

# Heading for the open road: costs and benefits of transitions in scholarly communications

April 2011



Commissioned by:



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## Important notice

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# Executive summary



## 1. Introduction

The aim of the study has been to provide evidence that will help the different constituencies involved in scholarly communication to understand better the dynamics of the transitions needed to improve access to research papers in a variety of ways; and the costs, benefits, opportunities and risks that this entails. Transition is understood to relate to changes in practice, business models and organisational culture within the relevant constituencies, and any new entrants, over the next five years.

We have sought to do this by defining and then comparing plausible but challenging scenarios that increase access to scholarly articles.<sup>1</sup> 'Access' is taken to mean that user groups are able to read, download and print a scholarly article without additional cash payment by them or their institution. The comparison and the associated modelling can best be described as a UK cost-benefit analysis, which builds on previous work by RIN, JISC and others. Those studies, however, have tended to focus on extreme states of the world and only what might be referred to as the steady state costs.

We do not claim in our modelling and analysis to have captured all the complexities of the scholarly communications system. Moreover, we must stress that what we present is essentially an exercise in comparison. We are more confident in the *comparisons between* the scenarios and the sensitivities associated with them than in the absolute values that result from our modelling. Nevertheless, we believe that our findings, and the conclusions we draw from them, are well-founded in those terms as a basis for further work and policy discussion.

<sup>1</sup> An important point to note is that the modelling and analysis in this report relates only to peer-reviewed journal articles as the primary means of scholarly communication. In order to simplify the analysis, we have intentionally excluded both monographs and conference publications.

## 2. Scenarios

The starting point for the study has been to define, in consultation with stakeholders, the scenarios to be compared. Table E1 summarises the scenarios that we have considered.

Table E1: Summary of the five scenarios

Scenario	Summary Description
Green Open Access	Increased deposit rates of accepted manuscripts into institutional and discipline-based repositories driven by enforcement of mandates by funders (globally) (40-60% deposit rates depending on discipline) and UK, US and European research institutions (15-30% deposit rates). We consider two variants of this scenario which show the impact of moving from the existing world and one assuming a theoretical world in which Green OA did not already exist, 'Zero'. <sup>2</sup>
Delayed Access	A significant increase – to 40% – in the number of publishers providing free access to the version of record for 65% of the articles on their websites, following an embargo period. Embargoes are set in relation to the readership 'half-life' and are assumed to be 12 months (biomedical); 24 months (science & technology); 36 months (arts & humanities).
Gold Open Access	Increased proportion of articles published with author-side payments leading to immediate access to the version of record. Applicable globally and to all disciplines as follows: biomedical (40%); science & technology (15%); arts & humanities (5%). We consider two variants of this scenario, to show the impact of a higher or lower level of article processing charges (APCs).
Licence Extension	Increased access to the version of record achieved through national licence extensions to the (i) HE sector, with 50% of larger publishers agreeing licence extension for all HEIs, covering 75% of articles; and (ii) NHS, with 30% of relevant (i.e. primarily biomedical) publishers participating, covering 55% of relevant articles.
Transactional	Increased access focused on targeted user groups (e.g. SMEs, independent researchers and professionals). Access to the version of record at the point of publication. Primary access expected to be via aggregating sites. A pay-per-view (PPV) price of \$10 is considered.

<sup>2</sup> The 'zero' case provides a comparison to a world in which repositories have not been established and deposits have not begun. The reason for including this comparison is to illustrate what happens in terms of the benefit-cost ratio when we take account of the full additional costs associated with Green.

### 3. Modelling and analysis

For each scenario we have analysed the drivers and transition steps (the activities likely to be required for the scenario to be realised); modelled steady state and transition costs; quantified the changes in the access; and finally, estimated the wider economic benefits.<sup>3</sup> We have used this analysis to draw comparisons and make judgements about the relative cost-effectiveness of different approaches to increasing access, and to inform policy conclusions.

In making comparisons it is important to note that we have compared each of the scenarios to a 2015 baseline rather than 2010 in order to take account separately of anticipated system-wide changes between 2010 and 2015 that would affect all scenarios. In addition, for each scenario we have explored key sensitivities. For example, for the Green and Gold scenarios we have considered how sensitive our results are to relaxing the assumption that the UK and the rest of the world are moving in step in terms of the levels of deposit rates (Green) and author-side payments (Gold).

Throughout our analysis we refer to two measures of the change in access. The first is a standardised unit of access (SUoA) which is a common currency of access taking account of embargo period, version and functionality. The second measure seeks to adjust the standardised unit of access to take account of the potential for diminishing marginal returns to access (as users have access to more and more articles), and is referred to as 'useful access'

### 4. Changes in access and cost to the UK

In what follows, we do not compare the results of the Transactional scenario with the other scenarios, because it is not directly comparable in terms of the access changes, costs and benefits that it considers. However, we note that, given its 'targeted' access, a Transactional route could be complementary to a licence extension in particular; and that, on the other hand,

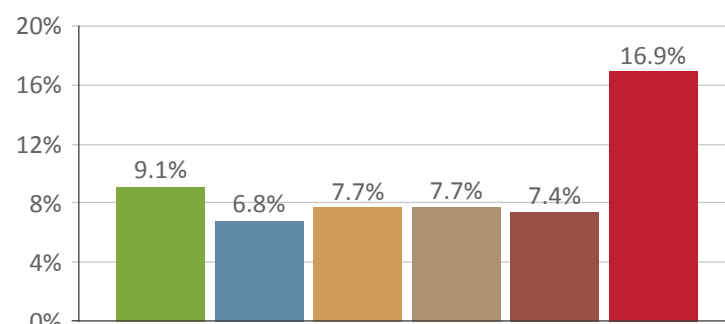
a significant increase in open access of either variety would reduce the potential market for PPV.

#### Changes in access

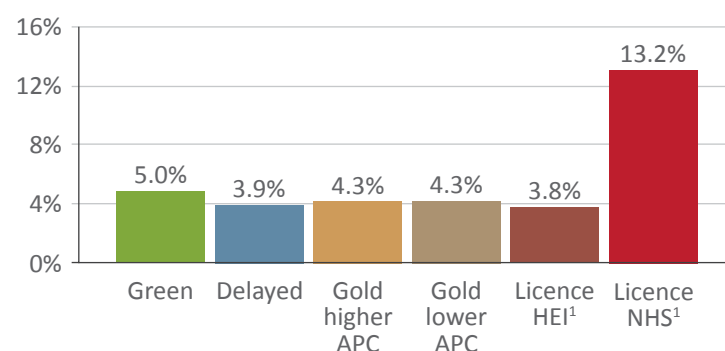
Figure E1 shows the estimated changes in the two measures of access in each of our scenarios. These changes reflect the assumptions that define the scenarios (in Table E1) as well as our modelling assumptions. With the exception of the NHS Licensing scenario, the changes in access are of a similar order of magnitude in each scenario.

Figure E1: Changes in SUoA and useful access compared to the 2015 baseline in each scenario

Panel A: Increase in SuOA



Panel B: Increase in useful access



<sup>1</sup> Increase applicable to HEI/NHS users only

<sup>3</sup> The steady state costs, changes in access and benefits have been estimated using a modified version of a model developed previously by CEPA (2008). Transition costs have been estimated separately and include both institutional transaction costs ('one-off' costs); and any 'ongoing' annual costs associated with system-wide transition (not captured in the 2008 CEPA model).

## Cost to the UK

Each of the scenarios involves some element of upfront expenditure in order to support transition. Figure E2 shows the estimated 'one-off' transaction costs associated with the transition (Panel A) and ongoing annual costs<sup>4</sup> (Panel B) to the UK for each of the scenarios.

The level, composition and profile of ongoing annual net costs or savings vary significantly between the scenarios. They vary also in their distribution across user groups and institutions. These differences are discussed in more detail below.

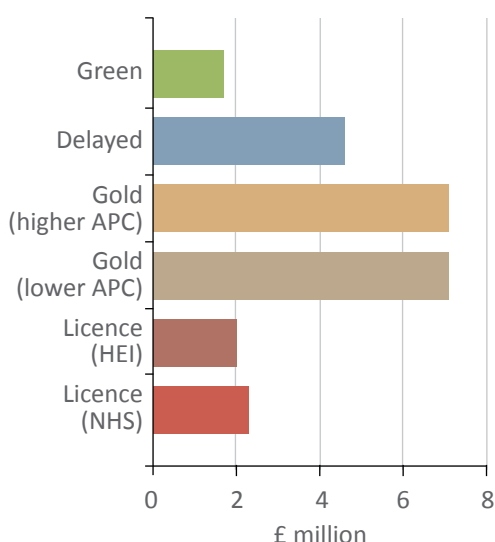
repositories are sunk. If these sunk costs were to be included in the comparison, Green would become the most expensive scenario to the UK, with additional net annual costs and one-off costs both in excess of £10m.

The *Delayed scenario* imposes no ongoing costs, and has low one-off transaction costs, incurred by publishers.

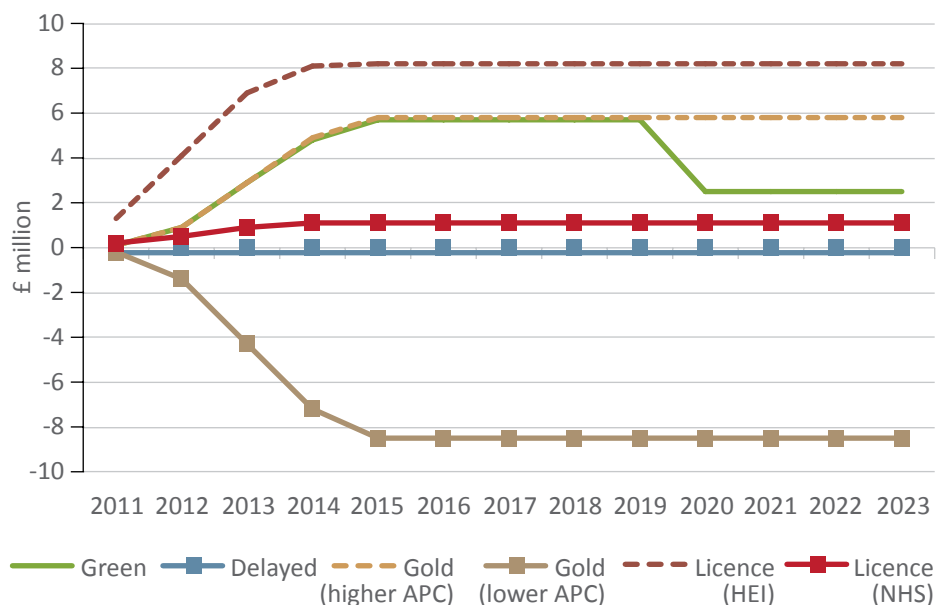
The *Gold scenario* has the highest expected one-off transition costs, associated with: business case development by funders and academic institutions to meet author processing charges (APCs); development and adoption of central funds by

Figure E2: Comparison of UK net annual costs

Panel A: Increase in SuOA



Panel B: Annual system costs (steady state plus ongoing transitional costs)



The one-off and ongoing costs associated with the *Green scenario* are relatively low compared with most of the other scenarios. This cost comparison may be misleading, however, since for Green it covers only the additional cost as compared to the 2015 Baseline, within which most of the costs of establishing

academic institutions; development and communication of institutional payment models and mechanisms to process APCs; development of publisher billing systems to deal with APCs; and negotiations between publishers, institutions and consortia to establish publishing deals.

<sup>4</sup> Ongoing annual costs include changes in (i) net costs incurred in supporting publication, distribution and access (i.e. 'steady state' costs); and (ii) the ongoing annual costs associated with transition.

Gold is, however, the only scenario that could in principle reduce the net annual costs for the UK, and in particular, for UK universities. But it would do so only if the weighted average level of APCs was sufficiently low so that, in a steady state, the increased costs of paying them was outweighed by a fall in subscription payments (as increasing numbers of articles became available as gold OA). In particular:

- Higher-level APC: if average APCs were set at a level equal to the estimated current global average cost per article (£2,634), UK universities' annual cash costs would rise significantly, leading to a high net cost to the UK relative to the other scenarios (other than licensing).
- Lower-level APC: if average APCs were set at about £1,457 (or \$2,185 – the estimate by Outsell of the 2009 weighted average for actual APCs charged)<sup>5</sup> then UK universities would benefit from substantial annual net savings that we estimate at £2.8m (or £3.0m including non-cash savings) at the level of uptake we have modelled.

There are significant uncertainties, however, about how Gold OA publishing – and the level of APCs – will evolve, and about the impact on traditional publishers' business models. Moreover, there are likely to be significant challenges in transition (perhaps more so than in other scenarios) including both (i) the one-off costs to create the necessary systems and infrastructure; and (ii) the lags that mean that ongoing net costs could rise before later falling, because of the need to pay APCs while retaining existing subscription journals.

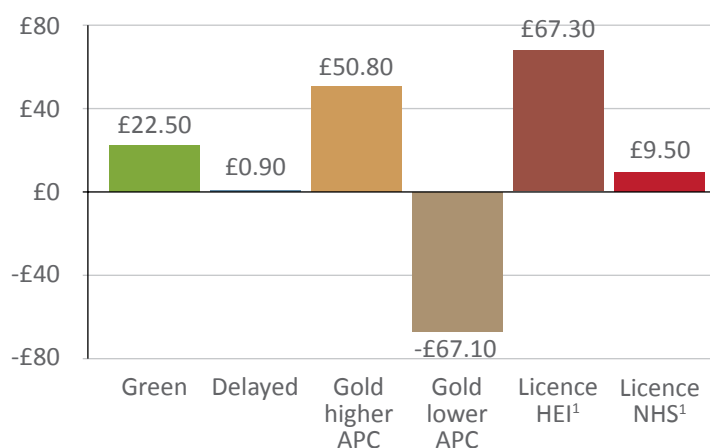
The ongoing costs associated with the *Licence Extension scenario* depend largely on the assumed licence premium. The one-off costs vary between the HEI and NHS licence scenarios, largely reflecting expected negotiation costs. But both the ongoing costs and one-off costs appear to fall somewhere between Green and Gold.

## 5. Cost-effectiveness and risk

### Cost-effectiveness of increasing access

In order to compare cost-effectiveness between scenarios, Figure E3 shows the net cost to the UK per additional SUoA for each scenario. This cost-effectiveness measure is calculated by dividing total average annual net costs in a scenario by the absolute increase in SUoAs that are expected to result.

Figure E3: Comparison of the net cost to the UK per additional SUoA



<sup>1</sup> Increase applicable to HEI/NHS users only

With the exception of the NHS licensing scenario (which has a significantly higher increase in access) the relative position of the scenarios broadly reflects the differences in net costs shown in Figure E2. Points to note are as follows.

The cost per SUoA in the *Green scenario* depends on whether or not the costs of establishing repositories are taken into account. Ignoring these sunk costs suggests costs per SUoA which are broadly in the middle of the range of other scenarios. Taking account of the sunk costs would push the cost per unit of access towards the upper end of the range.

<sup>6</sup> This number is confirmed by our own estimates and given further validation by the average APC of \$2,367 paid for 440 Wellcome Trust-funded articles published in the last quarter of 2010. The Wellcome Trust articles were published in journals with a wide range of APCs, up to and including \$5,000 for Cell Press; the median was \$2,250 and the mode \$3,000.

The *Delayed scenario* comes very close to being a cost-free route to increased access, in terms of both upfront and ongoing costs.

As discussed above, the cost effectiveness of the *Gold scenario* varies dramatically depending on the assumed level of the APC. There is thus a net saving (shown as a negative cost in the figure) to the UK on each additional SUoA if APCs are kept low, but a high net cost if they reflect our estimates of the current costs of publishing each article.

Finally, the cost per SUoA in the *Licence Extension scenario* for the NHS is low, although it provides an increase in access only to a particular population, unlike the Green, Delayed and Gold scenarios which provide open access. In contrast the Licence Extension scenario for HEIs appears to be a relatively expensive approach to increasing access.

### Benefits and cost-effectiveness

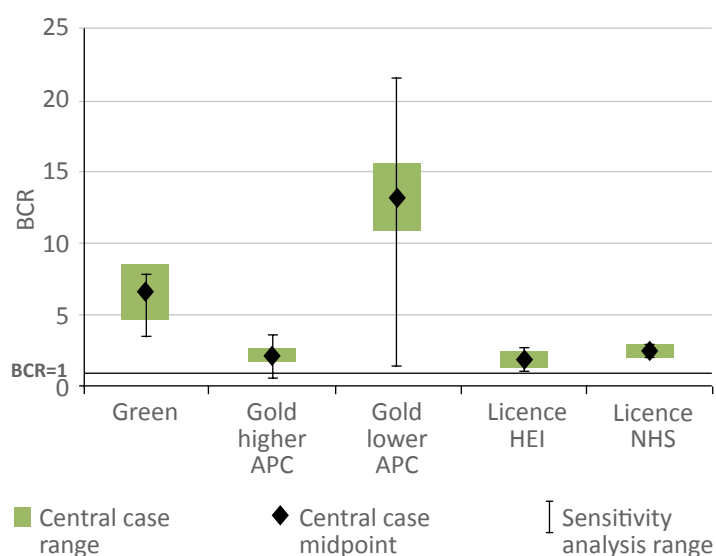
The benefits that arise from each scenario reflect the increase in access provided to each user group – universities, government, NHS, corporations and SMEs. The changes in our two access measures were used to estimate a range for potential UK economy-wide benefits using the ‘Solow-Swan’ economic growth model.<sup>6</sup>

We have compared these estimates of benefits in each scenario with their respective costs in order to calculate benefit-cost ratios (BCRs). Figure E4 below summarises this analysis, which provides an indication of the potential economic case for each scenario, and an alternative metric to compare cost-effectiveness. Given the relationship between increased access and economic benefits, however, the relativities are similar to those described above in Figure E3; and for reasons explained in the report, we have greater confidence in the comparisons between scenarios than in the absolute values.

In the tinted bars on the chart, the lower bound reflects the benefit estimates that we get from using the measure of access that takes account of potential diminishing marginal returns (‘useful’ access); the upper bound reflects access without this

adjustment (SUoA). The diamond denotes the mid-point of the range. The vertical lines represent the ranges covered by the sensitivity analyses that we have conducted, details of which are provided in the report.

Figure E4: Benefit-cost ratios



NOTE:  
 Delayed Scenario BCR of 113.2 is not consistent with this scale.  
 Transactional Scenario BCR is not comparable.

The modelling confirms what one might intuitively expect, that the *Green scenario* would provide a cost-effective route to improving access, with relatively high BCRs attributed to our central case in which much of the costs are treated as sunk. These BCRs and the overall economic case are relatively robust to our sensitivity analysis (illustrated by the line). However, as discussed below, the Green scenario may carry a relatively higher risk than the other scenarios given its potential to undermine the business model on which it relies; and that risk is not captured in the sensitivity analysis.

<sup>6</sup> Houghton et al (2009)

The midpoint BCR for the higher APC *Gold scenario* is relatively low. However, with lower APCs the BCR midpoint is considerably higher. This demonstrates how the BCRs for the Gold scenario are probably the most sensitive to changes in key assumptions. This is particularly true of the assumption that the UK moves in line with the rest of the world in terms of take-up of Gold OA – which provides the lower end of the sensitivity range – and is less than 1 in the higher APC case.<sup>7</sup>

As with Gold, the cost-effectiveness of the *Licence Extension scenario* depends directly on the assumed licence premium that would be charged by publishers. At the assumed level of premium both HEI and NHS licence extensions have the potential to offer a net benefit to the economy, with the NHS licence extension appearing to have a marginally-better BCR.

### Risks

The past five years have brought rapid change in the scholarly communications system as a whole: new technologies and services have brought changes in the roles, behaviours and attitudes of all the key groups of players in the system – universities, funders, libraries, publishers and researchers themselves. Rapid change brings all kinds of risks, and we cannot capture all of them in our modelling. We have, however, considered three groups of risks in relation to each scenario: potential impact on the overall funding or viability of the scholarly publishing system; risks to the transition process; and risks to achieving the calculated BCRs. Figure E5 provides a summary assessment of those risks. We must stress that this assessment reflects a judgement of the *relative* riskiness of the scenarios. It is not an assessment (quantified or otherwise) of absolute levels of risk. Key points to note are as follows.

The *Green scenario* involves a relatively high risk to the scholarly publishing system as a whole, since it could give rise to significant levels of subscription cancellations, rendering some journals and publishers unviable. However, the risks to the transition and BCR are not thought to be as great as for other scenarios.

The *Delayed scenario* involves some risk of subscription cancellations, but less than Green since publishers have more control in this scenario. Costs are very low, so the transition and BCR risks are also lower than other scenarios.

The *Gold scenario* presents a relatively low risk to the scholarly publishing system as a whole, since it offers a viable alternative business model. There are, however, slightly greater risks with respect to the transition (for funders, academic research institutions and publishers) and relatively high risks associated with achieving the BCR.

Our judgement is that the *Licensing extension scenario* has higher risks related to transition, but relatively low risk in the other categories.

The *Transactional scenario's* greatest risk is to the system as a whole from the potential cannibalisation of subscriptions, but given publisher autonomy, our judgement is that risk is not as high as the Green scenario. Transition and BCR risks are both low.

Figure E5: Relative risks of scenarios

Scenario	Scholarly Publishing System Risk	Transition Risk	Risks to Achievement of BCR
Green	Higher	Medium	Lower
Delayed	Medium	Lower	Lower
Gold	Lower	Medium	Higher
Licence Extension	Lower	Higher	Lower
Transactional	Medium	Lower	Lower


<sup>7</sup> The volatility of the BCR in the lower APC case reflects the relatively low level of costs in the central case. Small additions to these costs therefore have a disproportionate impact on the BCR.

## 6. Policy implications

As a result of our modelling and analysis, we believe that the overall policy messages that arise for those seeking to increase access to research articles are as follows:

1. The *Delayed scenario* offers closest to a zero cost. But it depends on voluntary action by publishers, and it is not directly amenable to policy influence (unless it were really the case that publishers would adopt it as a potential defensive response to Green, something for which we see no evidence at present). Moreover, it would probably involve embargoes longer than funders such as the Wellcome Trust currently require; it could preclude aggregation of articles in subject repositories; and – as with the Green scenario – there are risks to the sustainability of the subscription model on which it relies. In our view, therefore, while there is no harm in policy-makers encouraging it as a low-cost and arguably lower-risk<sup>8</sup> way of expanding access, it is unlikely in practice to provide significant changes in access.
2. The *Transactional scenario* has some potential to address access gaps, and it could be complementary to the Licence extension scenario, or to the subscription model generally, provided it did not cannibalise subscriptions. It seems unlikely, however, that it would lead to a substantial increase in access overall. Moreover, it is not particularly amenable to policy intervention, and the demand for transactional access would presumably fall as open access expands.
3. All the scenarios that are directly amenable to policy intervention (Green, Gold, and Licence extension) are – based on our modelling – capable of achieving benefits to the UK that are greater than their costs. However, all have significant upfront costs of different kinds.
4. Of these options, our view is that the *Licence extension* option is the least attractive from a policy perspective. Although the level of the BCR depends significantly on the premium that publishers actually charge for increased access, the combination of significant upfront and on-going cash costs (in the HEI licence extension in particular) and the difficulties of transition (including the allocation of costs) make the option relatively unattractive. These arguments are strengthened in the current difficult fiscal environment.
5. Our judgement is that the two open access routes offer the greatest potential to policy-makers in promoting access. Both have positive, and potentially high, BCRs.
6. The *Green scenario* appears capable of providing increases in access comparable to or greater than other scenarios, and since the infrastructure for Green has largely already been built, increasing access by this route is especially cost-effective. These gains, however, come with increased risks to the scholarly publishing system in the form of potential subscription cancellations, and thus the risk that the scenario is not self-sustaining.
7. Of the two open access routes, our view is that the *Gold route* is preferable in the long-run, given (i) its underlying sustainability; (ii) the advantages of the author-side business model in terms of improved transparency and lower barriers to market entry, which point to improved economic efficiency; and (iii) (depending on the level of the APC) the potential to achieve both higher BCRs and lower net costs for the UK in general and for its universities in particular.

<sup>8</sup> Given that publishers retain control and can take action.

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8. Set against those considerations, the scale of the costs and the benefits depends on the future level of APCs, which it may be hard for policy-makers to influence; and there are higher transition costs in the transition to Gold compared with Green.
  9. Taking all these factors into account, our view is that the prudent stance for policy-makers seeking to promote access in the current environment is likely to be as follows:
    - to encourage the use of existing Green infrastructure (whose costs are largely sunk); but to be cautious about pushing for reductions in embargo periods to the point where the sustainability of the underlying publishing model is put at risk.
    - in parallel, to work to facilitate a transition to Gold OA (in specific disciplines first) provided that (i) the average level of APCs remain at or below £1,995;<sup>9</sup> (ii) the proportion of articles funded through APCs moves broadly in line with global rates; and (iii) mechanisms are in place to ensure that total payments from UK universities and their funders do not rise as a consequence of this transition.

<sup>9</sup> At this APC value academic institutions have a zero change in annual net costs.

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## Background

The aim of the study has been to provide evidence that will help the different constituencies involved in scholarly communication to understand better the dynamics of the transitions needed to improve access to research papers in a variety of ways; and the costs, benefits, opportunities and risks that this entails. Transition is understood to relate to changes in practice, business models and organisational culture within the relevant constituencies, and any new entrants, over the next five years.

This is the second of three studies on transitions in scholarly communications commissioned by the Research Information Network in partnership with a number of organisations from the research, higher education, library and publishing sectors. The other projects are (i) Gaps in and barriers to access and (ii) E-only scholarly journals: overcoming the barriers. More details of these projects are available on the RIN website.<sup>10</sup>

<sup>10</sup> [www.rin.ac.uk/transitions-portfolio](http://www.rin.ac.uk/transitions-portfolio)



## Context

Scholarly communication is undergoing a revolution, with the principal drivers of change being economic (growth of R&D funding and hence outputs; relative growth of outputs and library budgets; geopolitical shifts; globalisation; pricing) and technological (ICT, especially the Web; and an explosion of data capture and use). These changes have raised access by researchers to historically high levels. But there is a perception that demand remains unfulfilled and access gaps continue; and an increasing interest in possible open access (OA) solutions.

Stakeholders including research funders, universities, libraries, publishers and researchers themselves all have an interest in improving access to research papers, but these different groups do not necessarily share priorities or preferred ways to achieve that goal. We identified in the course of this study five possible broad approaches or 'routes': open access repositories (Green OA); open access journals (Gold OA); delayed (embargoed) free access to subscription journals; licence extensions, including national site licences; and transactional solutions.

Recent work by the RIN, JISC and others (see the separate Literature Review for details) has contributed to the evidence available on the costs, benefits and funding flows of the current scholarly publishing system and possible alternatives. This work has, however, tended:

- to focus on 'static' comparisons between alternative, often 'extreme', states of the world (e.g. 90–100% Gold OA).
- not to consider the possible evolution of the scholarly publishing system to possible future scenarios, the mechanisms or drivers for that, or the transition costs associated with such changes.

This study seeks to build on the existing work by comparing the costs and benefits of five scenarios based on the broad approaches listed above over a five year period. It aims to consider both the drivers required for change and the costs involved in making the transitions.

Two additional points should be noted as context for this study.

- The backdrop of sustained increases in the supply of scholarly articles. This means that – regardless of any actions by stakeholders to increase access – there is an underlying pressure on the system. Although we have taken account of that to some degree in our modelling it is not the primary focus of the work.
- Our definition of scholarly communications is restricted to English language, quality-assured articles. We have not considered monographs, conference papers or other aspects of scholarly communication, or fundamentally different approaches to quality assurance, such as post-publication peer review.

# 3

## Approach and modelling methodology

### 3.1 Overview of approach

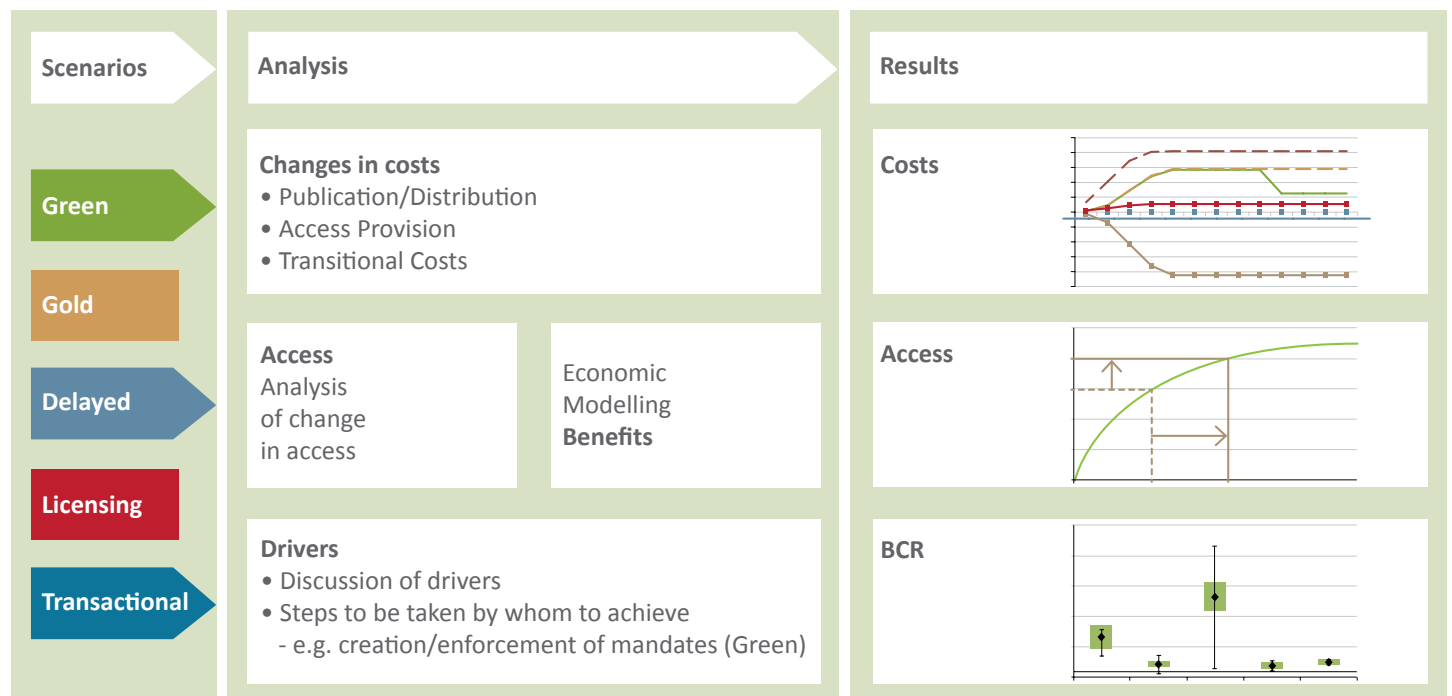
Our approach to this study can best be described as an UK cost-benefit analysis of different routes – as set out in five scenarios – to increasing access to scholarly articles.<sup>11</sup> ‘Access’ is taken to mean that the user groups are able to read, download and print a scholarly article without additional cash payment by them or their institution.

Each scenario considers changes against a common baseline of access, costs and funding flows assumed for 2015. Use of a

2015 baseline is a key element in our methodology. We use this approach – rather than comparing with a 2010 baseline – in order to take account separately of anticipated system-wide changes between 2010 and 2015 that would affect all scenarios. The 2015 Baseline is what might be thought of therefore as a ‘policy neutral’ position against which we compare each of the access-related policy scenarios.

Figure 3.1 illustrates our overall approach. Key elements are described in more detail below.

Figure 3.1: Illustration of approach



<sup>11</sup> An important point to note is that the modelling and analysis in this report relates only to peer-reviewed journal articles as the primary means of scholarly communication. In order to simplify the analysis, we have intentionally excluded both monographs and conference publications.

## Scenario choice

The study started by defining, in consultation with stakeholders including funders, librarians and publishers, a series of five scenarios to be considered. Table 5.1 (p.23) provides summary details of the scenarios that were selected and developed.

## Analysis

The main elements of the analysis that we have conducted for each scenario are as follows:

- A description of the drivers and, at a high-level, the transition steps (the activities likely to be required for the scenario to be realised).
- A quantification of changes in steady state costs associated with the scholarly communication process.
- Estimation of transition costs including (i) institutional transaction costs ('one-off' costs); and (ii) any 'ongoing' annual costs associated with a system-wide transition.
- Quantification of changes in two measures of access: (i) a standardised unit of access (SUoA); and (ii) a transformed measure of access that takes account of potential diminishing marginal returns, which we refer to as 'useful' access.
- Quantification of wider economic benefits from improved access, using the approaches developed by John Houghton et al (2009). We also discuss other non-quantified benefits.

## Results

We use this analysis to draw comparisons and make judgements about the relative cost-effectiveness of different approaches to increasing access. For each scenario we are therefore interested in three main modelling outputs, in addition to the changes in access. These are:

- **Annual cash costs and savings.** We present the level, profile and distribution of the change in costs and savings expected in each scenario. This tells us who incurs the cost and receives the cash savings associated with each route to access (where costs include the contribution that the UK makes to costs of publication, distribution and access as well as transition costs referred to above).

- **Annual net cost per standardised unit of access.** As a way of standardising across the different scenarios – which have different changes in the level of access – we present measures of the net annual cost per SUoA. This measure is the total estimated additional net cost incurred by the UK divided by changes in SUoA levels.
- **Benefit-cost ratios (BCRs).** In addition to knowing who incurs costs (or savings), we are interested to understand what is the expected economic 'pay-off' associated with the increase in access in each scenario. We measure this by comparing the net costs over 20 years with the estimated economic benefits over the same period. These net costs and benefit amounts are both presented as net present values (NPV), which are the values of each stream of net cost or benefit converted into 2015 values via a discount rate. The BCR is calculated by dividing the NPV of the benefits by the NPV of the costs, so that a value greater than 1 implies that expected benefits are greater than costs; and a value less than 1 implies the reverse.

We also provide a qualitative indication of the risks to: (i) the sustainability of the scholarly publishing system; (ii) the transition; and (iii) achieving the BCR associated with each scenario.



# 4

## Modelling methodology

In order to model the costs and benefits of the scenarios we have enhanced the model developed by CEPA for a study published by the RIN in 2008. The 2008 model was developed to provide estimates of the costs and funding flows associated with the scholarly communications system.<sup>12</sup> The scope of this project is significantly wider and includes estimates of changes in access for different user groups, and of potential economic benefits resulting from improved access to knowledge or efficiency in research. We have therefore made a number of changes to the model, full details of which are described in the separate Detailed Report.

The two main changes have been (i) to incorporate estimates of the level of access by different user groups and the changes in this access that occur in each scenario; and (ii) modelling to estimate economic benefits. These are each discussed in more detail below.

### 4.1 Access

#### Standardised unit of access

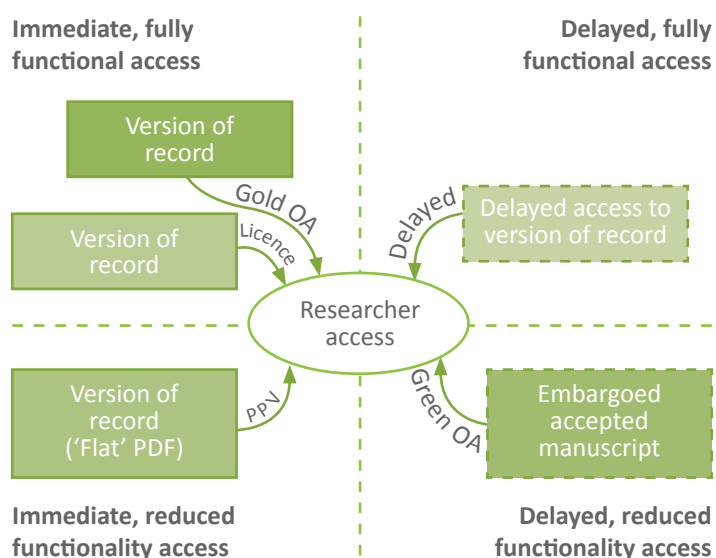
As defined for this study, ‘access’ relates to the ability of members of a particular user group to read, download and print an article without additional cash payment. In order to allow quantitative comparisons between the articles available to a user group via different routes we have defined what we refer to as a standardised unit of access (‘SUoA’).

To calculate the SUoA we adjust the value of article access according to (i) when the article is available (i.e. the length of any embargo); (ii) the version of the article (e.g. version of record or author manuscripts); and (iii) the level of functionality (e.g. a flat PDF is valued less than the XML/HTML version).

Figure 4.1 below describes the characteristics of the articles that are made available through the five different scenarios; and the discounts used are shown in Table 4.1.

In the Gold scenario, we assume that the user is able extensively to re-use the article (e.g. under a Creative Commons licence or equivalent) but not necessarily to re-use it for commercial purposes (OA publishers currently vary on this latter point). For the other scenarios we assume that such broad re-use rights are not generally included. In practice there will be a mosaic of different permissions applying to articles from different publishers. Although we acknowledge the potential value in such re-use, it is difficult to model for two reasons: first, the lack of uniformity previously mentioned; and second, that the more

Figure 4.1: Routes to access: embargo, functionality and version



<sup>12</sup> Many of the publishing and peer review model inputs and cost estimates are sourced from publishers and King et al (2000, 2004). While these have been inflated to 2010 values, we do not capture any productivity gains that may occurred over this time.

substantial value is likely to be a non-linear network benefit which derives from the ability to re-use a large corpus of work (e.g. in text- or data-mining) rather than being attributable to an individual article. For these reasons such differences in permissions and re-use rights are not explicitly valued in the benefit-cost analysis.

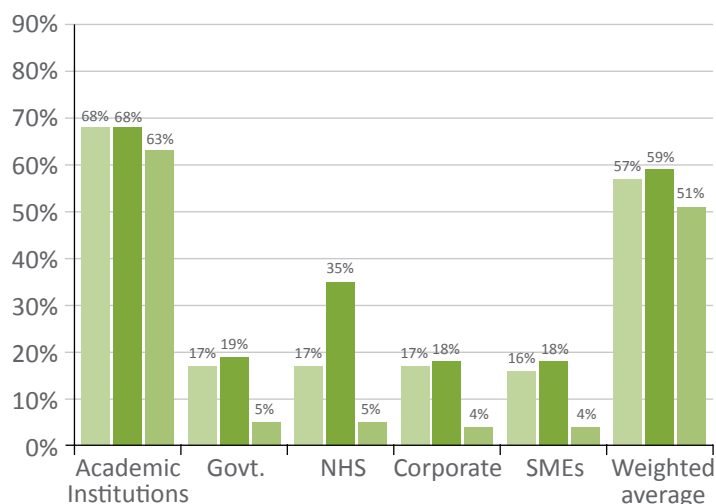
Table 4.1: Discount assumptions

Subject	Embargo	Version	Functionality
Science, Technology and Social Sciences (STS)	20%	10%	5%
BioMed (M)	30%	10%	5%
Arts and Humanities (AH)	10%	10%	5%

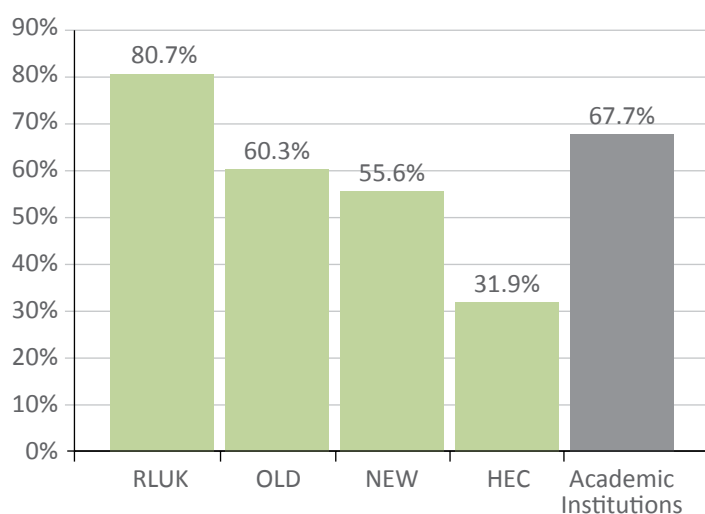
Figure 4.2 shows the level of standardised access for the five primary user groups in the 2015 Baseline; and a disaggregation of the level of access in academic institutions.<sup>13</sup> Access is measured as a proportion of the total number of articles generated per year, based on assumptions about levels of global research expenditure.<sup>14</sup>

Figure 4.2: Estimated levels of standardised access in 2015\*

Panel A: Access in 2015, by user group and subject



Panel B: Access in 2015, by academic institution



\* These SUoA access levels are the overall level of access for each user group provided via each of the routes to access. The levels of access provided by Gold OA, Green OA and Delayed are based on estimates in Björk (2010). Subscription access levels for academic institutions are based on SCONUL expenditure and serial subscriptions, as well as evidence on the distribution of journal size (articles per journal). Other user groups' access levels were calculated based on special library statistics and expenditure levels. PPV access levels were estimated using publisher revenue and average PPV price. All access levels represent the assumptions for moving from 2010 to 2015. Please refer to 'Supporting Paper 2: Modelling Assumptions' for more detail on sources.

<sup>13</sup> We weight access for non-academic researchers by research expenditure in order to get the weighted average across all user groups in Panel A. Research expenditure is used in order to separate out researchers engaged in experimental development. Averages are weighted by the numbers of researchers in Panel B for academic institutions.

<sup>14</sup> The changes in the access levels also take account of a user group's existing access. For example, suppose an additional 10% of all articles are made available via self-archiving. For a group that previously had subscribed access to 50% of the literature, we assume that an average of 50% of the newly-archived articles would already be available via the user group's existing subscription. As a result, the increase in access resulting from self-archiving would be discounted proportionately for this group.

### Diminishing marginal returns and ‘useful’ access

A further issue arises in how to value changes in access for different user groups while taking account of existing levels of access. For any given researcher the assumption is that there will come a point when access to additional articles will have reduced value. For example, imagine a researcher with access to a well-stocked library covering all core journals and many of the journals in peripheral or related fields. It is reasonable to expect that as more journals are added to the library’s collection, *on average* the proportion of high-quality articles relevant to the researcher in each additional journal will decline. For any given increase in overall access, therefore, the increase in *useful* access will depend on user groups’ existing level of access. This is the familiar economic concept of diminishing marginal returns (DMR).

The model estimates the size of this potential effect by using data from surveys that asked researchers to describe their ease of access to research articles to calibrate a DMR curve. By definition, the changes in *useful access* estimated by the model are less than the standardised units of access. We note that there are arguments to suggest that DMR may not always operate in this market or indeed in others. For this reason, we use the *useful* access measure to calculate the lower bound of our benefit estimates, and focus more generally on the mid-point estimates.

### 4.2 Access and economic benefits

The approach to calculating economic benefits for each scenario relies on the methodology developed by John Houghton et al (2009).<sup>15</sup> The basic intuition of this approach can be summarised as follows.

- The stock of knowledge, together with labour and capital, is a key input in determining a country’s level of national income; and additions to this stock are one determinant of economic growth (or growth in national income).
- The annual production of peer-reviewed scholarly articles contributes to the stock of knowledge and therefore to economic growth. Similarly, an increase in access to these articles will bring an increase in economic growth.
- Given this, we can estimate the impact of increased access to the outputs of UK annual research expenditure to provide a benefit estimate.
- Because the benefits of increased access to knowledge has a permanent effect on the level of national income,<sup>16</sup> the improved accessibility to knowledge continues to generate returns over time, reducing only in line with the obsolescence rate of the new knowledge stock.

As with any element of economic theory, it is dependent on a number of assumptions, which are explained in the Detailed Report. However, the key input is the assumed change in the level of access resulting from each scenario.

As noted above, in our analysis we use the change in both our *standardised* access and *useful* access measures as the basis for our estimates of economic impact. We think that this range provides a reasonable basis on which to estimate the level of benefits and to make comparisons across scenarios. As discussed in Section 6, the comparisons between the scenarios are likely to be more robust than the absolute values of the benefits shown.

<sup>15</sup> For the avoidance of doubt, although the methodology is similar, the question that we are addressing in this report is different from that which was addressed in Houghton et al (2009). In particular, Houghton et al compared the economic cost-benefit of alternative routes to access in general without reference to the distribution of costs between UK and the rest of the world; and between different funders of the scholarly communication system. (Using our modelling to ask the same questions results in very similar results).

<sup>16</sup> There is a permanent change in the level (as opposed to the growth) of national income.

## 4.3 Cost effectiveness measures

In order to compare the cost effectiveness of the different scenarios in achieving increases in access we present the results of our analysis in two main cost-effectiveness measures: (i) the average annual net cost per additional standardised unit of access (SUoA); and (ii) a benefit-cost ratio (BCR).

### 4.3.1. Average annual cost per additional SUoA

This cost-effectiveness measure is calculated by dividing the average annual net cost associated with the scenario by the absolute increase in standardised units of access in the scenario. The costs include (i) the net changes in the ongoing steady state costs incurred by the UK in supporting publication, distribution and access to English language peer-reviewed articles (captured in the CEPA model); (ii) one-off transaction costs; and (iii) any ongoing annual costs associated with system-wide transition in the scenario.

### 4.3.2. Benefit-cost ratio (BCR)

The second cost-effectiveness measure is the benefit-cost ratio (BCR). This is calculated as the NPV of the stream of estimated benefits and savings over 20 years in the scenario, divided by the NPV of the costs over the same period.

The value of using BCRs is twofold: first, it provides a metric that tells us whether the benefits of a scenario are greater than the costs (i.e. greater than 1) and therefore whether, other things being equal, the scenario would be beneficial to the UK; and second, it provides an indication of the relative cost effectiveness of the different scenarios.<sup>17</sup>

<sup>17</sup> There is an important caveat to this latter point, because there is degree of arbitrariness in the magnitude of the BCRs for different scenarios depending on how certain costs and savings are treated. For more information on the calculation of the benefit-cost ratios, please see the Detailed Report.

# 5

## Scenarios

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We have defined five scenarios, which follow the five routes to access referred to above. Table 5.1 provides a summary of the key elements of each of them. Our approach has been to model and present a central case for each scenario and then to present a range of sensitivities around this. The aim is to illustrate a range of plausible outcomes for the scenario.

The basis for the central case is largely judgement based on our consultations with stakeholders and the evidence available. Use of the term central should not therefore be taken to imply that we have conducted formal quantitative analysis of the expected outcome in a probabilistic sense. In the central case for the Green and Gold scenarios we have assumed that UK and the rest of the world are moving in step in terms of the levels of, respectively, deposit rates and author-side payments. We do not think that this is unreasonable. However, we make clear through

sensitivity analysis that the benefits in these scenarios would be significantly reduced relative to costs if the UK were to be significantly ahead of other publishing countries in terms of Gold or Green access.

It is also important to note from the outset that the ways in which we have considered the access changes, benefits and costs of the transactional scenario are not directly comparable with other scenarios. This is because access under pay-per-view (PPV) is fundamentally different from the access measured in the other scenarios, since it is access and use by a single individual, rather than general access. We do not therefore believe that it is appropriate to compare our results in terms of cost per SUoA or BCRs. The extent of our analysis on the PPV model is also limited by the absence of any data from publishers on these issues.

For each scenario a number of sensitivity analyses and variants have been considered, as set out in Table 5.2.

Table 5.1: Summary of the five scenarios (in 2015)

Scenario	Summary Description	Key metrics at 2015
Green <sup>18</sup>	Access is increased by growth in deposits – by authors and publishers – of accepted manuscripts into institutional and discipline-based repositories. The scenario is for all disciplines, although we vary the deposit rates. Accepted manuscripts are deposited in accordance with defined embargo periods. The driver of this scenario is the introduction and increased enforcement of mandates by funders globally and institutions in the UK, US and Europe.	Compliance with funder mandates is 40-60%, depending on discipline, with the highest rates in biomedicine and in specific niches with strong OA cultures; compliance with institutional mandates is 15-30%. Embargo periods in the central case are: 6 months (biomedical); 12 months (science & technology); 24 months (arts & humanities).
Delayed Access	A significant increase in the number of publishers providing free access to the version of record of articles on their platforms following an embargo period set in relation to the readership ‘half-life’. The scenario covers all disciplines, although with varying embargo periods. The driver for this scenario is a response by publishers to meet demands for increases in access in a way in which sustains access through their platforms and hence their control over some elements of their ‘value-add’ activities.	Roughly 40% of publishers offer delayed access to 65% of their content, hence about 26% of all articles. Embargo periods in the central case are: 12 months (biomedical); 24 months (science & technology); 36 months (arts & humanities).
Gold	Increased access achieved through growth in numbers of author-side payments leading to immediate access to the version of record through the publisher platform, and also in some cases by a subject and/or institutional repository. Applicable globally and to all disciplines, although with higher levels in disciplines with more direct research funding (e.g. biomedicine). The driver for this scenario is global coordination between research communities and funders; and on the supply-side an increase in the number of high volume Gold OA journals with relatively low APCs.	Proportion of articles published via Gold OA: 40% (biomedical); 15% (science & technology); 5% (arts & humanities). The same proportions apply to UK and global authors. We have modelled two cases for the Gold Scenario which vary according to the assumed average APC.
Licence Extension	Increased access to the version of record achieved through national licence extensions to the (i) HE sector; (ii) NHS. Such extensions are provided by a varying proportion of large commercial and non-commercial publishers and will be online, via publishers’ platforms. The driver for this scenario is government’s and research institutions’ desire to extend access to all UK users, and publishers’ desire to extend the commercial benefits of consortia deals.	HEIs: 50% of larger publishers agree licence extension to the HE sector, covering 75% of articles. NHS: 30% of relevant (primarily biomedical) publishers participate, covering 40% of relevant articles. Increase in total licence fees: +7.5% (HEIs); +15% (NHS).
Transactional	Increased access focused on targeted user groups (e.g. SMEs, independent researchers and professionals). Access to the version of record at the point of publication. Primary access expected to be via aggregating sites. The driver of this scenario is publishers’ desire to meet demand from user groups without access to content via subscriptions.	PPV price is \$10 in the central case.

<sup>18</sup> We recognise that incorporating an embargo within the scenario means that it does not fully comply with the SHERPA definition of Green. We use Green therefore as a shorthand for embargoed Green.

Table 5.2: Sensitivity analyses and variants for each scenario

Scenario	Summary Description	Key metrics at 2015
Green	Green deposit rates	±10%
	Embargo length	±50% (e.g. 3–9m for biomedical)
	Discount on version of record	±50%
	Discount on functionality	±50%
	Proportion of biomedical deposits done automatically by publishers	Increase in proportion from 25% of deposited articles to 50%
	10% loss of subscriptions	(a) offsetting price rises (b) cost savings to protect margin
	Lower Green deposit rate outside the UK	-50%
	Reduced access time (and thus increased efficiency) for users	+10% efficiency
Delayed Access	Proportion of articles available via delayed access	±10%
	Delay length	±50% (e.g. 6–24m for biomedical)
	Revenue Loss plus Cost Savings	-2.5% revenue on delayed articles
	Reduced access time (and thus increased efficiency) for users	+10% efficiency
Gold	Proportion of articles available via Gold OA	±10%
	Average size of subscription-based journals	-16% (this would keep the number of subscription journals published consistent with the 2015 baseline)
	Article processing charge (APC)	-10%
	Non-UK lower Gold uptake	-50%
	Reduced access time (and thus increased efficiency) for users	+10% efficiency
Licence extension	Licence extension price – HEIs	±2.5% points (5–10% fee increase)
	Licence extension price – NHS	±5% points (10–20% fee increase)
	Reduced access time (and thus increased efficiency) for users	+10% efficiency
Transactional	PPV price	-\$5 (to \$5); -\$9 (to \$1)

## Transition costs and barriers

The Detailed Report builds on the stated drivers for each of the scenarios – as set out briefly in Table 5.1 – indicating at a high-level what steps are required (and by whom) in the UK for the scenario to materialise. These steps form the basis of our assumptions about transition costs. The primary steps for each of the scenarios are as follows:

- **Green:** development of a business case for repositories by those academic institutions without one, internal negotiation and adoption of mandates by institutions and funders; installation of repository hardware and software; and monitoring and enforcement by funders and academic institutions.
- **Delayed:** communication by publishers of their intended policy; and negotiation and consultation between funders, institutions and publishers prior to policy implementation.
- **Gold:** business case development by funders and academic institutions to meet APCs; development and adoption of funding arrangements by academic institutions; development and communication of institutional payment models and mechanisms to process APCs; development of publisher billing systems to deal with APCs; and negotiations between publishers, institutions and consortia to establish publishing deals.
- **Licence extension:** development of framework and business case to extend licence deals; design and management of the procurement process; publisher bidding process; bilateral negotiations between publishers and JISC/NHS; implementation costs (including customer services and admin charges); and ongoing monitoring of value for money.
- **Transactional:** all costs are built into the PPV price, but steps would include establishment of better pay-per-view sites and payment mechanisms; securing capital; negotiations with publishers; marketing; etc.

It is important to note that our estimates of transition costs (which include both one-off transaction costs and ongoing system costs not included in the CEPA model) inevitably involve some degree of subjective judgement.



# 6

## Key results by scenario

In this Section we present the key findings for each Scenario.

### Summary tables

The modelling outputs for each of the scenarios are set out in the summary in Annex A. Figure 6.1 below provides a comparison of the changes in levels of *SUoA* and *useful access* as against the 2015 Baseline for each scenario. It provides an overview of the order of magnitude of the changes in access for each scenario. The changes in access in each scenario are of broadly similar magnitude, with the exception of the NHS licence extension, which has a much higher increase in access reflecting the low base level in the 2015 Baseline. These changes in access for each scenario are discussed in more detail below.

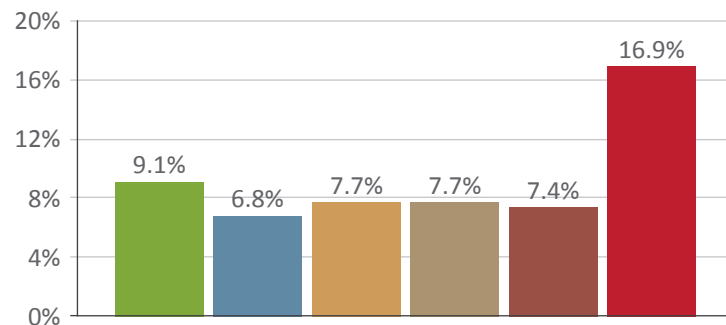
Further comparative information is provided in Annex A, where Tables A1 and A2 provide comparisons of the access gains in each scenario and the additional costs to the UK to achieve those gains; and Table A3 presents a summary of the resulting net present value of benefits and cost and the estimated BCR. In addition, Tables B4-B9 in Annex B show the results of the sensitivities under each scenario. Finally Annex C provides charts that show the profile of the main costs (savings) to the UK in each scenario.

### Modelling context

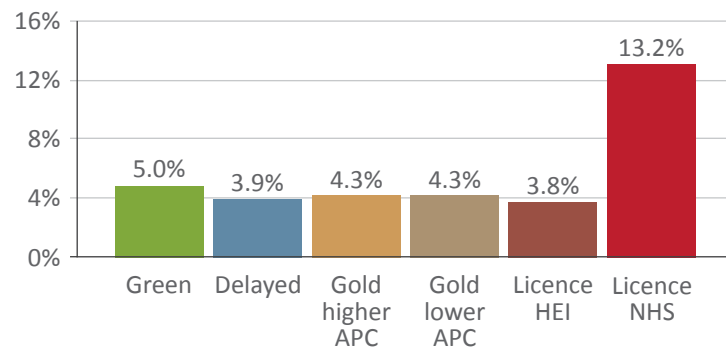
It is important to note that the modelling of system costs (non-cash peer review, publishing, distribution, access, non-cash reading, etc.) are qualitatively different from the estimates of increased economic activity attributable to increased access, on which the benefit side of the BCRs largely depend. The differences are twofold:

Figure 6.1: Changes in *SUoA* and useful access compared to the 2015 baseline in each scenario

Panel A: Percentage Point increase in *SUoA*



Panel B: Percentage Point increase in useful access



- First, the benefits are enjoyed by different economic actors (both the sectors incurring the cost; and over time). This is implicitly acknowledged whenever budget-holders prioritise current investment or spending over future economic growth.

<sup>12</sup> Many of the publishing and peer review model inputs and cost estimates are sourced from publishers and King et al (2000, 2004). While these have been inflated to 2010 values, we do not capture any productivity gains that may occurred over this time

- Second, although the chain of reasoning on the macro-economic impact of improved access is well based in theory and reasonably empirical, there is more scope for uncertainty than with the system costs, which are reasonably well understood and validated.

This means that we have greater confidence in the comparisons between scenarios than in the levels, particularly the BCRs; and we would place at least equal weight on cost per SUoA as a measure of cost-effectiveness for each scenario.

## 6.1 Green scenario

In order to compare the cost effectiveness of the different scenarios in achieving increases in access we present the results of our analysis in two main cost-effectiveness measures: (i) the average annual net cost per additional standardised unit of access (SUoA); and (ii) a benefit-cost ratio (BCR).

### 6.1.1. Access

The Green scenario as modelled here describes a world in which deposit rates have increased to 25-45% of articles, depending on discipline. This leads to an increase of 9.1 percentage points in our standardised measure of access compared to the 2015 Baseline.

Using our measure of *useful* access, the overall weighted increase is 5.0%. Within this average there is substantial variation by user group, with two groups in particular experiencing much larger increases in useful access: SMEs gain disproportionately (+19%) because they start from a position of relatively low initial access, and NHS users also do well (+15%), partly for the same reason but also because we assume that deposit rates will be highest in biomedicine.

We have also looked as part of our analysis at the comparison between the Green scenario and a theoretical world in which the Green deposits are zero and sunk costs associated with establishing and running repositories are not in the baseline (we refer to it as the 'Green Zero' case in the Detailed Paper). In this case the increase in SUoA is 13.7 percentage points. The reason for including the 'Green Zero' comparison is that the sunk costs mean that for Green OA the marginal cost of depositing another

article is much lower than the average cost. This is not the case in the other main OA case, Gold OA, where the marginal cost associated with access to an additional article is close to the average cost.

### 6.1.2. Changes in cost

The increase in system cash costs to support this scenario are relatively modest, requiring an additional £3.3m per year within the UK compared to the 2015 Baseline, comprising:

- an increase in annual steady state costs of £1.1m resulting from higher costs of repository operation and maintenance, and higher deposit costs; and
- average ongoing annual<sup>19</sup> costs of about £2.2m associated with monitoring and enforcement of mandates.

Transaction costs (the one-off costs required to get from 2010 to the 2015 Green scenario) are also relatively low at £2.3m NPV.

As expected from the nature of Green OA, the majority of increased steady-state costs are borne by academic institutions: 88% (£1.0m). UK academic institutions also incur the majority of the transitional costs (89% of transaction costs; and 61% of the ongoing costs).

The cost per additional SUoA in this scenario is £22.50.

### 6.1.3. Benefit-cost ratio

The economic benefits to the UK from increased returns to R&D are estimated to be worth between £212m and £386m (NPV). These figures are relatively large compared to the costs, leading to BCRs of 4.7-8.6. (In the 'Green Zero' case that we refer to above, the BCRs are in the range 2.4-4.0, reflecting the inclusion of the sunk costs of repository development and operation.)

### 6.1.4. Sensitivities

Much of the debate around Green OA focuses on embargo lengths. The model assumes that varying the lengths of embargo does not change costs in the system but does change levels of standardised access. Consequently, increasing or decreasing embargoes leads to a decrease or increase respectively in UK economic benefit. We estimate that changing embargo lengths by  $\pm 50\%$  compared to the central case would lead to a change in economic benefit of  $\pm £30-33m$  (NPV), or about 11% change.<sup>20</sup>

<sup>19</sup> We refer to annual average given that there is a profile – £4.6m per annum in the first five years, falling to £1.3m for subsequent years.

<sup>20</sup> Changes in economic benefits reported are based on the midpoint.

However, the model does not account for any impact on subscriptions as a result of changes to the embargo lengths.

Changing the discounts on the version of record and functionality were also modelled to assess the impact of standardising access. Varying these discounts by  $\pm 50\%$  of the levels in the central case (e.g. increasing a 10% discount to 15%) changes the BCR midpoint (of 6.6) by  $\pm 0.4$  for the version and  $\pm 0.2$  for the functionality. This suggests that the results are not unduly sensitive to the SUoA modelling approach.

The benefits need to be considered against the potential impact on journal viability caused by any fall in subscription volumes if libraries cancel journals in favour of access via repositories. The central case assumes no impact on subscriptions but we address the issue via a sensitivity analysis that considers the effects of a 10% cut in subscription volumes.

To start with, the lower subscription volumes would reduce article access by 4% on our standardised measure.<sup>21</sup> Reduced access in turn would reduce the economic benefits by slightly over £100m (or  $\sim 35\%$ ). However, the BCR reduces only slightly in this situation (by 1.7) because the reduced benefits are mostly offset by reductions in costs incurred by the UK because of the fall in the amounts paid in subscriptions.

Looking at this from a publisher's perspective, a 10% cut in academic subscriptions would cost about £373m in global lost annual revenues, which would imply (assuming unchanged operating margins) roughly £112m per year in lost global operating profit. In practice, publishers would respond to mitigate this potential impact. We model two possible publisher responses: (i) increasing prices to maintain operating margins; or (ii) cutting costs. Of these, cost-cutting would clearly be preferable.

The scale of cost reductions required to sustain the operating margins would lead to system savings (around £140m NPV). These would outweigh the reduced economic benefit (around £103m NPV), leading to an improved BCR (7.5, up from 6.6). Publishers may, however, feel that available cost savings would already have been taken. It is also important to be clear that we have not valued the impact of any reduction in publishing quality and/or outputs.

Finally, a 10% efficiency improvement in the time users spend in gaining access to articles (assumed to result from easier access to articles in subject and institutional repositories) leads to significant savings (£46m). The BCR also rises slightly, although costs are virtually unchanged.

#### 6.1.5. Discussion of key issues: plausibility, transition and risks

The key driver for this scenario is the introduction and increased enforcement of mandates by funders and institutions. These are already evident, and there are moves in the UK and elsewhere to extend them. There are clear difficulties in enforcing mandates, as the experience of the Wellcome Trust and others demonstrates. But the growing interest from funders and institutions in the monitoring and assessment of researchers and their performance makes our assumed levels of deposit plausible.

The primary risk in this scenario relates to the potential cancellation of subscriptions, which could undermine the current dominant publishing business model. In the first instance, the risk appears to rest with publishers. But if cancellations brought into question the business model without replacing it with an alternative, there would be a risk to all stakeholders with an interest in the publication of articles that are quality-assured to the current standard.

Although there is little available evidence that articles deposited in repositories are resulting in cancellations, we note that:

- there is some indication that deposits are having an effect on downloads from publisher sites, a key usage statistic employed by librarians in allocating serials budgets; and
- academic library budget restraints in the UK and elsewhere will increase pressure on libraries to cut journals from which articles can be sourced elsewhere.

The risk is mitigated in part – at least while uptake is low – so long as only a proportion of the articles in a given journals are deposited: in cancelling a journal a university would lose access to articles that are not available from a repository. Overall, it remains unclear whether or not Green deposit rates would

<sup>21</sup> Compared to the central case; access is still higher than the 2015 Baseline.

trigger significant levels of cancellations. But the stakes are high for publishers, and while we note that some stakeholders consider the risks to subscriptions to be negligible, we do not share that view.

Increasing prices to compensate for lost subscriptions has historically been part of the pricing strategy for many publishers. In the model, the numerical outputs appear relatively benign, with publishing costs relatively unchanged and savings elsewhere (e.g. processing and handling fewer subscriptions) partially offsetting the reduced economic benefit, leading to a marginally reduced BCR.<sup>22</sup> This assumes, however, that increased prices do not affect subscriptions, whereas in practice they are likely to lead to a further round of subscription cancellations.

Other risks in this scenario relate to the ability of funders and institutions to achieve the proposed levels of deposits. The transition to these levels of deposits would not be achieved easily, primarily because it involves cultural change, to ingrained author behaviours and researcher perceptions. We have assumed that change will be effected through the development of mandates, coupled with encouragement and advocacy, monitoring and enforcement, and the provision of support services. Such change is likely to proceed in fits and starts, with rates of change varying over time and according to specific contexts, with, for example, tipping point effects. There are real costs associated with these efforts which we have captured within the system and the transaction costs. We assume that they are larger in the early stages of transition, but later drop away as deposit becomes the norm.

Funders and academic institutions might face some risk if the UK moved significantly faster than the rest of the world in adopting Green OA, because UK costs would increase while the commensurate benefit would be lower. In practice we do not think this appears very likely.

In summary, Green OA offers a relatively cost-effective route to improving access, and a relatively high BCR. However, given the risk of cancellations which may undermine the business model, this scenario may not be self-sustaining.

## 6.2 Delayed scenario

In order to compare the cost effectiveness of the different scenarios in achieving increases in access we present the results of our analysis in two main cost-effectiveness measures: (i) the average annual net cost per additional standardised unit of access (SUoA); and (ii) a benefit-cost ratio (BCR).

### 6.2.1. Access

In this scenario we have assumed that a substantial number of publishers choose to make access to a proportion of their journals freely available subject to embargoes. We have assumed roughly 40% of publishers offer 65% of their journals, leading to an average 26% of journal articles being available in this way. This gives an increase in standardised access of about 6.8 percentage points, or an overall weighted average increase in useful access of 3.9%.

As with Green and Gold, the user groups with lower initial levels of access see larger proportionate increases in both standardised access and in useful access. SMEs and corporations see their standardised access nearly double (from 16.3/16.6 percentage points to 29.9/30.1 percentage points respectively) while NHS users' standardised access goes up from 33.3 to 44.3 percentage points. SMEs and NHS users also see the biggest increases in useful access.

### 6.2.2. Changes in cost

The transition and continuing costs of implementing this scenario are very low, indeed the lowest of all except the Transactional scenario. That is because there are assumed to be no significant additional ongoing costs with the scenario, and the only one-off costs are those associated with publishers' extension of the approach. The cost per additional SUoA in this scenario is consequently very low at £0.90.

<sup>22</sup> Publishers' actual costs may fall due to the lower number of subscriptions that they have to deal with.

### 6.2.3. Benefit-cost ratio

At the same time the scenario offers increases in access and associated economic benefits (£165m-£288m) at levels that are lower, but comparable to other scenarios. Given the low costs, it is not surprising to see very high BCRs in the range 82.2-144.1.

### 6.2.4. Sensitivities

The length of the delay imposed by publishers is a key aspect of this scenario. We estimate that changing delay lengths by  $\pm 50\%$  compared to the central case would lead to a change in economic benefit of  $\pm £16-21\text{m}$  (NPV), or about 15% change.<sup>23</sup>

As with the Green scenario, it is likely that in making articles or journals available via delayed access, publishers risk a fall in revenue. In the central case we have assumed a reduction of 2.5% in publishers' revenue from the delayed articles, but we then assume that this is offset through higher prices for journals not made available via delayed access. We estimate that if cost savings to offset the revenue loss were achievable (rather than a price increase) then savings of approximately £18m would be made, and the BCR would increase further, to 122.3.

This scenario requires publishers to give up the scope to charge for access to back archives, thus potentially reducing revenues. In the central case we assume that publishers are able to protect their revenues and margins by restructuring prices; hence at a global level consumers would pay the same total amount in subscriptions. If this were a plausible option, then publishers could implement this scenario without loss of revenue.

We consider an alternative variant which assumes that publishers are unable to secure this price restructuring and so instead opt to cut costs to protect margins. Within the bounds of the model this is highly desirable from the perspective of consumers, with increased access and lower costs; but the model does not consider any resulting loss of value delivered to consumers and the cost-savings may seem rather unrealistic from the perspective of the publishers.

### 6.2.5. Discussion of key issues: plausibility, transition and risks

From the point of view of UK universities this scenario would be highly desirable, offering a substantial increase in access at very low cost, or even with cost savings in one variant. The trade-off would be the longer embargo periods and the requirement to vary mandates to accommodate this.

However, the key transition question remains: why would publishers adopt a policy that risks cutting their revenues and their margins? One possibility could be that publishers would be motivated to retain usage on their platforms and mitigate the threat to subscriptions posed by Green OA. For such a deal to be struck in line with the assumptions of this scenario (bringing the large commercial publishers in alongside existing delayed access publishers), funders would have to make two key concessions: longer embargoes and no compulsion to deposit in repositories. This seems unlikely at present and there is also the issue for UK policy that key mandates are determined in Bethesda and Washington, not London.

As in the Green scenario, risks to the publishing system in the Delayed scenario could arise from the cancellation of subscriptions. That risk may be even greater than in the Green scenario given that the policy is likely to apply to whole journals, as distinct from a proportion of articles spread across titles. The risk is mitigated significantly in our view by the publishers' ability to set an embargo period longer than in the Green scenario, or indeed withdraw the access itself. But we still consider that the risk is moderate.

In summary, therefore, the delayed access route offers potential scope for substantial increases in access at very low cost, but publishers would face risks to their revenue from this approach, which is in any case not directly amenable to influence from UK policy.

<sup>23</sup> Changes in economic benefits reported are based on the midpoint.

## 6.3 Gold scenario

For the Gold Scenario we have considered two cases which vary – given the importance of this assumption – according to the APCs that are charged. The cases are:

- A higher APC case, in which we have based the APC on the observed per-article publishing costs for author-side payment journals (less any assumed contribution from other funding sources, such as advertising).<sup>24</sup> This gives a weighted average APC of £2,364.
- A lower APC case in which we have based the APC on the weighted average charges currently being paid to Gold publishers (£1,457).<sup>25</sup> This is a 38% reduction compared with the APCs described in the ‘higher’ case.

The lower APC case reflects the fact that much of the growth in Gold OA at present is occurring where APCs are considerably lower than the weighted average cost per article in the model.

### 6.3.1. Access

This scenario describes a world in which Gold OA across all disciplines averages a little over 23%. Within this average, however, we assume that Gold is becoming mainstream in biomedicine (with an uptake of 40%), while remaining a minority activity in other disciplines.

The growth in Gold OA delivers an increase in standardised access of 7.7 percentage points, which translates to an overall increase of about 4.3% in useful access. There are large differences between user groups, reflecting both their different initial levels of access and the focus on biomedicine. SMEs thus see the biggest increase in useful access (+16%), followed by NHS users (just under 16%). On the other hand, academics on average see only a 2.9% increase in useful access, although biomedical academics would of course see a greater advantage.

### 6.3.2. Changes in cost

Moving towards a Gold OA model will over time lower global publishing and distribution costs, primarily because of reductions in sales administration, online user management and delivery/fulfilment costs.<sup>26</sup> In the higher APC case, global costs fall by £80m (about 1% of total publishing and distribution costs). In the lower APC case this amount increases dramatically, with annual costs falling by almost £340m (4.4%).

The cost savings do not accrue to all groups equally. For academic institutions the key issue is the balance between savings in subscriptions compared to increased payments for APCs. The distributional impact is therefore very sensitive to the level of the APC.

- In the higher APC case, UK academic institutions are net losers, with subscription savings of £16m being offset by increases in the volume of APCs of £28m. Even with other savings (primarily in access costs) their costs rise by almost £8m per year and the proportion of total costs borne by them increases from 67.1% to 68.1%. At the national level there is a similar effect: owing to the above-average productivity of UK researchers, increases in APC payments outweigh other savings such that UK funding costs rise by £4.7m per year, and the proportion of global costs carried by the UK rises slightly from 4.7% to 4.9% (including user search costs).
- In the lower APC case the situation is significantly different. In terms of publishing and distribution costs, UK academic institutions’ expected subscription savings of £16m almost offset increases in the volume of APCs of £17m. But when combined with other annual savings (mainly to libraries in the costs of providing access) of £2.9m, academic institutions are expected to be net beneficiaries. Costs to other contributors fall by even more, however, and so the proportion of total costs borne by academic institutions actually increases from 67.0% to 67.7%. At the national level, the UK makes annual savings in funding costs of £9.7m, but since non-UK costs fall relatively more, the proportion of global costs carried by the UK again rises slightly from 4.7% to 4.9% (including user search costs).

<sup>24</sup> This is calculated based on the activity cost estimates sourced from publishers and King et al (2000, 2004). These costs are inflated to 2010 values, but any productivity gains over time have not been captured.

<sup>25</sup> This figure is the weighted average APC of \$2,185 (at an exchange rate of £1:\$1.5) calculated by Outsell and used for modelling purposes in their report Open Access Primer (Public Version) (Outsell 2009)

<sup>26</sup> However, while out of scope of the definitions of this scenario, incumbent subscription-based publishers may experience higher costs if they were to set up and operate hybrid Gold OA journals.

Achieving the changes in funding structures, as well as in cultures and behaviours, will require transaction costs that we estimate at £7.1m (NPV) for the UK. In addition to these one-off costs we have estimated recurring costs of about £1m per year over the 20 year modelling period. These costs would be highest at the start of the transition period, and fall away as Gold OA became an accepted mainstream model. A significant proportion of these costs are incurred by academic institutions (63% of transaction costs; and 20% of ongoing costs).

Taking all this together, the cost per additional SUoA in this scenario varies significantly. In the higher APC case, the cost is relatively high at £50.80; in the lower APC case it is actually negative at -£67.10, which reflects a net saving as access increases.

### 6.3.3. Benefit-cost ratio

Economic benefits to the UK in the form of higher returns to R&D arising from the increased access are valued at £184m-£325m (NPV). This leads to BCRs that vary for the two cases:

- For the higher APC case the BCR is in the range 1.7-2.7. The implication is that at both ends of the range the benefits are greater than the costs, albeit only marginally at the lower end of the range.
- For the lower APC case the BCR is very substantially positive, in the range 10.8-15.7.<sup>27</sup>

### 6.3.4. Sensitivities

Moving further towards a more fully open access world, by increasing the proportion of Gold OA articles, sees the costs and benefits moving broadly in line with each other, resulting in the overall BCR staying the same.

One question is how existing publishers would respond as authors moved their articles from subscription-based to Gold journals. Publishers might try to maintain journal numbers in order to retain their subscription revenues rather than closing or merging journals, or perhaps because editorial boards want to preserve the individual identity of the journal. If they did so, costs would tend to rise. We have modelled a 16% fall in the average size of subscription journals (sufficient to maintain the

same number of subscription journals as in the 2015 baseline), which generates an increase in costs due to lower efficiency (c.£21m NPV, under both the higher and lower APC cases).

If the rest of the world did not increase the proportion of Gold OA publications as much as the UK, the benefits would fall: if the global rate were 50% lower than the UK rate, benefits to the UK would almost halve and the BCR would fall significantly (to 0.6 in the higher APC case and to 1.5 in the lower APC case).<sup>28</sup> There would also be large increases in the measures of £ per SUoA and £ per 1% useful access: in the lower APC case these measures would be greater than zero. This analysis illustrates how the results for the Gold scenario depend on the extent to which the UK is in step with or ahead of the rest of the world.<sup>29</sup>

Finally, as with Green, a 10% efficiency improvement in the time users spend in gaining access to articles (assumed to result from easier access to Gold OA journals and articles) leads to significant savings (£46m). The BCR also rises slightly, although costs are virtually unchanged.

### 6.3.5. Discussion of key issues: plausibility, transition and risks

The driver for this scenario on the demand side is coordination between research communities and funders ('getting the money in the right place'), giving publishers confidence that the funding will be there to support investment in and transition to Gold models, and giving researchers confidence that this is a mainstream model with simple and routine reimbursement. On the supply side, large-scale open access journals are an increasingly significant part of the scholarly publishing landscape, and more are being launched. Achieving the changes in funding structures and in cultures and behaviours will nevertheless require more upfront investment. This would cover the development of OA funds and support by institutions and funders (building the business case, internal negotiation, and so on); and the development of new simplified payment models and bilateral publisher/institution negotiations.

We recognise of course that the lower APC case goes far beyond a simple sensitivity analysis and would imply a significant restructuring of publishing costs and risk for existing subscription model publishers. However, given the success of

<sup>27</sup> It is important to note that the size of the BCR is a reflection of how certain costs and savings are treated, and in particular the level of aggregation of costs, and therefore the extent of 'netting off'. For further details see the Detailed Report. The higher BCR for the lower APC case, however, is a clear indication of the ranking of the two scenarios.

<sup>28</sup> This significant fall in the BCR (to 1.5) in the lower APC case is an arithmetic result arising because of the 'netting off' issue referred to in footnote 27 above.

<sup>29</sup> Note that Gold is especially sensitive to this because the situation in which the UK moves out of step with the rest of the world has an impact on both its costs as well as the benefits. In contrast, in the Green scenario the impact is limited to the benefits.

PLoS ONE and the recent launch of similar journals such as NPG's *Scientific Reports* and APS' *Physical Review X* it does not seem to be completely implausible. In addition, unlike other scenarios, there are clear market (competitive) forces that are consistent with the emergence of Gold OA journals.

The Gold scenario presents a lower risk to the continuing viability of the scholarly publishing system relative to the Green and Delayed Scenarios, since it provides an alternative to the subscription-based publishing business model (rather than being reliant on the continuation of subscriptions). There are, nonetheless, risks faced by academic institutions, funders and publishers. A key risk for funders and academic institutions relates to timing, with an uncertain lag between the increase in Gold articles (and associated costs) and the later reduction in subscription costs. If there is not a widespread move towards support from academic institutions and funders for Gold OA publishing, then early adopters risk paying for both subscriptions and author-side payments, in addition to receiving minimal benefit from their upfront investment.

A related potential risk arises from 'double-dipping' in the hybrid publishing model, where journals charge for optional open access but pass on no savings in the subscription cost. Our definition for this scenario, however, assumes no significant increase in the hybrid model.

Whether APCs will be low enough to ensure funders and universities are not net losers is another significant risk. The above-average productivity of researchers in individual universities and across the UK as a whole means that, unless the weighted average of APCs is below c.£2,000, increases in APC payments could outweigh other savings so that funding costs rise. This risk could arise in a steady state, but it could be more acute during the transition period.

In summary the Gold OA scenario offers the potential for both high BCRs and cost savings to academic institutions in a model that should in principle be sustainable. However, the achievement of cost savings and benefits depends on the level of the APC – which may require significant change in publishing costs – and how subscription prices change as more articles are funded through author-side payments.

## 6.4 Licence Extension scenario

### 6.4.1. Access

A negotiated national licence for HEIs and/or the NHS could increase access in return for additional licence payments. In the scenario we have modelled, we assume that access would be offered to about 75% of journal literature for HEIs.<sup>30</sup> For the NHS, access would be provided to some 40% of the biomedical literature.

In terms of standardised access, this would translate to a 7.4 percentage point increase in access for HEIs. For the NHS standardised access would increase by 16.9 percentage points. Taking account of diminishing marginal returns, we estimate an increase in useful access of 3.8% for HEIs and 13.2% for the NHS.

Among HEIs there are big differences in the gains in access, depending on the current level of access. In other words, under a blanket national licence those institutions with the smallest current holdings – new universities and higher education colleges (HEC) – would gain the most.

### 6.4.2. Changes in cost

System costs would increase, primarily as a result of increased licence fees charged by publishers, together with some very small changes in access costs. We have estimated the possible increase in licence fees for the HEIs – 7.5% in the central case – by reference to the Scottish Higher Education Digital Library (SHEDL) model and consultations with publishers; for the NHS licence we have had to rely solely on publisher consultations, and assume a 15% increase in the central case. On this basis we assume in the central case an increase in steady state annual costs of £8.0m for HEIs and £1.0m for the NHS.

One-off transaction costs will consist largely of the costs for both parties in negotiating and justifying the deals struck. We estimate these are significant at £4.6m for the HEI licence and £1.7m for the NHS.

The average annual costs per additional SUoA in the HEI and NHS versions of the scenario are respectively £67.3 and £9.5.<sup>31</sup>

<sup>30</sup> RLUK would have much higher access than this as a result of other licensing deals.

<sup>31</sup> The difference in costs is driven by the relative difference in expenditure and existing levels of access between the two user groups.

### 6.4.3. Benefit-cost ratio

Comparing these costs with the benefits, we calculate a BCR for the HEI licence with a range of 1.3-2.5 (midpoint 1.9), which presents a fair, but not strong, economic case, since the BCR is just greater than 1 at the lower end of the range.

The BCR for the NHS licence in the central case is in the range 2.0-3.0 (mid-point 2.5).

### 6.4.4. Sensitivities

The benefit-cost ratios depend on the assumed licence premium in each case:

- For HEIs, the central case assumes an increase of 7.5%. If this were reduced to 5%, the midpoint BCR would rise from 1.9 to 2.7. Conversely if the premium were increased to 10%, the BCR would fall to 1.5.
- A similar analysis applies for the NHS licence. Reducing the premium to 10% (compared with 15% in the central case) would increase the BCR to from 2.5-3.1; if the premium were increased to 20% the BCR would fall to 2.1.

Applying a 10% user efficiency saving would generate some savings, which would marginally increase the BCR midpoint (by 0.1) under both scenarios. The HEI licensing extension savings are fairly large at £12.7m (NPV), whereas savings are much smaller (£0.2m, NPV) under the NHS licensing extension. This reflects the difference in scale of the NHS scenario in terms of number of users as compared with the HEI licensing scenario.

### 6.4.5. Discussion of key issues: plausibility, transition and risks

A licence extension is a well understood route to increasing access and appears to offer economy-wide benefits if applied across the UK HE sector or the NHS. There are relatively large additional costs to the public sector associated with both, however, and a number of issues arise from the analysis of this scenario:

- we noted above that for the academic institutions, there were substantial differences in the gains in access between types of institution, depending on current levels of access. Finding a method of allocating the increased costs among institutions would be difficult, particularly in the current economic climate, and this could be a significant barrier.
- there are also significant costs and complexities associated with negotiating such licenses and little certainty that these costs will deliver the number of agreements at reasonable premiums.
- the costs are largely cash costs, borne directly by the HE sector and the NHS, while the benefits are enjoyed at a national level in terms of increased economic output.

Because a licence extension involves increasing access and publishers' revenues in a saturated market it poses a relatively small risk to many larger publishers. As a funded expansion of access it does not, in our view, pose risks to the scholarly publishing system.

However there are risks faced by other stakeholders:

- first, that subscribing institutions – individually or collectively – become unable to afford the increased price, with withdrawal being a messy process, probably leading to reduced access (although unlikely to pose risks to the publishing system overall); and
- second, any growth of the 'Big Deal' model, is likely to increase the current risk of subscription cancellations for the journals – typically published by small, not-for-profit publishers – not covered by the deal, since the remaining part of library budgets is squeezed.

In summary, the risks are relatively low with a licence extension to the UK HE sector or the NHS; but the bodies that bear the costs do not reap the economic benefits that are calculated for the UK as a whole. The licence extensions offer publishers an opportunity to increase surpluses, since the additional licence premium would involve relatively little additional ongoing cost, but it would limit any scope for future growth.

## 6.5 Transactional scenario

### 6.5.1. Access

A reduction in price of pay-per-view (PPV) articles could increase access to users who would not otherwise decide to purchase an article. The increase in access depends on publishers' willingness to reduce prices. For publishers to be willing to do so, two conditions would have to be met: (i) that the price reduction would lead to an increase in volume (and therefore revenue) that outweighed the loss of revenue from the reduced price for articles previously sold;<sup>32</sup> and (ii) that the price reduction would not cannibalise revenue from other segments of the publishers' market, in particular subscriptions.

We do not have evidence on either of these. However, in order to illustrate the point, we present in the Detailed Report an illustrative scenario where both conditions hold, with a price reduction from \$30 to \$10 per article.<sup>33</sup> This leads to the number of articles purchased in the UK increasing from 58,000 to 300,000. The majority of articles are assumed to be purchased by large corporations and SMEs; but academic institutions and government would also increase their purchases.

### 6.5.2. Changes in cost

System costs would increase as a result of the increase in quantity demanded. The costs of purchasing 300,000 articles at \$10 is approximately £3.0m compared with £1.7m for 58,000 articles at \$30, giving an additional cost to users of around £1.3m. Of course the additional costs to users is additional revenue to publishers. There are no transition costs in this scenario, since setup costs associated with a new aggregating site(s) or better/ easier payment systems are assumed to be captured in the average price per article.

### 6.5.3. Benefit-cost ratio

As noted earlier, given the nature of the access changes in this scenario the scope for benefit-cost analysis is quite different. Instead of calculating benefits based on changing levels of standardised access and useful access, we have instead focused on the change in consumer surplus (the difference between

what a consumer pays and their willingness to pay) resulting from a reduction in price. This BCR is entirely dependent on the assumed elasticity of demand and the size of the modelled price change. In this case it has a value of 2.0 in the central case.

### 6.5.4. Sensitivities

Further reducing prices increases the quantity of articles demanded and publishers' revenue, but given the assumption of constant elasticity of demand, the illustrative BCR is unaffected.

### 6.4.5. Discussion of key issues: plausibility, transition and risks

The transactional scenario – if viable – could offer publishers increased revenue which would largely translate into increased surpluses (possibly shared with aggregators). But the scale would be very small compared to the existing industry; perhaps a viable business opportunity for a start-up but unlikely to have a significant impact on publishing at the global scale.

The key question, of course, is why (if it is profitable) have we not observed publishers reducing PPV prices? In short we presume that this is because either (i) the above conditions relating to demand and cannibalisation of other revenues have not held (or are believed not to hold); and/or (ii) the additional total revenue has been deemed to be too low to justify it. Another reason could be that it requires a third-party aggregating site and investment in improved user service, rather than just lower prices, to increase usage significantly. Going forward, however, with the introduction of DeepDyve,<sup>34</sup> it is possible that it will become a more significant and convenient form of access for certain users, although in absolute terms the impact on total system-wide access will remain small.

Given its potential to cannibalise subscriptions at lower price points, we have defined the Transactional scenario as posing a medium risk to the scholarly publishing system. However, in practice, this is unlikely to be material given that publishers retain in control of what they offer and at what price.

<sup>32</sup> In economic terms this is expressed by saying that the price elasticity should be less than -1.

<sup>33</sup> We assume a price elasticity of demand of -1.5. This is a plausible level for other products with 'price elastic' demand. Such goods are typically those that are not necessities and make up a relatively small proportion of income.

<sup>34</sup> An online rental service for scientific, technical and medical articles. See <http://www.deepdyve.com/corp/about/>

# Summary comparison of scenarios

There are a number of ways in which we could compare the scenarios on the basis of this analysis. In this penultimate section we compare scenarios in terms of (i) the level and distribution of changes in cost; (ii) cost-effectiveness (as measured by £ per SUoA and the BCR); and (iii) risk. We then present observations that may impact on the policy conclusions that might be drawn from the analysis.

Because of the difference of approach we do not report on the Transactional scenario in this section. However, we note that:

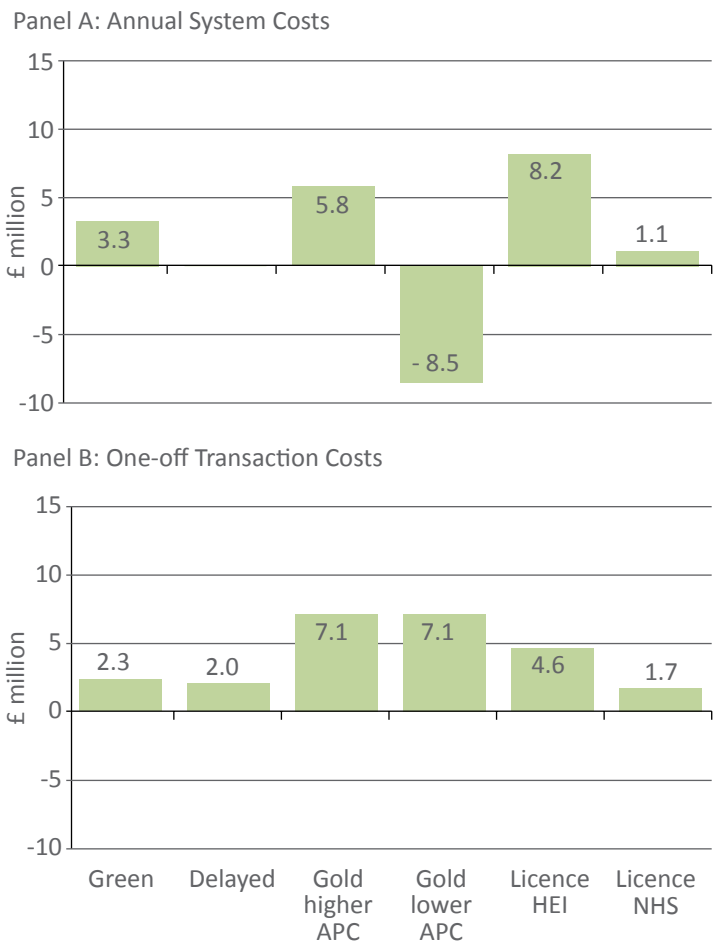
- given its ‘targeted’ access, a Transactional route could be complementary to a licence extension; and
- on the other hand, a significant increase in either Green or Gold open access would presumably reduce the potential market for PPV. So any perceived acceleration of OA uptake might be expected to reduce potential investment in Transactional solutions because of the increased risk.

## 7.1 The level and distribution of changes in cost

### 7.1.1. Cost to the UK

Figure 7.1 provides a summary of the changes in steady state, ongoing transition costs and one-off transaction costs incurred by the UK in each of the scenarios. These are the actual cash costs that will need to be funded by different users within the UK in each scenario. (The one-off transaction costs are assumed to be incurred in the transition period between 2010 and 2015.)

Figure 7.1: Comparison of changes in UK costs (changes compared to the 2015 Baseline)



The Delayed scenario imposes no ongoing costs, and has only low one-off transaction costs.

The Green scenario is relatively cheap with net additional annual costs at £3.3m and one-off costs of £2.3m. If the cost comparison is made between 2015 Baseline and the 'Green Zero' case described in Section 6.1.1, however, the additional annual ongoing and 'one-off' costs would rise significantly. This would make it the most expensive scenario to the UK, with additional net annual cost of £11.2m and one-off costs of £10.9m.

The Gold higher APC scenario also has moderately high costs. As discussed above (Section 6.3), the higher annual costs under this scenario reflect the high productivity of UK researchers in publishing scholarly articles, which results in an increase in the proportion of global cost carried by the UK. However, these costs are sensitive to the level of the APC. The Gold lower APC scenario, based on an average observed APC of £1,457, results in annual cost savings of £8.5m compared to the £5.8m annual costs in the Gold higher APC scenario.

Considering the Licence Extension scenario, the NHS licence extension has net additional annual costs at £1.1m and one-off costs of £1.7m. In contrast, the HEI licence extension is relatively expensive with £8.2m in annual costs and £4.6m in one-off costs. Unlike the other scenarios, the two licence extension scenarios are specific to particular sectors – either HE or the NHS – which bear a relatively large proportion of the costs. As with Gold, the ongoing costs associated with the Licence extension scenario depend on the assumed licence premium in each case. The one-off costs vary between the HEI and NHS licences largely because of expected negotiation costs. But in general both the costs appear to fall somewhere between Green and Gold.

### 7.1.1. Distribution and profile of costs (impact on academic research institutes)

Figure 7.2 shows the profile of the steady state, ongoing transition and one-off costs for academic institutions (Panel A) and other contributors (Panel B). In all scenarios (except Delayed and NHS Licence Extension) most of the increases in cost are incurred by academic institutions.

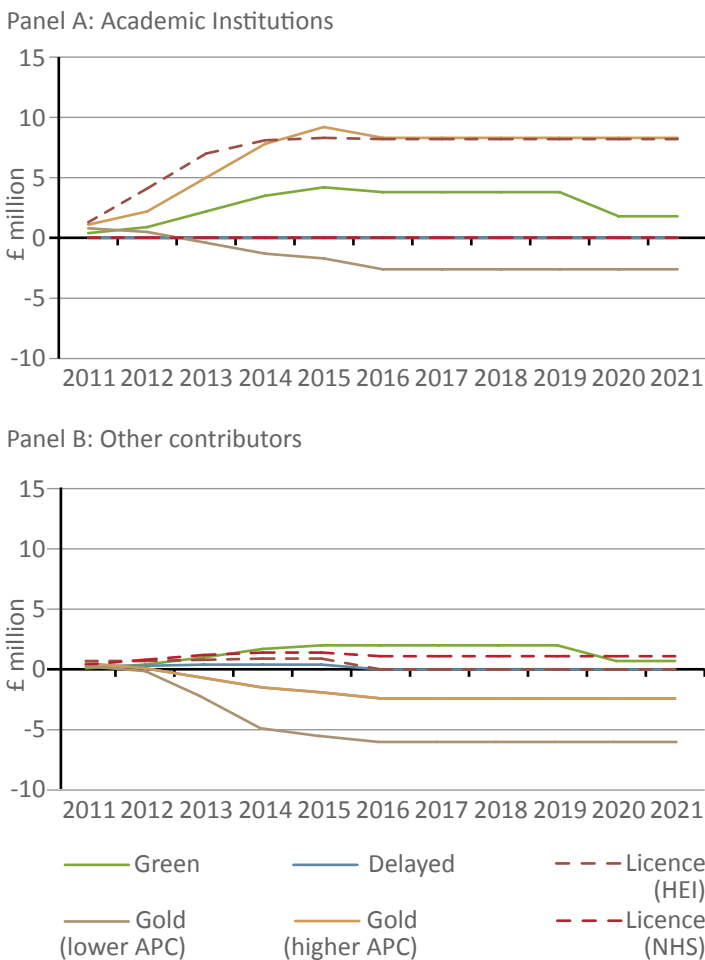
This distributional impact is particularly acute in the Gold higher APC scenario, where academic institutions experience significant increases in the costs they face while other contributors see reductions. This is, however, very much a function of the assumed cost of bringing an article to publication (met by the APC plus funding from advertising, etc).<sup>35</sup> The Gold lower APC scenario would lead to cash savings by institutions. It is the only scenario that could achieve that result.

Unlike Gold the Green scenario does not offer a route to cost savings for academic institutions, but instead involves increased annual costs, except in circumstances that give rise to other concerns as to sustainability. Although cheaper than the Gold model in the higher APC case, Green is significantly more expensive<sup>36</sup> for academic institutions in the lower APC case, although we note that the two are probably not mutually exclusive.

<sup>35</sup> We show that the central-case cost of £2,572 per article would only have to be reduced by 17% for academic institutions to show a net zero cash cost.

<sup>36</sup> The Green 'Zero' case, which includes these sunk costs, is the most expensive for academic institutions, and also for other users.

Figure 7.2: Profile of total steady state, ongoing transition and one-off costs



## 7.2 Cost-effectiveness

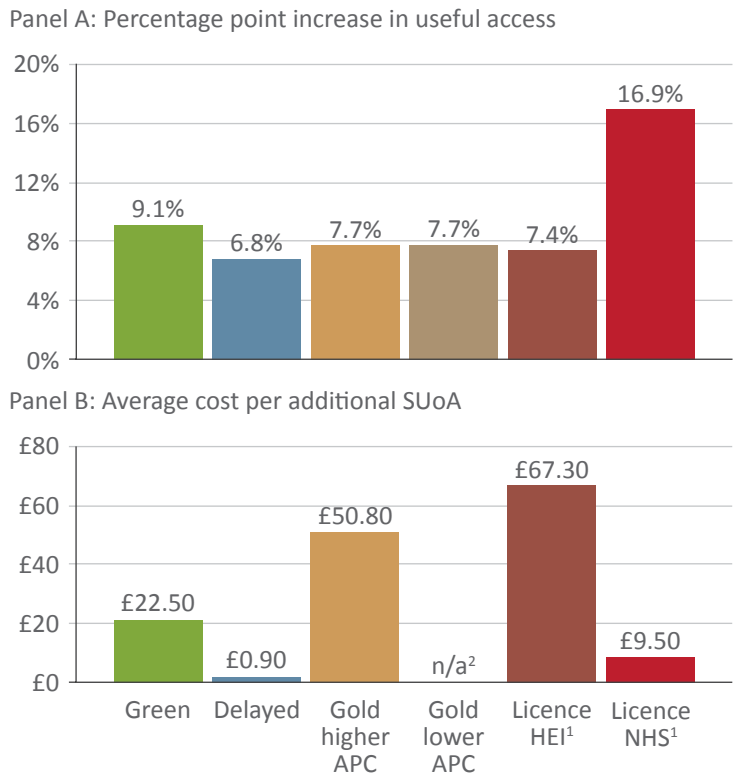
Our modelling considers two measures of cost-effectiveness. The first is the average annual net cost per additional SUoA; and the second is the benefit-cost ratio (BCR). The following summary of results should be read together with the summary of risks in Section 7.3.

### 7.2.1. Average annual cost per additional SUoA

Figure 7.3 shows in Panel B the average annual net cost per additional SUoA for each scenario. The costs include: (i) changes in the ongoing steady state costs incurred by the UK in supporting publication, distribution and access to English language peer-reviewed articles; and (ii) transition costs, which include both one-off transaction costs and any ongoing annual costs associated with system-wide transition in the scenario.

An important point to note is that these are *net costs to the UK*. They thus take account of any offsetting savings (particularly significant for the Gold scenario); and it is important to note also that the costs and savings may be distributed across different contributor groups.

Figure 7.3: Comparison of access costs (annual average costs per annum)



<sup>1</sup> Increase applicable to HEI/NHS users only

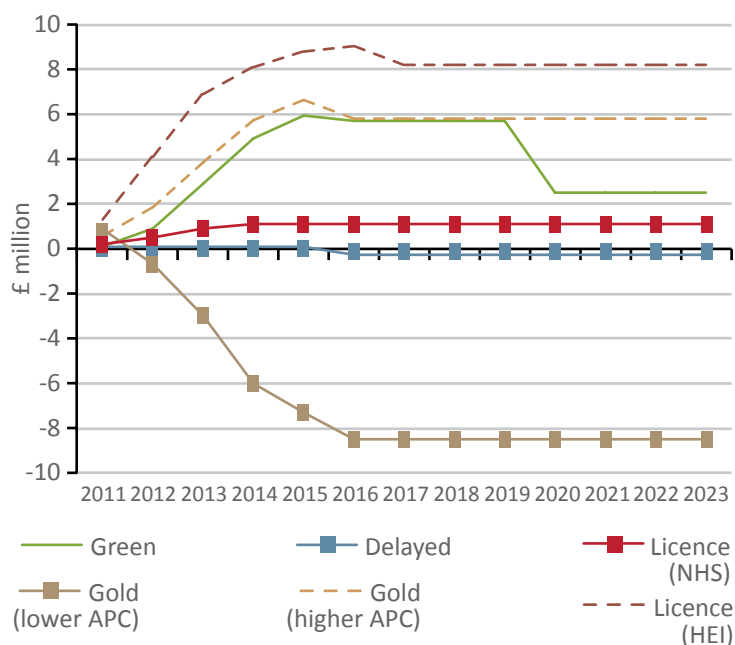
<sup>2</sup> Cost per additional SUoA is negative, and is therefore not applicable

At the highest level, Figure 7.3 illustrates that although the changes in SUoA are similar in the scenarios that we have modelled (except for the NHS licensing extension), the average annual net cost per additional SUoA varies considerably between scenarios. Taking each scenario in turn:

- The *Green scenario* has a cost per additional SUoA in the middle of the range compared with other scenarios (at £22.50). As noted earlier, however, the inclusion of sunk costs as in the 'Green Zero' case would push costs per additional SUoA towards the upper end of the range.
- The *Delayed scenario* comes very close to being a cost-free route to increased access (in terms of both upfront and ongoing costs) with an annual net cost per additional SUoA of just £0.90. This is considerably lower than all other scenarios except the Gold lower APC case.
- For the *Gold Scenario* the costs per additional SUoA vary significantly depending on the assumed level of the APC. In the higher APC case, the annual net cost per additional SUoA is £50.80, which is high relative to the rest of the scenarios other than HEI licensing. As discussed in Section 6, in the lower APC case, there is a net saving to the UK, since increases in author-side payments are more than offset by reduced subscription payments.
- For the *Licence Extension scenario* the costs per additional SUoA again vary in the two different cases. The cost per SUoA for the NHS licensing extension is low (£9.50). But the cost for the HEI licensing extension is high at £67.30, and appears to represent an expensive approach to increasing access. It is also important to note that the increase in access relates to a particular population, unlike the Green, Delayed and Gold scenarios, which provide open access.

Figure 7.4 shows the total costs and their profile over time.

Figure 7.4 : Comparison of UK net annual costs



### 7.2.2. Benefit-cost ratio

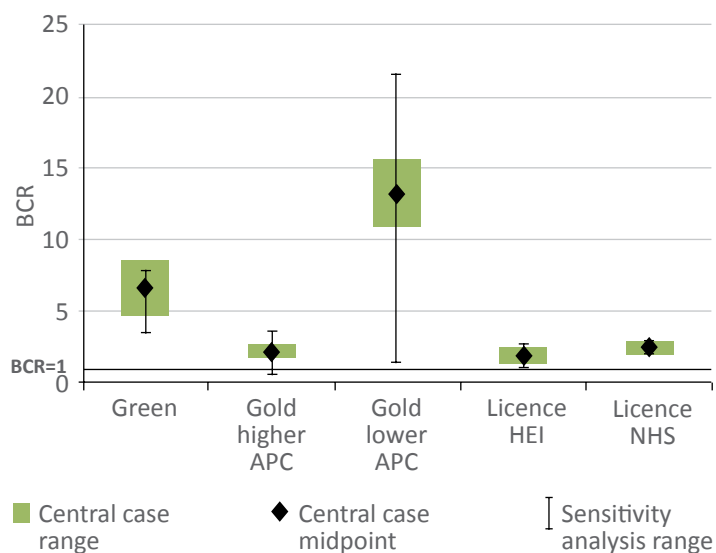
Figure 7.5 compares the BCR for each scenario. The figures should be read as follows:

- The bar shows the range – which reflects the different measures for access<sup>37</sup> – of the BCR around the mid-point in the central case.
- The line shows the range of results for the sensitivities conducted for this scenario, again around the mid-point in the central case.

As explained in Section 5, we place particular emphasis on the relative positions as distinct from the absolute values.

<sup>37</sup> Note that the different ranges shown for Green, Gold Higher APC and Gold Lower APC is an arithmetic result of dividing the same range of benefits by a proportionately lower cost number.

Figure 7.5: Benefit-cost ratios and risk



NOTE:

Delayed Scenario BCR of 113.2 is not consistent with this scale.  
 Transactional Scenario BCR is not comparable.

Many of the observations on the scenarios here are consistent with the average annual net cost per SUoA, but points to note are as follows:

- The modelling confirms what one might intuitively expect, that the *Green scenario* would provide a cost-effective route to improving access, with relatively high BCRs attributed to our central case in which much of the costs are treated as sunk. These BCRs and the overall economic case are relatively robust to our sensitivity analysis (as illustrated by the line). That analysis does not capture, however, the risk that the Green scenario carries to the business model on which it relies.
- The BCR midpoint for the *Gold higher APC scenario* is relatively low, and similar to the Licence extension scenario. But for the *Gold lower APC scenario* the BCR midpoint is considerably higher, and much higher than for any other scenario except Delayed. It is important to stress that the BCRs for the Gold scenario are probably the most sensitive to changes in key assumptions of our scenario. This is particularly true of the assumption that the UK moves in line with the rest of the world in terms of take-up of Gold OA publishing – which provides the lower end of the sensitivity range and means that the BCR is less than 1 in the higher APC case.<sup>38</sup>
- The BCRs for the *Licence Extension scenario* depend on the assumed licence premium that would be charged by publishers. At the level of premium we have assumed, both HEI and NHS licence extensions have the potential to offer a net benefit to the economy, with the NHS licence extensions appearing to have a marginally better BCR.
- Based on its very high BCR the *Delayed scenario* offers the most cost-effective way of improving access. As with Green, it has risks associated with undermining the business model on which it relies, and these are not taken into account in the BCRs.<sup>39</sup>

<sup>38</sup> The volatility of the BCR in the lower APC case reflects the relatively low level of costs in the central case. Small additions to these costs therefore have a disproportionate impact on the BCR.

<sup>39</sup> However, despite the greater ‘cancellability’ of a journal in which 100% of articles older than the embargo period are available, in the Delayed scenario the publishers have full control over both the length of the embargo and whether or not to withdraw from the model. Neither of these factors apply to Green.

### 7.3 Risks

The past five years have brought rapid change in the scholarly communications system as a whole: new technologies and services have brought changes in the roles, behaviours and attitudes of all the key groups of players in the system – universities, funders, libraries, publishers and researchers themselves. Rapid change brings all kinds of risks, and we cannot capture all of them in our analysis. We have, however, considered three groups of risks in relation to each scenario (see Table 7.1 below). The risks covered are in relation to the:

- **Scholarly publishing system.** Risks to the sustainability of the scholarly publishing system associated with each scenario. This risk relates primarily to the continued funding of the activities associated with publishing, whoever they are done by and whichever business model (e.g. subscription or author-side payment) is employed. In other words, the risk is associated with the continuing publication of the number of quality assured articles published under the existing system, assuming that all of these articles are valuable contributions to the stock of knowledge, and merit publication.
- **Transition.** Risks relating to the achievability and plausibility of the transition.
- **Benefit-cost ratio.** Risks associated with the achievement of the BCR, which is intended to pick up other wider risks associated with the scenarios, and particularly where the BCRs are particularly sensitive to changes in modelling assumptions.

Figure 7.6 provides a summary of the assessment. For the avoidance of doubt this risk assessment reflects a judgement of the relative riskiness of the scenarios. It is not an assessment (quantified or otherwise) of absolute levels of risk. Key points to note are as follows:

- The *Green scenario* involves a relatively high risk to the scholarly publishing system as a whole due to subscription cancellations. However, the risks to the transition and BCR are not thought to be as great as other scenarios.

- The *Delayed scenario* involves some risk of subscription cancellations, but less than Green since publishers have greater control. Costs are very low, so the transition and BCR risks are also lower than other scenarios.
- The *Gold scenario* presents a relatively low risk for the scholarly publishing system as a whole as it offers a viable alternative to the current dominant business model. However, there are slightly greater risks – for funders, academic research institutions and publishers – with respect to the transition, and relatively high risks related to the achievement of the BCR.
- Our judgement is that the *Licence Extension scenario* has higher risks related to transition, but relatively low risk in the other categories.
- The *Transactional scenario*'s greatest risk is to the publishing system as a whole from the potential cannibalisation of subscriptions, but given publisher autonomy, our judgement is that risk is not as high as in the Green scenario. Transition and BCR risks are both low.

Figure 7.6: Relative risks of scenarios

Scenario	Scholarly Publishing System Risk	Transition Risk	Risks to Achievement of BCR
Green	Higher	Medium	Lower
Delayed	Medium	Lower	Lower
Gold	Lower	Medium	Higher
Licence Extension	Lower	Higher	Lower
Transactional	Medium	Lower	Lower

Table 7.1: Summary of relative risks associated with each scenario

Scenario	Scholarly publishing system risk	Transition risk	Risks to achievement of BCR
Green	<b>Higher risk.</b> In our view, there is a greater potential for Green to undermine the business model on which it relies, if it leads to significant subscription cancellations.	<b>Medium risk.</b> Although most UK academic institutions already have repositories, a significant shift in culture and practice is required amongst authors. Although this should be achievable, it requires significant impetus from funders and academic institutions.	<b>Lower risk.</b> Since most costs are sunk, relatively small benefits will result in a BCR greater than one. In addition (compared with Gold) the expected BCRs are less sensitive to slower uptake of Green deposits in the rest of the world.
Delayed	<b>Medium risk.</b> Like Green, there is a risk of undermining the business model. However, this is significantly mitigated by publisher control of whether to offer delayed access and, if so, the length of the embargo.	<b>Lower risk.</b> Funders may not be willing to make concessions in relation to embargo lengths and non-compulsory deposit in repositories. This is especially difficult as funders' policies may vary by country.	<b>Lower risk.</b> Very low costs (although publishers' revenue may be at risk) mean that relatively small benefit levels achieve a BCR greater than one.
Gold	<b>Lower risk.</b> We consider Gold is a low risk scenario, since it provides an alternative to the subscription-based publishing business model.	<b>Medium risk.</b> There is a series of significant challenges in a transition to Gold OA. These include (for funders and academic research institutions) getting money in the right place; and (for publishers) adjusting their business models and cost structures. There are also risks associated with the distribution of costs in the transition, with a greater potential burden on research-intensive institutions.	<b>Higher risk.</b> The net costs to academic institutions (and to the UK as a whole) are very sensitive to the level of APCs charged. In addition, net cost reductions rely on reductions in subscription charges to offset increased author-side payment. The BCR is also relatively sensitive to a slower move to Gold outside the UK, since that impacts on both costs and benefits.
Licence extension	<b>Lower risk.</b> We consider that licence extensions pose a low risk to the scholarly publishing system as they are an extension of the existing system.	<b>Higher risk.</b> We regard the difficulties in allocating cost and complexity of negotiations as a significant risk to the transition. This is particularly the case for HEIs, less so for the NHS extension.	<b>Lower risk.</b> There is a relatively low risk to achieving the BCR. Although the BCRs are sensitive to the licence premium, this would be a matter for negotiation.
Transactional	<b>Medium risk.</b> Although there is a potential for cannibalisation of subscriptions, publishers would be in control of this and could take corrective steps (e.g. by changing the PPV price) if required.	<b>Lower risk.</b> This scenario relies on investment in the development of a third-party aggregating site, or improvements in existing sites that may not be recovered if demand does not materialise.	<b>Lower risk.</b> While the risks to the BCR are low, benefits will be targeted to those users for purchase articles.

## 7.4 Other observations

### 7.4.1. Market/economic efficiency

A further issue that should be taken into account in considering the relative costs and benefits of the scenarios is the underlying market structure implied by the business model. As has been observed by others, the market dynamics of the subscription-based business model has some inherent disadvantages. In particular:

- that authors (one of the primary beneficiaries of the scholarly communication process) do not face direct price signals in their publishing decisions, which reduces the potential for competition at this point in the publishing process; and
- the subscription-based model makes market entry more difficult given the expected lag between establishing (and incurring the costs of) a new journal, and building a subscription revenue base.

This is clearly a complex issue, and there are many dimensions to it which are not covered here or in the Detailed Report. However, at its simplest, our view is that an author-side payment business model (i.e. Gold) offers some potential improvement in transparency of the relevant, underlying prices in the publishing market. It also may reduce barriers to entry, particularly in certain segments of the journal market. We have observed this in practice with the entry into the market of new OA publishers. In our view these factors point toward wider economic benefits that we have not captured in our modelling.

### 7.4.2. Public good

Another factor that we have not quantified is the value that UK residents place on knowing that they can access research articles if they want to – referred to in economics as the non-use value of a public good. Typically, the value would be estimated through surveys of people's willingness to pay. The value is created for UK residents who are not economically engaged in research (those who are, are captured in our access modelling) but who may, now or at some point in the future, wish to gain access to a particular article. For each individual UK resident this benefit is likely to be marginal (perhaps a few pence), but in essence represents an option to read the article if they so desire.



# Conclusions

In this final section we bring together our conclusions from the study. Unlike Sections 6 and 7, which focus on the key modelling results for each of the scenarios and a number of our observations about them, this final section aims to provide a narrative of what the analysis might mean for public policy.

This report appears at a time of growing financial constraint in the UK academic system. Against this background all cost items, large and small, will come under increased scrutiny. In this context we start by noting that all the scenarios involve some additional cost at some point, although the amounts and timing vary.<sup>40</sup>

## 8.1 Scenario summary

### 8.1.1. Delayed

The Delayed scenario comes very close to the desirable outcome of a cost-free route to increased access: and the transition costs involved would all be borne by publishers rather than academic institutions, which might be seen as an advantage from a public policy perspective.

Looking simply at the economic BCR, this scenario clearly offers the most cost-effective way to improve access, largely as a result of the lowest costs, and should perhaps for this reason be preferred.

The scenario is not, however, very amenable to policy intervention, since its uptake depends on individual publishers' decisions to adopt it or otherwise. Some have suggested that pressing harder for Green OA might trigger an increase in delayed access as a response, but there seems little evidence to support this.

Our view is that the likelihood of delayed access expanding substantially is relatively low: given that there is simply too little motivation for the publishers who have not already for their own reasons chosen to adopt it. We also note that there is little likelihood that academic institutions or funders will prioritise this option over Green or Gold OA, because of its disadvantages (longer embargoes; lack of deposit in open repositories). Publishers could increase the access value if they made the post-embargo articles truly open access (e.g. with a Creative Commons licence) rather than just freely available.

### 8.1.2. Gold

Gold is the only scenario that could in principle reduce the annual costs for academic institutions. This would be the result, however, only if article processing charges (APCs) were on average sufficiently low; if average APCs were set at a level equal to the current global average cost per article (£2,364) UK institutions' annual cash costs would actually rise, by £8.3m. We calculate, however, that:

- if the average APC was just 17% lower than this (c. £1,950), the change to Gold would be cash-neutral for UK academic institutions; and
- if average APCs were set at about £1,457 (or \$2,185, which is Outsell's estimate of the 2009 weighted average of APCs)<sup>41</sup> then UK academic institutions would benefit from substantial annual net savings that we estimate at £2.8m at the level of uptake we have modelled (or £2.9m including non-cash savings).

In addition to other transition issues discussed below, there are significant uncertainties about how Gold OA publishing –

<sup>40</sup> The ordering of scenarios in this section differs from previous sections to reflect this narrative.

<sup>41</sup> This figure is confirmed by our own estimates and given further validation by the average APC of \$2,367 paid for 440 Wellcome Trust-funded articles in 2010. The Wellcome Trust articles were published in journals with a wide range of APCs, up to and including \$5,000 for Cell Press; the median was \$2,250 and the mode \$3,000.

and the level of APCs – will evolve, and about the impact on traditional publishers’ business models. For example, it is likely to be a challenge for the publishing industry to shift a significant part of its portfolio from its current cost base to a lower-cost Gold model. Nonetheless, this is already starting to happen, with the current growth in Gold OA publishing primarily in lower-cost publishing models, with APCs even lower than the Outsell/Wellcome averages, namely in the range \$1,350–\$1,700.

It may be easier for new entrants to operate at this level, either because they lack any pre-existing cost infrastructure to slim down and can therefore design low-cost operations from scratch; or because they do not need to worry about cannibalising existing, potentially more profitable revenue streams; or because they focus on journal models with light peer review and lower rejection rates, and hence lower editorial costs. We note, however, that the Wellcome/Outsell figures that we used as the basis of the lower APC Gold case are weighted averages including some high and medium quality APC journals, which suggests APCs at these average levels would be feasible as Gold expanded. It is also possible publishers may set prices artificially low as a market entry strategy, or that APCs may rise as Gold OA publishers mature and increase the proportion of ‘higher-rejection rate’ journals in their portfolios.

However, at these lower levels of average APC not only would there be cost-savings for academic institutions but the overall economic case for the Gold scenario is strong with high BCRs and with the clear advantage of providing a sustainable funding model.

### **Transition issues**

The key transition issues are as follows:

First, the net cash costs for UK academic institutions, and thus the economic benefit to the UK, could be affected by differential uptake of Gold as between the UK and the rest of the world. That is, if the UK were to act such that it was significantly in advance of the rest of the world, its costs would rise (through additional APCs) but it would benefit less from access to overseas articles. The effect of this on the BCRs is more dramatic with Gold than with Green because it impacts on both the benefits and the costs. While we see little evidence

for this occurring in practice, it is a material risk and it would be appropriate for policy-makers to monitor the situation.

Second, existing subscription journals in some fields may currently enjoy (or in some cases depend on) income from the corporate sector in the form of subscriptions/licences or commercial reprints. That income would largely be lost if the journal were to adopt an open access model and would have to be replaced by income from APCs which come disproportionately from university-based rather than corporate researchers (the so-called ‘corporate free-rider’ issue). This was reflected in our modelling, though the overall effect was small: the proportion of costs carried by academic institutions rose from 67.1% to 68.1%. Provided that average APCs are set at the point where UK academic institutions see a net annual cost reduction, however, it is not clear that they will mind that the APCs are somewhat higher than they might theoretically otherwise have been.

Third, and perhaps more importantly, although Gold has the potential to reduce academic institutions’ costs while simultaneously increasing access, there are substantial transitional issues:

- There are the one-off costs to create the necessary infrastructure and systems. To start with, practical payment issues like handling post-grant publication, multi-authorship and mobile authors are yet to be fully resolved, and where policies have been drawn up, researchers are far from familiar with them. Payment for non-grant-funded authors requires funding from academic institutions, and the funding, policies and communication for this has barely started (only a handful of UK universities have established OA funds). We note, however, that while these costs are rightly included in the benefit-cost modelling, much of academic institutions’ share (roughly half of the total) would be management and staff time.
- There are also lags and distributional effects that mean that ongoing net costs under Gold would rise before later falling, as a result of the need to pay APCs while retaining existing subscriptions. This ‘hump’ in costs (only partly reflected in our model, which does not include lagging) is likely to be one of the biggest obstacles to the growth of Gold.

- The expansion of Gold would also of course have differential impacts on academic institutions, in effect redistributing the share of total publishing/distribution costs from more teaching-oriented institutions to the research-intensive ones.

There are a number of possible policy responses. More widespread adoption by research funders of policies similar to that of the Wellcome Trust would allow expansion of Gold without any impact on academic institutions' budgets. A case could be made for additional transitional funding, though the timing for this does not seem propitious.

The hybrid OA model was originally conceived of a way to allow subscription journals to shift to Gold OA, and could have a role in mitigating the short-term cost hump. But it has to date seen only low uptake, and has incurred some suspicion, partly because of concerns of potential 'double dipping' and partly due to the pricing. The variant of the hybrid model in which a consortium deal provides a bundle of licensed access and APCs for a single agreed price may have a role here, so long as the model can be given sufficient transparency for institutions to have confidence in it, and if the APCs are low enough.

The redistribution of publishing and distribution costs to the more research-intensive institutions should not cause major difficulties for them so long as charges are met by the Research Councils and other key research funders rather than falling on the QR side of the dual support system. It is also likely to be much less of an issue if the net cost falls for everybody, including the research-intensive universities, as we see in the steady state for the lower APC variant of the Gold scenario.

More generally, the importance of the level of APCs in determining the case for Gold raises the question of whether funders' or academic institutions' policy should specify a maximum reimbursable APC, in order to promote a lower overall average. On balance we think that this is not likely to be desirable, for several reasons: unlike subscriptions, the market for APCs is likely to involve some competition on price; the evidence currently suggests that it is unnecessary; and a cap could discourage high quality journals with inherently high editorial costs from entering the Gold arena.

### 8.1.3. Green

The modelling confirms what one might intuitively expect, that Green OA would provide a cost-effective route to improving access, with relatively high BCRs attributed to our central case in which much of the costs are treated as sunk. Unlike Gold, however, the Green scenario does not offer a route to cost savings for academic institutions, but instead involves increased annual costs, except in circumstances that give rise to other significant concerns.

In other words, if we take Green solely to provide *additional* access to those who do not already have subscribed or licensed access, then we have shown that it offers a cost-effective approach: at least as good as that offered by Gold for the case in which APCs are £1,995 (the level at which the net annual cost change for institutions is zero) or higher.

If, however, Green were also to *replace* some existing access and become (if only partly) a route to journal cancellation, there could of course be savings, but the scenario is potentially not then self-sustaining.

This suggests that it would be logical for policy to promote Green deposits – since the repositories are already built it would make sense to encourage their use – as a way of expanding access, so long as this was not at the expense of the other routes to access (in other words, with embargoes set at levels that did not damage subscriptions as Green volumes rose). The issue is of course obviated if publishing were to move to a Gold model.

As for Gold, the BCRs would be lower if the UK acted unilaterally in expanding its Green programme significantly faster than the rest of the world, because costs would rise while the full benefits would not be enjoyed. We see no evidence, however, that this is likely to be the case.

#### 8.1.4. Licence Extension

An investment in a national licence for UK academic institutions would provide a benefit–cost ratio greater than one but lower than those for all the other scenarios. It has the disadvantage that it requires both initial one-off negotiating and other costs, and substantial continuing increased cash costs. It also faces significant implementation issues in dealing with the problem of cost allocation between institutions.

Such difficulties might be mitigated given the current weight being placed on shared services (albeit as a route to cost-savings), or if a top-slicing solution is deemed to be politically feasible, particularly if there were other attractive features in the deal. Any comprehensive national arrangement would, however, be contrary to current competitive practice between universities, at a time when such competition will be increasing.

On balance, therefore, it seems unlikely that a national academic licence will be a priority at a time of public sector cuts. There may, however, be scope for new consortium licences based around regional blocs in which the primary negotiating focus of the institutions will be cost saving but will secondarily lead to some increased access.

#### 8.1.5. Transactional

Similar considerations also apply in respect of the Transactional scenario. Although there may be scope to increase access via improved service at lower prices, we lack the evidence to say with confidence that this is indeed the case, or if it is, whether it can be achieved in an economically sustainable way. What we can say is that, even with what we believe to be optimistic assumptions about the expansion of transactional volumes, the potential for increased access by this route is small compared to the total volume of existing access. For this reason, unless achieving a marginal increase in access by groups such as SMEs or the general public is seen as particularly important, there does not seem to be any public interest here. In any case this scenario does not appear to be amenable to public policy, being more a matter of entrepreneurial activity and market forces.

## 8.2 Overall policy implications

What then are the overall policy messages that might be taken from this analysis?

1. The *Delayed scenario* offers closest to a zero cost. But it depends on voluntary action by publishers, and it is not directly amendable to policy influence (unless it were really the case that publishers would adopt it as a potential defensive response to Green, something for which we see no evidence at present). Moreover, it would probably involve embargoes longer than funders such as the Wellcome Trust currently require, it could preclude aggregation of articles in subject repositories, and – as with the Green scenario – there are risks to the sustainability of the subscription model on which it relies. In our view, therefore, while there is no harm in policy-makers encouraging it as a low-cost and arguably lower-risk<sup>42</sup> way of expanding access, it is unlikely in practice to provide significant changes in access.
2. The *Transactional scenario* has some potential to address access gaps, and it could be complementary to the Licence Extension scenario, or to the subscription model generally, provided it did not cannibalise subscriptions. It seems unlikely, however, that it would lead to a substantial increase in access overall. Moreover, it is not particularly amenable to policy intervention, and the demand for transactional access would presumably fall as open access expands.
3. All the scenarios that are directly amenable to policy intervention (Green, Gold, and Licence Extension) are – based on our modelling – capable of achieving benefits to the UK that are greater than their costs. However, all have significant upfront costs of different kinds.
4. Of these options, our view is that the Licence Extension option is the least attractive from a policy perspective. Although the level of the BCR depends significantly on the premium that publishers actually charge for increased access, the combination of significant upfront and on-going cash costs (in the HEI licence extension in particular)

<sup>42</sup> Given that publishers retain control and can take action.

and the difficulties of transition (including the allocation of costs) make the option relatively unattractive. These arguments are strengthened in the current difficult fiscal environment.

5. Our judgement is that the two open access routes offer the greatest potential to policy-makers in promoting access. Both have positive, and potentially high, BCRs.
6. The *Green scenario* appears capable of providing increases in access comparable to or greater than other scenarios, and since the infrastructure for Green has largely already been built, increasing access by this route is especially cost-effective. These gains, however, come with increased risks to the scholarly publishing system in the form of potential subscription cancellations, and thus the risk that the scenario is not self-sustaining.
7. Of the two open access routes, our view is that the *Gold route* is preferable in the long run, given (i) its underlying sustainability; (ii) the advantages of the author-side business model in terms of improved transparency and lower barriers to market entry, which point to improved economic efficiency; and (iii) (depending on the level of the APC) the potential to achieve both higher BCRs and lower net costs for the UK in general and for its universities in particular.
8. Set against those considerations, the scale of the costs and the benefits depends on the future level of APCs, which it may be hard for policy-makers to influence; and there are higher transition costs in the transition to Gold compared with Green.

9. Taking all these factors into account, our view is that the prudent stance for policy-makers seeking to promote access in the current environment is likely to be as follows:

- to encourage the use of existing Green infrastructure (whose costs are largely sunk); but to be cautious about pushing for reductions in embargo periods to the point where the sustainability of the underlying publishing model is put at risk.
- in parallel, to work to facilitate a transition to Gold OA (in specific disciplines first) provided that (i) the average level of APCs remain at or below £1,995;<sup>43</sup> (ii) the proportion of articles funded through APCs moves broadly in line with global rates; and (iii) mechanisms are in place to ensure that total payments from UK universities and their funders do not rise as a consequence of this transition.



<sup>43</sup> At this APC value academic institutions have a zero change in annual net costs.

# Glossary

Abbreviation	Full	Definition
SUoA	Standardised unit of access	See section 4.1
BCR	Benefit-cost ratio	See section 4.3.2
DMR	Diminishing marginal returns	See section 4.1
NPV	Net present value	See section 3.1
PPV	Pay-per-view	A system whereby articles are purchased on a case-by-case basis by the user
APC	Article Processing Charge	The fee charged by publishers to offset the costs of publishing a journal article, where those costs are not covered by a subscription model







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