Green Book Discount Rate Review:

Summary of Findings and Recommendations

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Recommendations

- Green Book guidance applies a real discount rate of 3% for maturities of up to 30 years. This is comprised of a 2% risk-free rate and a 1% adjustment for project systematic risk.
- This rate is used for all projects, including health and the environment, unless an exceptional case is made to HM Treasury for exemption. This is to be granted in only one of two cases:
  i. When HM Treasury can be persuaded that a project-specific risk premium can be applied in a way that is practical, proportionate, and evidence-based;
  ii. When HM Treasury can be persuaded that the project has significant social insurance properties: public interventions designed to mitigate severe downside systemic risks to society. Unlike standard public investments, these interventions are characterised by strongly counter-cyclical benefits, yielding their highest returns during periods of acute macroeconomic decline. Examples include pandemic preparedness programmes, which can be deployed to suppress disease transmission and mitigate broader societal impacts during an epidemic, as well as counter-terrorism measures designed to avert the largest attacks on society. In such cases, the discount rate is reduced to 1.5%, reflecting a risk premium of −0.5%.
- The Green Book applies the forward discount rates given in Table 1. These reflect a flat term structure for the risk premium (1% for all horizons for standard projects; −0.5% for social insurance projects) and a declining term structure for the risk-free rate:

Forward rate	0-30 years	31-75 years	76-125 years	>126 years
Standard projects	3.0%	2.5%	2.25%	Explicit welfare analysis
Social insurance projects	1.5%	1.0%	0.75%	Explicit welfare analysis

Table 1. Recommended forward discount rates

- These values are reviewed every five years, or sooner if there is clear evidence that forecasts of economic growth have changed materially in the meantime.
- Considerations of, for example, specific environmental, health, and place-based effects are accounted for in changes to welfare weights and/or relative prices. These lead to adjustments in the estimates of expected net social benefits (social benefits minus social costs) in the present value equation and not in the discount rate.
- For public finance projects, both the cost of capital used to set the unitary charge and the separate discount rate used to calculate the social present value reflects the risks borne by the public sector and the private partner in a proportionate way.
- For the largest, non-marginal, most complex, and longest-maturity projects, including transformational projects and nuclear decommissioning, HM Treasury does not over-rely on a simple schedule of centrally set discount rates to value risk and maturity. Explicit welfare analysis is undertaken in a way that is proportionate to the project under appraisal.
- Discount rate sensitivity analysis is not undertaken.

Introduction

1. In December 2025, the then Chief Secretary to the Treasury, the Rt. Hon. James Murray MP, appointed us to conduct a review of the Green Book discount rate. This followed from the findings and actions of the wider Green Book Review 2025.

2. Formal Terms of Reference laid out a series of questions which we respond to below, as well as specifying certain requirements concerning how this review should be undertaken.

3. Over the last six months, we have completed this work through a process that has involved us:

   - considering the history of the Green Book discount rate,
   - reviewing the academic literature,
   - assessing international guidelines,
   - running a primary survey of recommendations from a wide range of stakeholders, and analysing its results,
   - speaking with Green Book user Observer Groups,
   - running panel meetings with leading international academic experts in the field and consulting further with them as we were reaching our conclusions,
   - re-calibrating empirical models,
   - considering best practice from outside the public sector, and
   - presenting preliminary conclusions to HM Treasury and members of the Observer Group and receiving feedback.

4. This is a complex topic on which there are strong and often conflicting opinions. This report provides only brief evidence in support of our findings. A second report also delivered to HM Treasury, *Green Book Discount Rate Review: Technical Annexes*, presents our arguments in substantially greater depth.

5. We use the term "project" throughout this document and the Technical Annexes as a general term to cover any proposed public investment, policy, or regulation that falls under Green Book guidance.

Background

6. HM Treasury's Green Book is the UK government guidance on assessing the costs, benefits and risks of different options for achieving government objectives. The Green Book provides a structured framework for developing evidence-based, objective, and impartial advice to decision-makers on the best way of achieving their objectives.

7. Such guidance requires the application of a social discount rate, for which the existing framework is set out in the report *Green Book supplementary guidance: discounting*. The current social discount rate, denoted by r, is set using the *Ramsey Rule:*

$$r = \delta + \mu g + L$$

where, currently, $\delta = 0.5\%$ is the rate of pure time preference, $\mu = 1$ is the elasticity of marginal utility of consumption, $g = 2\%$ is the expected annual growth rate of future real per capita consumption, and $L = 1\%$ is an adjustment for catastrophic risk. Using the Ramsey Rule with these parameter values gives $r = 3.5\%$.

8. The Green Book makes certain adjustments to this. For projects of more than 30-year maturity, the discount rate is lower (*declining discount rates*), while for very long-term projects sensitivity analysis is run with $\delta = 0\%$ as well as $\delta = 0.5\%$. Health has its own discount rate of 1.5%, the argument being that the wealth effect, μg, is not relevant.

9. This is a "Social Time Preference Rate" (STPR) structure. The Ramsey Rule is derived from an economic framework that explicitly considers how the government can optimise social welfare. This contrasts with the "Social Opportunity Cost" (SOC) approach, where the discount rate is set based on observed rates of return available to private investors, including yields on Treasury bonds.

10. "Discounting enables profiles of benefits and costs stretching over many years to be expressed in 'present value' terms" (Green Book, #6.52). The purpose of the discount rate is to assign a weight to costs and benefits that arise at some future time, *t,* which then allows them to be expressed in terms of their present value (PV) today:

$$PV = \frac{\text{Expected net benefits at t}}{(1+r)^t} = \frac{\text{Expected benefits at } t \ - \text{Expected costs at } t}{(1+r)^t}$$

11. We will refer to the *numerator* of this equation (expected net benefits at time t) and the *denominator* of this equation (which is influenced by the discount rate, r). This should not be confused with the Benefit-Cost Ratio (BCR) equation, which has a different numerator and denominator.

12. These individual PVs are then used as inputs to calculations of Net Present Social Values, BCRs, and other metrics when public bodies estimate social value (Green Book, Table 10).

Overarching principles

Principle 1: The Green Book discount rate accounts for maturity and risk only

13. As described in the Background section, the discount rate appears in the *denominator* of the present value (not BCR) equation, the expected net benefits in each period appear in the *numerator*. For any adjustment to the inter-temporal social welfare analysis made in the discount rate, there is an alternative adjustment to the evolution of expected net benefits that would have an identical impact on the estimated present value. For example:

    - HM Treasury's Environmental Discount Rate Review concluded that changes in the scarcity of ecosystem services is accounted for in the numerator through changes to relative prices rather than through a special environmental discount rate.
    - Project systematic risk adjustments in cost-benefit analysis can either be accounted for in the numerator by using "certainty equivalent" net benefits or through a risk-adjusted discount rate instead.

14. We recommend that the discount rate is not overworked in the Green Book. It accounts for the maturity of any social benefit that is being appraised, as well as the systematic risk

of that benefit; the extent to which it is related to the overall wellbeing of society at that time. Risk-free benefits arising at different points in time can, in principle, be discounted at different discount rates (declining discount rates). For any given maturity, different projects can have different discount rates depending on their levels of risk.

15. We recommend that projects that offer the highest payouts at times of secular declines have lower discount rates than other projects. In future states of the world where society is much poorer than it is today, any investment we make now on its behalf has particularly high social value. Even if we assign a low probability to such states of the world, the potential for rare disasters still has a significant impact on estimates of social value. The negative risk premium, −0.5%, that we recommend for such social insurance projects will account for this effect.

16. That many other complexities of economic appraisal are handled in the numerator of the present value equation through relative price adjustments and welfare weights is broadly consistent with the conclusions of previous HM Treasury reports including the Dasgupta Review and the Environmental Discount Rate Review. We support these conclusions.

Principle 2: Green Book discounting guidance is applied consistently

17. We recommend that public bodies are not permitted to have their own specific discount rates except insofar as these represent variations in project-specific maturity and/or systematic risk, in which case a consistent basis for variation is set by HM Treasury across public bodies.

18. While not strictly incorrect, the utility discounting approach that underpins the separate health discount rate in the current version of the Green Book adds unnecessary complication when applying consistency across public bodies. We recommend that health utility measures be converted into monetary values in each time-period and then discounted as usual. This brings all departments and public bodies into alignment. If, under current Green Book guidance, the relative price of health utility is assumed to increase at 2% annually, this will make no material difference to the estimated present value compared to current practice.

19. While growth in health values at c.2% could be an acceptable default under these revised recommendations, we further recommend that the precise elasticity of willingness-to-pay for health to income is calculated in future analysis. This is a general recommendation for all relative price adjustments and is consistent with the conclusions of the Environmental Discount Rate Review.

Principle 3: Green Book discounting guidance is applied proportionately

20. The Green Book is applied across vastly differing types of projects in terms of their size, complexity, and maturity. Following from the findings and actions of the Green Book Review (2025), “Green Book guidance should be used proportionately. Business cases should contain sufficient detail to support sound decision making, but they should not take up more time and resources than is necessary. The effort involved in developing a proposal should correlate to its scale, cost, complexity and risk" (Green Book, #1.8). Our

recommendations on the discount rate, and associated wider welfare analysis, follow this principle of proportionality.

21. This review provides a robust long-term framework for Green Book discounting. However, the current estimate of real per capita consumption growth, g, is out of date. It takes a value of 2%, reflecting the average annual rate of growth of real per capita consumption between 1949 and 1999. It is also misaligned with the assumptions that some departments are currently making about the growth rates of expected net benefits, introducing inconsistency between the numerator and denominator of the present value equation.

22. To keep the approach and inputs to discounting up to date, we recommend that the empirical value of the discount rate is reviewed at a maximum of every five years. We recommend that this focuses on the growth parameter, g, in the Ramsey Rule, but may also be widened to other values. We are not recommending that the broader framework for the discount rate be regularly reassessed unless there are significant advances in the academic literature.

23. We recommend that the empirical value of the discount rate be reviewed earlier than five years if there are clear reasons to believe that economic growth forecasts have substantially changed. Significant differences between the STP rate and the Bank of England's real yield curve, and/or changes in the Office for Budget Responsibility's (OBR) forecasts, provide a foundation for deciding whether an earlier review is proportionate.

Principle 4: Green Book discounting guidance is unequivocal

24. If the discount rate exists to account for project maturity and project systematic risk only, then we recommend that the Green Book states unequivocally only one specific discount rate for any given risk and maturity, and that discount rate sensitivity analysis is removed from the Green Book. This applies most notably to the $\delta = 0\%$ and $\delta = 0.5\%$ for intergenerational effects. Present values give an *expected* change in welfare, which is a single number, reflecting HM Treasury's single best view of what constitutes social welfare. Instead, we recommend that intergenerational projects report the time profile of undiscounted values of net benefits so that issues of fairness can be separately discussed. We also recommend that, for very long-term projects (maturities >125yrs), explicit welfare analysis is conducted.

What evidence should the UK government consider for remaining with the current Social Time Preference Rate (STPR) approach or instead changing to a Social Opportunity Cost (SOC) approach?

(i) Conceptually, the Green Book discount rate is an STP rate; (ii) The Ramsey Rule and its extension are not literal identities; (iii) SOC rates, revealed social preference, survey data, and international guidelines all provide relevant information.

25. "Appraisal involves estimating the social value of different options and selecting the option that represents best value for money. This concept of social value is based on the principles of welfare economics." (Green Book, #2.4). This principle also applies to the

discount rate, clearly signalling that, within a UK context, the STPR approach is to be preferred. This was also the dominant recommendation amongst our survey respondents.

26. Yet STPR models of discount rates are, by their very nature, parsimonious and rely on numerous assumptions that are unlikely to reflect the subtleties of governmental social objectives. They are also difficult to calibrate, raising both conceptual and empirical questions on how best to estimate the parameter values.

27. We recommend that the Ramsey Rule is not taken too literally; it is not an accounting identity. The rates calculated from this equation are not *the* STP rate. While the Ramsey Rule has a clear foundation in welfare economics, and it reflects HM Treasury's essential view of the welfare objective of government as the discounted sum of wellbeings, the precise form is a pragmatic simplification that facilitates estimation.

28. We recommend that HM Treasury uses an updated calibration of the Ramsey Rule to provide a core estimate of the STP rate but then triangulates this estimate with other sources. We provide evidence on the SOC rate, responses from our survey and others, and international guidelines. Each of these sources provides relevant information to HM Treasury even within a purely STPR conceptual framework for the discount rate.

Do the current estimates for the parameters of the STPR (excluding L) remain broadly valid for short-to-medium term risk-free social discounting? What new evidence on these parameter values has emerged since the previous review in 2018?

We recommend that the growth parameter, g, is reduced to 1.5%, δ is left unchanged at 0.5%, and μ is increased to 1.25. Rare disaster macroeconomic risk reduces the STP risk-free rate by 0.5% compared to the Ramsey Rule. This leads to an estimate of the STP risk-free rate of 1.875%. However, this alone does not determine the risk-free social discount rate. We recommend that this value is set at 2%, based on triangulating the 1.875% STP rate with other sources described below.

29. Calibrating the Ramsey Rule sets both conceptual and empirical challenges. Conceptually, it is necessary to determine what is meant by "welfare". There are a range of different interpretations, and each gives a different view on how HM Treasury might set about calibrating the Ramsey Rule.

30. This raises specific difficulties for calibrating the rate of pure time preference. Some welfare perspectives assert that $\delta = 0$, arguing that fairness concerns should be discussed separately. Others propose $\delta > 0$, but high-quality empirical estimates of social preferences are scarce. We recommend maintaining the current value of $\delta = 0.5\%$ based on the best available evidence and on expert opinion. We recommend that intergenerational projects are handled separately as described above.

31. There are strong reasons to believe that the current value of $g = 2\%$ is too high and we recommend that this is reduced to $g = 1.5\%$. This broadly is in line with OBR long-term assumptions on per capita GDP growth and Bank of England data on per capita consumption growth over the last 50 years.

32. By contrast, the latest evidence indicates that the current value of the elasticity of marginal utility of consumption, $\mu = 1$, is at the lower end of the most likely range of 1 –

1.5 for the UK. This elasticity differs from the inequality aversion parameter that determines welfare weights in the Green Book, which is $\epsilon = 1.3$. We recommend that these conceptually similar parameters are harmonised for simplicity: $\mu = \epsilon = 1.25$. Triangulating $\mu > 1$ and $\mu = \epsilon$ also has desirable conceptual properties, aligning with our survey responses and expert opinion that the current value is too low.

33. Low probability but severe negative shocks to the economy, including deep recessions, have a major impact on estimated STP rates. The prospect of negative shocks causes a strong precautionary savings motive, thereby reducing the estimated risk-free rate. We recommend that HM Treasury includes an adjustment of -0.5% for such an effect in the Green Book discount rate.

34. Taking into account the best available evidence, we recommend that the parameter values in Table 2 are applied to give an updated Ramsey Rule STP rate:

Parameter	Current value	Plausible Range	Recommendation
Pure time preference ($\boldsymbol{\delta}$)	0.5% (0% sensitivity)	0 or 0.5%	0.5%
Elasticity of marginal utility ($\boldsymbol{\mu}$)	1	1 – 1.5	1.25
Intratemporal inequality aversion (used in welfare weights, $\boldsymbol{\epsilon}$)	1.3	1 – 1.5	1.25
Consumption growth ($\boldsymbol{g}$)	2%	1% – 1.75%	1.5%
Rare disaster (**R**)	0%	-1% – 0%	-0.5%
RAMSEY RULE STP RATE			**1.875%**

Table 2. Recommended risk-free STPR parameters.

35. The Ramsey Rule STP risk-free rate (excluding L) is derived from $r = \delta + \mu g + R = 0.5\% + 1.25 \times 1.5\% - 0.5\% = 1.875\%$. The R term is a new adjustment that we recommend to account for the potential for rare disasters.

36. 1.875% should not be interpreted as our recommendation for the risk-free rate. Because the Ramsey Rule is derived from a highly parsimonious model of social welfare, and because of the difficulties in accurately calibrating it, this value represents a pragmatic judgement. This requires triangulation with other sources of information, which we discuss below. The Ramsey Rule STP rate is a central piece of information in setting the risk-free social discount rate, but we recommend that the actual value applied is 2% and not 1.875%.

What rate of return should be used for short-to-medium term risk-free social discounting if the UK government chooses to switch to an SOC approach?

A mid-maturity rate from the Bank of England's real yield curve, currently slightly over 2%. When triangulated with the STP rate, survey data, and international guidelines, we recommend a risk-free component of the social discount rate of 2%.

37. An appropriate SOC risk-free social discount rate can be inferred from the Bank of England's real yield curve. Current rates are given in Table 3:

Real yield	10 year	15 year	20 year	30 year	40 year
Spot rate	1.7%	2.1%	2.2%	2.2%	2.0%

Table 3. Bank of England real yield curve data: June 2026

38. While reasonable questions arise over which maturity to select, and whether adjustments should be made for the methodologies used in protecting index-linked gilts against inflation, day-to-day variations in the yield curve give such adjustments spurious accuracy. An SOC rate of 2% is consistent with yields as viewed in the index-linked gilts market.

39. This 2% rate is also consistent with the evidence we gathered from our survey, as well as from much international guidance. Triangulating with the Ramsey Rule estimate gives us confidence that 2% forms a robust estimate for the risk-free component of the Green Book discount rate.

40. While there has, over recent years, been a substantial discrepancy between real gilt yields and the risk-free Green Book rate, this was caused by a range of specific factors that heavily influenced financial market prices. This included quantitative easing, which is of less relevance to Green Book users now. A well-specified welfare-based model of the risk-free rate that captures the impact of rare disasters should produce rates that are broadly in alignment with real gilt yields. For a wide range of well-documented reasons these will never be identical, but the extent of the SOC – STPR divide is commonly overstated, particularly given current market conditions.

41. When SOC risk-free rates do vary significantly from STP rates, this reveals information to HM Treasury about the behaviour of the real economy, which may in turn affect forecasts of g. Just stating that a divide exists without trying to understand its cause, and the impact of that cause on the prospects for public projects, may lead to sub-optimal economic appraisal. The risk-free SOC – STPR divide is a strong indicator for when an early review of the Green Book discount rate may be required, and specifically that such a review takes place if real gilt yields are negative for a sustained period.

What evidence should the UK government consider for and against the declining discount rate (DDR) regime currently in use? Does the existing guidance on intergenerational wealth transfers and social discounting remain appropriate?

The theoretical justification for DDRs is robust, but updated evidence based on UK consumption data somewhat flattens the term structure compared to current guidance. DDR schedules become hypersensitive to small changes in assumptions at very long horizons, requiring that explicit welfare analysis then replaces the use of discount rates.

42. In 2003, the Green Book set a precedent by introducing declining discount rates (DDRs) for policy purposes. This had widespread international influence, with many other governments following suit. The theory and empirics behind DDRs have also been widely developed over the last quarter of a century. Our survey respondents strongly advocated for discount rates that vary with maturity and specifically for declining discount rates.

43. The precise schedule of DDRs in the Green Book, which is based on the calibration of old theoretical models based on historic US interest rate data, requires revision. We have undertaken this task using UK consumption data obtained from the Bank of England spanning 1830 to 2025.

44. The standard DDR conceptual model of consumption growth dynamics is insufficient to generate any substantial declining term structure: the levels of persistence and variance in the raw UK data are too low. Only structural uncertainty about possible future growth regimes leads to any strongly declining term structure.

45. Such structural uncertainty is supported by responses to our survey. Many people forecast persistently lower consumption growth in the long run future; dropping from 1.5% to 1% over the course of the next century. Empirical analysis of historic data identifies even lower long-cycle growth states than this. Potential persistent states like these can drive DDRs, but not to the extent that is implicit in current guidance. We recommend that HM Treasury embeds this latest theory and evidence in an updated DDR term structure.

46. A model of structural growth uncertainty calibrated using a time series of UK consumption growth over the full 1830 – 2025 period, but also specifically the last 50 years, suggests that the term structure of risk-free social discount rates declines by 0.75% for a 100-year horizon, with little further decline beyond this point. This is largely consistent with the survey responses that we received. As with the current Green Book, these are adjustments to forward (not spot) rates.

47. Long-term appraisals are hypersensitive to the choice of the discount rate. It is impossible to observe or estimate the perfect STP discount rate without error, and the impact of any estimation error compounds over time.

48. Intergenerational projects also raise specific issues in relation to the choice of the pure time preference parameter, δ. We recommend alternatives to simple sensitivity analysis on δ to address intergenerational concerns. Similarly, considerations of proportionality may lead to more fundamental welfare analysis for nuclear decommissioning and other ultra-long maturity projects rather than the application of a standardised DDR schedule.

Does the L term within the STPR continue to correctly account for 'catastrophic' and 'systemic' risk? Should the discount rate adjustment for risk depend on whether the government chooses an STPR or SOC approach?

We recommend that the current value of $L = 1\%$ is retained, although with a very different conceptual justification. In general, we recommend that L is not adjusted on a project-by-project basis. The core variation, to be applied only in exceptional circumstances and with explicit HM Treasury consent, is for projects with significant social insurance properties, where we recommend that $L = -0.5\%$.

49. We recommend that HM Treasury reconsiders the conceptual basis for the $L = 1\%$ adjustment to the Green Book discount rate and aims to place this on a more robust and consistent theoretical footing.

50. Latest evidence makes it difficult to support the Arrow-Lind theorem. This states that, because the government is so well diversified, the risk of social projects should not be

included in the present value calculation. In our opinion, L, when interpreted as a systematic risk premium, is greater than zero.

51. In a standard STPR environment, the risk premium is generally set by the Consumption Capital Asset Pricing Model (CCAPM). This produces very low empirical estimates. However, augmenting this model to allow for rare disaster risk raises this estimate to approximately 0.3% – 0.5%. When combining all sources of systematic risk, an STPR risk premium of 0.5% can be justified.

52. When triangulating with other sources, this estimate is low. Survey responses suggest values closer to 1%. International guidance in similar frameworks to the ones that underlie our reports generally lie in the 0% – 2% range.

53. There is strong evidence to suggest that the SOC – STPR risk premium gap, while being larger than for the risk-free rate, is much narrower than has sometimes previously been suggested. The history of Green Book discount rates from the early 1970s stemmed from HM Treasury aiming to address the low rates of return that nationalised industries were delivering compared to their private sector counterparts. If the SOC – STPR division gets too large, then problems arise. Theoretically, considerations of welfare should help explain financial market behaviour as well as setting the social discount rate.

54. Our central estimate for the SOC risk premium for the average public project is 1.9%. This is based on the observations that the UK equity premium now lies at c.5%, that the government can accept a lower price of risk than this because it experiences fewer frictions (including taxes) than the average investor, and because the "beta" of the average social project is approximately 0.4 – 0.5. This central SOC estimate of 1.9% is also broadly consistent with the risk premia allowed by the UK Regulators Network (UKRN) for utility companies.

55. Our recommendation, after balancing all this evidence, is that the Green Book applies a risk premium for the average social project of 1%. We recommend that the term structure of this risk premium is flat: 1% is applied at all maturities for standard projects. We therefore recommend a 3.0% short term rate, with the forward rate declining to 2.5% at 31 years, 2.25% at 76 years, and then remaining flat thereafter for standard projects.

56. Within the welfare framework of the Green Book, there is a strong theoretical argument to adjust this risk premium on a project-by-project basis according to the systematic risk of any individual proposal. Ignoring this artificially inflates the estimated welfare benefits from highly procyclical projects. Many of our academic experts and survey responses very strongly advocated for this approach.

57. Our opinion is that project-specific risk premia are disproportionate for many smaller and medium-sized projects. For transformational projects, wider and explicit welfare analysis will capture any risk effects outside a discount rate framework. But for mid-sized projects with distinctive risk characteristics, risk adjustment of the discount rate may be proportionate. We recommend that this is set by the project's beta; the extent to which its net benefits covary with aggregate consumption.

58. At present, high-quality evidence in the UK on public sector betas is lacking, and there is also evidence from financial markets that betas are less predictive of required rates of return than theory suggests under an SOC approach. While some international guidelines

give a concrete schedule of betas for social cost-benefit analysis, we understand that uptake of this practice has been patchy at best, even in departments that would benefit from a lower discount rate as a result.

59. Our recommendation, therefore, is that, at this stage, HM Treasury does not adjust for project-specific betas except where there are strong reasons to believe that this is practical, proportionate, and evidence-based. We further recommend that HM Treasury keeps this matter under active review and gathers the evidence base necessary to assess whether this recommendation is leading to sub-optimal economic analysis.

60. Projects that pay off at times of societal decline – for example, pandemic protection programmes – are an important special case. Investments that are highly protective to society in times of war or large-scale terrorist attacks are a further example. In most states of the world, such investments deliver low benefits, but they are extremely useful when they need to be brought to bear. Climate change economics has a strong history in applying this logic to justify greenhouse gas emission policies and investments. If benefits overwhelmingly arise when marginal utility is high, then using the standard discount rate can substantially underestimate the expected welfare gains from the project. We recommend that this is adjusted for in the social discount rate, with a risk premium of -0.5% at all horizons. We therefore recommend a 1.5% short term rate for such projects, with the forward rate declining to 1.0% at 31 years, 0.75% at 76 years, and then remaining flat thereafter.

61. The current guidance assumes that L contains existential risk, mortality risk, and the risk of obsolescence, each in unspecified quantities. We recommend that disaster risk is treated as we describe above, that the calibration of the social discount rate does not account for individual mortality risk, and that the risk of obsolescence is handled in the net benefits calculations.

What are the main conceptual issues and considerations when using discounting in appraisals involving private finance models?

Private finance models distribute the underlying risks of a project between the public sector and the private partner. We recommend that the rates used to set the unitary charge, and the way that this is discounted in a social cost-benefit analysis, reflect in a proportionate way the risks held by each party.

62. Private finance models provide two additional sources of complexity. First private providers apply SOC rates when negotiating the unitary charge, while these are discounted under Green Book guidance using an STP rate. This gives central importance to the STPR – SOC divide. Second, the underlying risk of the project is shared, often unequally, between the public sector and the private partner. The latter generally takes the early construction risk but then receives very low-risk unitary charge payments.

63. With the STPR – SOC divide now much narrower than it has been over recent years, the first point of complexity has significantly diminished. Whether any remaining gap between the two rates, when matched on maturity and systematic risk, is of policy significance is unclear. Comparing a risk-free gilt rate with a risk-compensating weighted

average cost of capital does not account for Principle 1 of this review; that the discount rate is adjusted for maturity and risk.

64. Private finance models act like corporate gearing; they give a residual claim to the public sector after the fixed unitary charge is paid. In principle, the public sector should then apply a higher risk-adjusted discount rate to the social benefits.

65. Whether, in practice, this can be done in a way that is practical, proportionate, and evidence-based is a matter that we leave for Green Book users and HM Treasury.

Should the discount rate be adjusted for issues such as place-based objectives and environmental scarcity?

No. For place-based objectives, we recommend that the Green Book retains its application of welfare weights to reflect regional differences in income. Differences in regional trajectories could also be considered. For environmental scarcity, we support the findings of the Environmental Discount Rate Review. In both cases, this will require that HM Treasury updates existing guidance beyond revising the discount rate.

66. We support the recommendations of the 2021 Environmental Discount Rate Review. Changes to physical environmental scarcity and limited substitutability of non-marketed goods, and the increasing willingness to pay for them, are reflected in relative accounting prices used in the numerator of the present value equation. Following the principle that the discount rate reflects maturity and risk only, such relative price adjustments are preferred to potentially confusing sector-level discount rates. Correctly accounting for the sustainability of economic growth requires clear treatment of stocks of wealth, not just flows of services, and is not solved by adjusting the discount rate.

67. Relative price corrections already happen in some departments, but it is important that the Green Book updates existing central guidance on these adjustments (Green Book, Chapter 6). The latest evidence indicates that relative prices for ecosystem services should increase at the rate of income growth as a default. We recommend that an evidence base for other sectors is developed so that carefully estimated bespoke adjustments can be deployed more widely.

68. To assess environmental sustainability, the Green Book currently recommends that an intervention's impact on natural capital stocks is evaluated via the *Enabling Natural Capital Approach (ENCA)* developed by Defra. Intervention level assessments of natural capital impacts help to prevent creeping incremental losses of strategic natural capital.

69. Our recommendation is that this approach can be both strengthened and broadened to other forms of wealth such as human capital and health, in line with ONS guidance following earlier advice from the Natural Capital Committee. This will provide a clear picture of the compatibility of government interventions with the government's long-term growth and wellbeing objectives.

70. Exceptions to the relative price adjustment rule exist where determinants of wellbeing are non-substitutable with consumption goods. Non-substitutability, irreversibility and irreplaceability require alternative valuation approaches. These could be treated separately in an economic appraisal via a shadow price approach, akin to HM Treasury's shadow pricing approach to carbon. The HM Treasury Biodiversity Working Group

proposed the *Target and Cost Approach* to shadow price biodiversity, which could provide a central accounting price as a default. This would be in line with HM Treasury's response to the *Dasgupta Review on the Economics of Biodiversity*, with the target formed by the Environment Act (2021) and the government's international commitments to the Convention on Biodiversity. These are pricing recommendations, not discount rate recommendations, in line with the principles of this review.

71. Issues of irreversibility, such as extinction or lock-in, are better handled by real options approaches than by standard discounting techniques.

72. While high-level recommendations in the current Green Book encourage consideration of the strategic impact of place-based costs and benefits, the economic analysis of projects recommends the use of welfare weights. These capture the fact that additional net-benefits to low-income areas are worth more in welfare terms than the same net-benefit to higher income areas. Welfare weights help capture place-based issues to the extent that disparities in income are a sufficient measure of distributional concerns.

73. Welfare weights are inconsistently used in government cost-benefit analysis. We recommend that they are deployed as a matter of course in government appraisal as a numerator correction to net benefits. We do not recommend regional-specific discount rates. Disparities in the growth trajectories of different regions can be accommodated by time-varying welfare weights to reflect convergence or divergence if such an adjustment is proportional.

74. Many expert academic panellists and survey respondents expressed concern that welfare weights and relative price adjustment schedules are not sufficiently well-developed in the current Green Book guidance. Welfare weights are essential if distributional issues are to be addressed in valuation and a single schedule of consumption discount rates is to be applied to all projects.

75. We recommend that measures of inequality aversion are harmonised for intertemporal welfare weights and interpersonal welfare weights so that $\mu = \epsilon = 1.25$. If one person has half the income of another, this places 2.4 times more weight on their wellbeing. We also recommend that the appropriateness of mean versus median consumption as the reference for welfare weighting be carefully thought through.

76. We strongly recommend that HM Treasury further considers how inequality and fairness are treated in public appraisal, and its sufficiency for addressing strategic place-based concerns. Recent advances in international guidance provide a precedent for HM Treasury to consider.

Should the social discount rate be adjusted for transformational projects, and if so, how?

Transformational projects are too complex for the application of a standard discount rate: explicit welfare analysis is required instead. If HM Treasury decides instead to apply discount rates to such projects, we recommend that the risk-free component is the same as for all other projects of the same maturity, and variations from $L = 1\%$ may be permitted if evidence based.

77. Present values provide information about the expected changes in social welfare arising from investing in public projects. But discounting and present values represent a specific type of welfare economics that relies on many assumptions – both theoretical and empirical.

78. The central 3% social discount rate that we have laid out above is proportionate for use in the economic evaluation of smaller and less complex projects. For projects of medium complexity, certain project-specific adjustments to the discount rate may be necessary to account for variations in systematic risk. Declining discount rates will also apply for maturities longer than 30 years, which would be less likely for smaller projects. For the most complex transformational projects, or extremely long-maturity projects such as nuclear decommissioning, no generic discount rate schedule may be applicable because of their highly project-specific welfare impacts.

79. Transformational projects are likely to involve all the complexities that we have discussed in previous sections; regional effects, environmental effects, the use of private finance models, real options characteristics, and potentially very long maturities. They may even affect the growth rate of the economy itself. Because of these complexities, applying a standard centralised discount rate risks failing the principle of proportionality. Our recommendation is that major transformational projects are afforded detailed welfare analysis aligned with their scale and macroeconomic impact. Nuclear decommissioning also requires special consideration because of the ultra-long maturities involved. We discuss this further in the *Technical Annexes*.

80. If HM Treasury does decide to continue to use discount rates for transformational projects and nuclear decommissioning, there is no convincing case to deviate from the principles and empirical values that have been recommended earlier in this report.

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