



Monitoring open access publishing of NWO funded research

April 2020



Universiteit
Leiden

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Report for the Dutch Research Council (NWO)

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1. Introduction

NWO has requested CWTS to analyze the extent to which research funded by NWO is made openly accessible. In 2009, NWO introduced its first open access (OA) policy, stating that publications funded by NWO should be made openly accessible ‘as soon as possible’. Following the Dutch OA ambitions presented by state secretary Sander Dekker in 2013, NWO turned its OA policy into a formal mandate in 2015. According to this mandate, all publications funded by NWO must be openly accessible at the time of publication, preferably through the gold OA route, although the green OA route is also supported. This mandate should make sure that NWO funded research meets the OA targets set by the Dutch government. According to these targets, of all publicly funded publications, 60% should be openly accessible in 2018 and 100% in 2020.

To monitor NWO’s progress in making the publications it funds openly accessible, this report presents statistics on the extent to which publications from the period 2015–2018 funded by NWO are openly accessible. Separate statistics are presented for publications funded by ZonMW and for publications of the national research institutes managed by NWO. Throughout the report, a distinction is made between gold, hybrid, bronze, and green OA. The report also discusses differences in citation impact between OA and non-OA publications.

Differences with VSNU open access statistics

The VSNU provides an annual report on the overall progress of OA uptake in the Netherlands. For 2018, the VSNU reported that 54% of all publications affiliated with Dutch institutions are openly accessible. Importantly, the methodology used in the present report differs from the methodology used by the VSNU. The OA statistics in the different reports therefore should not be directly compared. The statistics in the present report relate only to publications funded by NWO, which form a subset of the total publication output in the Netherlands. In addition, the statistics in the present report are based on a bibliometric approach using Web of Science data, while the VSNU statistics are based on data from the internal registration systems of the Dutch institutions. The same caution applies to the OA statistics provided in the annual report of NWO.

2. Methodology

Below we first discuss the approach taken to identify publications funded by NWO or ZonMW (Section 2.1). We then discuss how the OA status of these publications was determined (Section 2.2).

2.1. Identifying publications funded by NWO or ZonMW

Researchers funded by NWO and ZonMW are requested to report the publication output of their projects. However, there are concerns about the quality and completeness of the data. For this reason, we did not use this data. Instead, we identified publications funded by NWO and ZonMW ourselves. We used the Web of Science (WoS) database, produced by Clarivate Analytics, for this purpose. Within the WoS database, the following three citation indices were used: Science Citation Index Expanded, Social Sciences Citation Index, and Arts & Humanities Citation Index. We considered only publications from the period 2015–2018 published in journals and classified as research article or review article in the WoS database. Books, publications in conference proceedings, and other types of publications in journals (e.g., letters, editorials, and book reviews) were not considered.

We identified publications funded by NWO by searching in the WoS database for publications that include a funding acknowledgment in which funding from NWO is reported. In a similar way, we also identified publications funded by ZonMW. Authors of publications may refer to NWO and ZonMW in various different ways (e.g., using the full name of the funder or the abbreviated name). In order to obtain an accurate data set, we carefully identified the different ways in which authors refer to NWO and ZonMW.

To identify publications of the NWO institutes, we searched in the WoS database for publications that include an author affiliation mentioning an NWO institute. This was done separately for each of the nine NWO institutes. We carefully accounted for the different ways in which authors may refer to the NWO institutes (e.g., using full names or abbreviated names).

Almost half of the publications of the NWO institutes include a funding acknowledgment in which funding from NWO is reported. These publications were excluded from the analysis of NWO funded publications. They were included in the analysis of publications of the NWO institutes.

Some limitations of our approach need to be acknowledged. Most importantly, the WoS database provides a selective coverage of the scholarly literature, focusing on publications in international journals that meet certain standards determined by the producer of the database. This means that some of the publications funded by NWO or ZonMW are not included in our analysis. Especially in the humanities and the social sciences, the WoS database provides only a limited coverage of the scholarly literature. Books and publications in conference proceedings are not included at all in our analysis. The lack of conference proceedings publications reduces the coverage of our analysis in particular in the field of computer science. Another limitation is caused by authors that do not acknowledge funding from NWO or ZonMW in their publications, even though their research was in fact supported by these funders.

The above-mentioned limitations need to be taken into account in the interpretation of the OA statistics presented in this report. This for instance means that the OA statistics for NWO institutes active in the humanities and the social sciences need to be interpreted with special care. Despite these limitations, the OA statistics in this report offer a reasonably complete overview of the extent to which publications funded by NWO or ZonMW have been made openly accessible.

2.2. Determining the open access status of publications

The OA status of publications was determined by linking the WoS database to the Unpaywall database. For each publication funded by NWO or ZonMW, we used the Unpaywall database to determine whether the publication is OA or not. If the publication is OA, we determined the type of OA according to Unpaywall data. We distinguish between four types of OA:

- *Gold OA*. Publications in an OA journal.
- *Hybrid OA*. OA publications in a subscription journal.
- *Bronze OA*. OA publications without a clearly identifiable license.
- *Green OA*. Publications in a journal that are also available in an OA repository (e.g., in an institutional repository or on a preprint server).

Gold, hybrid, and bronze OA are mutually exclusive. Green OA may overlap with the other types of OA. For instance, if a publication in an OA journal is also available in an OA repository, the publication is both gold and green OA. In this report, we have chosen to classify a publication as green OA only if it is not gold, hybrid, or bronze

OA. In this way, each OA publication is classified as exactly one of the four types of OA listed above.

Because bronze OA publications lack a clearly identifiable license, their inclusion in the OA statistics presented in this report might be considered debatable. We manually examined a random sample of bronze OA publications funded by NWO or ZonMW. Almost all publications in our sample seemed to be genuine OA publications, as opposed to, for instance, publications that are temporarily made openly accessible by publishers for marketing purposes. Based on this finding, we decided to include bronze OA publications in the OA statistics in this report.

Sometimes publications are openly accessible, but it is questionable whether this is legal. Well-known examples are publications made available in Sci-Hub and in academic social network platforms such as ResearchGate and Academia.edu. In this report, we only consider legal forms of OA publishing. Hence, if a publication is made available in, for instance, ResearchGate, we do not regard this as OA publishing.

There are three limitations that need to be acknowledged. First, there may be minor inaccuracies in the data from the Unpaywall database. For instance, a small share of the OA publications may be incorrectly classified as non-OA. Second, the Unpaywall data does not make clear when a publication became openly accessible. We therefore do not know whether publications were made openly accessible immediately at the time of publication or at a later time. Third, using Unpaywall data, the OA status can be determined only for publications that have a DOI in the WoS database. About 1% of the publications funded by NWO or ZonMW and indexed in the WoS database do not have a DOI.

3. Findings

We first discuss our findings for publications funded by NWO or ZonMW (Section 3.1). We then consider our findings for publications of NWO institutes (Section 3.2). Finally, we analyze differences in citation impact between OA and non-OA publications.

3.1. Open access status of publications funded by NWO or ZonMW

For each publication year in the period 2015–2018, Figure 1 presents a breakdown of the publications funded by NWO by their OA type (i.e., green, gold, hybrid, bronze, or closed). The overall percentage of NWO funded publications that are OA varies between 60% in 2015 and 70% in 2017. Each year, around 20% of the NWO funded publications are green OA, and about 18% are gold OA. The percentage of hybrid OA publications has increased substantially, from 12% in 2015 to 24% in 2018. This can be explained by the (transformative) OA agreements that in recent years were negotiated by the VSNU with a number of publishers. About 11% of the NWO funded publications from the period 2015–2017 are bronze OA. Only 5% of the NWO funded publications from 2018 are bronze OA.

Importantly, the OA statistics presented in Figure 1, and also elsewhere in this report, show whether publications were openly accessible at the time of analysis. They do not show whether publications were made openly accessible immediately at the time of publication. This means that time trends need to be interpreted with special care. Figure 1 shows that in 2018 the percentage of OA publications is lower than in 2017. Most probably, this is due to the effect of embargos. Publications from 2017 made openly accessible after the expiration of an embargo are counted as OA publications in our analysis, while similar publications from 2018 for which the embargo has not yet expired are counted as non-OA publications. This effect is likely to explain the decrease in the percentage of OA publications between 2017 and 2018. Based on Figure 1, the statistics on bronze OA publications seem to be strongly influenced by this effect.

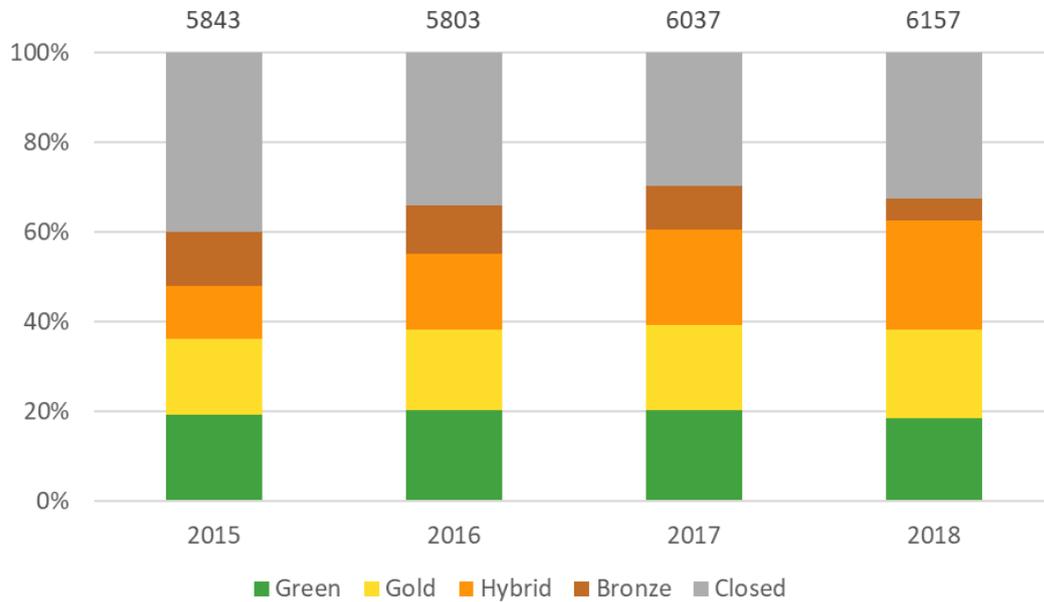


Figure 1. For each publication year in the period 2015–2018, the bar chart shows the number of publications funded by NWO and the percentage of publications of the different OA types.

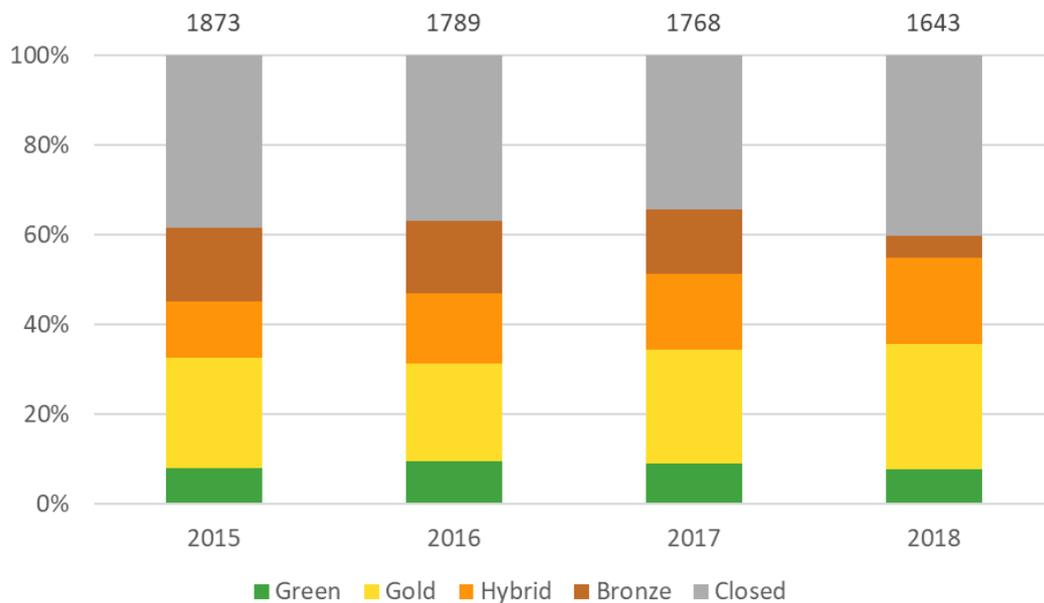


Figure 2. For each publication year in the period 2015–2018, the bar chart shows the number of publications funded by ZonMW and the percentage of publications of the different OA types.

Figure 2 presents the same information as Figure 1, but for publications funded by ZonMW instead of NWO. For ZonMW, the overall percentage of OA publications is somewhat lower than for NWO. It fluctuates around 63%. Especially the percentage of green OA publications is much lower for ZonMW than for NWO (9% vs. 20%). On the other hand, gold OA publishing is more common for ZonMW than for NWO (25% vs. 18%). Like in the case of NWO, the percentage of ZonMW funded publications from 2018 that are bronze OA may still increase.

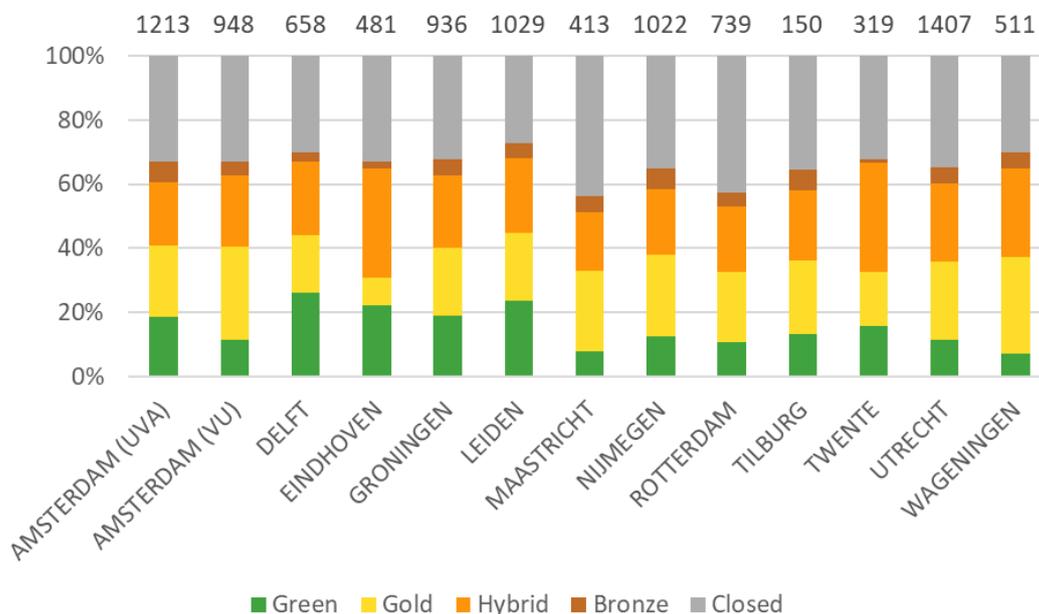


Figure 3. For each of the Dutch Universities, the bar chart shows the number of publications funded by NWO or ZonMW and the percentage of publications of the different OA types. Only publications from 2018 are considered.

Of all publications funded by NWO or ZonMW, 94% are authored by researchers affiliated with Dutch universities, including the university medical centers. For each of the Dutch universities, Figure 3 presents a breakdown by OA type for publications from 2018 funded by NWO or ZonMW. Maastricht University and Erasmus University Rotterdam have the lowest percentage of OA publications, respectively 56% and 57%. Leiden University has 73% OA publications, which is the highest percentage of the Dutch universities. Some universities, in particular Wageningen University, VU Amsterdam, and University of Twente, have a strong focus on gold and hybrid OA publishing, with more than half of their publications being gold or hybrid OA. Other

universities have a relatively high percentage of green OA publications. This is in particular the case for Delft University of Technology, Leiden University, and Eindhoven University of Technology, which each have more than 20% green OA publications.

To obtain a deeper understanding of the differences in OA uptake between the Dutch universities, a more in-depth analysis would be needed. In such an analysis, comparisons could for instance be made with the OA statistics reported in the [CWTS Leiden Ranking](#). These statistics take into account the entire publication output of universities, not only the publications funded by NWO or ZonMW.

3.2. Open access status of publications of NWO institutes

For each of the nine NWO institutes, Figure 4 presents a breakdown by OA type for publications from 2018. In total, 79% of the publications of the NWO institutes are openly accessible. However, there are large differences between the institutes. On the one hand, NIKHEF has almost 100% OA publications and SRON, ASTRON, and CWI each have about 90% OA publications. On the other hand, DIFFER and NSCR have only, respectively, 35% and 46% OA publications. Many publications of DIFFER are made openly accessible on the webpage of the institute. However, these publications are not counted as OA publications in our analysis, because they have not been made openly accessible in a sustainable way (e.g., by depositing them in a repository that guarantees the long-term accessibility of the publications). A large share of the publications of NSCR are not indexed in the WoS database and, consequently, are not included in our analysis. The OA statistics for NSCR therefore relate only to a small subset of the publication output of this institute.

Figure 4 also shows major differences in the way institutes make their publications openly accessible. NIKHEF for instance has a strong focus on gold and hybrid OA. In contrast, SRON, ASTRON, and CWI are much more focused on green OA. This probably reflects the long tradition in some of the physical sciences of posting publications in repositories ('preprint servers') such as arXiv.

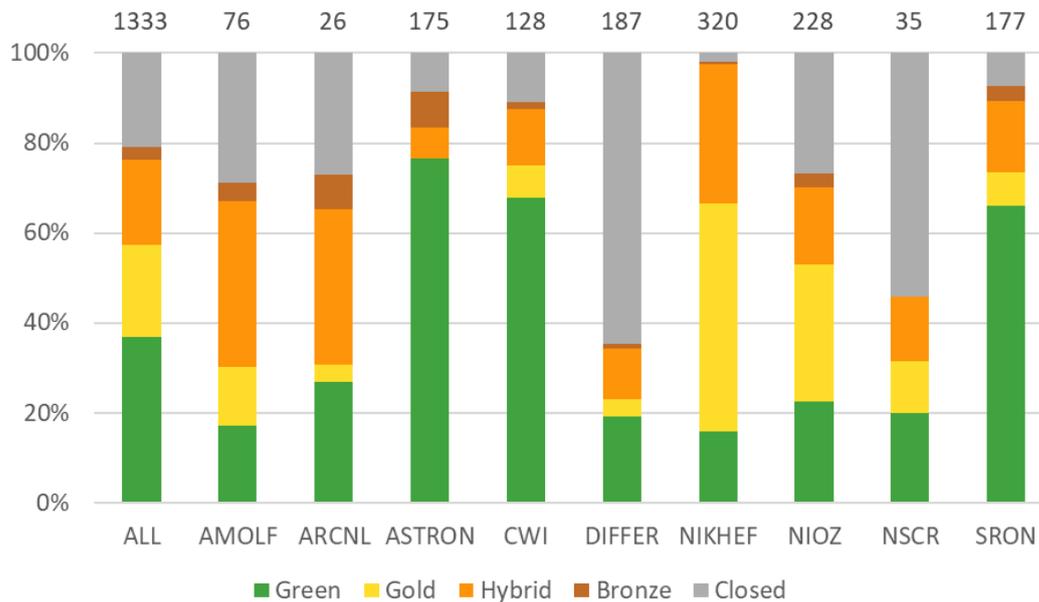


Figure 4. For each of the NWO institutes, the bar chart shows the number of publications and the percentage of publications of the different OA types. ‘ALL’ refers to the publications of all NWO institutes taken together. Only publications from 2018 are considered.

3.3. Open access status and citation impact

OA publishing makes research results more widely available. This is sometimes claimed to cause an increase in the number of citations received by OA publications relative to non-OA publications. Various studies have indeed shown that there is a correlation between publications being OA and publications receiving more citations. However, it is hard to determine whether this correlation reflects a causal effect of OA publishing on the number of citations received by a publication.¹ The correlation may for instance also be due to a self-selection effect. Such an effect occurs when researchers selectively choose to make only their best work openly accessible. Another possibility is that the availability of a preprint causes citations to be received earlier in the lifetime of a publication.

Figure 5 presents citation impact statistics for publications funded by NWO or ZonMW with a breakdown by OA type. For each OA type, the figure shows the mean normalized citation score (MNCS) of NWO and ZonMW funded publications. The

¹ There is no consensus in the literature on the existence of a causal ‘OA citation advantage’. [Gargouri and colleagues](#) for instance claim that such a citation advantage exists, while [Davis](#) rejects this claim.

MNCS is the average number of citations of a set publications, normalized for differences in publication year (to correct for the fact that older publications tend to have more citations than recent publications) and differences between scientific fields (to correct for differences in citation practices between scientific fields).² The MNCS of all publications in the WoS database equals one, so an MNCS above one indicates a citation impact above the average level of the database. Publications from 2018 are not included in the statistics reported in Figure 5. Because these publications are quite recent, it is not yet possible to calculate meaningful citation impact statistics for them.

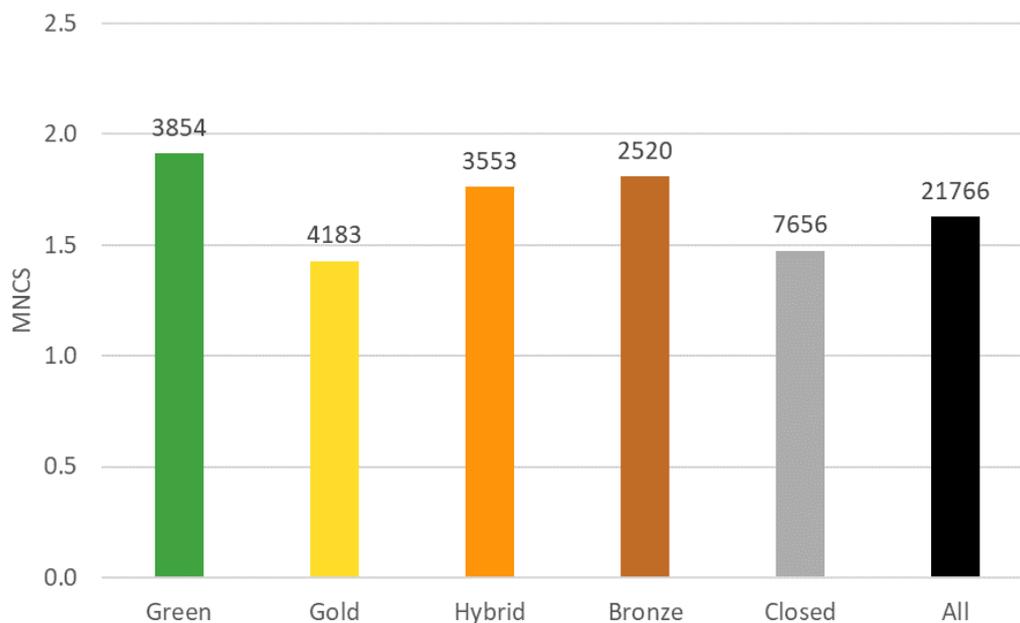


Figure 5. For each OA type, the bar chart shows the mean normalized citation score (MNCS) of publications funded by NWO or ZonMW. 'ALL' refers to all NWO and ZonMW funded publications, both OA and non-OA. Only publications from the period 2015–2017 are considered.

Figure 5 shows that gold OA publications have a similar citation impact as non-OA publications. Hybrid and bronze OA publications have a citation impact that is about

² We emphasize that the MNCS is based on citations received by individual publications, not by the journals in which publications have appeared. The use of journal-level citation impact statistics would violate NWO's commitment to the [San Francisco Declaration on Research Assessment \(DORA\)](#).

20% higher than the citation impact of non-OA publications. For green OA publications, the citation impact is 30% higher than for non-OA publications. These statistics show that OA publishing correlates with publications receiving more citations. This may be due to OA publications being more easily accessible, but other effects, such as self-selection, are also likely to play a role.

4. Conclusions

In this report, we have analyzed the extent to which publications funded by NWO and ZonMW, and also publications of the NWO institutes, are made openly accessible. Our conclusions can be summarized as follows:

- In each year in the period 2015–2018, at least 60% of the NWO funded publications are openly accessible. Of the NWO funded publications from 2018, the most recent year included in our analysis, 68% are openly accessible. This means that NWO has met the target set by the Dutch government, requiring 60% of the publicly funded publications to be openly accessible in 2018.
- In each year in the period 2015–2018, at least 60% of the ZonMW funded publications are openly accessible. Of the ZonMW funded publications from 2018, exactly 60% are openly accessible. Hence, ZonMW has just met the target set by the Dutch government.
- For the national research institutes managed by NWO, 79% of the publications from 2018 are openly accessible. Hence, collectively, the NWO institutes have clearly met the target set by the Dutch government. For two individual NWO institutes, DIFFER and NSCR, there seems to be more work to be done to increase the open accessibility of their publication output.
- An important caveat applies. Since 2015, NWO's OA policy requires publications to be made openly accessible immediately at the time of publication. However, in the case of green, hybrid, and bronze OA, it is not clear whether publications were made openly accessible immediately at the time of publication or at a later time. The percentage of bronze OA publications is substantially lower for publications from 2018 than for publications from earlier years. This suggests that bronze OA publications often are not made openly accessible immediately at the time of publication but at a later time, probably determined by an embargo set by the publisher. Bronze OA also has other limitations. Because bronze OA publications lack a clearly identifiable license, these publications are free to read, but they are

not free to reuse. Also, there is no guarantee that these publications will remain free to read in the future.³

- On average, OA publications funded by NWO or ZonMW have a higher citation impact than non-OA publications. The difference in citation impact may be due to OA publications being more easily accessible, but other effects, such as self-selection, are also likely to play a role.

Although NWO has met the target set by the Dutch government for 2018, meeting the target of 100% OA publishing in 2020 seems to be a major challenge. NWO could potentially benefit from experiences of other funders, some of which have managed to reach more than 90% OA publishing.⁴ Based on these experiences, possible ways to increase the percentage of OA publications include the introduction of stricter compliance monitoring and enforcement policies, where payments may be withheld if publications are not made openly accessible. Another possibility is to take into account only OA publications in the evaluation of grant proposals. NWO may also consider joining EuropePMC. This may make it easier for NWO funded researchers, especially in biomedical fields, to meet the requirements of NWO's OA policy.

Open accessibility of NWO funded publications can be expected to benefit substantially from the recently announced agreement of the VSNU, NWO, and NFWO with Elsevier. It is also likely to be stimulated by NWO's support of Plan S, a plan developed by a group of research funding organizations to realize full and immediate OA. Plan S will be applicable to publications resulting from calls published by NWO from January 1, 2021 onward. Future updates of this report can be used to track the progress made by NWO toward the target of 100% OA publishing and to evaluate the effects of initiatives such as Plan S.

4.1. Recommendations for improved monitoring of open access publishing

As discussed in Chapter 2, the methodology for monitoring OA publishing used in this study has a number of limitations. To address some of these limitations, we offer a few recommendations for improved monitoring of OA publishing:

³ The notion of bronze OA was introduced by Piwowar and colleagues in a research article published in 2018. We refer to [this article](#) for a further discussion of bronze OA.

⁴ Examples of these funders are NIH in the US and Wellcome Trust in the UK. For more details, see [this analysis](#) by Larivière and Sugimoto of researchers' compliance with funders' OA mandates.

- In the current study, data on the publications funded by NWO was obtained from the WoS database. An alternative to the use of such an external database could be to use an internal database of NWO. NWO has a database in which grantees are required to register the publications resulting from their NWO funded projects, but the quality and completeness of the data is uncertain (see also the box below). For future monitoring of OA publishing, we recommend to evaluate the pros and cons of using either an external or an internal database.

Note from NWO on publication output registration

All NWO funded researchers are required to register their publication output in NWO's grant management system ISAAC. The statistics presented in NWO's annual report are based on this data. NWO suspects this data to be incomplete. Lack of standardization makes it difficult to use the data for analyses like the one presented in this report.

NWO is in the process of improving its publication output registration. Currently a pilot project is running in which publications resulting from NWO funded projects are being harvested automatically from the information systems of three universities. The use of persistent identifiers such as Grant IDs and ORCID IDs seems an important prerequisite to establish such an automated exchange between universities and NWO.

- External databases can be improved in several ways. We recommend to encourage or mandate publishers to include license data in the metadata they deposit in Crossref. This will improve the quality of data on OA publishing, for instance by enabling publications to be classified as gold or hybrid OA rather than bronze OA. We also recommend to NWO to consider adopting grant IDs and to encourage or mandate publishers to include grant IDs and funder IDs in the metadata they deposit in Crossref. This will make it easier to keep track of the publications funded by NWO. Likewise, the use of institution IDs will make it easier to keep track of the publications of the NWO institutes. Plan S can potentially make an important contribution to improving external databases, since it mandates publishers to make license data available and it strongly recommends the use of funder IDs, grant IDs, and institution IDs.

- In the case of the use of an internal database, we recommend to explore the possibility of integrating such a database in the open knowledge base infrastructure that may be established as a result of the discussions between NWO, VSNU, NFU, and Elsevier that are currently ongoing.
- When external databases have been improved or a high-quality internal database has been established, we recommend that CWTS and NWO will reconsider the use of the WoS database for monitoring OA publishing. The selectivity of the WoS database has certain advantages (e.g., the exclusion of predatory journals), but it also has important disadvantages. First of all, this selectivity leads to the exclusion of certain publications and it therefore yields an incomplete picture of the current state of OA publishing. More fundamentally, the selectivity of the WoS database creates a divide in the scholarly publishing system between journals that are indexed in the WoS database and journals that are not. This divide inhibits innovation in scholarly publishing because newly established journals, many of which try to bring innovation, by default are not indexed in the WoS database. As an alternative to the WoS database, we recommend to consider the use of more comprehensive databases such as Crossref and Dimensions.