.35
Finland	FI	1.69	2.10	1.49	1.15	2.21	1.35	0.73	2.51	1.57	1.99
Luxembourg	LU	1.63	1.88	1.64	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Cyprus	CY	1.55	1.03	2.09	1.97	0.95	N/C	N/C	N/C	N/C	N/C
Belgium	BE	1.55	1.62	1.70	1.07	1.80	1.96	1.74	2.04	1.86	1.04
Norway	NO	1.49	1.75	1.83	1.22	1.15	1.05	1.15	2.07	1.64	0.98
Japan	JP	1.49	1.32	1.91	1.38	2.66	1.15	1.49	1.88	1.39	1.06
Greece	EL	1.45	1.36	1.58	1.39	1.30	1.39	2.21	1.95	1.02	N/C
Denmark	DK	1.40	1.64	1.21	0.88	1.67	1.93	0.88	2.28	1.98	1.50
Ireland	IE	1.32	1.55	1.67	1.10	1.04	1.60	1.12	1.63	0.67	N/C
France	FR	1.31	1.43	1.35	1.13	0.75	1.13	1.78	1.13	1.04	1.23
Italy	IT	1.28	1.23	1.66	1.13	0.91	1.18	1.32	1.72	1.21	1.08
Hungary	HU	1.26	1.39	1.54	1.01	1.98	1.44	0.52	1.12	N/C	1.03
China	CN	1.23	1.36	1.13	1.50	1.33	1.00	0.97	0.84	0.91	0.92
United Kingdom	UK	1.23	1.23	1.08	1.05	1.12	1.42	1.17	1.63	1.30	1.46
Canada	CA	1.21	1.24	1.05	1.03	1.23	1.11	1.28	1.56	1.46	1.39
United States	US	1.15	1.10	1.25	0.95	1.01	1.21	0.99	1.47	1.10	1.24
Spain	ES	1.01	1.01	1.38	0.85	0.91	1.22	1.25	0.96	0.42	1.26
Estonia	EE	1.01	0.57	1.79	0.56	2.13	N/C	N/C	0.62	N/C	N/C
Rep. of Korea	KR	0.92	0.78	1.20	0.70	1.07	1.08	0.92	0.86	1.00	1.04
Romania	RO	0.84	0.78	0.72	1.31	1.38	0.69	1.03	0.35	0.00	0.35
Czech Republic	CZ	0.82	0.64	0.59	0.72	0.32	0.54	0.53	1.14	1.57	1.22
Slovakia	SK	0.82	0.57	0.49	1.29	1.15	1.11	0.42	0.52	N/C	N/C
Portugal	PT	0.81	0.91	0.56	0.95	0.54	0.83	0.55	1.19	0.97	1.19
Poland	PL	0.76	0.48	1.40	0.86	0.37	0.50	0.45	0.97	0.82	0.89
Bulgaria	BG	0.67	0.30	1.68	0.22	N/C	N/C	0.64	0.30	N/C	N/C
Australia	AU	0.60	0.78	0.60	0.40	0.54	0.90	0.40	0.86	0.77	0.40
United Arab Emirates	AE	0.56	0.70	0.65	0.45	0.28	0.60	0.45	0.35	1.28	0.46
Latvia	LV	0.55	0.53	0.91	0.41	0.00	N/C	0.39	0.63	N/C	N/C
Lithuania	LT	0.52	0.42	0.86	0.28	1.31	N/C	N/C	0.21	N/C	N/C
Brazil	BR	0.51	0.69	0.48	0.46	0.29	0.42	0.67	0.49	1.04	0.82
Saudi Arabia	SA	0.45	0.47	0.30	0.44	0.20	0.12	0.75	0.49	1.14	0.46
Chile	CL	0.42	0.37	0.37	0.28	0.44	0.42	1.36	0.62	N/C	N/C
Mexico	MX	0.39	0.29	0.84	0.55	0.07	0.59	0.59	0.18	0.35	0.60
India	IN	0.26	0.29	0.33	0.21	0.22	0.35	0.26	0.27	0.36	0.17
Indonesia	ID	0.17	0.14	0.23	0.36	0.06	0.21	0.04	0.20	0.11	0.16

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 40: Share of publications among the 10 % most cited for all KAs combined, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**14.9%**	**15.1%**	**15.1%**	**14.9%**	**15.0%**	
EU27	**EU27**	**15.4%**	**14.7%**	**14.6%**	**14.2%**	**13.3%**	
MI	**MI**	**15.3%**	**15.5%**	**15.6%**	**15.5%**	**15.8%**	
Luxembourg	LU	25.0%	11.8%	18.9%	17.7%	32.2%	
Australia	AU	20.3%	21.4%	22.2%	23.8%	22.7%	
Denmark	DK	23.0%	22.6%	23.7%	21.6%	21.9%	
Saudi Arabia	SA	19.8%	22.2%	20.5%	19.8%	21.1%	
Netherlands	NL	21.2%	20.2%	19.8%	18.5%	19.4%	
United Kingdom	UK	20.7%	20.1%	21.2%	20.7%	18.8%	
United States	US	22.5%	21.6%	21.6%	19.6%	18.7%	
China	CN	12.9%	14.5%	15.0%	16.0%	17.8%	
Canada	CA	19.9%	18.5%	19.2%	16.7%	16.7%	
Greece	EL	11.2%	17.7%	18.1%	20.1%	16.6%	
Estonia	EE	8.6%	12.6%	10.2%	15.6%	16.3%	
Belgium	BE	21.2%	22.2%	18.2%	18.0%	15.6%	
United Arab Emirates	AE	27.7%	18.9%	21.1%	18.2%	15.4%	
Italy	IT	17.4%	16.1%	15.8%	17.8%	15.4%	
Norway	NO	16.5%	19.5%	15.0%	12.9%	15.0%	
Sweden	SE	19.0%	15.0%	17.0%	15.8%	15.0%	
Finland	FI	13.7%	10.3%	13.8%	14.0%	15.0%	
Germany	DE	17.4%	16.3%	14.8%	14.4%	13.8%	
Spain	ES	15.6%	16.8%	16.0%	13.7%	13.6%	
Ireland	IE	21.8%	17.1%	22.6%	16.7%	13.3%	
Portugal	PT	17.2%	15.1%	14.2%	16.1%	12.1%	
Rep. of Korea	KR	11.4%	12.3%	11.7%	12.1%	11.4%	
Cyprus	CY	15.2%	6.2%	11.1%	14.8%	11.3%	
France	FR	14.3%	12.5%	13.1%	12.5%	11.2%	
India	IN	11.3%	11.8%	12.4%	11.0%	10.6%	
Austria	AT	13.2%	12.5%	11.8%	11.7%	10.2%	
Slovenia	SI	13.5%	8.6%	9.3%	7.5%	9.8%	
Brazil	BR	6.7%	7.7%	7.9%	7.9%	9.1%	
Chile	CL	13.2%	12.5%	13.7%	10.9%	8.5%	
Japan	JP	10.6%	10.4%	9.5%	8.2%	8.1%	
Lithuania	LT	7.3%	5.6%	6.0%	4.5%	8.0%	
Croatia	HR	5.3%	6.3%	9.4%	8.1%	7.3%	
Romania	RO	5.5%	6.9%	6.2%	7.1%	7.0%	
Hungary	HU	3.5%	3.3%	6.2%	6.8%	6.9%	
Mexico	MX	5.4%	6.4%	5.4%	7.3%	6.4%	
Poland	PL	4.5%	5.7%	5.4%	6.5%	5.5%	
Czech Republic	CZ	5.7%	5.7%	5.5%	4.7%	5.4%	
Latvia	LV	0.8%	6.5%	5.1%	3.0%	5.3%	
Indonesia	ID	7.4%	4.3%	2.2%	4.1%	3.7%	
Slovakia	SK	2.5%	2.9%	4.4%	3.7%	3.6%	
Bulgaria	BG	4.2%	2.7%	6.4%	4.8%	0.9%	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 41: Share of publications among the 10 % most cited in KA1-2, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**14.6%**	**14.3%**	**14.3%**	**13.5%**	**13.0%**	
EU27	**EU27**	**16.8%**	**15.3%**	**15.4%**	**13.4%**	**12.2%**	
MI	**MI**	**14.6%**	**14.5%**	**14.6%**	**13.9%**	**13.5%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	19.2%	19.5%	20.3%	22.7%	22.1%	
Denmark	DK	22.8%	22.0%	20.0%	17.4%	16.1%	
Saudi Arabia	SA	15.4%	21.3%	19.8%	13.9%	20.6%	
Netherlands	NL	26.9%	19.2%	21.9%	16.5%	20.6%	
United Kingdom	UK	25.9%	22.1%	21.8%	19.2%	18.5%	
United States	US	23.7%	24.0%	22.2%	20.5%	18.1%	
China	CN	10.0%	10.8%	11.9%	13.0%	13.9%	
Canada	CA	20.8%	16.0%	17.1%	14.6%	12.5%	
Greece	EL	11.3%	17.3%	19.8%	23.9%	15.4%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	20.9%	18.5%	17.5%	15.0%	14.9%	
United Arab Emirates	AE	27.3%	19.7%	13.8%	19.0%	13.7%	
Italy	IT	19.5%	18.7%	20.0%	16.5%	14.7%	
Norway	NO	16.1%	20.0%	12.9%	9.6%	13.5%	
Sweden	SE	22.0%	16.6%	18.3%	13.6%	12.1%	
Finland	FI	10.5%	8.7%	12.8%	17.3%	12.6%	
Germany	DE	17.7%	15.8%	14.3%	13.8%	13.5%	
Spain	ES	17.7%	16.8%	16.7%	12.4%	11.1%	
Ireland	IE	21.8%	15.0%	15.4%	12.8%	10.7%	
Portugal	PT	23.4%	15.9%	12.6%	17.4%	10.0%	
Rep. of Korea	KR	10.1%	11.7%	12.1%	11.0%	9.2%	
Cyprus	CY	N/C	5.8%	11.0%	13.4%	8.5%	
France	FR	14.9%	13.3%	12.5%	11.0%	10.3%	
India	IN	9.6%	9.9%	11.5%	10.1%	8.4%	
Austria	AT	11.6%	11.4%	12.6%	13.7%	8.2%	
Slovenia	SI	5.3%	6.6%	5.2%	3.7%	6.0%	
Brazil	BR	5.8%	9.4%	8.4%	5.6%	8.7%	
Chile	CL	18.6%	10.9%	16.0%	12.9%	13.8%	
Japan	JP	11.0%	10.9%	10.4%	8.7%	9.1%	
Lithuania	LT	5.2%	9.3%	8.1%	12.1%	15.3%	
Croatia	HR	5.2%	2.5%	10.0%	2.0%	5.4%	
Romania	RO	5.0%	7.4%	5.4%	1.5%	5.7%	
Hungary	HU	9.7%	2.8%	6.0%	11.4%	4.9%	
Mexico	MX	7.3%	10.4%	6.3%	7.6%	7.3%	
Poland	PL	3.5%	5.9%	3.9%	5.3%	4.5%	
Czech Republic	CZ	6.3%	4.5%	5.8%	5.5%	2.9%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	6.4%	3.9%	1.4%	2.6%	3.5%	
Slovakia	SK	2.3%	N/C	N/C	N/C	0.8%	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 42: Share of publications among the 10 % most cited in KA3, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**14.2%**	**14.5%**	**15.2%**	**16.5%**	**16.1%**	
EU27	**EU27**	**16.9%**	**15.7%**	**16.6%**	**19.2%**	**16.5%**	
MI	**MI**	**14.4%**	**14.7%**	**15.5%**	**16.9%**	**16.6%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	23.7%	21.5%	25.5%	27.3%	27.0%	
Denmark	DK	8.0%	24.5%	17.4%	31.7%	27.0%	
Saudi Arabia	SA	8.7%	18.8%	23.3%	23.0%	20.1%	
Netherlands	NL	23.6%	24.1%	19.7%	17.3%	15.3%	
United Kingdom	UK	20.7%	25.9%	24.5%	27.1%	25.9%	
United States	US	23.3%	22.8%	23.5%	22.2%	23.1%	
China	CN	11.6%	12.2%	13.3%	15.4%	17.2%	
Canada	CA	21.0%	21.4%	23.1%	21.1%	20.9%	
Greece	EL	6.8%	15.8%	20.9%	23.7%	20.6%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	14.1%	20.7%	11.8%	26.3%	14.1%	
United Arab Emirates	AE	N/C	17.2%	13.2%	14.8%	15.3%	
Italy	IT	24.0%	21.9%	19.1%	24.1%	18.1%	
Norway	NO	7.8%	28.1%	12.8%	21.6%	29.1%	
Sweden	SE	24.4%	15.0%	25.9%	35.1%	28.1%	
Finland	FI	21.9%	13.9%	20.8%	25.4%	27.0%	
Germany	DE	17.0%	15.8%	13.9%	13.7%	11.2%	
Spain	ES	14.8%	14.6%	17.7%	19.0%	18.9%	
Ireland	IE	25.5%	15.7%	19.2%	22.3%	16.9%	
Portugal	PT	21.0%	18.8%	21.5%	17.6%	16.7%	
Rep. of Korea	KR	10.0%	10.9%	11.3%	12.5%	11.0%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	17.2%	15.4%	15.9%	19.4%	17.0%	
India	IN	9.5%	8.9%	12.0%	11.4%	9.4%	
Austria	AT	12.5%	14.3%	13.5%	18.3%	8.5%	
Slovenia	SI	N/C	9.3%	N/C	N/C	N/C	
Brazil	BR	10.1%	9.5%	6.9%	16.0%	15.0%	
Chile	CL	N/C	N/C	N/C	N/C	16.3%	
Japan	JP	15.9%	13.6%	13.2%	13.0%	12.0%	
Lithuania	LT	0.0%	2.2%	6.5%	4.7%	11.9%	
Croatia	HR	N/C	N/C	12.9%	N/C	12.6%	
Romania	RO	1.6%	3.8%	10.4%	13.5%	16.3%	
Hungary	HU	N/C	N/C	N/C	5.2%	8.2%	
Mexico	MX	6.2%	5.0%	7.2%	7.1%	9.6%	
Poland	PL	11.3%	2.3%	8.7%	8.5%	5.8%	
Czech Republic	CZ	N/C	14.4%	11.7%	8.5%	11.9%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	4.3%	2.0%	7.1%	
Slovakia	SK	N/C	N/C	N/C	N/C	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 43: Share of publications among the 10 % most cited in KA4, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**17.8%**	**18.0%**	**17.0%**	**17.0%**	**16.5%**	
EU27	**EU27**	**17.0%**	**17.0%**	**16.6%**	**16.8%**	**14.3%**	
MI	**MI**	**18.4%**	**18.3%**	**17.4%**	**17.7%**	**17.1%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	25.1%	29.7%	27.1%	28.1%	24.3%	
Denmark	DK	35.6%	28.8%	40.7%	38.0%	31.9%	
Saudi Arabia	SA	29.0%	39.0%	23.8%	33.9%	26.8%	
Netherlands	NL	11.0%	16.0%	16.2%	22.4%	18.3%	
United Kingdom	UK	24.5%	25.9%	25.2%	24.7%	22.3%	
United States	US	28.4%	24.7%	24.8%	24.6%	21.5%	
China	CN	15.5%	17.2%	16.0%	16.8%	17.7%	
Canada	CA	27.3%	27.0%	25.1%	22.9%	23.0%	
Greece	EL	11.2%	20.5%	18.0%	20.4%	16.7%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	28.9%	18.7%	20.3%	20.8%	21.0%	
United Arab Emirates	AE	32.3%	25.3%	27.0%	21.2%	20.7%	
Italy	IT	20.7%	17.0%	13.2%	20.8%	15.8%	
Norway	NO	18.4%	30.6%	23.9%	18.1%	22.9%	
Sweden	SE	24.0%	22.4%	20.7%	21.2%	15.0%	
Finland	FI	13.2%	13.5%	16.6%	16.9%	13.8%	
Germany	DE	20.5%	16.8%	17.9%	15.0%	14.7%	
Spain	ES	18.8%	21.9%	20.5%	16.1%	14.5%	
Ireland	IE	42.7%	20.3%	31.6%	17.4%	20.0%	
Portugal	PT	20.6%	19.9%	13.1%	17.6%	12.5%	
Rep. of Korea	KR	16.1%	14.2%	14.2%	16.5%	15.6%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	13.9%	15.0%	16.7%	15.5%	9.1%	
India	IN	15.6%	15.7%	13.3%	12.3%	11.5%	
Austria	AT	5.1%	20.0%	8.3%	8.2%	11.7%	
Slovenia	SI	N/C	9.3%	8.2%	N/C	N/C	
Brazil	BR	9.4%	8.0%	10.3%	8.5%	11.0%	
Chile	CL	24.0%	21.7%	17.7%	14.8%	11.3%	
Japan	JP	11.0%	9.6%	8.9%	6.7%	7.2%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	2.1%	7.3%	6.3%	7.2%	
Romania	RO	13.0%	10.5%	8.2%	11.2%	7.7%	
Hungary	HU	N/C	N/C	N/C	8.6%	N/C	
Mexico	MX	8.6%	9.4%	8.1%	5.4%	4.4%	
Poland	PL	3.1%	8.6%	5.9%	6.5%	6.9%	
Czech Republic	CZ	6.5%	8.0%	2.3%	1.1%	5.6%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	6.3%	4.5%	1.3%	6.5%	4.7%	
Slovakia	SK	N/C	N/C	N/C	5.4%	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 44: Share of publications among the 10 % most cited in KA5, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**15.2%**	**14.8%**	**14.9%**	**14.1%**	**13.4%**	
EU27	**EU27**	**15.2%**	**14.6%**	**13.6%**	**14.4%**	**11.8%**	
MI	**MI**	**16.7%**	**15.2%**	**14.9%**	**15.2%**	**14.4%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	22.6%	20.3%	20.8%	23.4%	21.2%	
Denmark	DK	22.0%	18.4%	14.2%	27.7%	17.6%	
Saudi Arabia	SA	N/C	18.6%	14.1%	20.7%	19.5%	
Netherlands	NL	17.0%	23.9%	22.2%	21.4%	18.6%	
United Kingdom	UK	18.2%	12.6%	17.7%	17.5%	13.8%	
United States	US	20.4%	16.3%	17.4%	17.0%	17.6%	
China	CN	13.1%	16.3%	16.4%	15.7%	16.1%	
Canada	CA	18.3%	20.2%	17.9%	17.0%	12.7%	
Greece	EL	9.2%	14.0%	27.7%	17.8%	16.6%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	29.9%	23.3%	18.7%	16.4%	20.4%	
United Arab Emirates	AE	N/C	N/C	6.8%	21.5%	12.0%	
Italy	IT	20.6%	20.3%	17.4%	20.1%	16.3%	
Norway	NO	19.5%	22.4%	12.4%	18.5%	15.4%	
Sweden	SE	16.1%	13.3%	10.6%	17.7%	15.9%	
Finland	FI	17.0%	5.0%	11.8%	10.1%	16.5%	
Germany	DE	20.8%	17.9%	17.6%	14.0%	8.7%	
Spain	ES	9.0%	12.4%	12.6%	11.0%	7.1%	
Ireland	IE	N/C	N/C	15.8%	26.1%	8.2%	
Portugal	PT	16.3%	12.4%	13.9%	13.7%	10.7%	
Rep. of Korea	KR	12.2%	10.2%	6.0%	5.5%	6.4%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	20.4%	14.0%	11.1%	6.2%	12.5%	
India	IN	11.4%	9.5%	10.6%	9.3%	10.4%	
Austria	AT	8.2%	7.2%	5.1%	5.8%	7.3%	
Slovenia	SI	N/C	N/C	N/C	N/C	N/C	
Brazil	BR	5.6%	4.2%	11.8%	7.7%	14.2%	
Chile	CL	N/C	N/C	3.9%	4.6%	1.4%	
Japan	JP	3.3%	6.0%	5.0%	5.7%	7.1%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	N/C	N/C	N/C	N/C	
Romania	RO	N/C	5.6%	N/C	7.4%	5.9%	
Hungary	HU	1.3%	N/C	N/C	N/C	2.6%	
Mexico	MX	N/C	N/C	N/C	N/C	1.6%	
Poland	PL	1.4%	6.9%	0.7%	8.0%	5.3%	
Czech Republic	CZ	N/C	2.5%	6.0%	0.0%	4.1%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	3.1%	N/C	0.0%	
Slovakia	SK	N/C	N/C	N/C	N/C	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 45: Share of publications among the 10 % most cited in KA6, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**13.7%**	**14.3%**	**15.0%**	**15.1%**	**14.4%**	
EU27	**EU27**	**15.0%**	**13.8%**	**13.8%**	**15.3%**	**14.0%**	
MI	**MI**	**14.6%**	**15.4%**	**16.4%**	**16.5%**	**16.4%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	17.3%	28.4%	15.2%	18.3%	30.5%	
Denmark	DK	25.5%	22.3%	14.1%	19.3%	23.3%	
Saudi Arabia	SA	34.7%	11.4%	25.8%	30.3%	28.2%	
Netherlands	NL	26.9%	18.5%	15.2%	19.5%	22.9%	
United Kingdom	UK	14.0%	19.2%	26.7%	26.5%	22.7%	
United States	US	19.8%	18.4%	21.5%	17.8%	20.0%	
China	CN	10.8%	16.2%	15.3%	18.0%	17.7%	
Canada	CA	28.1%	13.1%	18.3%	12.4%	15.6%	
Greece	EL	N/C	N/C	6.4%	N/C	6.5%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	18.3%	29.7%	28.5%	17.4%	9.1%	
United Arab Emirates	AE	N/C	N/C	N/C	N/C	N/C	
Italy	IT	20.1%	13.9%	13.5%	25.2%	20.3%	
Norway	NO	N/C	N/C	N/C	24.6%	14.6%	
Sweden	SE	22.4%	17.1%	12.0%	15.5%	11.9%	
Finland	FI	N/C	6.5%	15.4%	12.8%	17.9%	
Germany	DE	11.1%	12.3%	12.6%	12.2%	13.3%	
Spain	ES	12.5%	14.2%	16.0%	12.6%	16.9%	
Ireland	IE	N/C	N/C	N/C	N/C	N/C	
Portugal	PT	21.5%	20.3%	26.3%	12.9%	17.9%	
Rep. of Korea	KR	22.7%	12.1%	14.5%	9.0%	8.0%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	16.5%	11.0%	21.2%	11.4%	19.4%	
India	IN	9.0%	11.2%	18.3%	11.3%	11.0%	
Austria	AT	16.6%	28.9%	9.6%	15.4%	12.3%	
Slovenia	SI	N/C	N/C	N/C	N/C	N/C	
Brazil	BR	7.1%	7.6%	7.0%	10.4%	17.1%	
Chile	CL	N/C	N/C	N/C	N/C	N/C	
Japan	JP	10.5%	7.6%	8.6%	6.2%	7.3%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	N/C	N/C	N/C	N/C	
Romania	RO	9.8%	N/C	N/C	N/C	3.1%	
Hungary	HU	N/C	N/C	N/C	N/C	N/C	
Mexico	MX	N/C	N/C	7.1%	5.7%	9.3%	
Poland	PL	0.0%	4.5%	7.9%	8.4%	2.0%	
Czech Republic	CZ	N/C	N/C	N/C	N/C	0.9%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	N/C	N/C	0.9%	
Slovakia	SK	N/C	N/C	N/C	N/C	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 46: Share of publications among the 10 % most cited in KA7, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**20.3%**	**20.3%**	**20.1%**	**18.8%**	**19.5%**	
EU27	**EU27**	**22.8%**	**19.0%**	**18.7%**	**15.5%**	**16.1%**	
MI	**MI**	**20.3%**	**20.6%**	**20.6%**	**19.5%**	**20.3%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	31.5%	25.2%	25.4%	37.1%	21.7%	
Denmark	DK	31.0%	29.8%	33.5%	29.3%	24.6%	
Saudi Arabia	SA	21.9%	N/C	18.8%	20.3%	34.4%	
Netherlands	NL	49.1%	29.2%	25.3%	21.2%	28.6%	
United Kingdom	UK	28.4%	23.7%	28.3%	28.5%	24.2%	
United States	US	32.6%	29.6%	29.7%	28.0%	24.9%	
China	CN	16.4%	19.1%	19.0%	18.7%	22.2%	
Canada	CA	31.9%	28.7%	34.8%	28.7%	23.6%	
Greece	EL	N/C	N/C	N/C	34.6%	N/C	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	41.0%	21.4%	39.5%	15.0%	26.5%	
United Arab Emirates	AE	N/C	N/C	N/C	N/C	N/C	
Italy	IT	19.0%	18.6%	18.2%	17.9%	12.9%	
Norway	NO	N/C	N/C	27.2%	31.2%	17.9%	
Sweden	SE	27.8%	23.2%	19.1%	11.8%	22.7%	
Finland	FI	N/C	N/C	N/C	N/C	19.3%	
Germany	DE	23.2%	22.6%	19.9%	18.1%	18.8%	
Spain	ES	19.9%	22.3%	24.3%	16.6%	12.7%	
Ireland	IE	N/C	N/C	31.9%	8.2%	21.4%	
Portugal	PT	16.3%	22.9%	10.9%	20.0%	25.0%	
Rep. of Korea	KR	16.8%	17.9%	17.2%	15.1%	14.5%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	23.9%	13.9%	15.7%	14.0%	11.7%	
India	IN	12.2%	14.4%	15.7%	9.7%	8.2%	
Austria	AT	N/C	3.1%	17.0%	4.2%	14.8%	
Slovenia	SI	N/C	N/C	N/C	N/C	N/C	
Brazil	BR	1.6%	12.2%	18.0%	21.5%	12.3%	
Chile	CL	N/C	N/C	N/C	N/C	N/C	
Japan	JP	13.1%	13.0%	12.1%	7.9%	8.4%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	N/C	N/C	N/C	N/C	
Romania	RO	N/C	N/C	N/C	N/C	2.6%	
Hungary	HU	N/C	N/C	N/C	N/C	N/C	
Mexico	MX	N/C	N/C	N/C	N/C	0.8%	
Poland	PL	3.1%	6.2%	0.3%	9.2%	1.1%	
Czech Republic	CZ	N/C	N/C	N/C	0.3%	6.2%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	N/C	N/C	5.1%	
Slovakia	SK	N/C	N/C	N/C	N/C	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 47: Share of publications among the 10 % most cited in KA8, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**14.7%**	**15.0%**	**15.4%**	**15.4%**	**16.8%**	
EU27	**EU27**	**14.2%**	**13.7%**	**13.8%**	**13.2%**	**13.5%**	
MI	**MI**	**15.3%**	**15.7%**	**16.3%**	**16.0%**	**17.9%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	18.8%	18.5%	21.1%	20.7%	21.8%	
Denmark	DK	19.2%	19.8%	21.7%	11.8%	19.8%	
Saudi Arabia	SA	21.8%	18.6%	16.6%	19.0%	18.6%	
Netherlands	NL	17.4%	19.1%	17.8%	18.9%	18.5%	
United Kingdom	UK	17.7%	18.2%	21.1%	20.7%	17.9%	
United States	US	20.6%	19.2%	19.7%	16.2%	17.8%	
China	CN	15.4%	17.7%	18.9%	20.4%	23.4%	
Canada	CA	13.9%	14.5%	14.6%	11.9%	13.5%	
Greece	EL	12.6%	18.8%	13.7%	13.8%	16.9%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	17.7%	25.9%	11.4%	21.9%	10.6%	
United Arab Emirates	AE	31.0%	17.5%	25.0%	16.2%	16.6%	
Italy	IT	12.7%	13.1%	13.3%	15.3%	16.1%	
Norway	NO	17.6%	15.1%	16.4%	11.0%	16.9%	
Sweden	SE	18.3%	12.9%	16.5%	11.8%	15.9%	
Finland	FI	13.8%	11.7%	13.4%	9.6%	10.8%	
Germany	DE	16.8%	16.0%	14.3%	14.8%	13.8%	
Spain	ES	15.2%	15.6%	13.4%	12.4%	16.3%	
Ireland	IE	11.0%	18.1%	27.2%	11.9%	8.1%	
Portugal	PT	11.1%	8.5%	12.2%	20.7%	9.8%	
Rep. of Korea	KR	10.7%	12.6%	11.8%	13.2%	13.7%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	15.0%	12.5%	16.7%	14.6%	12.4%	
India	IN	12.9%	13.5%	13.9%	12.3%	14.4%	
Austria	AT	16.1%	10.7%	12.7%	12.7%	7.8%	
Slovenia	SI	22.6%	7.6%	7.4%	6.7%	9.6%	
Brazil	BR	6.3%	6.6%	6.4%	6.8%	6.3%	
Chile	CL	4.6%	2.5%	10.9%	9.2%	3.5%	
Japan	JP	11.5%	12.1%	9.6%	9.4%	9.6%	
Lithuania	LT	15.2%	7.2%	5.0%	0.0%	4.8%	
Croatia	HR	N/C	N/C	N/C	N/C	13.5%	
Romania	RO	3.4%	6.0%	6.8%	10.0%	7.6%	
Hungary	HU	3.3%	5.3%	9.6%	5.8%	12.0%	
Mexico	MX	4.9%	5.2%	4.9%	7.3%	7.3%	
Poland	PL	5.0%	5.3%	6.7%	6.5%	7.4%	
Czech Republic	CZ	9.0%	6.5%	6.6%	7.3%	6.7%	
Latvia	LV	0.0%	N/C	3.3%	7.3%	N/C	
Indonesia	ID	8.4%	5.6%	1.2%	6.1%	3.7%	
Slovakia	SK	5.3%	2.3%	N/C	3.8%	5.7%	
Bulgaria	BG	2.9%	N/C	10.1%	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 48: Share of publications among the 10 % most cited in KA9, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**18.1%**	**19.0%**	**18.3%**	**17.1%**	**17.9%**	
EU27	**EU27**	**18.9%**	**20.5%**	**18.1%**	**16.8%**	**16.9%**	
MI	**MI**	**18.2%**	**18.8%**	**18.6%**	**17.3%**	**18.4%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	14.2%	19.0%	21.9%	18.6%	19.7%	
Denmark	DK	20.8%	30.5%	16.4%	15.9%	16.9%	
Saudi Arabia	SA	26.0%	26.1%	26.9%	15.0%	17.6%	
Netherlands	NL	23.9%	26.2%	26.6%	18.2%	25.9%	
United Kingdom	UK	20.0%	21.9%	17.8%	18.8%	17.6%	
United States	US	23.6%	23.7%	25.4%	20.5%	20.5%	
China	CN	16.5%	17.5%	18.6%	18.5%	20.5%	
Canada	CA	19.1%	16.7%	17.3%	15.2%	19.3%	
Greece	EL	9.3%	26.2%	15.1%	27.4%	21.6%	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	29.2%	51.5%	36.9%	29.2%	23.5%	
United Arab Emirates	AE	N/C	N/C	N/C	11.8%	16.5%	
Italy	IT	21.6%	17.0%	16.6%	15.3%	18.6%	
Norway	NO	13.4%	8.8%	11.4%	6.2%	6.8%	
Sweden	SE	13.2%	10.9%	19.1%	14.6%	10.4%	
Finland	FI	N/C	N/C	9.7%	10.8%	12.7%	
Germany	DE	20.1%	21.1%	18.8%	18.3%	18.8%	
Spain	ES	20.4%	24.1%	18.5%	19.0%	17.4%	
Ireland	IE	N/C	N/C	N/C	N/C	N/C	
Portugal	PT	23.0%	23.2%	22.0%	5.6%	11.7%	
Rep. of Korea	KR	14.7%	17.6%	11.2%	13.6%	12.6%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	21.9%	19.0%	15.8%	19.9%	15.6%	
India	IN	15.1%	16.1%	15.9%	14.2%	14.7%	
Austria	AT	N/C	15.3%	20.5%	10.8%	19.1%	
Slovenia	SI	N/C	N/C	N/C	N/C	N/C	
Brazil	BR	10.7%	14.7%	11.2%	7.1%	9.9%	
Chile	CL	N/C	N/C	N/C	N/C	N/C	
Japan	JP	17.1%	17.4%	17.7%	11.6%	15.0%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	N/C	N/C	N/C	N/C	
Romania	RO	N/C	N/C	N/C	N/C	N/C	
Hungary	HU	N/C	N/C	N/C	N/C	N/C	
Mexico	MX	N/C	N/C	0.3%	12.1%	3.8%	
Poland	PL	9.5%	6.5%	5.9%	5.7%	7.5%	
Czech Republic	CZ	N/C	N/C	N/C	8.9%	14.7%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	N/C	N/C	2.1%	
Slovakia	SK	N/C	N/C	N/C	N/C	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 49: Share of publications among the 10 % most cited in KA10, 2014–2018

Country	Code	2014	2015	2016	2017	2018	Trend
World	**World**	**4.6%**	**4.7%**	**4.5%**	**4.4%**	**3.8%**	
EU27	**EU27**	**5.7%**	**6.1%**	**4.3%**	**6.0%**	**5.2%**	
MI	**MI**	**5.1%**	**5.1%**	**5.0%**	**5.0%**	**4.0%**	
Luxembourg	LU	N/C	N/C	N/C	N/C	N/C	
Australia	AU	2.8%	14.9%	13.8%	10.7%	5.6%	
Denmark	DK	16.9%	N/C	8.7%	N/C	N/C	
Saudi Arabia	SA	N/C	N/C	N/C	N/C	N/C	
Netherlands	NL	7.3%	5.3%	8.2%	9.7%	8.7%	
United Kingdom	UK	8.2%	7.4%	7.4%	7.5%	4.8%	
United States	US	9.4%	10.5%	10.3%	8.5%	7.2%	
China	CN	2.0%	1.8%	3.4%	3.1%	2.5%	
Canada	CA	5.3%	4.8%	5.2%	2.8%	1.5%	
Greece	EL	N/C	N/C	N/C	N/C	N/C	
Estonia	EE	N/C	N/C	N/C	N/C	N/C	
Belgium	BE	5.3%	5.6%	5.6%	2.4%	0.7%	
United Arab Emirates	AE	N/C	N/C	N/C	N/C	N/C	
Italy	IT	3.3%	2.4%	5.0%	4.8%	4.1%	
Norway	NO	0.0%	N/C	N/C	N/C	N/C	
Sweden	SE	4.3%	3.3%	6.6%	6.6%	2.0%	
Finland	FI	5.2%	3.5%	3.7%	4.0%	2.4%	
Germany	DE	10.3%	10.9%	5.7%	11.1%	9.3%	
Spain	ES	2.7%	6.4%	3.1%	2.6%	5.3%	
Ireland	IE	N/C	N/C	N/C	N/C	N/C	
Portugal	PT	3.2%	5.0%	2.5%	2.9%	2.1%	
Rep. of Korea	KR	2.9%	2.3%	2.1%	0.8%	2.5%	
Cyprus	CY	N/C	N/C	N/C	N/C	N/C	
France	FR	6.3%	7.0%	3.2%	5.6%	6.0%	
India	IN	3.2%	1.7%	2.3%	3.5%	2.5%	
Austria	AT	11.6%	4.4%	4.9%	6.4%	11.6%	
Slovenia	SI	0.0%	N/C	N/C	2.3%	0.0%	
Brazil	BR	0.1%	2.6%	0.8%	0.0%	0.0%	
Chile	CL	N/C	N/C	N/C	N/C	N/C	
Japan	JP	4.6%	3.9%	3.5%	3.7%	1.5%	
Lithuania	LT	N/C	N/C	N/C	N/C	N/C	
Croatia	HR	N/C	N/C	N/C	N/C	N/C	
Romania	RO	1.7%	5.4%	0.1%	1.4%	1.0%	
Hungary	HU	1.2%	0.0%	1.5%	2.5%	1.9%	
Mexico	MX	0.0%	0.0%	N/C	N/C	N/C	
Poland	PL	4.0%	1.2%	5.4%	0.6%	0.3%	
Czech Republic	CZ	2.5%	4.0%	1.2%	2.4%	0.4%	
Latvia	LV	N/C	N/C	N/C	N/C	N/C	
Indonesia	ID	N/C	N/C	N/C	N/C	N/C	
Slovakia	SK	N/C	N/C	N/C	1.2%	N/C	
Bulgaria	BG	N/C	N/C	N/C	N/C	N/C	
Malta	MT	N/C	N/C	N/C	N/C	N/C	

Source: These statistics were calculated using data from Scopus (Elsevier)

Table 50: Share of publications cited by patents normalised by the world weighted average for each KA (2016)

Country	Code	All KAs	KA1-2	KA3	KA4	KA5	KA6	KA7	KA8	KA9	KA10
World	**World**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**
EU27	**EU27**	**0.94**	**1.02**	**0.99**	**0.99**	**0.60**	**0.90**	**0.81**	**1.06**	**0.92**	**0.68**
MI	**MI**	**1.09**	**1.10**	**1.09**	**1.09**	**1.17**	**1.13**	**1.07**	**1.06**	**1.05**	**1.11**
United States	US	1.82	1.81	1.84	2.20	1.52	1.77	1.75	1.69	2.02	1.54
Luxembourg	LU	1.82	1.45	0.98	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Rep. of Korea	KR	1.56	1.71	1.50	1.33	0.94	2.78	1.45	1.40	1.00	2.24
Belgium	BE	1.32	1.31	1.10	1.72	0.00	1.39	1.73	1.86	1.61	0.00
Ireland	IE	1.30	0.72	1.19	1.25	5.40	N/C	1.24	1.75	N/C	N/C
Denmark	DK	1.29	1.29	0.63	1.19	1.20	0.00	0.22	2.48	1.17	0.00
Finland	FI	1.26	0.99	2.40	0.91	0.00	0.00	0.40	1.20	1.31	0.00
Saudi Arabia	SA	1.26	1.39	0.91	1.10	0.00	3.41	0.99	0.98	1.56	0.00
Sweden	SE	1.25	1.15	1.73	1.81	0.66	0.97	0.86	1.18	0.49	1.79
Canada	CA	1.22	1.42	1.10	1.54	1.76	0.91	1.18	1.12	0.40	0.73
Netherlands	NL	1.18	1.53	1.06	1.03	0.57	0.67	0.62	1.52	0.91	0.00
Australia	AU	1.13	1.10	1.07	1.19	0.94	1.22	0.85	1.21	0.97	4.18
Germany	DE	1.12	1.31	1.15	1.11	0.27	1.30	0.92	1.00	1.55	0.73
Japan	JP	1.11	1.05	1.18	1.09	2.37	1.75	1.17	1.15	1.43	1.28
United Kingdom	UK	1.09	1.03	1.28	1.16	1.25	1.69	1.08	1.06	0.55	1.56
Austria	AT	1.06	0.95	1.09	1.09	0.41	1.06	1.11	0.94	1.67	2.25
France	FR	0.98	1.11	0.75	1.01	1.33	1.12	1.17	1.50	0.67	0.81
Spain	ES	0.97	0.90	1.15	1.40	0.56	1.64	0.93	0.87	0.70	0.18
Hungary	HU	0.94	0.88	0.42	0.73	0.00	0.77	N/C	2.04	N/C	0.00
Cyprus	CY	0.91	0.89	1.11	N/C	N/C	N/C	N/C	N/C	N/C	N/C
China	CN	0.86	0.83	0.85	0.80	1.31	0.47	0.91	0.84	0.77	0.61
United Arab Emirates	AE	0.78	1.26	0.35	0.71	1.97	2.67	N/C	0.77	0.00	N/C
Slovenia	SI	0.75	0.76	0.64	0.90	0.00	N/C	N/C	0.67	N/C	5.64
Italy	IT	0.75	0.99	0.90	0.83	0.66	0.88	0.50	0.47	0.45	0.44
Norway	NO	0.65	0.51	0.55	0.91	1.41	1.33	1.31	0.67	0.32	0.00
Czech Republic	CZ	0.56	0.56	1.10	0.23	0.21	0.00	0.26	0.64	N/C	2.36
Greece	EL	0.54	0.56	0.56	0.43	0.66	0.00	0.34	0.81	0.00	N/C
Brazil	BR	0.52	0.55	0.47	0.61	1.16	0.29	0.14	0.47	0.87	0.00
India	IN	0.52	0.45	0.47	0.41	0.90	0.93	0.39	0.65	0.77	0.88
Croatia	HR	0.51	0.00	0.41	1.33	N/C	N/C	N/C	0.00	N/C	N/C
Poland	PL	0.50	0.60	0.23	0.41	0.00	0.47	0.66	0.86	0.30	0.00
Portugal	PT	0.49	0.21	0.85	0.55	0.61	0.00	0.55	0.31	1.20	0.00
Lithuania	LT	0.49	2.33	0.00	N/C	0.00	N/C	N/C	0.00	N/C	N/C
Chile	CL	0.39	0.26	0.00	0.87	2.60	N/C	N/C	0.00	N/C	N/C
Estonia	EE	0.38	0.00	N/C	1.05	0.00	N/C	N/C	N/C	N/C	N/C
Indonesia	ID	0.27	0.28	0.50	0.00	0.00	N/C	0.00	0.39	0.00	N/C
Slovakia	SK	0.21	0.00	0.42	0.00	0.00	N/C	N/C	0.76	N/C	0.00
Romania	RO	0.18	0.18	0.22	0.11	0.59	0.00	0.36	0.00	N/C	0.00
Bulgaria	BG	0.15	0.00	N/C	0.00	N/C	N/C	N/C	0.74	N/C	N/C
Latvia	LV	0.15	0.00	0.00	0.00	0.00	N/C	N/C	0.48	N/C	N/C
Mexico	MX	0.14	0.00	0.24	0.00	0.00	0.00	N/C	0.34	0.00	0.00
Malta	MT	0.00	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

Source: These statistics were calculated using data from Scopus (Elsevier) and LexisNexis

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The Clean Energy Innovation Index (CEII) is a composite indicator designed to track progress in clean energy innovation performance, as measured through the lens of scientific publications, patents and export. This report focuses on the bibliometric dimension of the CEII. Science-Metrix computed and tested 10 publication-based indicators of potential relevance to the policy context surrounding the development of the CEII, with data covering EU and MI member countries from 2016 to 2020.

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