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Valuing the Future: Legal and Economic Considerations for Updating Discount Rates

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Introduction

A dollar today is worth more to most individuals than a dollar tomorrow. A dollar today affords individuals more certain and instant consumption opportunities, for example, or could be invested to grow over time. Such economic concepts have historically compelled government decisionmakers to discount future costs and benefits to some degree when analyzing policy options. Discounting allows apples-to-apples comparison between the present values of, for example, regulatory costs occurring next year versus regulatory benefits occurring over the course of multiple decades.

Selecting appropriate discount rates is more than a technical choice. Discount rates strongly influence which actions government can or cannot justify as net beneficial to society. The choice of discount rates also raises thorny empirical and ethical questions about how society today values the future. With the Biden administration signaling openness to revisiting the discount rates that federal agencies apply in regulatory analysis, this article explores the legal standards and economic principles that should inform updated guidance on discounting.

Since 2003, federal guidance has recommended that agencies calculate two separate estimates of net present value in typical regulatory analyses, with future costs and benefits discounted alternately at default rates of 3% and 7%.[1] These rates were based on data from 1973-2003 on financial returns on U.S. Treasury notes and on market investments of private capital, estimated in 2003 to be about 3% and 7%, respectively. Future costs and benefits are discounted by applying a discount factor equal to $\frac{1}{(1+r)^t}$ where *r* is the discount rate and *t* is the discrete number of years in the future when the effect will occur.[2] For example, if $1 million in benefits is estimated to occur in the year 2050, the present value in year 2022 is less than a half million at a 3% discount rate, and only $150,000 at 7%.

Table 1: Discounting a $1 Million Effect from a Future Year Back to Present Value in 2022

	Discount Rate					
Year When Effect Occurs	7%	3%	2.50%	2%	1.50%	0%
2022	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
2030	$582,009	$789,409	$820,747	$853,490	$887,711	$1,000,000
2050	$150,402	$437,077	$500,878	$574,375	$659,099	$1,000,000
2100	$5,106	$99,700	$145,726	$213,396	$313,075	$1,000,000
2150	$173	$22,742	$42,398	$79,283	$148,712	$1,000,000
2200	$6	$5,188	$12,335	$29,456	$70,639	$1,000,000
2300	$0.01	$270	$1,044	$4,066	$15,938	$1,000,000

[1] Office of Mgmt. & Budget, *Circular A-4 on Regulatory Analysis* 33–34 (2003) [hereinafter "*Circular A-4*"].

[2] *Id.*

For many policy analyses, federal agencies often select a time horizon of 30 years or less,[3] and so implicitly assume that the costs and benefits of government action will mostly fall on the current generation of the affected population. Even over a single-generation time horizon, the choice of discount rate can greatly influence which policy options can be cost-benefit justified. If regulations impose upfront costs on regulated entities but deliver long-term benefits, lower discount rates may demonstrate the policy's large net social benefits, whereas higher discount rates could show the same policy to have net costs instead.[4]

As influential as the choice of discount rate can be on cost-benefit analyses conducted over a single-generation time horizon, the choice is even more determinative for inter-generational analyses. Government actions that address climate change, long-lived toxic pollutants,[5] and even education[6] or product safety[7] can affect future generations over decades or centuries. Over the course of just 80 years, a 7% rate discounts away 99.5% of a future effect's value (see Table 1). The discount factor compounds exponentially over time and so can be decisive for long-term cost-benefit assessments. And over prolonged timeframes, estimates of what the future discount rate should be—and ethical questions of what the current generation owes to the future—become more complex. While the choice of discount rates is crucial even when assessing intra-generational impacts, its importance is magnified in the inter-generational context.

The federal government may soon review the discount rates for assessing regulatory costs and benefits. On his first day in office, President Biden signed a *Memorandum on Modernizing Regulatory Review*, calling on agencies to ensure that their regulations would "promote the public interest" by fully considering "equity, and the interests of future generations," and by reflecting "new developments in scientific and economic understanding."[8] That same day, President Biden also signed an Executive Order instructing agencies to ensure that their valuations of climate costs "are based on the best available economics and science" and "adequately take account of…intergenerational equity."[9] Because both instructions implicate the discount rates applied over long time horizons, this article explores the legal and economic considerations for updating discount rates.

This article focuses on climate policy as a prime instance where the long-term benefits of government actions must be compared to upfront costs. But this article's recommendations apply more broadly to discounting both intra-generation and inter-generation effects across policy contexts. Similarly, while this article focuses on the discount rates chosen for federal regulatory analyses, many of the same economic and legal arguments apply with equal force to other contexts, including federal programmatic reviews or state-level analyses.

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[3] *See id.* at 34.

[4] For example, the Department of Transportation's recent vehicle efficiency proposal shows that, for some alternatives, private consumers could experience net costs over the next few decades if calculated at a 7% discount rate, but net benefits if calculated at 3%. 86 Fed. Reg. XX, XX, tbls. III-37 & -38 (Sept. 3, 2021) (note the proposal also generates significant long-term climate benefits; those effects are excluded from this example, to demonstrate how discount rates can influence near-term costs and benefits).

[5] *E.g.*, 86 Fed. Reg. 4198, 4263 (Jan. 15, 2021) (monetizing effects of lead exposure on lifetime earnings for children born in the next 35 years).

[6] *E.g.*, Head Start Performance Standards, 81 Fed. Reg. 61,294 (Sept. 6, 2016) (recognizing increased lifetime earnings benefits for early education, but not quantifying them).

[7] *E.g.*, Lead-Soldered Food Cans, 58 Fed. Reg. 33,860 (June 21, 1993) (calculating lifetime earnings benefits to unborn children).

[8] Memorandum on Modernizing Regulatory Review §§ 1, 2(a), 2(b)(i), 86 Fed. Reg. 7223, 7223 (signed Jan. 20, 2021, published Jan. 26, 2021).

[9] Exec. Order No. 13,990 § 5(b)(ii)(D)-(E), 86 Fed. Reg. 7037, 7040-41 (signed Jan. 20, 2021, published Jan. 25, 2021).

The federal government has repeatedly revised its recommended discount rates downward over time, as recounted in Section I of this article. Section II details the compelling economic evidence for once again lowering the current default rates for regulatory analyses. Not only is 7% too high an estimate for a "capital-based" rate, but capital-based rates are inappropriate to apply to many key policy contexts, including climate change. While a "consumption-based" rate is more broadly applicable, recent data points strongly to a rate below 2% (as opposed to the current default of 3%). And such a rate should be further adjusted downward to account for long-term uncertainty, irreversible future damages to non-market goods, insurance premiums, and ethical considerations. Section III then reviews the legal standards for implementing such revisions. Statutes and executive orders charge agencies to base decisions on the best available data and to consider future generations' welfare. Though agencies must thoroughly explain their discounting choices, agencies have discretion to lower their discount rates consistent with updated evidence and ethical obligations. Agencies especially must justify any choices to apply different discount rates to different contexts or effects, but a declining discount rate framework can consistently harmonize agency practices and so put agencies on sound legal footing in their approach to valuing the future.

I. Background on Discounting

This section reviews the most common rationales for discounting and approaches for estimating rates. Notably, the federal government has repeatedly revised its discount rates downward over time as developments emerged.

I.A. Overview of Common Rationales for Discounting, and Their Limits

Government decisionmakers rely on several rationales for discounting in *intra-generational* contexts—that is, analyses conducted over a time horizon usually 30 years or less, when a single generation is assumed to be predominantly affected. Some of those rationales apply awkwardly at best to *inter-generational* contexts, when future generations are substantially affected. (Of course, no clear bright line in time demarcates a new generation or the switch from intra- to inter-generational.)

The "pure rate of time preference" reflects the fact that "people generally prefer present to future consumption."[10] Besides a psychological preference shared by most people for more instant gratification,[11] future costs and benefits carry a probability of failing to occur. Individuals cannot collect future benefits from the government if, in the intervening years, they die, the government collapses, or other contingencies occur.

However, the concept of pure time preference becomes exceedingly fraught when moving from intra-generational to inter-generational contexts. Instead of merely reflecting that individuals prefer present welfare over their own future welfare, a positive inter-generational time preference implies that current generations should value their own welfare over future generations' welfare. Many, though not all, economists and philosophers express serious qualms about such a justification for inter-generational

[10] *Circular A-4* at 32.

[11] However, time-inconsistent preferences and internalities show we are not always rational stewards of our future selves (e.g., smoking), and market failures may disrupt our ability to make fully informed, rational trade-offs between present and future consumption (as with energy efficiency investments). *See* Bethany Davis Noll et al., *Shortchanged* 18 (Policy Integrity Report, 2020), https://policyintegrity.org/files/publications/Clean_Car_Standards_Rollback_and_Fuel_Savings_Report.pdf (on how myopia and other market failures artificially appear to inflate consumers' discount rates); *see also* Richard L. Revesz, *Environmental Regulation, Cost-Benefit Analysis, and the Discounting of Human Lives*, 99 COLUMB. L. REV. 941, 1016 (1999) (on offsetting discount rates to account for dread about future health impacts).

discounting.[12] It is hardly clear that contemporary time preferences should guide society's treatment of future generations who lack any say in the process. (See Section II.C for more on this argument.)

Similarly, the possibility that, at some future point, the human race may not exist (due to natural, extra-planetary, or political disasters) may justify some exceedingly low inter-generational time preference, since current generations need not value the welfare of non-existent future generations. Yet it is ethically questionable for the current generation to justify discounting the future due to extinction if the current generation's policy choices exacerbate the risk of future extinction (due, for example, to inaction on climate change).[13]

Another rationale for discounting is that individuals may expect to become wealthier over time.[14] Consumption rates have increased over most of U.S. history.[15] The principle of "diminishing marginal utility of consumption" states that as total consumption increases, the value of a marginal unit of consumption decreases. In other words, one extra dollar is worth less to individuals the wealthier they become. The growth rate of consumption, therefore, is an appropriate consideration in intra-generational discounting.

Economists also generally expect future generations to be wealthier and so may value an additional increment of material consumption less than the current generation. If true, some level of inter-generational discounting is justifiable, to prevent government actions from inefficiently transferring resources from poorer people today to richer people tomorrow.[16] However, continued economic growth into the future is by no means certain, especially in the face of climate-based economic disruptions. Such uncertainty must factor into the chosen discount rate. (See Sections II.D.1-2 for more.)

The inter-generational context raises other issues for growth-based discounting. For example, environmental quality is a prominent category of inter-generational effects from government actions. Increased material wealth tends to increase individuals' relative valuation of environmental quality. Materially wealthier future generations may value environmental protections more highly than current generations,[17] particularly if environmental goods and services become scarcer due to human-driven pressures including climate change. Economists propose that discount rates should be adjusted downward to reflect that increased valuation.[18] (See Section II.E for more.)

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[12] *See* Richard L. Revesz & Matthew R. Shahabian, *Climate Change and Future Generations*, 84 S. CAL. L. REV. 1097, 1105-06 (2011) (summarizing this debate); *see also* Ramsey, *A Mathematical Theory of Savings*, 38 ECON. J. 543, 543 (1928) (quipping that the "ethically indefensible" practice of "discount[ing] later enjoyments in comparison with earlier ones" simply "arises merely from the weakness of the imagination"). In a prominent expert elicitation, the mode response—that is, the most commonly given response from experts—was a pure time preference of zero. Moritz Drupp et al., *Discounting Disentangled*, 10 AM. ECON. J.: ECON. POL'Y 109 (2018).

[13] The United Kingdom's *Stern Review on the Economics of Climate Change*, for example, added 0.1% to its discount rate based on this justification, though the authors admitted that even that value "seems high"; only an "infinitesimal" discount rate could be justified on such grounds. Revesz, 99 COLUMB. L. REV. at 1001.

[14] A related motivation for discounting assumes technological advancement. Individuals may hope that by deferring costs, something better will materialize: a person might discount the costs of future hearing loss from not wearing earplugs at concerts if she thinks scientists will soon invent a cure for hearing loss. Similarly, society may hope technological advances will cheaply resolve climate change and so may want to discount future climate costs. However, for potentially catastrophic harms like climate change, risk aversion counsels against high discount rates based on technological dreams. *Id*.

[15] *Circular A-4*.

[16] *But see* Revesz & Shahabian, 84 S. CAL. L. REV. at 1155 (observing that some climate benefits of U.S. government action will accrue to future developing countries, who may still be less financially advantaged than the current U.S. generation).

[17] *Id.* at 1159.

[18] Future generations' increased willingness-to-pay could also be valued directly rather than through discount adjustments. *See e.g.*, W. Kip Viscusi et al., *Responsible Precautions for Uncertain Environmental Risks*, 10 J. BENEFIT COST ANAL. 296, 312 (2019).

A related argument grounds discounting in the fact that resources not consumed today can be invested and, normally, earn financial returns. Spending $100 in regulatory costs today to generate $150 in regulatory benefits after ten years may not be a good deal if the $100 could have earned 7% per year and so instead become almost $200 after ten years.[19] Under this theory, forgone returns on investment must be discounted from future benefits, as opportunity costs.

This concept may seem to break down for non-financial effects, like health benefits or environmental damage. After all, you cannot invest a year of life now and earn two extra years in the future.[20] Yet the resources that society would have spent to preserve health benefits or offset environmental damages today can be invested to earn returns that could potentially be put toward greater future benefits.[21] Studies suggest that, in the intra-generational context, individuals' rates of time preference for their own health risks are similar to market interest rates—about 2%, after adjusting for inflation.[22] Accordingly, intra-generational discounting for both market and non-market goods can make sense.

However, longer time horizons raise practical and conceptual challenges for discounting based on opportunity costs. As a practical matter, except for property there are few inter-generational assets to observe in the market and from which to derive a discount rate; market rates reflect individuals' private preferences for financial returns, but society may have different preferences, especially over the course of multiple generations. More conceptually, can the current generation assume that future generations will willingly trade risks to their health and environment in exchange for money? Will money invested today in financial returns rather than in societal programs actually go toward future health and environmental protections?[23] If the current generation, for example, lets polar bears go extinct to save money but plans to put future financial returns instead toward reviving an even larger panda population, will future generations be satisfied, or are some costs and benefits incommensurable across time or irreversible?[24] Such considerations warrant adjustment of the discount rate in intergenerational contexts, as explored below in Section II.

I.B. Overview of Methods for Estimating the Discount Rate

The federal government's current default discount rates are derived from market data. The 7% social opportunity cost of capital (SOC, or "capital-based") estimate is, as the name implies, based heavily on the opportunity cost justification for discounting. The approach assumes that government actions disrupt private capital investment, which could otherwise have earned financial returns, and so

[19] Council of Econ. Advisers, *Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate* 1 (Issue Brief, 2017) [hereinafter "CEA"] ("[R]esources that are required to be invested by government regulations displace capital that would otherwise be earning a positive return.").

[20] Revesz, 99 COLUMBIA L. REV. at 974.

[21] *Circular A-4*.

[22] Revesz, 99 COLUMBIA L. REV. at 956-957.

[23] Interagency Working Group on the Social Cost of Carbon, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866, at 18 (2010) [hereinafter "2010 TSD"] ("[T]here is no assurance that returns will actually be set aside to provide compensation, and the very idea of compensation is difficult to define in the intergenerational context.").

[24] Revesz & Shahabian, 84 S. CAL. L. REV. at 1148 ("We cannot say the replacement value of killing off the panda bear is 2.5 grizzly bears per panda bear."); *id.* at 1150 (""[W]e can always set aside money for future generations, but by doing so instead of investing it in mitigating [climate change], we may leave future generations with irreversible damage."). Additionally, with climate change, forgoing cheaper mitigation options now and letting the climate deteriorate could leave the future with only exponentially more expensive mitigation options. *Id.* at 1152.

estimates the discount rate based on market rates of return to real estate, small business capital, and corporate capital.[25]

The social rate of time preference (SRTP, or "consumption-based") approach assumes instead that how average savers trade off their own current for future consumption should be the measure of how society as a whole should discount. The consumption-based estimate is more closely connected with the pure time preference and growth justifications for discounting.[26] The tax-free rate of return on low-risk securities is a common proxy for this kind of discount rate; the federal government's current 3% estimate is based on U.S. Treasury note yields from 1973-2003.[27]

Discounting all costs and benefits at the capital-based rate would be most theoretically appropriate only when all costs and benefits primarily affect private capital investment decisions. Similarly, discounting all effects at the consumption-based rate would be most appropriate when government actions predominantly affect consumption choices.[28] In reality, government actions may to some extent affect both investment and consumption. Though analysts could try to estimate what proportion of costs and benefits will primarily affect either investment or consumption and discount at the corresponding rate (sometimes called the "opportunity cost" approach), such disaggregation is typically technically impractical. A related approach—often considered the "analytically preferred" method[29]—is "shadow price" discounting. In shadow price discounting, all costs and benefits are first adjusted to reflect their value in equivalent units of consumption;[30] then the SRTP is applied to discount those consumption-equivalent values back to present values. However, shadow price adjustments "are not well established for the United States," as the relative distribution of regulatory impacts on capital versus consumption is not typically known.[31] As explained below (Section II.B), climate change is a major exception where a shadow price approach to discounting is practical.

The Ramsey equation offers a different technique for calibrating discount rates. Under basic economic assumptions,[32] the simple Ramsey equation is

$$r = \rho + \eta \times g$$

where ρ is the pure rate of time preference, η is the elasticity of the marginal utility of consumption (and also reflects relative risk aversion and aversion to temporal inequality), and *g* is the growth rate in per capita consumption. These parameters can be calibrated to market data, expert elicitations, or other empirical or normative valuations. Importantly, the equation can also be expanded to add additional parameters to capture growth uncertainty, risk aversion, and other adjustments reflecting the latest

[25] *Circular A-4* at 33. Though the marginal rate of return would be the preferred data point, "[i]n practice, it is not clear how to estimate marginal returns, and therefore average rates of returns are measured." CEA at 4 (explaining that average rates could be higher or lower than marginal rates).

[26] *See* CEA at 3.

[27] *Id.* at 3 (referencing tax-free or after-tax rates on Treasury bills); *but see id.* at 2 (referencing pre-tax rates).

[28] *Circular A-4* at 33.

[29] *Id.*; *accord* EPA, EPA, *Guidelines for Preparing Economic Analysis* (2010).

[30] *See* Qingran Li & William A. Pizer, *Discounting for Public Benefit-Cost Analysis* (Resources for the Future Issue Brief 21-05, June 2021) ("'Shadow price' refers to society's valuation of some good or service when market prices are either lacking or distorted by taxes, regulation, or market failures. In the case of capital, a large part of capital income is being taxed away by the government and then used to benefit society. When a household thinks about saving for the future, however, it typically does not consider the societal value of tax revenue. For BCA, we need to value that revenue.").

[31] *Circular A-4* at 33.

[32] Specifically, assuming an ideal world under certainty, isoelastic preferences, and perfect substitutability between market and non-market goods. As explored below, real-world updates, like limited substitutability, prompt adjustments to the discount rate.

economic and ethical literature. Section II explores how the extended Ramsey equation reveals that discount rates should be lower than current estimates.

Any of these approaches can estimate a single, constant discount rate to apply to all future effects, no matter how distant. For example, if market forecasts for future returns remain steady and no adjustments are made for inter-generational considerations, a single, constant estimate based on market data (like a 3% consumption-based rate) could be applied to all effects, whether they will occur 1, 10, or 100 years into the future. Similarly, if estimates of the growth rate, pure time preference, and other parameters are held constant into the future, the Ramsey equation can generate a constant discount rate.

However, any of these approaches can also estimate a declining discount rate schedule, under which rates decrease over time. For example, if market forecasts show lower rates of return in the future,[33] or if the economy-wide growth rate is projected to slow over time,[34] either a data-based estimate or a Ramsey-based estimate could indicate that the discount rate should drop in the future. A declining discount rate schedule means that the discount factor will decrease more slowly over time, and so distant effects preserve more of their value than they would under a constant discount rate.

As the next subsection recounts, the U.S. government has historically used the capital-based and consumption-based approaches to select constant rates based on market data. However, other jurisdictions have used more normative-based approaches and adopted rates based on declining or step-function schedules. For example, the United Kingdom's guidance published in 2008 factored long-term uncertainty and intergenerational equity into its calibration of Ramsey parameters, and recommended discounting at 3.5% for the first thirty years, then dropping to 3% through year 75, and continuing down to 1% after year 301 (with sensitivity analysis starting at 3% and dropping to 0.86%).[35] Given that the U.S. government has shown increasing openness over time to revise its rates down and consider ethical principles, moving toward declining discount rates could be the next step in the evolution of federal guidance on discounting.

I.C. Historical and Current Practices to Discounting

Through history, the federal government has tended to revise its discount rates down.

1. OMB's Downward Rate Revisions

The Office of Management and Budget (OMB)—and its component Office of Information and Regulatory Affairs (OIRA)—reviews federal agencies' regulatory analyses, as well as cost-effectiveness analyses of programs, investments, and other decisions. OMB has regularly revised its discounting guidance based on updated empirical evidence and developments in expert opinion. Over time, the recommended rates have trended downward, and OMB has increasingly moved away from discounting based solely on the capital-based or opportunity cost approaches.

In 1969, OMB issued *Circular A-94: Discount Rates to Be Used in Evaluating Time-Distributed Costs and Benefits* and set the recommended discount rate at 10%, representing average, before-tax private returns; three years later, in 1972, OMB revised the Circular to clarify that the rate was required for budgetary analyses and "suggested" for other executive branch planning (to the extent other laws or

[33] *See infra* Section II.A.

[34] *See infra* note 178.

[35] H.M. Treasury, *Intergenerational Wealth Transfer and Social Discounting: Supplementary Green Book Guidance* 5 (2008). Note that effects in, for example, year 75, are not discounted all the way back to year 0 at 3%; rather, they are discounted first back to year 30 at 3%, and from year 30 back to year 0 at the starting 3.5% rate. *See id.* at 6 (showing discount factors).

executive guidance did not prescribe different rates).[36] In its 1981 *Interim Regulatory Impact Analysis Guidance*, OMB clarified that agencies could test the sensitivity of their regulatory analyses to other discount rates.[37] But, as Michael Livermore recounts in his scholarship, the Environmental Protection Agency (EPA) quickly began marshalling evidence and expert opinions to support lower rates consistent with a consumption-based approach; over time, EPA helped persuade OMB first to recognize the role of consumption-based rates and, ultimately, to lower its recommended estimates.[38]

In 1992, OMB revised *Circular A-94* and reduced the default discount rate for regulatory analyses to 7%.[39] This rate approximated private returns to capital in "recent years," though OMB acknowledged that regulations would tend to "displace both private investment and consumption," and OMB felt a shadow price approach would be "analytically preferred."[40] Perhaps due to such considerations, OMB told agencies they should test their analyses' sensitivity to other discount rates.[41] Notably, *Circular A-94* announced that the default 7% rate would be revised in "future updates" to reflect any "[s]ignificant changes" in data.[42] *Circular A-94* also announced that, unlike for regulatory analyses, cost-effectiveness analyses of federal programs and investments "should use the real Treasury borrowing rate on marketable securities of comparable maturity."[43] In 1992, that indicated discount rates between 2.7%-3.8% for analyses of federal programs and investments.[44]

In 1996, in its guidance on *Economic Analysis of Federal Regulations under Executive Order 12866*, OMB stuck with the default 7% rate but expanded its discussion about how a shadow price approach would be preferred.[45] OMB suggested the alternate approach, though methodologically challenging, could apply in special cases, such as when access to global capital indicated that regulations were unlikely to "crowd[] out" private investment, and when regulations "raise special questions about equity" "across generations."[46] By the early 2000s, OMB observed that agencies "often" applied alternative rates around 3%, based on the social rate of time preference,[47] and OMB began considering broader revisions.

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[36] *See* William S. Heffelfinger, Asst. Sec'y, Dept. of Transp., Discount Rates to be Used in Evaluating Time-Distributed Costs and Benefits, DOT Order 5000.1, June 30, 1972, https://perma.cc/N5AX-UNFD (explaining the "primary reasons" why OMB's original 1969 circular was being revised); OMB Circular A-94 at 2, 4 (revised 1972) (defining the discount rates), https://perma.cc/HZ58-M2FM. *See also* 57 Fed. Reg. 35,613, 35,613 (Aug. 10, 1992) ("[I]n 1972…the Circular specified a 10 percent real discount rate for use in most…analyses."); Randolph M. Lyon, *Federal Discount Rate Policy, the Shadow Price of Capital, and Challenges for Reforms*, 18 JEEM S-29, S-30 to S-32 (1990) (citing the 1972 version and describing exceptions to the 10% rate); Richard O. Zerbe Jr. et al., *A History of Discount Rates and Their Use by Government Agencies* (2002), https://perma.cc/JSB9-KVZJ (reporting that *Circular A-94* applied "to all agencies of the executive branch," with a few exceptions). Water resources projects have historically been subject to their own congressional and executive guidance on discounting. CRS, *Discount Rates in the Economic Evaluation of U.S. Army Corps of Engineers Projects* (2016), https://crsreports.congress.gov/product/pdf/R/R44594/4.

[37] Michael A. Livermore, *Cost-Benefit Analysis and Agency Independence*, 81 U. CHICAGO L. REV. 609, 643 (2014).

[38] *Id.* at 643-44 ("In essence, by 2003, OIRA had adopted the discounting approach developed by EPA in 1984.").

[39] OMB, *Circular A-94* at 9, 57 Fed. Reg. 53,519 (Nov. 10, 1992).

[40] *Id.; see also* 57 Fed. Reg. at 35,614 (explaining that compared to a 10% rate, a 7% rate was "more consistent with a variety of other discounting principles…includ[ing], under some assumptions, the shadow price of capital approach").

[41] *Circular A-94* at 9.

[42] *Id*.

[43] *Id*.

[44] *Circular A-94*, Appendix C, 57 Fed. Reg. at 53,528.

[45] *Available at* https://georgewbush-whitehouse.archives.gov/omb/inforeg/riaguide.html, https://perma.cc/N62R-4CYG.

[46] *Id.*

[47] *See* Jacob J. Lew, OMB Director, M-00-08: Guidelines to Standardize Measures of Costs and Benefits and the Format of Accounting Statements 7 (Mar. 22, 2000), https://www.whitehouse.gov/wp-content/uploads/2017/11/m00-08.pdf, https://perma.cc/BS7B-HULY; *see also id.* at 7-8 (asking agencies to check with OMB before using a shadow price approach or a

In 2003, OMB issued new guidance, *Circular A-4: Regulatory Analysis*, which significantly revised the discounting recommendations for regulatory analyses. After first reiterating that the shadow price approach is analytically preferred but challenging to implement, *Circular A-4* recommended two "default" rates.[48] First, a 7% capital-based discount rate, noting that rate would be most appropriate if "the main effect of a regulation is to displace or alter the use of capital in the private sector."[49] The 7% estimate was grounded in the same analysis conducted in 1992 for *Circular A-94* (though OMB insisted in 2003 that "recent analysis" confirmed the rate "remains near" 7%).[50]

Second, *Circular A-4* recommended also using a 3% consumption-based rate, estimated from the average return on 10-year U.S. Treasury notes from 1973 to 2003.[51] OMB explained this rate was most appropriate "[w]hen regulation primarily and directly affects private consumption (e.g., through higher consumer prices for goods and services)."[52]

Finally, *Circular A-4* recommended applying additional rates in sensitivity analyses when regulations either are likely to cause resource allocations away from corporate investments,[53] or present important intergenerational effects. Specifically, *Circular A-4* explained that agencies may consider "lower but positive discount rate[s]," in addition to the default rates, for rules with "important intergenerational benefits or costs."[54]

Meanwhile, OMB continues to revise *Circular A-94*'s Appendix every year to update discount estimates for cost-effectiveness analyses of federal programs, based on the latest Treasury interest rates. Appendix C explicitly does not change the discount rates for regulatory analyses or benefit-cost analyses of public investments,[55] even though *Circular A-4*'s 3% rate was based on similar data. Since 2008, *Circular A-94*'s rates for cost-effectiveness analyses have consistently been under 3%. In 2021, all rates fell to negative numbers: from -1.8% for 3-year real Treasury interest rates, to -0.3% for 30-year real Treasury interest rates.[56]

special intergenerational discount rate; alternatively advising agencies not to modify the discount rate for intergenerational equity, uncertainty, or expected changes in relative prices, and instead to deal with those considerations in other ways).

[48] *Circular A-4* at 33.

[49] *Id.* (reflecting returns to real estate, small business capital, and corporate capital).

[50] *Id.*

[51] *Id.* at 33-34.

[52] *Id.* at 33.

[53] *Id.* at 34.

[54] *Id.* at 36.

[55] *See, e.g.*, Russell T. Vought, OMB Director, M-21-09: Memorandum for the Heads of Executive Departments and Agencies, 2021 Discount Rates for OMB Circular No. A-94 (Dec. 21, 2020) ("The rates presented in Appendix C do not apply to regulatory analysis or benefit-cost analysis of public investment. They are to be used for lease-purchase and cost-effectiveness analysis."); *accord* 60 Fed. Reg. 9414 (Feb. 17, 1995) (similar).

[56] OMB, Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94, Dec. 21, 2020, https://www.whitehouse.gov/wp-content/uploads/2020/12/discount-history.pdf, https://perma.cc/NU9E-3RB6.

Table 2. OMB Revisions to Default Discount Rates Over Time

Year	Document	Default Rates (and Basis)	Alternate Rates & Exceptions
1969, revised 1972	*Circular A-94*	10% (SOC) for most cost-benefit and cost-effectiveness analyses	When otherwise set by law. Treasury rates for lease-purchases and water project investments.
1981	*Interim RIA* Guidance	10% (SOC) for regulatory analyses	Test sensitivity to other rates.
1992	*Circular A-94*	7% for regulatory analyses (SOC, informed by shadow price approach) 2.7%-3.8% (depending on timespan) for cost-effectiveness analyses of federal investments and programs (based on real Treasury rates)	Agencies "should" conduct sensitivities. Shadow price approach is preferred. "Future updates" to rates will reflect "significant changes" in data.
1996	*Economic Analysis* Guidelines	7% for regulatory analyses (SOC)	Intergenerational equity and special cases may warrant a shadow price approach using consumption-based rates.
2003	*Circular A-4*	3% (SRTP) and 7% (SOC) for regulatory analyses	Encourages lower rates for intergenerational contexts. Shadow price approach is preferred but difficult.
1995-2021 (updated annually)	*Circular A-94*: Appendix C	Since 2008, rates for cost-effectiveness analyses have consistently been <3% across all investment timespans. In 2021, all rates fell to negative numbers: e.g., -1.8% for 3-year real Treasury rates; -0.3% for 30-year real Treasury rates.	Explicitly does not apply to regulatory analyses or other benefit-cost analyses (even though *Circular A-4*'s 3% rate was based on similar data).

OMB has repeatedly revised its default discount rates, and three decades ago announced its intention to update its recommendations whenever the data changed significantly.[57] More recently, in a 2015 document discussing discount rates for inter-generational climate effects, OMB called *Circular A-4* "a living document, which may be updated as appropriated to reflect new developments."[58]

In 2017, the U.S. Council of Economic Advisers (CEA) published an issue brief on the *Theory and Recent Evidence on the Merits of Updating the Discount Rate*.[59] The brief observed that OMB's default discount rates were "not based on timeless truths but instead on actual economic opportunities and observed market behavior, which changes over time."[60] CEA called for updating *Circular A-4*'s default discount rates, based on more recent data. As explored below (Section II), CEA's arguments for revised discount rates have only grown stronger since 2017.

[57] *Circular A-94*.

[58] Interagency Working Group on Social Cost of Carbon, Response to Comments: Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 at 36 (2015), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-response-to-comments-final-july-2015.pdf, [hereinafter "2015 RTC"]. OMB co-chairs the Working Group and published the request for comments, *id.* at 2.

[59] CEA, *supra*.

[60] *Id.* at 1.

2. Regulatory Precedents for Lower Rates

Before *Circular A-4*'s publication in 2003, agencies often picked their own discount rates.[61] Two examples of agencies applying lower discount rates in the face of long time horizons merit discussion. In 1987, EPA proposed regulations to protect the stratospheric ozone layer from chlorofluorocarbons, with anticipated reductions in skin cancer, cataracts, crop damage, and even sea-level rise.[62] Although OMB at the time recommended a 10% discount rate, EPA discounted benefits using a "central" estimate of 2%, with sensitivity analyses at 1% and 6%.[63] As EPA explained, the rule's long time horizon—benefits were projected over 89 years[64]—called for a "more refined selection."[65]

EPA observed that some methodologies produced "relatively high rates" that "impl[y] a systematic bias against the welfare of future generations," yet "[i]t is not at all clear that such an ethical stance is appropriate."[66] EPA explained that environmental damages could slow economic growth over longer time horizons,[67] and noted that ozone depletion could be "quasi-irreversible," with "catastrophic" ecosystem damages. Furthermore, the regulations would "not obviously displace private investments,"[68] and so a discount rate based purely on opportunity costs was not appropriate. Finally, EPA concluded the regulation's high insurance value from "avoiding both potentially projected damages and the possibility of large disruptions not encompassed in the standard estimation of discount factors" pushed the rates lower.[69] All these same arguments—uncertain economic growth, irreversible future damages, limited displacement of private investment, insurance premiums, and ethical considerations—remain potent arguments for lowering the discount rates today (*see* Section II).

Similarly, in 1999, the U.S. Department of Housing and Urban Development ("HUD") finalized rules for lead-based paint hazards in certain residences.[70] While OMB at that time recommended using only a 7% discount rate, HUD discounted the lifetime earnings benefits for young children who avoid lead exposure at both 3% and 7%. As HUD explained, a special "intergenerational discount rate" was applied because "lifetime earnings benefits will be realized by the children and grandchildren of the[] adult taxpayers" bearing the rule's costs.[71] HUD also discussed why the 7% discount rate may be less appropriate because the rule's costs, which would fall mostly on federally-assisted housing, would be funded not by private investments but by federal expenditures, and so would tend to increase federal borrowing rather than displace private capital.[72]

Since *Circular A-4*'s publication in 2003, however, agencies have mostly applied the default 3% and 7% rates,[73] even when agencies believe those rates underweight future welfare. In a recent rule on lead

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[61] Cass Sunstein, *Cost-Benefit Default Principles*, 99 MICH. L. REV. 1651, 1712 (2001); *see also* Edward R. Morrison, *Comment, Judicial Review of Discount Rates Used in Regulatory Cost-Benefit Analysis*, 65 U. CHI. L. REV. 1333, 1336 (1998).

[62] 52 Fed. Reg. 47,489, 47,494 (Dec. 14, 1987).

[63] *Id.* at 47,514.

[64] *See, e.g.*, *id.* at 47,499.

[65] EPA, Regulatory Impact Analysis: Protection of Stratospheric Ozone H-20 (Aug. 1, 1988), *available at* https://nepis.epa.gov/Exe/ZyPDF.cgi/9101PLVM.PDF?Dockey=9101PLVM.PDF, https://perma.cc/9WFP-7RPZ.

[66] *Id.* at H-19.

[67] *Id.* at H-20.

[68] *Id*. ("rather they tend merely to redirect private capital formation").

[69] *Id.* More recent stratospheric ozone rules have used 3% and 7% rates, following *Circular A-4*. *E.g.*, 81 Fed. Reg. 82,272, 82,344 (Nov. 18, 2016).

[70] 64 Fed. Reg. 50,140 (Sept. 15, 1999).

[71] *Id.* at 50,186.

[72] *Id.* at 50,187 (also considering a 4-5% discount rate, consistent with nominal costs of government borrowing).

[73] *See* W. Kip Viscusi, *Rational Discounting for Regulatory Analysis*, 74 U. CHI. L. REV. 209, 224-26 (2007).

hazards, for instance, HUD acknowledged that discounting at the 3% and 7% rates "giv[es] lower weight to future generations."[74] HUD nevertheless used those default rate, without any sensitivity analysis at lower rates.

Agency guidance on cost-benefit analysis reflects this shift. For instance, the 2000 edition of EPA's *Guidelines for Preparing Economic Analysis*, released three years before *Circular A-4*, advised analysts to apply discount rates between 0.5% and 3% in inter-generational contexts.[75] But EPA removed this specific recommendation when it updated those *Guidelines* in 2010, after *Circular A-4*'s publication. The updated *Guidelines* acknowledges the unique inter-generational issues and suggest alternative approaches, including declining discount rates, but does not endorse any specific lower values.[76]

But in 2010, multiple agencies—including OMB—announced a reinterpretation of *Circular A-4*'s guidance, to allow the exclusive use of lower, consumption-based discount rates in a key policy context: estimating the social cost of greenhouse gases.

3. Lower Rates Selected for the Social Cost of Greenhouse Gases

Following a U.S. Court of Appeals for the Ninth Circuit ruling—which found a regulatory analysis had arbitrarily ignored the monetary value of reducing future climate risks[77]—OMB convened in 2009 an Interagency Working Group to develop robust estimates of the social cost of greenhouse gas emissions. The Working Group applied the three most peer-reviewed reduced-form "integrated assessment models" (IAMs), which calculate how an additional unit of greenhouse gas affects atmospheric concentrations and temperature, and forecast how such temperature and weather changes will cause economic damages. Because greenhouse gases have long atmospheric lifespans and affect the global climate for centuries, climate damages can be projected through the year 2300 or beyond.

Since releasing its first social cost of carbon dioxide estimates in 2010, the Working Group—co-chaired by OMB—has consistently rejected application of capital-based discount rates in favor of focusing on consumption-based rates, including rates below 3%.[78] While the Working Group has acknowledged and justified this departure from *Circular A-4*'s default rates, the Working Group has also maintained that its discounting choices are consistent with *Circular A-4*'s broader principles.[79] Notably, the underlying IAMs present climate damages "in terms of reduced consumption (or consumption equivalents)."[80] As such, *Circular A-4*'s preference for shadow price discounting is actionable, and the consumption-equivalent climate damages can be discounted using consumption-based rates. The Working Group further cited

[74] 81 Fed. Reg. 60,304, 60,321 (Sept. 1, 2016).

[75] EPA, Guidelines for Preparing Economic Analysis 52 (2000), *available at* https://www.epa.gov/sites/production/files/2017-09/documents/ee-0228c-07.pdf.

[76] *See* EPA, Guidelines for Preparing Economic Analysis 6-18 to 6-20 (2010), *available at* https://www.epa.gov/sites/production/files/2017-09/documents/ee-0568-06.pdf. Other agencies' guidance follows a similar approach. *See, e.g.*, HHS, Guidelines for Regulatory Impact Analysis A-4 n.17 (2016) ("If your rule will have important intergenerational benefits or costs you might consider a further sensitivity analysis."); DOT, Regulatory Impact Analysis: Frequently Asked Questions 11 (Feb. 7, 2011).

[77] Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1197-98 (9th Cir. 2008).

[78] *See* 2010 TSD; Interagency Working Group, Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990 (2021) [hereinafter "2021 TSD"].

[79] *Compare* 2010 TSD at 17–18 ("adapt[ing] and revis[ing]" the default approach in *Circular A-4*) *with* 2015 RTC at 36 ("Circular A-4 is a living document. . . . [T]he use of 7 percent is not considered appropriate for intergenerational discounting. There is wide support for this view in the academic literature, and it is recognized in Circular A-4 itself.").

[80] 2021 TSD at 17.

long-term uncertainty and ethical responsibilities to future generations as grounds for rejecting the 7% capital rate as inappropriate.[81]

Instead, the Working Group settled in 2010 on the using three alternate consumption-based discount rates to present a range of estimates of the social cost of greenhouse gases: 2.5%, 3%, and 5%.[82] The 3% estimate, which the Working Group used as the "central value," was chosen to represent the SRTP as estimated by *Circular A-4*.[83] The 5% rate, which the Working Group presented as an upper bound, was "included to represent the possibility that climate damages are positively correlated with market returns"[84] (*see infra* Section II.D.2 for more on this idea). The Working Group presented the lower value of 2.5% to address multiple concerns, including that economic growth and discount rates are uncertain over time (*see* Section II.D.1), that climate damages might be negatively correlated with market returns (*see* Section II.D.2), and that rates derived solely from market data do not reflect ethical responsibilities to future generations on climate change (*see* Section II.C).[85]

Table 3. Social Cost of Carbon Dioxide Estimates (in 2020$, per metric ton)[86]

Year	Estimates at a 5% Discount Rate	**"Central" Estimates at a 3% Discount Rate**	Estimates at a 2.5% Discount Rate
2020	$14	**$51**	$76
2025	$17	**$56**	$83
2030	$19	**$62**	$89
2035	$22	**$67**	$96
2040	$25	**$73**	$103
2045	$28	**$79**	$110
2050	$32	**$85**	$116

Through the Obama administration, agencies sometimes included the Working Group's estimates calculated at 2.5% and 5% in their regulatory analyses, but typically focused on the social cost of greenhouse gas values calculated at 3% as the "central" values. In particular, recognizing that a 7% capital-based discount rate was inappropriately high for future climate effects, agencies would discount climate effects at 3% even when presenting other regulatory costs and benefits at 7%. Recall that *Circular A-4* advises agencies to typically run two alternate cost-benefit comparisons: one at a 3% discount rate, and one at 7%. In a 7% run on regulations with climate effects, an agency like the Department of Energy would, for example, discount a future manufacturer compliance cost or consumer cost-saving occurring in 2050 back to present value at 7%. But if the regulation also reduced carbon emissions in the year 2050, not only were future climate benefits through the year 2300 discounted at 3% to estimate a per-ton total climate benefit of $85 for an emissions reduction in 2050, but that future benefit of $85 per ton would be further discounted back to present value at 3%. Those present-value

[81] *See* 2010 TSD; 2021 TSD.

[82] 2010 TSD at 23. A fourth "high-impact" estimate highlighted the 95th percentile of the probability distribution of values calculated at the 3% discount rate.

[83] *Id.*

[84] *Id.* (also considering consumer smoothing).

[85] *Id.*

[86] 2021 TSD. The table shows rounded figures. Unrounded values are available at https://www.whitehouse.gov/wp-content/uploads/2021/02/tsd_2021_annual_unrounded.csv.

climate effects, discounted at 3%, were then stacked up against other costs and benefits discounted at 7%.[87]

In March 2017, the Trump administration released an executive order disbanding the Working Group and calling for revisions to reduce the social cost of greenhouse gas values, including by selecting discount rates to be "consistent with the guidance contained in OMB Circular A-4."[88] Thereafter, regulatory agencies during the Trump administration typically[89] (though not always[90]) applied social cost of greenhouse gas values using 3% and 7% discount rates in their regulatory analyses, on the mistaken assumption that *Circular A-4* required that approach. But as EPA continued to observe, applying a 7% rate to climate change did not adequately account for "tradeoffs between improving the welfare of current and future generations," and discount rates of 3% or lower are more appropriate in the intergenerational context.[91] EPA and other agencies during the Trump administration also continued to focus on values calculated at the 3% rate in their main analyses, even combining them with other costs and benefits calculated at a 7% rate, just as agencies had done during the Obama administration.[92]

In 2017, the National Academies of Sciences identified the tension from applying different discount rates to climate damages than to other regulatory costs and benefits, while also emphasizing that discount rates for climate change must be evidence-based and sensitive to concerns that arise over long, inter-generational time horizons. The National Academies identified several possible approaches to harmonize the treatment of climate impacts with other regulatory costs and benefits, such as by "combining other cost and benefit estimates with the [social cost of carbon] estimate whose near-term discount rate most closely matches that particular discount rate" or "combining other costs and benefits based on a high discount rate with the [social cost of carbon] estimate based on its highest discount rate, and analogously combining the low discount rate estimates."[93] Other economists have more rigidly concluded that any analysis that discounts different effects occurring in the same year at different rates is inappropriately inconsistent.[94]

In 2021, the Biden Administration reconstituted the Working Group, which soon issued new guidance. The new guidance again rejected the 7% capital-based rate as inappropriate for climate change, given that climate damages are estimated in consumption-equivalent units, and because issues of uncertainty and ethics arise over longer time periods.[95] The Working Group also recognized that strong evidence pointed toward re-estimating the consumption-based rate below 3%.[96] While the 2021 guidance did not

[87] *E.g.*, Dept. of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products: Residential Central Air Conditioners and Heat Pumps at 1-3 (2016), https://perma.cc/PDA2-Y2WK; *see also* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,930 tbl.20 (Oct. 23, 2015) (applying the SCC "at [a] 3 percent discount rate" in central regulatory impact analysis while otherwise discounting regulatory impacts at both 3% and 7%).

[88] Exec. Order 13,783 § 5(c), 82 Fed. Reg. 16,093 (Mar. 28, 2017).

[89] CITE EPA, BLM.

[90] CITE DOE STANDARDS.

[91] The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, 85 Fed. Reg. 24,174, 24,735 (Apr. 30, 2020).

[92] *Id.* at xx.

[93] Nat'l Acads. of Scis., Eng'g & Med., Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide 181–82 (2017).

[94] Kenneth Arrow et al., *Should Governments Use a Declining Discount Rate in Project Analysis?*, 8 REV. ENVTL. ECON. & POL'Y 145 (2014) ("Consistency in decision-making requires that the same discount rate must be applied to all certain benefits and costs that occur in the same year, irrespective of whether the project has intra- or inter-generational consequences.").

[95] 2021 TSD at 18-19 (also citing Li and Pizer's 2021 demonstration that the capital-rate is not an appropriate lower bound for distant benefits).

[96] *Id.* at 19-21.

yet revise its estimates or move to a declining discount rate schedule, the Working Group recommended that agencies consider conducting sensitivity analyses with discount rates below 2.5%.[97] The Working Group also acknowledged that combining climate effects discounted at lower rates with other costs and benefits discounted at higher rates could raise issues of inconsistency, and moving toward a declining discount rate schedule could help maintain consistency.[98]

4. Other Jurisdictions

States vary widely in the rigor of their cost-benefit analyses.[99] Unsurprisingly, therefore, the application of discount rates also varies across states and across policy contexts. For cost-benefit analyses of transportation projects, for instance, some states follow *Circular A-4*'s guidance, some favor a 7% rate, while others focus on rates around 1-2%, tied to U.S. Treasury notes.[100] When setting state electricity policy, many states focus on social discount rates based on Treasury rates.[101] Of the over a dozen states that use the social cost of greenhouse gases in some analyses, most have adopted the Working Group's central value using a 3% rate,[102] but a few states have begun applying lower discount rates.

First, in 2014, Washington selected the Working Group's 2.5% estimates of the social cost of greenhouse gases, offering both general and climate-specific rationales.[103] As a general matter, Washington noted that more recent market data supported lower rates, and that intergenerational discount rates should be even lower, because of a general expert consensus that "[a]n intergenerational discount rate is not well represented by private sector discount rates which seek profit, or [by] the cost of governments to obtaining capital in a low-risk environment."[104] Washington also offered climate-specific arguments: for example, while the Working Group's values are underestimates because they cannot currently monetize all significant climate damages, the higher valuations generated at lower discount rates partly offset that underestimation.[105] Adopting such higher numbers allowed Washington to maintain its leadership position on climate action.[106] Finally, Washington offered a game theory argument: either overestimating the discount rate (and so underestimating the social cost of greenhouse gases) or underestimating the discount rate (and so overestimating the social cost of greenhouse gases) creates the risk of inefficient public investments. But government should prefer, for example, to overpay upfront for more energy-efficient buildings and vehicles than may ultimately prove necessary if future climate change is less costly than anticipated—rather than underinvest in efficiency if climate change

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[97] *Id.* at 21.

[98] *Id.* at 22.

[99] Jason A. Schwartz, *52 Experiments With Regulatory Review* 12 (Policy Integrity Report, 2010), https://policyintegrity.org/publications/detail/52-experiments-with-regulatory-review.

[100] Fed. Highway Admin., Use of Benefit-Cost Analysis by State Departments of Transportation: Report to Congress (2016), *available at* https://www.fhwa.dot.gov/policy/otps/pubs/senate_bca_report_05172016_revised.pdf.

[101] *See* Conn. Dept. Energy & Envtl. Prot., Policy Memo: Rationale for Discount Rate to be Applied in Connecticut's Conservation and Load Management Plans 5 (Dec. 19, 2018) (noting that Vermont, Rhode Island, and Massachusetts use rates ≤ 3%), https://perma.cc/7UB5-SQ8J; *see also* E3, *CPUC Workshop on Societal Cost Test* 12 (2013), https://web.archive.org/web/20200830152543/http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=11819 (citing Iowa, DC, Maine, and Minnesota).

[102] States Using the SCC, https://costofcarbon.org/states. Minnesota adjusted the IWG's estimates by using a range between the central estimate and a lower bound that uses a 5% discount rate and a shortened timeline of 100 years.

[103] Wash. Dept. of Commerce, *Recommendation for Standardizing the Social Cost of Carbon When Used for Public Decision-Making Processes* (2014) http://www.commerce.wa.gov/wp-content/uploads/2015/11/Energy-EV-Planning-Social-Cost-of-Carbon-Sept-2014.pdf; *see also* Wash. Dep't of Ecology, Preliminary Cost-Benefit and Least-Burdensome Alternative Analysis 60 (2016), https://apps.ecology.wa.gov/publications/documents/1602008.pdf.

[104] Wash DOC at 3-4.

[105] *Id.* at 4.

[106] *Id.* at 5.

proves more costly than anticipated—because "it is easier to operate an efficient asset in a low cost environment than it is to operate an inefficient asset in a high cost environment."[107] In 2021, Colorado followed Washington's lead and also selected a 2.5% discount rate.[108]

Meanwhile, in 2020, New York developed its own social cost of greenhouse gas estimates applying a range of discount rates from 1%-3%, with 2% as the central value.[109] New York cited updated expert opinion and research supporting lower rates, the understanding that long-term decisions about public welfare should use lower rates than private investments, and (like Washington) the idea that a lower rate helps offset the models' tendency to underestimate the social cost of greenhouse gases.[110] New York also indicated it would consider a declining discount rate in the future.[111]

Several countries—including the United Kingdom, France, Germany, and Norway—have already moved toward declining discount rates, adopting schedules in which the discount rate steps down over time.[112] Some other foreign countries generally favor consumption-based discount rates tied to the social rate of time preference, rather than capital-based rates;[113] some use relatively low rates based solely on risk premiums;[114] and some have chosen lower discount rates specifically for environmental effects.[115] As

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[107] *Id.* at 5 ("As much of the risk associated with underestimating the SCC falls on society, public entities are under a unique responsibility to mitigate the risk associated with underestimation.").

[108] H.B. 21-1238

[109] N.Y. Dep't of Envtl. Conserv., Establishing a Value of Carbon: Guidelines for Use by State Agencies 18 (2020; revised 2021), https://www.dec.ny.gov/docs/administration_pdf/vocguidrev.pdf.

[110] *Id.* at 18-19.

[111] *Id.* at 19.

[112] The U.K. Green Book recommends considering two declining rate schedules, based on considerations from the Ramsey equation and the Stern Report: the standard rate starts at 3.5%, drops to 3% after 30 years, to 2.5% after 75 years, and so on, until it reaches 1% after 300 years; the "reduced" rate excludes any pure rate of time preference, and so starts at 3% and drops toward 0.86% after 300 years. H.M. Treasury, Intergenerational Wealth Transfer and Social Discounting: Supplementary Green Book Guidance (2008). France's most recent guidance, applying the Ramsey equation, recommends a risk-free rate of 2.5% through 2070, then declining to 1.5%; but a project-specific risk premium can be added, up to 2% through 2070, and up to 3% thereafter. *See* https://www.strategie.gouv.fr/english-articles/discount-rate-evaluation-public-investment-project *(*summarizing the Quinet Commission's 2013 update of the 2005 Lebegue Report). Norway recommends discounting effects of ordinary projects in years 0-40 at a risk-adjusted rate of 4% (adding a 1.5% risk premium to the risk-free rate of 2.5%, to "reflect the opportunity cost of capital"); at a 3% rate for years 40-75, and at a 2% rate after year 75. *See* https://www.regjeringen.no/en/dokumenter/nou-2012-16/id700821/?ch=6. Germany's 2012 guidance on estimating environmental costs recommends a 3% discount rate through about 20 years, after which it recommends a constant 1.5% rate. Dr. Sylvia Schwermer, German Federal Environment Agency (UBA), Methodological Convention 2.0 for Estimates of Environmental Costs at 37 (2012), https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/methodological_convention_2_0_for_estimates_of_environmental_costs.pdf. More recent reports of interviews with German officials suggests that German analysis start with a 3% discount rate that declines to 2% by 2250. GAO, GAO-20-254, *Social Cost of Carbon* at 66 (2020) (unclear if that is a climate-specific framework). Denmark: 4% through year 35, declining to 2% by year 71. *See https://www.mkba-informatie.nl/index.php/download_file/force/313/644/#:~:text=4.5%20Denmark&text=After%2035%20years%20costs%20and,risk%20free%20rate%20of%202%25.*

[113] E.g., Sweden's guidance for cost-benefit analysis in the transport sector recommends a 3.5% social discount rate (lowered from a prior recommendation of 4% based on the Ramsey equation and to approximate a declining rate over time). *See* https://www.trafikverket.se/contentassets/4b1c1005597d47bda386d81dd3444b24/asek-2021/19_english_summary_a7.pdf.

[114] The Netherlands, for example, currently recommends that most cost-benefit analyses use a discount rate of 2.25%, based on a -1% risk-free interest rate plus a 3.25% risk premium. Rijksoverheid, *Rapport Werkgroep discontovoet 2020* at 9 (2020), https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/kamerstukken/2020/11/10/rapport-werkgroep-discontovoet-2020/rapport-werkgroep-discontovoet-2020.pdf.

[115] The Netherlands for example uses a lower rate for climate effects and effects on non-renewable resources. *See* https://www.mkba-informatie.nl/index.php/download_file/force/313/644/#:~:text=4.5%20Denmark&text=After%2035%20years%20costs%20and,risk%20free%20rate%20of%202%25. Also Israel Ministry of Envtl. Protection, Green Book on External Costs of Air Pollutants (2020), https://www.gov.il/BlobFolder/publicsharing/pc_external_costs_of_air_pollution/he/public_comments_2020_External

the next section argues, the U.S. federal government should follow these examples, consider more recent data, limit the application of capital-based rates, and move toward a declining discount rate framework.

II. Economic Principles for Selecting the Discount Rate

Circular A-4 recommends agencies should typically calculate two alternate cost-benefit comparisons: one at a capital-based 7% discount rate, and the other at a consumption-based 3% discount rate. That recommendation, now nearly twenty years old, is inconsistent with the most recent economic data and expert thinking. Both rates should be adjusted downward based on newer data. Moreover, the capital-based rate not only is overestimated but is wholly inappropriate in a range of contexts, especially climate change and other long-term policy issues. And the consumption-based rate should also be adjusted to better reflect long-term uncertainty, irreversible future damages to non-market goods, insurance premiums, and ethical considerations.

II.A. Updated Market Evidence Supports Lower Rates

OMB's 3% consumption-based estimate was based on data going back to 1973. OMB's 7% capital-based estimate has not changed since 1992. Both estimates are out of date.

II.A.1. The Consumption-Based Rate Should Be Below 2%

A consumption-based approach to discounting assumes that the rate at which the average saver trades off present for future consumption, measured by the tax-free rate of return on low-risk securities, is society's discount rate. In 2003, *Circular A-4* used 10-year Treasury note data from the thirty years between 1973-2002, found an average rate of 3.1%, and settled on an estimated consumption-based discount rate of 3%.[116]

However, real Treasury interest rates on 10-year notes have fallen fairly steadily since at least 2000, and even recently hit negative numbers.[117] Consequently, applying the same estimation methodology to the most recent 30 years of data on Treasury rates (i.e., from 1991-2020) would indicate a consumption-based discount rate of 2%.[118] In fact, the Council of Economic Advisers had already reached that conclusion by 2017: based on more recent data and forecasts, the consumption-based discount rate should be at most 2%.[119] Simply replacing old data (from 1970-2002) with updated data (1991-2020) by itself presents a straightforward and compelling case for significantly lowering the consumption-based discount rate.

_air_pollution_costs_pc_accessible.docx ("[T]he standard discount rate in Israel for environmental and social issues is 3%." Germany has selected a 1% discount rate for its valuation of climate damages. Umweltbundesamt, Methodological Convention 3.0 for the Assessment of Environmental Costs at 8 (2019), https://perma.cc/CQ8M-ZD47. *See also generally* OECD, https://www.oecd-ilibrary.org/sites/9789264085169-11-en/index.html?itemId=/content/component/9789264085169-11-en (summarizing practices of various countries).

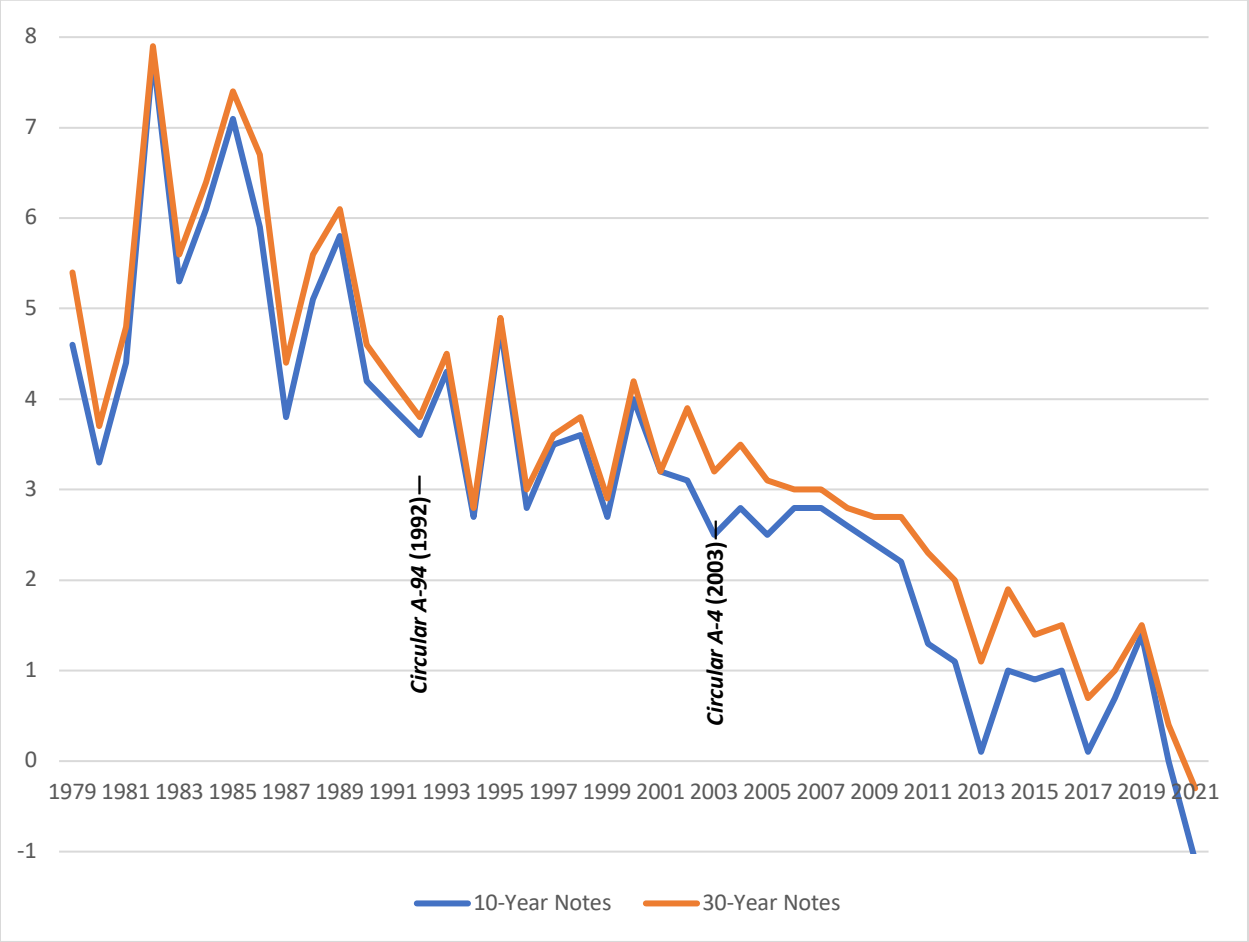
[116] *Circular A-4* at 33-34.

[117] OMB, Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94 (Dec. 21, 2020), https://perma.cc/5VYS-LAFH (showing that rates on 30-year bonds have also fallen steadily); *see also* CEA, *supra* note 130, at 5 (explaining past negative real rates were due largely to very high inflation, whereas recent negative numbers are because of very low nominal rates and not because of high inflation).

[118] 2021 TSD, *supra* note, at 20.

[119] CEA, *supra* note 19, at 4-7, 12.

Figure 1: Real U.S. Treasury Rates (in %) Over Time



Besides the steady decline in U.S. Treasury rates, other empirical evidence supports a lower consumption-based rate.[120] Other advanced economies worldwide have seen similar recent downward trends in rates.[121] U.S. savings rates have climbed over the last decade,[122] suggesting consumers are placing somewhat less value on current consumption relative to future consumption.[123] The increase

[120] A few papers on U.K. and Singapore housing markets may also provide some revealed-preference evidence for long-run market discount rates. *See* Eric Fesselmeyer et al., *How Do Households Discount Over Centuries? Evidence from Singapore's Private Housing Market* (IZA Disc. Paper 9862, 2016); Stefano Giglio et al., *Climate Change and Long-Run Discount Rates: Evidence from Real Estate* (NBER No. w21767, 2018) (finding evidence of a downward sloping discount rate for real estate).

[121] CEA, *supra* note 19, at 6 (showing rates in Japan, France, Germany, U.K., Canada, and Korea); Edward Gamber, Cong. Budget Off., *The Historical Decline in Real Interest Rates and Its Implications for CBO's Projections* at 22-24 (CBO Working Paper 2020-09, Dec. 2020), https://perma.cc/63AW-VHD4 CBO at 22, 24 (showing declining global rates). New Zealand, for example, estimates a risk-free rate of 2%, and then considering risk premiums, taxation, and asset betas, estimates a corresponding social opportunity cost discount rate of 4% to use, for instance, in analyses of transportation projects. *See* https://www.nzta.govt.nz/assets/planning-and-investment/docs/investment-decision-making-framework-review-discount-rate-november-2019.pdf.

[122] FRED St. Louis, Personal Saving Rate, https://fred.stlouisfed.org/series/PSAVERT (from 1992-2003, the rate averaged 6.4%; increased to an average of 7% over 2008-2019; saving rates spiked in 2020 during the recession).

[123] *But see* Revesz & Shahabian, 84 S. CAL. L. REV. at 1135 (first posing that savings rates should be interpreted in light of technological growth and other factors, before concluding that savings rates and other observed market data provide little useful guidance on an appropriate intergenerational discount rate).

may be partly explained by demographic shifts prompting people to save more for longer projected lifespans.[124] Forecasts for future rates have also fallen.[125] These data-points reinforce the conclusion that the consumption-based discount rate should be at most 2%.

Moreover, newer methodologies can more fully account for some of the random variation over time that characterizes the bond interest rate data.[126] In a recent working paper published by the Federal Reserve Bank, economists Michael Bauer and Glenn Rudebusch found that, had such an updated methodology been applied to the same data used by OMB in 2003 (i.e., to Treasury rates from 1973-2002), *Circular A-4*'s original calculation of the consumption-based discount rate would have dropped from 3% down to about 2%.[127] And when Bauer and Rudebusch took the average estimates from the recent literature, which draws on more recent data, they found an average equilibrium real rate of interest of 0.68% in the prior decade.[128]

In short, due to demographic shifts, other trends, and improved methodologies, the best empirical estimate of the discount rate based on long-term interest rates is under 2%, is likely to remain below 2% for the foreseeable future, and may even already be under 1%.[129]

II.A.2. The Estimated Capital-Based Rate Is Too High

On the theory that government actions will disrupt private capital investments, which could otherwise earn returns that will benefit society via increased consumption and tax revenue, the capital-based approach derives a discount rate from market data on private investment returns, as an imperfect proxy for society's benefits from investment. *Circular A-4*'s default rate of 7% was based on the National Income and Product Accounts data, with parameters estimated using what the Council of Economic Advisers has called "imperfect data like tax returns, surveys and imputations."[130] As EPA has noted, alternative estimation strategies could instead generate capital-based rates as low as 4.5%.[131] Estimating the discount rate based on private market rates of return is even more problematic over the long term, because markets are often driven by preferences for short-term returns.[132] Property is one of the few

[124] Gamber, CBO, *supra* note 121, at 4-7.

[125] CEA, *supra* note 19, at 2, 6 (citing long-run forecasts of 1.4-1.5%); *see also id.* at 7 (citing similar data from futures markets); Gamber, CBO, *supra* note 121, at 4-7 (listing other factors, including slowed labor force growth, a global savings glut, a shortage of safe assets, and secular stagnation); *id.* at 39 (showing medium-term and long-term forecasts of 1.2-2.3%).

[126] *See* Richard G. Newell & William A. Pizer, *Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?*, 46 J. ENVTL. ECON. & MGMT. 52 (2003).

[127] Michael D. Bauer & Glenn D. Rudebusch, *The Rising Cost of Climate Change: Evidence from the Bond Market* (Fed. Reserve Bank Working Paper 2020-25); *see also* 2010 TSD, *supra* note, at 20 (calculating the rate as 2.7%).

[128] Bauer & Rudebusch, *supra* note 127 (averaging estimates from Del Negro et al. (2019), Johannsen & Merten (2016), Laubach & Willians (2016), Kiley (2020), Christensen & Rudebusch (2015), and Bauer & Rudebusch (2020)).

[129] *See id.*

[130] Council of Econ. Advisers, Discounting for Public Policy: Theory and Recent Evidence on the Merits of Updating the Discount Rate at 2 (2017) [hereinafter "CEA"]. Note that while some estimation strategies have produced relatively stable capital-based rates over recent decades, *id.*, current market data can reflect the preferences of only the current generation of investors, based on current conditions, and does not necessarily predict what future private rates of return will look like far into the future. Notably, there are "no regular private forecasts of the economywide rate of return." *Id.* at 2.

[131] EPA, Guidelines for Preparing Economic Analyses at 6-11 (2010) (citing, for example, Moore et al. (2004)'s estimate based on AAA corporate bonds). Also, using average rather than marginal return rates may make the 7% calculation too high. CEA, *supra* note 19, at 4.

[132] *See* Sheila Bair, Short-Termism and the Risk of Another Financial Crisis, Wash. Post (July 8, 2011) (op-ed by the former Chair of the FDIC, in which she calls short-termism a "market failure"); *accord* Marc Jarsulic et al., Long-Termism of Lemons, Ctr. for Am. Progress Rep. 11–12 (Oct. 2015), https://cdn.americanprogress.org/wp-content/uploads/2015/10/21060054/LongTermism-reportB.pdf.

assets that may be held inter-generationally, and some real estate data suggests longer-run rates may decline over time.[133]

Regardless of the estimation strategy, a capital-based rate derived from unadjusted market data will overestimate the discount rate that society should use, because of market distortions. Market distortions mean that society's rate of return on investment (i.e., what the capital-based discount rate arguably should be) diverges from the private return on investment (i.e., what the observable market data show). While *Circular A-4* focused on how taxation distorts the market rate of return,[134] which benefits society by funding government expenditure, private returns to capital investment also include returns based on the production of negative social externalities, on the exercise of market power, and on private (as opposed to social) risk premiums. Consequently, the capital-based discount rate should be adjusted downward. Consider, for example, that private investors in oil and gas will earn market returns based in part on their ability to transfer some pollution costs generated by their investment onto society, in the form of negative health and environmental externalities. If government aims to maximize social welfare, government should not use private rates of return, inflated by the market's ability to externalize damages, as the benchmark for discounting and comparing the net social benefits of government action. Yet current estimates of the capital-based discount rate do not subtract out returns from externalities, market power, or private risk premiums—and so are artificially high.

Indeed, recent evidence suggests the magnitude of such distortions. Taxation, along with externalities, market power, private risk premiums, and other factors, are the reasons why the capital-based rate diverges from the consumption-based rate in the first place.[135] In recent decades, the consumption-based rate has been falling (as explored above), while estimates of returns to private capital investment have remained fairly constant.[136] Yet taxation cannot explain the growing apparent gap between the rates, since the effective tax rate has declined in recent decades.[137] Therefore, the relative stability of the rate of return to private capital investments, even as the consumption-based rate and tax rates have been falling, may be driven by increasing market power, externalities, or rising private risk premiums[138]—none of which should be reflected in the discount rates that society uses to make decisions. Estimates of the capital-based approach should be adjusted downward if they are to be used at all. Given that market data supports reducing the consumption-based rate from 3% at least down to 2%, and assuming the gap between the consumption-based rate and the capital-based rate should remain constant over time, market data would therefore support reducing the capital-based rate from 7% at least down to 6%. Yet even that estimate may still reflect significant externalities, private risk premiums, and other considerations that would call for a further decrease. One noted discount rate expert, William Pizer, recently suggested that if the consumption-based rate is in the range of 2-3%, the capital-based rate may only be 3-5%.[139]

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[133] *Supra* note 120.

[134] Circular A-4, *supra* note 142, at 33.

[135] CEA, *supra* note 130, at 3-4.

[136] *Id.* at 11-12.

[137] *See* Econ. Pol'y Inst., Corporate Tax Rates and Economic Growth Since 1947, fig.B (2013), https://perma.cc/PQ62-2SKB.

[138] *See* CEA, *supra* note 130, at 11 (noting, for example, that monopoly rents may have increased); R.J. Caballero et al., *Rents, Technical Change, and Risk Premia Accounting for Secular Trends in Interest Rates, Returns on Capital, Earning Yields, and Factor Shares*, 107 AM. ECON. REV. 614 (2017).

[139] Pizer suggests that the capital-based rate should equal $r_c * \frac{1}{(1-tax\ rate)}$, and so if the consumption-based rate (r_c) is around 2% and the tax rate is 30-40%, then the capital-based rate should be 2.8%-3.3%; if the consumption-based rate is 3%, then the capital-based rate would be 4.3-5%. William A. Pizer, *A Shadow-Price-of-Capital Approach to Harmonize Discounting for Greenhouse Gases in Broader Benefit-Cost Analyses* (submitted as comments to the Working Group, June 21, 2021), *available at* https://www.regulations.gov/comment/OMB-2021-0006-0059.

More generally, applying an un-adjusted capital-based discount rate really only makes sense under the relatively extreme assumption that *all* the costs of government action would fully displace private investment, as the next section explores further.[140] In this way, any capital-based rate based purely on market data should be viewed as a *maximum* discount rate that reflects a relatively extreme assumption.[141] In fact, the rate is wholly inapplicable in a variety of policy contexts.

II.B. In Many Policy Contexts, the Capital-Based Approach Lacks a Theoretical Basis

Circular A-4 proposed a capital-based rate only as an imprecise, second-best option for discounting.[142] The analytically preferred approach—the "shadow price" approach—applies a consumption-based discount rate after converting costs and benefits to reflect their value in equivalent units of consumption.[143] But because calculating costs and benefits in consumption-equivalent values may be challenging, *Circular A-4* suggested that agencies could instead apply two alternate discount approaches: a straight application of a consumption-based rate derived from market data (without necessarily first converting all costs and benefits to consumption-based equivalents); and a capital-based rate.

Therefore, in at least one key policy context—calculating and applying the social cost of greenhouse gases—the capital-based approach very clearly should not apply. The reduced-form integrated assessment models (IAMs) used to calculate the social cost of greenhouse gases already estimate climate damages "in terms of reduced consumption (or consumption equivalents)."[144] In such a case, implementing *Circular A-4*'s current guidance dictates the exclusive use of consumption-based discount rates for climate policy, especially if any other costs resulting from displaced capital investments due to the regulation or other agency action can also be converted into consumption-based equivalents (either through the shadow price of capital approach or by estimating costs in a general equilibrium framework).[145] The National Academies of Sciences has agreed that a capital-based rate would be inappropriate for use with the social cost of greenhouse gases, given that climate damages are estimated in consumption-equivalent units.[146]

A broader issue for the applicability of the capital-based rate is how often the costs of agency actions will actually displace capital investments. The capital-based rate theoretically assesses whether the net benefits from government action will exceed the returns that society could earn by instead investing the same resources in the private sector. A straight application of the capital-based discount rate is thus appropriate only if the costs of agency actions fully displace capital investments—that is, if the government action crowds out private investment. However, as the United States has a relatively open economy—with increased connectedness and trade with foreign economies compared to in 1992 when OMB first set a 7% capital-based discount rate[147]—there is less of a chance that U.S. government actions will crowd out private investments.[148] Additionally, the magnitude of the costs and benefits involved in

[140] 2021 TSD, *supra* note, at 18-19.

[141] *Id.* (explaining the rate "at best creat[es] a lower bound on the estimate of net benefits").

[142] 2021 TSD, *supra* note, at 18-19; Off. of Mgmt. & Budget, Circular A-4 at 33 (2003) (calling the shadow price approach the "analytically preferred method" and then recommending an alternate "default position").

[143] Circular A-4, *supra* note 142, at 33.

[144] 2021 TSD, *supra* note, at 17.

[145] *Id.* at 18.

[146] National Academies of Sciences, Engineering, and Medicine, Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide at 167 (2017) [hereinafter NAS].

[147] OMB, Circular A-94 at 9, 57 Fed. Reg. 53,519 (Nov. 10, 1992).

[148] *See* EPA, Guidelines, *supra* note 131, at 6-11.

many agency actions will be relatively small compared to the overall U.S. debt, again making it unlikely that agency actions will significantly crowd out private U.S. investment.[149] Some agency actions may also induce more private investment than they displace.[150] Finally, the costs of many agency actions will be more likely to be borne primarily through displaced consumption rather than displaced investment; some recent agency analyses of major regulatory proposals, for example, have assumed high or even complete pass-through of costs to consumers.[151] Under any of these conditions—an open economy; a policy effect small relative to U.S. debt; the potential to induce new investment; or pass-through of costs to consumers—applying a high capital-based discount rate may be worse than creating a lower-bound estimate of net benefits[152]—it may inaccurate, misleading, and simply inappropriate.

In theory, agencies could try to determine what portion of the costs of government action may affect capital formation as opposed to consumption, and then blend the capital-based discount rate with the consumption-based discount rate in proportion. However, not only is estimating this split extremely difficult,[153] but such a blended rate would still be inappropriately high for application to longer-term, inter-generational government decisions, especially given uncertainty and ethical considerations.[154]

Long-term time horizons in general counsel strongly against application of a capital-based rate. A recent paper by Qingran Li and William A. Pizer was the first to build a compelling case for why the capital-based rate is inappropriate for policies with significant costs or benefits occurring as little as a "a few decades" into the future.[155] Specifically, Li and Pizer use the shadow price approach to discounting to show that, because [of the relative impacts to ultimate welfare from effects to investment versus consumption,] the rate will converge toward the consumption-based rate over time.[156] Consequently, the appropriate social discount rate collapses to the consumption-based rate by around 30 years.[157]

Ethical considerations bolster the case against capital-based rates in inter-generational contexts. As discussed further below, market data does not reflect society's preferences toward or obligations to future generations (partially due to a dearth of intergenerational assets), and so basing a discount rate solely on market data ignores important inter-generational considerations.[158] Furthermore, several standard justifications for capital-based discount rates break down in the face of longer-term environmental threats. For example, one argument for capital-based discount rates is that spending

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[149] *Id.*

[150] 2021 TSD, *supra* note, at 19 (noting that if the social returns to induced investments have not been quantified, using a capital-based discount rate "is not even a lower bound").

[151] *E.g.*, Nat'l Highway Traffic Safety Admin. & Envtl. Prot. Agency, Final Regulatory Impact Analysis: The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule for Model Year 2021-2026 Passenger Cars and Light Trucks at 829, tbl.VI-181 (2020), https://perma.cc/Y7G3-EBB9 (assuming that line 1 = line 3, indicating all manufacturer costs will be passed to vehicle buyers).

[152] 2021 TSD, *supra* note, at 18-19.

[153] EPA, Guidelines, *supra* note 131, at 6-8 to 6-10 ("The literature is not conclusive on the degree of crowding out.").

[154] 2021 TSD, *supra* note, at 19.

[155] Qingran Li & William A. Pizer, Use of the Consumption Discount Rate for Public Policy over the Distant Future, 107 J. ENVTL. ECON. & MGMT. 102,428 at 3 (2021) ("We are not the first to suggest that the consumer rate is a more appropriate discount rate over long horizons, but we believe we are the first to provide particularly compelling arguments against the investment rate.").

[156] Note that Li & Pizer do not rely on uncertainty over the discount rate; their finding starts by assuming with certainty that the consumption rate is 3% and the investment rate is 7%. To the extent there may actually be uncertainty about the correct rates, as well as the share of investment displaced by the policy relative to consumption, a Weitzman-type approach to uncertainty may indicate that the appropriate rate actually declines toward the consumption rate even more quickly than Li & Pizer estimate. *See infra* on Weitzman's observation of declining discount rates in light of uncertainty.

[157] Specifically, starting with an investment rate of 7% and a consumption rate of 3%, applying Li & Pizer's approach finds the range of appropriate social discount rates by 30 years between 1.8-4.3%, with a midpoint of 3.05%—almost the same as the original assumed consumption rate (3%). *Id.* at 12.

[158] Revesz & Shahabian, 84 S. CAL. L. REV. at xx.

capital on climate abatement policies has opportunity costs and so, in policy analysis, future costs and benefits should be discounted at the rate of return to capital. However, the irreversible, uncertain, and catastrophic risks of climate change may disrupt this "opportunity cost" rationale: while it may seem, for instance, that future, wealthier generations might have better opportunities to address climate change for themselves, irreversible or catastrophic damages could arise that make future mitigation efforts more expensive or impossible.[159] Similarly, if climate damages are "non-marginal," such that climate change significantly affects the very same natural resources needed to drive economic growth, growth could plummet or even turn negative.[160]

Overall, a capital-based approach to discounting is simply not appropriate in many policy contexts. If a regulation is unlikely to crowd out significantly private investment but instead is more likely to primarily affect either consumption (for example, if costs will be passed through to consumers) or government expenditures; if a regulation has significant effects stretching beyond 30 years or otherwise falling on future generations; if inaction could cause irreversible damages or disrupt future economic growth, while action will deliver insurance value; or if important costs and benefits can be translated into consumption-based equivalents, then a capital-based discount rate may be inappropriate.

Given the limited applicability of capital-based rates derived from market data, the federal government should rethink its exclusive reliance on market data to calibrate its discount rates. As the next section explores, the extended Ramsey formula—which can be calibrated based on expert elicitations, normative valuations, the latest economic models, as well as updated market data—offers an appealing path forward.

II.C. Moving Toward the Ramsey Equation

Even as updated market evidence strongly supports lowering OMB's current default discount rate estimates, a consumption-based rate around 2% could still be too high for longer-term policy contexts, including climate change.[161] Market rates largely reflect the investment preferences and relatively short-run expectations of only the current generation. Rates based on assets held inter-generationally are rarer and harder to observe in the market.[162] Because the current generation of consumers, savers, and investors will not fully or efficiently consider the welfare of future generations, discount rates based on market data may overestimate the optimal rate for society to use in an inter-generational context. Society has a longer planning horizon than most individuals. For example, the probability of death likely causes individuals to demand a relatively higher rate of return when trading their own current versus future consumption;[163] by contrast, the probability of an end-of-civilization event is relatively low and so

[159] *Id.* at 1149-52.

[160] *Id.* at 1153 & n.246 (citing Heal's observation that estimates of productivity growth based on historical records omit depletion of natural resources, and thus bias discount rates upwards).

[161] It is also possible that foreign demand for safe investments could be driving down U.S. Treasury rates by reflecting the time preferences of foreign investors, which arguably should not influence U.S. policy analyses. *See* CEA, *supra* note 130, at 3. If true, this could partially offset some of the other factors suggesting that market data leads to an overestimated discount rate. Regardless, it is yet another reason why market data should be supplemented by other inputs, like expert elicitation.

[162] EPA, Guidelines, *supra* note 131, at 6-12 (explaining that intergenerational discounting is complicated by the fact that "the 'investment horizon' is longer than what is reflected in observed market interest rates representative of intertemporal consumption tradeoffs made by the current generation"). Real estate investments are among the few potentially intergenerational assets, though real estate investments, too, may generate externalities.

[163] CEA, *supra* note 130, at 3.

can only justify an exceedingly small discount rate.[164] Relying on data on relatively short-run average returns can be particularly misleading in calculating a long-run declining discount rate schedule.[165]

While the current generation of consumers and investors will not fully or efficiently consider the welfare of future generations in their market behavior, most people do have a strong ethical preference to split resources fairly between generations, as shown in informal surveys conducted by Richard Revesz.[166] But people need government to help implement this preference for them.[167] And whereas market data on savings rates and investment preferences can reflect only intrapersonal market behavior and not inter-generational preferences, empirical evidence on inter-vivos wealth transfers to subsequent generations and stated-preferences studies on people's attitudes about discount rates over long time horizons suggest lower discount rates than typically estimated from market data.[168]

Finally, discount rates derived solely from market data cannot account for uncertainty, ethics, or the limited substitutability of market and non-market goods (as explored below, Sections II.D-E).

For all these reasons, agencies should supplement their calibration of the discount rate by considering evidence besides market data. The Ramsey equation can be calibrated descriptively to market data,[169] but importantly it can also incorporate valuations from expert elicitations and other normative approaches developed in the economics literature.[170] Recall that the simple Ramsey equation is

$$r = \rho + \eta \times g$$

where ρ is the pure rate of time preference, η is the elasticity of the marginal utility of consumption (and also reflects relative risk aversion and aversion to temporal inequality), and *g* is the growth rate in per capita consumption.

The Ramsey framework offers several advantages for estimating the discount rate, especially in the climate context. First, it explicitly connects the discount rate to consumption growth, reflecting that climate damages affect the discount rate.[171] Second, it provides a means of extrapolating discount rates into the future as economic growth slows towards a steady state.[172] Last, the formula can be extended in several ways to allow for: a consistent framework for addressing uncertainty (see Sections II.D.1-2); risk aversion (see Section II.D.3); and the imperfect substitutability of market and non-market goods (see Section II.E.). For similar reasons, the National Academies of Sciences has recommended a Ramsey-

[164] *See* Revesz & Shahabian, *supra* note 158, at 1116-17 (discussing the Stern Report's reliance on a world-ending disaster to justify a pure rate of time preference of 0.1%, but noting even that seems too high).

[165] *See* Giglio et al. (2018), *supra* note 120.

[166] Revesz & Shahabian, *supra* note 158, at 1123 (reporting the "overwhelming response" from asking professional and academic audiences how to divide resources among different generations living on an isolated island; Kenneth Arrow reported the same ethical intuition and acknowledged that a positive pure rate of time preference would be inconsistent with this overwhelming ethical intuition).

[167] *Id.* at 1142 (without government enforcement mechanisms, "people . . . who would otherwise be willing to sacrifice collectively for future generations by mitigating climate change may not reflect that preference in their everyday behavior if they think their sacrifice alone will have little impact").

[168] *Id.* at 1136, 1139-41, 1141.

[169] For example, Nordhaus calibrates the simple Ramsey equation to reflect the observed market savings rate, *see* Revesz & Shahabian, *supra* note 158, at 1117-19 (summarizing Nordhaus's approach).

[170] See About Time for an explanation of prior summaries of the individual parameters.

[171] NAS, *supra* note 146, at 18-19 (recommending a Ramsey-like formula); Peter H. Howard & Derek Sylvan, *Wisdom of the Experts: Using Survey Responses to Address Positive and Normative Uncertainties in Climate-Economic Models*, 162 CLIMATIC CHANGE 213 (2020).

[172] *See* CEA, *supra* note 130, at 7.

type approach for discounting climate effects.[173] And because of the growing consensus in the economic literature around the value of key parameters, a reasonable range of discount rates (along with central and maximum values) can be estimated using the Ramsey equation.

Several recent expert elicitations show a growing consensus around a discount rate below 2%.[174] For example, both Howard and Sylvan (2020) and Drupp et al. (2018) find a median estimate of the appropriate social discount rate of 2%, while Drupp et al. also find a median values of 0.5% for the pure rate of time preference and 1% for the elasticity of marginal utility of consumption.[175] However, Drupp et al. (2018) finds some disparities between individuals' direct estimates of the appropriate social discount rate and their views on individual parameters in the Ramsey formula.[176] This disparity likely stems from the fact that the basic parameters of the simple Ramsey formula are inadequate to fully and consistently capture important factors like uncertainty and limited substitution between market and non-market goods. Notably, Drupp et al. (2018) find lower estimates of the appropriate social discount rate among experts who specifically highlighted issues of uncertainty or relative prices in their survey response. Therefore, this article looks at these key extensions of the Ramsey formula next.

II.D. Factoring Uncertainty into the Ramsey Framework

In the past, the Interagency Working Group on the Social Cost of Greenhouse Gases used uncertainty to justify considering both a slightly lower discount rate (2.5%) and a substantially higher discount rate (5%) as sensitivity analyses compared to its central rate (3%). As this section shows, based on more recent literature, proper treatment of uncertainty points to a much lower overall range of discount rates as appropriate for climate change and other policies with longer-term costs and benefits.

II.D.1. Considering Growth Uncertainty and Declining Discount Rates

Intuitively, uncertainty over future economic growth will lead to increased savings rates and so to a corresponding decrease in the discount rate. The Ramsey equation can be extended to account for growth uncertainty as follows:

$$r = \rho + \eta * g - 0.5\eta(\eta + 1)\sigma^2$$

where ρ is the pure rate of time preference, η is the aversion to inter-generational inequality (also equal to the elasticity of the marginal utility of consumption)[177] and the future growth of consumption (g) is uncertain, with a mean of μ and variance of σ^2.[178]

Applying this extended Ramsey formula leads to two conclusions. First, the overall discount rate should be lower as a result of growth uncertainty, because the precautionary response to uncertainty is to increase savings, and because global growth rates will likely slow down over time toward a steady state.[179] Second, because empirical evidence for the United States indicates that future shocks to the

[173] NAS, *supra*.

[174] 2021 TSD, *supra* note, at 20 (reporting a "surprising degree of consensus among experts").

[175] Howard & Sylvan, *supra* note; Drupp et al. (2018), *supra* note (also eliciting views on the appropriate real, risk-free interest rate); *see also* About Time, *supra*, at 13 (summarizing results from Hansel et al. (2020) and other literature).

[176] Drupp et al. (2018), *supra* note.

[177] Note that this term is also connected to risk aversion and prudence. *See infra* Section II.D.3.

[178] *See* Christian Gollier & James K. Hammitt, *The Long-Run Discount Rate Controversy*, 6 ANN. REV. RESOURCE ECON. 273 (2014). The formula can also be written as $r = \rho + \eta * \mu - 0.5\eta^2\sigma^2$.

[179] The Working Group assumed a slowdown in growth of GDP per capita from 2100 to 2300 until reaching zero in 2300, *see* 2010 TSD, *supra* note, at 43-45; *see also* Peter Christensen, Kenneth Gillingham & William D. Nordhaus, *Uncertainty in Forecasts*

growth rate may be correlated over time, the extended Ramsey formula implies a declining discount rate schedule.

There is a strong consensus in the economics literature that uncertainty over economic growth and future discount rates results in a declining discount rate schedule.[180] This follows from economist Martin Weitzman's observation that, given uncertainty about future discount rates, the present-day value of a future effect should be valued based averaging the expected discount factors; consequently, the discount rate over time declines toward the lowest possible reasonable value.[181] Imagine that economists are uncertain whether the discount rate will be 1% or 3%. Averaging the discount rates would suggest the rate could be assumed to be 2%. But because the influence of the discount factor (i.e., $\frac{1}{(1+r)^t}$) compounds over time, averaging the *rates* is the wrong approach; instead, the discount *factors* must be averaged, because in any given year, there is a 50% chance that either the discount factor associated with a 1% rate or the factor associated with a 3% will apply. Because the scenario with a lower discount rate preserves more value over time, that scenario more heavily influences expected value calculations, and the equivalent valuations could be reached by assuming a single discount rate (called the certainty-equivalent discount rate) that declines over time.

Table 4: Declining Discount Rates

Year	**Discount Factors at 1% Rate**	**Discount Factors at 3% Rate**	**Expected Discount Factors, Averaging 50/50 Chance of Either 1% or 3%**	*Compare Discount Factors at Constant 2% Rate (always less than the prior column)*	**Certainty-Equivalent Discount Rate Given 50/50 Chance of 1% or 3%**
1	0.9901	0.9709	0.9805	*0.9804*	**1.99%**
10	0.9053	0.7441	0.8247	*0.8203*	**1.95%**
20	0.8195	0.5537	0.6866	*0.6730*	**1.90%**
30	0.7419	0.4120	0.5770	*0.5521*	**1.85%**
40	0.6717	0.3066	0.4891	*0.4529*	**1.80%**
50	0.6080	0.2281	0.4181	*0.3715*	**1.76%**
100	0.3697	0.0520	0.2109	*0.1380*	**1.57%**
300	0.0505	0.0001	0.0253	*0.0026*	**1.23%**

Furthermore, the certainty-equivalent discount rates will also decline over time if growth shocks are correlated. For example, while it may remain uncertain whether a shock to global economic growth will occur in any particular year, climate change may mean that a decline in growth in one year or in one sector is likely to be positively correlated with continuing declines in growth over time or spilling across

of Long-Run Economic Growth, 115 PNAS 5409 (2018); William D. Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PNAS 1518 (2017).

[180] Maureen Cropper et al., *Declining Discount Rates*, 104 AM. ECON. REV. 538 (2014); Arrow et al., *supra* note 94; Intergov't Panel on Climate Change, Climate Change 2014: Synthesis Report (2014).

[181] Cite Weitzman 1998; Martin L. Weitzman, *Gamma Discounting*, 91 AM. ECON. REV. 260 (2001); Circular A-4; EPA Guidelines; etc.

multiple sectors. That increases the chance that there could be long periods of persistently low discount rates, which would push today's best estimates of the expected discount rate over time lower.[182]

Adopting a declining discount rate schedule is actionable and appropriate now. Other countries have adopted their own declining schedules,[183] and several empirical discount rate schedules have been estimated for the United States.[184] Importantly, as detailed further below (Section III.C), broadly adopting a declining discount rate schedule for use in agency analysis can help agencies resolve possible inconsistencies in their application of discount rates, which may otherwise create some legal risks.[185]

II.D.2. Project Risks and GDP-Damage Correlations

In the past, the Interagency Working Group on the Social Cost of Greenhouse Gases justified using a higher discount rate (5%) for sensitivity analysis on the grounds that climate damages could be positively correlated with GDP.[186] But more recent thinking about such correlations suggests there is as much, if not more, reason to favor a lower discount rate. And outside climate change, the default assumption should probably be that project risk is independent from future economic growth.

Climate damages could be positively correlated with GDP.[187] For example, if higher GDP in the future results from increased economic activity, and if increased economic activity generates more emissions, a future world with higher GDP could be a world with greater greenhouse gas concentrations and so higher marginal climate damages. Additionally, at a higher global GDP, individuals may have greater wealth and so have an increased willingness to pay for environmental protection, thus increasing the monetized damages from climate change.[188] But if a world with greater climate damages is also a world with higher overall GDP—and with all the welfare benefits of higher GDP—a self-interested current generation arguably may prefer to spend fewer resources on climate mitigation and more resources on its own current consumption, on the assumption that the richer future world can take care of itself. A higher discount rate would reflect the current generation's preference for its own consumption over spending money to protect the richer future world from climate change.[189]

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[182] Arrow et al. (2014), *supra* note 94; Christian Gollier, *Should We Discount the Far-Distant Future at Its Lower Possible Rate?*, 3 ECON: OPEN-ACCESS (2009); Christian Gollier, *Ecological Discounting*, 145 J. ECON. THEORY 812 (2010).

[183] 2021 TSD, *supra* note, at 21-22.

[184] *See* Newell & Pizer, *supra* note 126; Ben Groom et al., *Discounting the Distant Future: How Much Does Model Selection Affect the Certainty Equivalent Rate?*, 22 J. APPLIED ECONOMETRICS 641 (2007); Mark C. Freeman et al., *Declining Discount Rates and the Fisher Effect: Inflated Past, Discounted Future?*, 73 J. ENVTL. ECON. MGMT. 32 (2015); Bauer & Rudebusch (2020), *supra* note 127; Weitzman (2001), *supra* note; Mark C. Freeman & Ben Groom, *Positively Gamma Discounting: Combining the Opinions of Experts on the Social Discount Rate*, 125 ECON. J. 1015 (2015).

[185] Even if agencies continue using constant rather than declining discount rates, growth uncertainty still supports a downward adjustment. *See* About Time, *supra* note XX, at 15.

[186] 2010 TSD, *supra* note, at 20; 2021 TSD, *supra* note, at 17.

[187] To begin, the reduced-form IAMs calculate damages as a percentage of GDP: DICE and PAGE have proportional damage functions, so as GDP increases, the monetized damages calculated by the IAMs will increase as well. FUND has a mix, but even the non-proportional damages are proportional to income, though not explicitly.

[188] Note that if damage estimates do not reflect this increased willingness to pay for environmental protection, this fact may weigh in favor of a *lower* discount rate. *See* Revesz & Shahabian, *supra* note 158, at 1159; W. Kip Viscusi et al., *Responsible Precautions for Uncertain Environmental Risks*, 10 J. BENEFIT COST ANAL. 296, 312 (2019).

[189] Arguably, society should put less weight on projects that increase society's aggregate risk and more weight on projects that decrease this risk. *See* Christian Gollier, *The Cost-Efficiency Carbon Pricing Puzzle* (Working Paper, 2021). *But see* Revesz & Shahabian, *supra* note 158, at 1131 (noting that while an earlier generation may be entitled to retain a greater share of resources if they work hard to generate those resources, an earlier generation may also be responsible for protecting subsequent generations if the earlier generation caused the harm, and ultimately questioning whether "the choice of a discount rate" can adequately address such moral issues).

In the past, the Working Group used this line of thinking to justify selecting a much higher discount rate (5%) for sensitivity analysis, as compared to its central rate (3%).[190] The Working Group also acknowledged that returns to climate policies could instead be *negatively* correlated with market returns, such that a climate policy will pay off more in the future if overall GDP declines. The Working Group combined this rationale together with two other independent rationales for lower discount rates—uncertainty over economic growth, and ethical objections in an inter-generational context—to also calculate a slightly lower rate (2.5%) for sensitivity analysis.[191]

The Ramsey equation can be extended with an additional term to account for project risk.[192] Applying standard assumptions incorporated by the current IAMs, the equation can be rewritten as:

$$r = \rho + \eta\,\mu\ - 0.5\eta^2\sigma^2 + \beta\eta\sigma^2$$

where β ("beta") captures the uncertainty or risk about the returns that climate policies will deliver for future consumption. A positive beta suggests that climate mitigation policies will pay off more if the world is in a better overall economic state, and thus suggests a higher discount rate; a negative beta suggest that climate mitigation policies will pay off more if the world is in a worse overall economic state, and thus suggest a lower discount rate.

Though some past work seemed to support a positive climate beta estimate,[193] there are numerous reasons to doubt that climate betas are positive,[194] and a positive correlation between damages and GDP may not hold under numerous conditions:

- if climate change affects economic growth rates[195] or fundamentally alters available resources in ways that impoverishes the future or makes future climate mitigation prohibitively expensive;[196]
- if climate damages are not just a function of GDP but are additive independent of changes in income;[197]
- if catastrophic climate risks occur or if sudden tipping points break any proportional relationship between GDP and climate damages;[198]

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[190] 2010 TSD, *supra* note, at 20.

[191] *Id.* at 23.

[192] Simon Dietz et al., *The Climate Beta*, 87 J. ENVTL. ECON. & MGMT. 258 (2018); Christian Gollier, *Discounting and Growth*, 104 AM. ECON. REV. 534 (2014).

[193] *See* Dietz et al. (2018), *supra* note 192 (finding that the climate beta is positive when uncertainty is primarily driven by emissions-neutral progress (i.e., not climate impact uncertainty) and climate damages are small).

[194] *See e.g.*, D. Lemoine, The Climate Risk Premium: How Uncertainty Affects the Social Cost of Carbon, 8 J. ASSOC. ENVTL. & RES. ECON. 27 (2021) (finding negative climate betas and critiquing Dietz et al. (2018)'s finding). *See also* William D. Nordhaus, *Revisiting the Social Cost of Carbon*, 114 PNAS 1518 (2017); Nordhaus, *Climate Change: The Ultimate Challenge for Economics*, 109 AM. ECON. REV. 1991 (2019); About Time, *supra*, at 17 nn.93-94 (collecting the literature).

[195] Lemoine, *supra* note. Note, for example, that growth impacts may be more likely as climate change becomes more severe, C.P. Traeger, *Why Uncertainty Matters: Discounting Under Intertemporal Risk Aversion and Ambiguity*, 56 ECON. THEORY 627 (2014); Peter Howard & Derek Sylvan, Gauging Economic Consensus on Climate Change (Policy Integrity Report, 2021).

[196] Revesz & Shahabian, *supra* note 158, at 1153 (noting that if climate change impacts the natural resources needed to drive growth, growth could plummet or even turn negative); *id.* at n.246 (citing Heal's observation that estimates of productivity growth based on historical records omit depletion of natural resources, and thus bias discount rates upwards).

[197] van den Bremer & van der Ploeg, *supra* note 193, at 30.

[198] Giglio et al. (2018), *supra* note 120; Giglio et al. (2020), *supra* note 193; *see also* Revesz & Shahabian, *supra* note 158, at 1149-52 (warning that the irreversible, uncertain, and catastrophic risks of climate change disrupt the opportunity cost rationale for discounting; while it may seem that a future, wealthier generation may have better opportunities to address climate change, irreversible or catastrophic damages could arise that make future mitigation efforts more expensive or

- if more standard assumptions about risk aversion are applied;[199]
- if adaptation to climate change increases with income,[200] and so climate damages become negatively correlated with income growth as a wealthier future society adapts;[201]
- if climate damages are distributed unevenly across sectors, such that non-market goods and services suffer disproportionate impacts not necessarily connected to any rise in GDP;[202]
- or if climate damages and GDP growth are distributed unevenly across the world, with the countries that will suffer the most future climate damages also experiencing the least future economic growth.[203]

Under such conditions, climate betas may be more likely to be negative than positive, and so the discount rate could be much lower.[204]

Any alternate discount rates that agencies might select for sensitivity analysis based on assumptions about positive or negative GDP-damage correlations should reflect realistic assumptions about growth, should be empirically grounded,[205] and should also deal with the fact that the climate beta may change over time. Furthermore, any upward adjustment to account for project risk in sensitivity analysis should be accompanied by another discount rate for sensitivity analysis that is adjusted down by at least the same (if not greater) proportion, given the evidence of possible negative climate betas.

II.D.3. Considering Risk Aversion and Inequity Aversion

Ultimately, the precise effect of the climate beta on the discount rate is somewhat uncertain, because it is also mediated by the risk premium (i.e., the amount of excess return that individuals demand as compensation for exposure to risk), and estimates of the risk premium from data and economic models vary.[206] One solution to deal with this issue is to extend the Ramsey equation's parameters to disentangle risk aversion from inequity aversion.

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impossible). Note that climate betas do not necessarily reveal whether low-probability but catastrophic climate outcomes could be correlated with certain lower-probability GDP outcomes, and so adding a positive climate beta to the discount rate may contradict society's desire to adopt insurance-like climate policies to avoid worst-case scenarios.

[199] Lemoine, *supra* note; Ton S. van den Bremer & Rick van der Ploeg, The Risk-Adjusted Carbon Price (CESifo Working Paper No. 7592, 2019).

[200] Tol (2018), *supra* note 193; Howard & Sylvan (2021), *supra* note 195.

[201] Giglio et al. (2018), *supra* note 120; Giglio et al. (2020), *supra* note 193.

[202] Traeger, *supra* note 195. Non-market damages make up a large portion of damage. Peter H. Howard & Derek Sylvan, *Expert Consensus on the Economics of Climate Change* (Policy Integrity Report, 2015); Peter H. Howard & Thomas Sterner, *Few and Not So Far Between: A Meta-Analysis of Climate Damage Estimates*, 68 ENVTL. & RES. ECON. 197 (2017).

[203] Revesz & Shahabian, *supra* note 158, at 1155; *but see* Gollier (2017) (suggesting developing countries have high discount rates, but also assuming a positive climate beta without considering the possibility of poverty traps). The issue of inter-regional equity could also be addressed by equity weights, *id.* at 1156, and issues of region-specific discount rates are complex. But at a more general level, because the ethical issues of inter-generational discounting can also implicate inter-regional equity, a higher discount rate based on climate betas may be inadvisable, and a lower discount rate may be justifiable.

[204] Lemoine, *supra* note, estimates a discount rate of 3% in the short-run, declining to 1% in around 500 years, while Giglio et al. (2018), *supra* note 120, finds a discount rate below the risk-free rate of 1.5% (1% to 2%).

[205] See About Time, explaining inconsistencies between the Working Group's assumptions and its choices of discount rates in 2010.

[206] Dietz et al. (2018), *supra* note 192; Drupp et al. (2018), *supra* note. For instance, while market data supports a risk premium as high as π = 5%, application of isoelastic preferences support $\pi = \eta\sigma^2 \approx 0.3$ to 0.5%.

In the simple Ramsey equation, η is the elasticity of the marginal utility of consumption, but also represents the coefficient of relative risk aversion, as well as the aversion to inequality over time. Having one variable do triple duty masks how individual factors influence the discount rate,[207] and is problematic given that estimates of risk aversion differ from estimates of inter-generational inequity. Real-world evidence suggests that risk aversion tends to be higher than aversion to inter-generational inequality; disentangling those parameters and recalibrating the extended Ramsey equation can result in even lower discount rates.[208]

II.E. The Scarcity and Limited Substitutability of Non-Market Goods

Economists recognized decades ago that the value of non-market goods—particularly environmental goods and services[209]—may increase relative to market goods if they become scarcer.[210] Environmental goods and services are becoming scarcer over time, and climate change in particular will almost certainly accelerate and exacerbate that trend. A future increase in market goods would not necessarily make up for, or substitute for, the loss of many kinds of environmental goods and services that may be threatened by climate change.[211]

Because the Ramsey equation incorporates a growth term, but non-market goods will grow at a lower (or even negative) rate compared to market goods, a discount rate based on the Ramsey equation applicable to non-market goods should be lower than a discount rate calibrated for market goods. And because impacts to non-market goods and services are expected to be a large portion of total climate damages,[212] analysis of policies that will mitigate climate change and so preserve non-market goods should use lower discount rates (what can be called the "ecological discount rate"), as compared to the standard consumption discount rate.[213] The magnitude of the decrease in the discount rate depends on how quickly non-market goods become scarcer and on how readily market goods can or cannot substitute for non-market goods with respect to consumption.[214] In general, limited substitutability will

[207] In fact, it is quintuple duty: aversion to income inequality also equals the inverse of the elasticity of intertemporal substitution, and $1 + \eta =$ society's prudence or aversion to ambiguity. People prefer known unknown (i.e., probability distribution functions) to unknown unknowns (i.e., uncertainty over even the probability distribution functions), and so ambiguity aversion can further decrease the discount rate. *See* About Time, *supra* note XX, at 21-22.

[208] *See* About Time summarizing the application of Epstein-Zin-Weil preferences to resolve the equity premium puzzle, and recommending use of Traeger (2014)'s methodology.

[209] Note that there may be some additional considerations for health impacts as compared to other environmental impacts. First, relative prices may be different for health than for environmental goods, as environmental goods are becoming relatively scarcer. Second, the U.S. value of statistical life is based on a combination of contingent valuation and revealed preference studies, which do not originally specify or control for when the mortality event would (or was perceived to) occur, leading to the potential that the willingness to pay to avoid mortality risks was already at least partly discounted by the respondents; this can lead to double discounting compounded by the application of higher private discount rates by the respondents. Arden Rowell, *The Cost of Time: Haphazard Discounting and the Undervaluation of Regulatory Benefits*, 85 NOTRE DAME L. REV. 1505 (2010).

[210] Anthony C. Fisher & John V. Krutilla, *Resource Conservation, Environmental Preservation, and the Rate of Discount*, 89 Q. J. ECON. 358 (1975). Environmental goods may also be more valuable if the future is wealthier, since wealthier individuals have a higher willingness to pay to protect the environment.

[211] *See* Revesz & Shahabian, *supra* note 158, at 1149 (warning of the potential incommensurability of environmental goods and money).

[212] *See* Howard & Sylvan (2015), *supra* note 202; Howard & Sterner, *supra* note 202.

[213] Frederick van der Ploeg, *Discounting and Climate Policy* (CESifo Working Paper 8441, 2020).

[214] *Id.*; Gollier (2010), *supra* note, at 825 (estimating environmental goods as a function of market goods finding a negative relationship) Moritz A. Drupp, *Limits to Substitution Between Ecosystem Services and Manufactured Goods and Implications for Social Discounting*, 69 ENVTL. & RES. ECON. 135 (2018); Moritz A. Drupp & Martin C. Hansel, *Relative Prices and Climate Policy:*

lead to a lower ecological discount rate,[215] and that rate should decrease further because uncertainty over the growth (or decline) of environmental goods and their relation to GDP is even greater than uncertainty over general economic growth (see Section II.D.1 on growth uncertainty).[216]

Furthermore, ecosystem services also support the production of goods and services: therefore, scarcity and the limited substitutability of physical or human capital to replace natural capital in the production process can also have effects relevant for the discount rate. To the extent market goods cannot fully substitute for non-market goods in the production of additional goods and services, the growth rate will decline so over time, such that the consumption discount rate will decline towards the ecological discount rate.[217]

In short, there is sufficient evidence to justify further lowering the discount rate based on the increasing scarcity and limited substitutability of non-market goods over time,[218] perhaps dropping the rate a full percentage point.[219]

II.F. Multiple Adjustments Together Will Yield Lower Discount Rates

To summarize the main conclusions from above, multiple lines of evidence point toward a lower discount rate than 3%. First, market data now suggest a central consumption-based discount rate under 2%—before accounting for uncertainty, risk, or relative prices. Based on some of the best evidence from the literature, factoring in those additional considerations could push a central estimate of a constant discount rate to around 1.5%, or even lower.[220]

But even that could still be a conservative overestimate, because the factors explored above could all interact. In much of the literature discussed above, economists study the effect of adjusting one parameter at a time. But all of these adjustments—growth uncertainty, project uncertainty, relative prices of non-market goods—are warranted in calculating the discount rate most appropriate for long-term policy contexts like climate change. The adjustments may be additive, and they may also interact and result in further effects to the discount rate. For example, because market and non-market goods may not be linked in the same way to GDP, accounting for the limited substitution between non-market and market goods may further undermine the argument for a positive climate beta.

Though some of these arguments are specific to climate change, others apply to any long-term or intergenerational contexts, and still others apply to even more policy contexts. As explained in the next section on legal standards, agencies will be on the safest legal footing if their discount rate choices are consistent across policy contexts; consistency also facilitates implementation, since agencies will not need to reinvent a discount rate schedule for each individual policy.

How the Scarcity of Nonmarket Goods Drives Policy Evaluation, 13 AM. ECON. J.: ECON. POL'Y 168 (2021). Gollier (2010, p. 825) estimates.

[215] Gollier (2010), *supra* note, at 814; C.P. Traeger, *Sustainability, Limited Substitutability, and Non-Constant Social Discount Rates*, 62 J. ENVTL. ECON. & MGMT. 215 (2011) (but note that ecological discount rate can increase when the elasticity of substitution declines, though not necessarily, contrary to common conception).

[216] Gollier (2010), *id.*, proves these results when the loss of environmental and the loss of consumption goods are mutually aggregating. *See* About Time for more details.

[217] For example, the market discount rate will decline from 3% to 2.4% under an elasticity of substitution of 1 and relatively optimistic environmental growth assumptions. Zhu et al., *supra* note.

[218] See About Time, summarizing the literature and estimates.

[219] *See* Drupp et al. (2018) (experts who considered relative prices reported an average discount rate -1% lower).

[220] See About Time.

The simplest way to adopt an internally consistent approach given that different time horizons may raise different considerations for uncertainty, relative prices, ethics, and other considerations, is to adopt a declining discount rate framework. For many policies, any use of a capital-based rate may be inappropriate, and agencies should begin with a consumption-based estimate of the discount rate around 2% and decline the rate over time from there. A more conservative approach, appropriate if there is a significant chance that a government action will crowd out some private investment, would start by acknowledging some uncertainty as to whether costs and benefits will affect capital investments or consumption more, and assume a 50-50 split at the start. Agencies could then start in year one of analysis by taking an average of the discount factors based on a consumption-based rate (i.e., $\leq$ 2%) and a capital-based rate corrected for some market distortions (i.e., somewhere in the 3-6% range).[221] The rate would then decline toward the consumption-based rate by around year 30 (as per Li & Pizer (2021)), and afterward would continue to decline based on long-term uncertainty, inter-generational equity, and other factors as explored above.

Alternatively, agencies could continue to estimate constant discount rates, updating the values based on more recent market data and economic literature.[222] Such an approach might lead agencies to continue using lower values to discount long-term climate effects, as compared to the discount rates applied to other costs and benefits. That is essentially what agencies have done to date, often combining social cost of greenhouse gas values calculated at rates between 2.5%-5% with other costs and benefits calculated at both the 3% and 7% rates. A declining discount rate framework would create a more harmonized approach. If agencies instead continue to pick different discount rates for different categories of effects, they will need to thoroughly justify such decisions to survive legal review.

III. Legal Principles for Selecting the Discount Rate

Legal challenges to agencies' chosen discount rates have occurred sporadically in the past but may become increasingly likely in the near future. Shortly after the Biden administration reconstituted the Interagency Working Group on the Social Cost of Greenhouse Gases and that entity confirmed that a 7% capital-based discount rate was inappropriate for climate analysis,[223] two lawsuits challenged the Working Group's discount rates. These suits argued that the Working Group had failed to adequately explain its change from the Trump administration's prior approach, its departure from *Circular A-4*'s guidance, or more generally its refusal to use the 7% capital-based rate.[224] These will certainly not be the last lawsuits over climate policy. Because the choice of the discount rate prominently affects which environmental policies can or cannot be cost-benefit justified, any future changes to the discount rates may attract additional legal challenges as well as political scrutiny.[225]

This section explains that agencies have considerable discretion to implement best practices in selecting discount rates. That said, agencies need to thoroughly justify their choices, explain any departures from prior practice or rejections of alternate options, and ground their decisions in the science and economics. Statutes and executive orders requiring agencies to base their decisions on the best

[221] The specific application of these factors has not yet been studied jointly, and is an area for further research if agencies move toward this approach.

[222] *See* About Time, at 26 (concluding that a long-term, constant discount rate should be between 0.5%-2.5%, with a central estimate of 1.5%).

[223] 2021 TSD, *supra* note, at 18-19.

[224] Complaint, *Louisiana v. Biden*, No. 2:21-cv-01074 (W.D.La. filed Apr. 22, 2021), *available at* https://perma.cc/KV66-YF7T; Complaint, *Missouri v. Biden*, No. 4:21-cv-00287-AGF at 20-21 (E.D. Mo. filed Mar. 8, 2021).

[225] For example, in 2017, some members of Congress introduced legislation seeking to prohibit use of the social cost of greenhouse gases unless the estimate "uses the discount rates of 3 and 7 percent." H.R. 3117, 115th Cong. § 4(b)(2)(C) (2017).

available data and to consider the welfare of future generations should help bolster agencies' authority to select lower discount rates, especially in climate analyses. One issue that agencies should be particularly mindful of is the need either to consistently apply discount rates throughout their analyses, or else to adequately explain why different discount rates may be appropriate and justified in different contexts.

III.A. The Laws Shaping Agencies' Discretion on Discount Rates

Statutes rarely specify either the discount rate[226] or time horizon[227] for analysis of agency decisions, though Congress sometimes prescribes discount rates for analysis of particular projects, investments, grants, and similar decisions.[228] When Congress has not specified a rate, agencies are still obligated to base decisions on the best available information; while these obligations are not always judicially enforceable, they create norms that counsel agencies to review and update important analytical inputs. Furthermore, the text and purpose of key statutes granting agency authorities reveal a concern for future generations, indicating that agencies should meaningfully consider the interests of future generations when exercising authority. Executive orders reinforce these twin requirements to use the best data and consider future generations. Together, such laws will support agencies' selection of updated discount rates that are well-grounded in the latest data and economic literature, and that are more appropriate for intergenerational analyses. Courts will likely give agencies considerable discretion to update discount rates consistent with best practices, but the case law defines some limits and so provides insights for agencies on how to proceed.

III.A.1. Statutes Require Use of the Best Available Data

Several statutes contain specific requirements for individual agencies to use the best available data in particular decisionmaking contexts.[229] Regardless of whether any such requirements are judicially enforceable, they all contribute to a norm for agencies to use the best available information in their analyses. A few notable requirements apply more broadly across agencies and across policy contexts.

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[226] This is especially true for regulatory analysis. *See* Sunstein, 99 MICH. L. REV. at 1711 ("I have been unable to find *any* statute that specified a discount rate for agencies to follow.").

[227] *E.g.*, 42 U.S.C. § 8254 (specifying the Department of Energy determine a discount rate to apply in calculating the energy lifecycle costs of federal buildings over either 40 years or the expected life, whichever is shorter). *Cf.* Nuclear Energy Inst. v. EPA, 373 F.3d 1251, 1270 (D.C. Cir., 2004) (explaining the fact that Congress "*mentions* 10,000 years" in a statute on setting nuclear waste disposal standards did not mean Congress had set that period as the analytical time frame; rather, the agencies needed to assess health risks over a much longer period).

[228] *See*, *e.g.,* 2 U.S.C. § 661a(5)(E) (specifying Treasury-based discount rates for federal credit programs); 16 U.S.C. § 838l(b)(1) (similar, for Bonneville Power Administration refinancing); 42 U.S.C. § 2065(4)(B) (similar, for uranium leases and take-back programs); 45 U.S.C. § 821(1)(E) (similar, for certain railroad financing); 42 U.S.C. § 1962d-17 (incorporating by reference the discount rate for certain river basin projects); 33 U.S.C. § 579a(b)(2)(B)(x)-(xi) (similar, for certain Army Corps of Engineers projects); 5 U.S.C. § 8135 (specifying a 4% discount rate to calculate lump-sum worker compensation payment).

Some past congressional pronouncements on discount rates may be obsolete. *See, e.g.*, 10 U.S.C. § 2922b (Amendment Notes) (showing that Pub. L. 101-510 § 2852(a), 104 Stat 1485 (Nov. 5, 1990), struck old statutory language requiring a 7% discount rate and a maximum 25-year period, and instead adopted new language allowing lifecycle cost-effectiveness analysis of renewable energy systems as set by the Department of Energy).

[229] *E.g.* 49 U.S.C. § 31136(f)(1) ("Within each regulatory impact analysis…issued by the Federal Motor Carrier Safety Administration, the Secretary shall, whenever practicable…(B) formulate estimates and findings based on the best available science."); 42 U.S.C. § 300g-1(b)(3)(A) ("In carrying out this section [of the Safe Drinking Water Act]…the Administrator shall use (i) the best available, peer-reviewed science…and (ii) data collected by accepted methods or best available methods."). In its guidelines implementing the Information Quality Act, OMB adopts the Safe Drinking Water Act's standard for information quality and applies it generally to all analyses of "risks to human health, safety and the environment." 67 Fed. Reg. 8452, 8458 (Feb. 22, 2002) (adopting the "principles applied by Congress . . . [in] the Safe Drinking Water Act").

For example, the National Environmental Policy Act (NEPA) broadly charges all federal agencies to "develop methods and procedures . . . [to] insure that presently unquantified environmental amenities and values may be given appropriate consideration,"[230] and the Council on Environmental Quality's regulations implementing NEPA call on agencies to "ensure the…scientific integrity of the discussions and analyses in environmental documents," and to "make use of reliable existing data and resources."[231]

Another notably broadly provision, relevant to climate analysis, was adopted in the Energy Policy Act of 2005:

> It is the sense of Congress that Federal agencies conducting assessments of risks to human health and the environment from energy technology, production, transport, transmission, distribution, storage, use, or conservation activities shall use sound and objective scientific practices in assessing such risks [and] shall consider the best available science (including peer reviewed studies)….[232]

While "the sense of Congress" may not be strictly enforceable, the provision uses the mandatory phrase "shall" and applies to any Federal agency's analysis of any health or environmental risk from any "activit[y]" relating to energy, including the combustion of fossil fuels.

Even more broadly, in 2001, Congress passed the Information Quality Act (also known as the Data Quality Act), which required agencies, with OMB's guidance, to "ensur[e] and maximiz[e] the quality, objectivity, utility, and integrity of information (including statistical information) disseminated."[233] Though brief, the Information Quality Act requires all federal agencies—including independent agencies[234]—to incorporate data that is objective, accurate, complete, and reliable. OMB interprets "information disseminated" to include any risk assessments[235] and cost-benefit analyses[236] that inform rulemakings. According to OMB's guidance, the information quality standards are heightened for "influential scientific, financial, or statistical information" that "will have . . . a clear and substantial impact on important public policies,"[237] and consistency with peer-reviewed studies makes technical and scientific information "presumptively objective."[238] Thus whenever the chosen discount rate will substantially influence important policy decisions, agencies have a heightened responsibility to ensure their choice is objective, accurate, and consistent with peer-reviewed work. Some courts have held that the Information Quality Act is not judicially enforceable,[239] but it nonetheless creates expectations and norms against which agencies can assess the quality of their data. Agencies' discount rates selections will be on firmer footing if they satisfy the Information Quality Act's criteria.

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[230] 42 U.S.C. § 4332(2)(B).

[231] 40 C.F.R. § 1502.23.

[232] 42 USC § 13557; Pub. L. 109-58, title XIV § 1401, 119 Stat. 1061 (Aug. 8, 2005).

[233] Information Quality Act § 515(a), 44 U.S.C. § 3516 note.

[234] The Information Quality Act applies to Federal agencies subject to the Paperwork Reduction Act. 67 Fed. Reg. at 8453. Because the Paperwork Reduction Act applies to "any executive department…or any independent regulatory agency," 44 U.S.C. § 3502(1) (excepting only a few specific entities), the Information Quality Act similarly applies to independent agencies.

[235] 67 Fed. Reg. at 8454 (providing "a risk assessment prepared by the agency to inform the agency's formulation of possible regulatory or other action" as the main example of "agency initiated distribution of information").

[236] *Id.* at 8457 (referencing "regulatory impact analysis prepared by an agency for a major rule"); *see also* Circular A-4 at 43 ("Under the Information Quality Law…[t]he data and analysis that you use to support your rule must meet these agency and OMB quality standards.").

[237] 67 Fed. Reg. at 8455.

[238] *Id.* at 8454 (but explaining that the presumption can be rebutted by persuasive evidence).

[239] *See, e.g.*, *Salt Inst. v. Leavitt*, 440 F.3d 156, 159 (4th Cir. 2006).

III.A.2. Executive Orders Require Use of the Best Available Data

Reinforcing the statutes above, several executive orders require agencies to use the best available data—particularly in regulatory analyses. President Clinton's Executive Order 12,866, which continues to guide regulatory analyses today, requires executive agencies to base regulatory decisions "on the best reasonably obtainable scientific, technical, economic, and other information."[240] President Obama's Executive Order 13,563—also still operational today—expanded on that language to specify that "each agency is directed to use the best available techniques to quantify anticipated present and future benefits and costs as accurately as possible."[241] That language was added partly to call attention to future generations (as discussed below), but more generally it implicates discounting by calling on agencies to accurately weigh present and future effects using the best techniques.

Even more broadly, in January 2021, President Biden issued a *Memorandum on Restoring Trust in Government through Scientific Integrity and Evidence-Based Policymaking*. The two first sentences read:

> It is the policy of my Administration to make evidence-based decisions guided by the best available science and data. Scientific and technological information, data, and evidence are central to the development and iterative improvement of sound policies, and to the delivery of equitable programs.[242]

The fact that this Memorandum was part of a suite of early actions intended to set an ambitious tone, especially on climate change,[243] lends this Memorandum extra weight. The connection made between data-driven policy and equity also has implications for the discount rate, again especially in intergenerational contexts.

Thus, even if agencies were not already statutorily required to use the best available data to determine their discount rates, these executive actions fill any remaining gap. Though not judicially enforceable, these orders reinforce norms around best practices and provide agencies with guidance on how to exercise their discretion when their choices are not constrained by statute. Consequently, agencies will be on firmer footing when they ground their discount rate selections in the best available data and literature.

III.A.3. Statutes Often Require Consideration of Future Generations

When agency actions have effects over long time horizons, the discount rate determines how much weight is given to the welfare of future generations. As agencies justify their chosen discount rates—or, more specifically, their calibration of the pure rate of time preference, approach to future growth uncertainty, consideration of future scarcity of non-market goods, or any adjustments made for intergenerational equity—it will be helpful to know that such choices are consistent with (or at least do not violate) legal requirements to consider the welfare of future generation.

Many statutes explicitly reference the interests of future generations. In others without explicit references, statutory structure and legislative history provide strong evidence that future generations

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[240] Exec. Order No. 12,866 § 1(b)(7).

[241] Exec. Order. No. 13,563 § 1(c).

[242] Pres. Biden, Memorandum on Restoring Trust in Government through Scientific Integrity and Evidence-Based Policymaking (Jan. 27, 2021).

[243] *See* White House, Fact Sheet: President Biden Takes Executive Actions to Tackle the Climate Crisis, Jan. 27, 2021, https://www.whitehouse.gov/briefing-room/statements-releases/2021/01/27/fact-sheet-president-biden-takes-executive-actions-to-tackle-the-climate-crisis-at-home-and-abroad-create-jobs-and-restore-scientific-integrity-across-federal-government/

are an important factor for agencies to consider. Indeed, Congress rarely, if ever, forbids agencies from considering future generations.[244] Thus, agencies will typically retain some discretion in how they consider the needs of future generations. But before turning to key examples of explicit or implicit statutory references, this section first rejects the contrary argument that statutes in fact preclude agencies from directly valuing the welfare of future generations at all.

III.A.3.a: The Federal Government Cares about Posterity

The U.S. Constitution's preamble famously pledges to "promote the general Welfare, and secure the Blessings of Liberty to ourselves *and our Posterity*."[245] But several scholars draw on public choice theory to argue that Congress and the President care chiefly for the short-term interests of voters who elect them to power; that voters care little for distant generations; that Congress and the President enact statutes to fulfill voter preferences and get reelected; and so statutes reflect current voters' preferences and may not authorize agencies to give much weight to future generations.[246] In the extreme, Eric Posner has argued that agencies are legally bound to apply an infinitely *increasing* discount rate, with effects "beyond a few generations" discounted completely, down to zero.[247] Claiming that "Americans today value living foreigners at about 1/2000 of an American" and extrapolating that it therefore "seems highly unlikely that they will value future Americans much more," Posner concludes that "[b]eyond thirty or fifty years, the discount rate should be infinity."[248]

Posner's recommendation for infinitely increasing discount rates is empirically and conceptually suspect. The 1/2000 figure is a single study's "blunt" estimate—based on foreign aid, and assuming the United States weights poor countries' welfare less than richer ones—of how the United States values the welfare of one of the poorest countries (namely, Ethiopia).[249] The study's estimate of U.S. valuation of foreign welfare *worldwide* was much higher: 1/6.[250] Even that was almost certainly an underestimate, since the study focused on official governmental financial aid and not private charitable giving, remittances, or non-financial assistance,[251] and since the study admitted it could not distinguish whether countries reduced their aid due to perceived inefficiency or corruption when foreign countries spend that aid, or due to free-rider incentives.[252] And though likely an underestimate, a 1/6 valuation (i.e., valuing $1 as $0.167) would not translate to an unusually small weighting of future welfare: for example,

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[244] Though Congress has in at least a few instances specified a relatively short timeframe for analysis, *see, e.g.*,42 U.S.C. § 8254 (specifying the Department of Energy determine a discount rate to apply in calculating the energy lifecycle costs of federal buildings over a period of either 40 years or the expected life, whichever is shorter), even this does not foreclose considering how events transpiring during such a timeframe may impact the needs of future generations.

[245] *See also* Gardner, *Discrimination Against Future Generations: The Possibility of Constitutional Limitation*, 9 ENVTL. L. 29, 35 ("[T]he draftsmen of the Constitution invariably took the view that their generation had an obligation to protect the well-being of future generations.").

[246] Bradford C. Mank, *Standing and Future Generations: Does Massachusetts v. EPA Open Standing for Generations to Come?*, 34 COLUM. J. ENVTL. L. 1, 3 & fn4 (2009) (citing the work of John Edward Davidson, Richard Epstein, and others); Todd J. Zywicki, *Environmental Externalities and Political Externalities: The Political Economy of Environmental Regulation and Reform*, 73 TUL. L. REV. 845, 900 (1999); Cole, *Clearing the Air: Four Propositions about Property Rights and Environmental Protection*, 10 DUKE ENVTL. L. & POL'Y FORUM 103 n.79; Peter Pashigian, *Environmental Regulation: Whose Self-Interests Are Being Protected?*, 23 ECON. INQUIRY 551, 580-81 (1985); *but see id.* at 558, 581 (acknowledging the potential role of political philosophy or the desire to protect the future).

[247] *Agencies Should Ignore Distant-Future Generations*, 74 U. Chi. L. Rev. 139 (2007).

[248] *Id.* at 141, 143 (citing Wojciech Kopczuk et al, *The Limitations of Decentralized World Redistribution: An Optimal Taxation Approach*, 49 EUROPEAN ECON. REV. 1051,1075 (2005)).

[249] Kopczuk et al., at 1072.

[250] *Id.* at 1075.

[251] *See id.* at 1070 (referencing only official development assistance).

[252] *Id.* at 1075; *see also* Revesz (on corruption).

valuing a $1 cost occurring in 50 years at $0.167 implies just a 3.6% discount rate, and just a 1.8% discount rate if the current generation values $0.167 out of a $1 cost occurring in 100 years[253]—a point in time when this generation's children or grandchildren could still be alive.

Foreign aid data is ultimately a highly problematic proxy for valuing how Americans feel about foreign welfare, let alone for the welfare of future generations.[254] Substantial empirical evidence in fact reveals that the current generation may attach a premium to, rather than discount, the next generation's welfare.[255] And Richard Revesz reports that, after a decade of posing a thought experiment to students and professional audiences, the "overwhelming response" has been to give equal weight to the preferences of people regardless of whether they happen to live in the future.[256]

Even if living voters cared little for future generations, elected officials are not necessarily motivated only by voters' preferences. Many elected officials likely care about their legacy and reputation, career advancement outside politics, their own progeny, and implementing their own political and moral philosophies—all of which could motivate concern for future generations.[257] As the next two subsection explore, Congress has repeatedly written a direct concern[258] for the welfare of future generations into statutory text or legislative history. To assume that Congress did not mean what it wrote, such that agencies should ignore future welfare, surely would require more evidence than cherrypicked foreign aid data. Without evidence to the contrary, agencies should take Congress at its word and value the welfare of future generations.

III.A.3.b: Explicit Statutory References to Future Generations

Many explicit references to future generations appear in statutory sections on general findings and purposes that are hard to enforce. Still, such direct references strongly indicate that Congress intended agencies to think about future generations. Notable examples include:

- the National Environmental Policy Act (NEPA), which establishes a federal policy "to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans";[259]
- the Federal Land Policy and Management Act, which instructs agencies to manage public lands consistent with "multiple use," defined as "a combination of balanced and diverse resource uses that takes into account the long-term needs of future generations for renewable and nonrenewable resources";[260]

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[253] $r = (1/PV)^{(1/t)} - 1$. Even the unreasonably low 1/2000 valuation (0.0005) would suggest, for example, applying a 5% discount rate to effects occurring in 150 years. $(1/0.0005)^{(1/150)} - 1 = 0.052$.

[254] *See, e.g.*, Arden Rowell, *Time in Cost-Benefit Analysis*, 41 U.C. IRVINE L. REV. 1215, 1235 n.106 (2014) ("[T]here are significant differences between the issues involved in valuing foreign and future lives, which make [Posner's] back-of-the-envelope application of Kopczuk et al.'s study inappropriate.").

[255] Sean Hannon Williams, *Statistical Children*, 30 YALE J. REG. 63, 68 (2013) (noting parents and non-parents both attach premiums to reducing risks to children).

[256] Revesz & Shahabian at 1123.

[257] *See* H. George Frederickson, *Can Public Officials Correctly Be Said to Have Obligations to Future Generations?* 54 PUB. ADMIN. REV. 457, 457 (1994); Edward L. Rubin, *Beyond Public Choice: Comprehensive Rationality in the Writing and Reading of Statutes*, 66 N.Y.U. L. REV. 1, 31 (1991).

[258] In other words, statutes directly reference future welfare, not just the current generation's limited altruistic valuation of future welfare.

[259] 42 U.S.C. § 4331(a).

[260] 43 U.S.C. § 1702(c). Many statutes relating to natural resources reference future generations. *E.g.*, 54 U.S.C. 100101 (requiring the National Park Service to regulate to "leave [resources] unimpaired for the enjoyment of future generations").

- the Natural Gas Act, which requires an assessment of the "present or future public convenience and necessity";[261]
- the National Energy Conservation Policy Act, which stresses the relevance of conservation to being "able to provide energy to meet future needs";[262] and
- the Superfund law, which defines "remedial actions" to ensure hazardous substances will not "cause substantial danger to present or future public health or welfare or the environment."[263]

Many more statutory programs—for safe drinking water regulations,[264] toxic substance controls,[265] residential lead limits,[266] and Head Start education programs,[267] to name a few—explicitly aim to safeguard the welfare of at least the next generation of children over the course of their future lives.

The absence of explicit references in other statutes should not be interpreted to indicate agencies can ignore the needs of future generations.[268] Congress has at least once removed an explicit statutory reference to the "present and future" public welfare as an unnecessary "surplus."[269] In 1972, the Federal Aviation Administration was given authority to regulate aircraft noise and sonic booms to protect both "present and future . . . public health and welfare."[270] But in 1994, Congress changed the language to refer generally to "public health and welfare"[271]—evidently believing the reference to "present and future" was obviously implied and therefore was removable "surplus."[272]

As that example demonstrates, Congress may have often believed that general references to the "public" implicitly included future generations. In fact, many legislative histories confirm that Congress often had future generations in mind when legislating to protect the public welfare, as the next subsection explores.

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[261] 15 U.S.C. § 717f(e). *See also* Fed. Power Comm'n v. Hope Nat. Gas Co., 320 U.S. 591, 657 (1944) (Jackson, J., dissenting) ("The public interest, of course, requires stopping unjust enrichment of the owner. But it also requires stopping unjust impoverishment of future generations."); *id.* at 627 (Frankfurter, J., dissenting) ("'[P]ublic interest'…includes more than contemporary investors and contemporary consumers."); Christopher J. Bateman & James T.B. Tripp, *Toward Greener FERC Regulation of the Power Industry*, 38 HARV. ENVTL. L. REV. 276, 295 (2014) (arguing to reconceptualize FERC's role based on Jackson and Frankfurter's dissents).

[262] 42 U.S.C. § 8201(3). The Energy Policy and Conservation Act also expresses Congress's desire "to deal with the short-, mid, and long-term energy problems of the Nation." *Id*. § 7112(3); *see also id.* § 5801 ("Congress hereby declares that the general welfare…require[s]…energy sources to meet the needs of present and future generations.").

[263] 42 U.S.C. § 9601.

[264] The Safe Drinking Water Act requires cost-benefit analysis to give special consideration to "infants, children, [and] pregnant women," calling attention minimally to at least the next generation. 442 U.S.C. § 300g-1.

[265] 15 U.S.C. § 2602(12) (including at least the next generation of children in "susceptible subpopulation").

[266] 42 U.S.C. § 4851b.

[267] 42 U.S.C. § 9840.

[268] *See generally Shook v. District of Columbia Fin. Responsibility & Mgmt. Assistance Auth.*, 132 F.3d 775, 782 (D.C. Cir. 1998) (describing limits of the *expression unius* canon).

[269] H.R. Rep. 103-180 at 352, 103rd Cong., 1st Sess. (July 15, 1993) (to accompany H.R. 1758). (explaining that in the text of 49 App.: 1431(a), re-designated at 49 U.S.C. § 44715(a)(1), "[t]he words 'present and future' . . . are omitted as surplus"); *see also* 49 U.S.C. § 44715 (revision notes, explaining the same).

[270] Pub. L. 92-574, 86 Stat. 1239 (Oct. 27, 1972).

[271] Pub. L. 103-272, 108 Stat. 1196 (July 5, 1994).

[272] H.R. Rep. 103-180 at 352, 103rd Cong., 1st Sess. (July 15, 1993) (to accompany H.R. 1758) (explaining that in the text of 49 App.: 1431(a), re-designated as 49 U.S.C. § 44715(a)(1), "[t]he words 'present and future' . . . are omitted as surplus"); *id.* at 1 (explaining the bill's purpose was to "revise…*without substantive change*") (emphasis added); S. Rep. 103-265 at 4-5, 103rd Cong., 2nd Sess. (May 19, 1994) (to accompany H.R. 1758) (explaining language was simplified while preserving "legal effect," and confirming that "mere changes in terminology" make "no substantive change in the law").

III.A.3.c. Legislative Histories Confirm Congress Cared about Future Welfare

The legislative histories of many statutes, especially environmental statutes, reveal a clear motivation to protect future generations. This subsection dives into the Clean Air Act, the Energy Policy and Conservation Act, and the National Environmental Policy Act (NEPA) as three statutes especially relevant to climate change. But the histories of other statutes may be just as rich.[273] When interpreting a statutory charge to protect public welfare, agencies will generally have considerable discretion to fully consider the needs of future generations.

Under the Clean Air Act, EPA Must Anticipate and Prevent Future Harms

The Clean Air Act's subchapter on acid rain explicitly references "future generations,"[274] but the lack of explicit language in other provisions does not diminish their clear focus on preventing future harms. Multiple Clean Air Act sections direct EPA to anticipate the endangerment of public welfare.[275] While "welfare" notably is defined to include "effects on…climate,"[276] terms like "endanger," "reasonably anticipate," and "potential" are not defined.[277] Yet their plain dictionary definitions all include a temporal element, and Congress deliberately chose this language to ensure that harms need not be imminent before EPA may act.

"Endanger" has appeared in the Clean Air Act since the statute's earliest incarnations. At first, in 1963, Congress used the present tense construction "is endangering the health or welfare of persons."[278] By 1967, Congress began adding the more forward-looking "may endanger,"[279] and in 1970, Congress strengthened EPA's authority to prevent "anticipated adverse effects on welfare."

Such revisions were aimed at preventing future harms. Consider one exchange during debate on the 1970 Conference Committee report, between Senator Randolph (Chair of the Environment and Public Works Committee) and Senator Muskie (a subcommittee chair who was instrumental in drafting the 1970 Clean Air Act).[280] Randolph asked Muskie whether the amendments went beyond "immediate problems" to provide "effective means of prevention of future air pollution problems." Muskie responded "Yes; I think that to a greater extent than we might have in past legislation, we are undertaking to *deal with the long-term aspects*."[281] Randolph later opined: "The implementation of the

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[273] For example, Senator Howard Baker broke from his party leader's position to help Congress override President Nixon's veto of the Federal Water Pollution Control Act Amendments of 1972 because "the kind of natural environment we bequeath to our children and grandchildren is of paramount importance." Committee on Public Works, Legislative History of the Water Pollution Control Act Amendments of 1972, Together With Section-by-Section Index 117 (1973). The House report for the Endangered and Threatened Species Conservation Act of 1973 spoke of "present or future" value of biodiversity, H.R. 93-412, at 144 (July 27, 1973), https://nctc.fws.gov/courses/csp/csp3116/resources/ESA_Section_7_Legislative_History/Part_1_pages_140-179.pdf, and when Nixon signed that law, he called it an "important step toward protecting a heritage which we hold in trust to countless future generations of our fellow citizens," Presidential Statement on Signing S. 1983 Into Law (Dec. 28, 1973), https://nctc.fws.gov/courses/csp/csp3116/resources/ESA_Section_7_Legislative_History/Part_1_pages_486-487.pdf..

[274] 42 U.S.C. § 7651(a)(5).

[275] *E.g.*, 42 U.S.C. § 7411(b)(1)(A); 42 U.S.C. § 7521(a)(1); 42 U.S.C. § 7470(1)

[276] 42 U.S.C. § 7602(h); *see also* Richard L. Revesz, *Bostock and the End of the Climate Change Double Standard*, 46 Columb. J. Envtl. L. 1 (2020) (diving deep into legislative history and unearthing early references to climate)..

[277] *See* 42 U.S.C. § 7602. "Public" is also not defined, but nothing in any dictionary or legislative history suggests "public" should refer exclusively to current generations.

[278] Pub. L. 88-206, §5 https://www.wilderness.net/NWPS/documents/publiclaws/PDF/88-206.pdf

[279] Pub. L. 90-148, §108 "which endangers…which is endangering"; §111 on federal facilities began to go further, "may endanger" but also said "is endangering"; §202 "likely to cause or to contribute to, air pollution, which endangers." http://www.tandfonline.com/doi/pdf/10.1080/00022470.1968.10469096

[280] December 18, 1970.

[281] Legislative History Vol. 1 at 144.

policies that are contained in this measure will test the determination in this country to achieve a livable environment, not only for ourselves *but for future generations*."[282]

Other Senators and Representatives also spoke repeatedly of future generations,[283] including Senate Minority Leader Scott, who "urge[d] immediate passage" to protect "future generations" from threats, including "irreversible atmospheric and climatic changes capable of producing a snowballing adverse effect to the health and safety of our citizens."[284] When signing the amendments into law, President Nixon pronounced that "1970 will be known as….[when] we really began to move on the problems of clean air and clean water and open spaces *for the future generations of America*."[285] And a few years later, in its 1977 amendments, Congress even more directly stated its goal to "insure the protection of the public health and the environment, both of this *and future generations*."[286]

Courts have confirmed the Clean Air Act's forward-looking intent. In 1975, the U.S. Court of Appeals for the D.C. Circuit found that the statute's repeated reference to "endanger" made the Clean Air Act "precautionary," meaning EPA need not wait for imminent harms before acting.[287] And in 2012, the D.C. Circuit upheld EPA's finding that greenhouse gas emissions endangered public welfare, concluding that the language "may reasonably be anticipated to endanger" required "a precautionary, forward-looking scientific judgment."[288]

In short, the Clean Air Act's repeated use of the phrase "may reasonably be anticipated to endanger public health or welfare" requires EPA to consider effects to future generations.

Under the Energy Policy Acts, "Need to Conserve" Includes the Needs of Future Generations

Under the Energy Policy and Conservation Act, the Department of Energy issues "economically justified" energy efficiency standards for industrial equipment[289] and consumer products;[290] and the Department of Transportation issues fuel efficiency standards for motor vehicles.[291] In defining "economically justified," the statute instructs the Department of Energy to "determine whether the benefits of the standard exceed the burden…[by] considering…the *need for national energy conservation*; and other factors."[292] Similarly, to set the "maximum feasible average fuel economy," the Department of Transportation must consider "economic practicability…and the *need of the United States to conserve energy*."[293]

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[282] *Id.* at 145.

[283] *Id.* at 268 (Senate Debate on S. 4358, Sept. 21, 1970; Senator Baker); *id.* at 259 (Debate on S. 4358, Sept. 21, 1970, Senator Cooper); Vol. 2 at 812 (House Debate on H.R. 7255, June 10, 1970, Rep. Thompson of Georgia) (equating the "needs of the public" with a clean environment for the present and "future generations").

[284] Vol. 1 at 349 (Statement of Senator Scott).

[285] *Id.* at 106; President's Remarks upon Signing the Clean Air Amendments of 1970 Into Law, Dec. 31, 1970 https://babel.hathitrust.org/cgi/pt?id=mdp.39015077941642;view=1up;seq=245.

[286] H.R. Rep. 95-294, 34, 1977 U.S.C.C.A.N. 1077, 1112. Congress also added the phrase "may reasonably be anticipated to endanger" to "assure that regulatory action can effectively prevent harm before it occurs…[and] to authorize the Administrator to weight risks and make reasonable projections of future trends." Report of the House Committee on Interstate and Foreign Commerce, H.R. Rep. 95-294 [at 50] (1977).

[287] Ethyl Corp v. EPA, *reheard en banc* (D.C. Cir. May 30, 1975).

[288] Coal. for Responsible Regulation, Inc. v. E.P.A., 684 F.3d 102, 121–22 (D.C. Cir. 2012), *aff'd in part, rev'd in part sub nom.* Util. Air Regulatory Grp. v. E.P.A., 134 S. Ct. 2427 (2014).

[289] 42 U.S.C § 6313.

[290] 42 U.S.C. § 6295.

[291] 49 U.S.C. § 32902.

[292] §6313(a)(6)(B)(ii); *see also* § 6295(o)(2)(B)(i) (practically the same language).

[293] §32902(f) (among other factors).

The statutes never define the "need" to conserve energy.[294] The language was added by the National Energy Conservation Policy Act of 1978,[295] and the codified congressional findings for that Act reveal a concern for the energy needs of future generations: "[U]nless effective measures are promptly taken…the United States will become…unable to provide the energy to meet future needs."[296] Related statutory language establishing the Department of Energy in 1977 connected the need for conservation with future environmental protection: "A strong national energy program is needed to meet the present and future energy needs of the Nation…[and] deal with the short-, mid-, and long-term energy problems of the Nation."[297]

Legislative history confirms that "need to conserve energy" included the need to protect both the environment and future generations.[298] President Carter's national addresses were instrumental in pushing Congress to act on energy conservation, and Carter repeatedly called for balancing present energy demands against protecting the environment and providing "a decent world *for our children and our grandchildren*."[299] Upon signing the National Energy Conservation Policy Act—and the rest of the National Energy Act legislative package—into law in 1978, Carter concluded that "Today we can rightfully claim that we have a conscious national policy for dealing with the energy problems of the present and also to help us deal with them in the future."[300]

More recently, federal courts have found there is "no doubt that Congress intended [agencies to] have the authority under the EPCA to consider" environmental costs,[301] including hundreds of years of future climate effects,[302] and also found that agencies must consider the most recent "scientific knowledge of climate change" in deciding how to balance EPCA's statutory factors.[303] Thus, it is appropriate under EPCA for the Departments of Energy and Transportation to consider the latest scientific and economic evidence when selecting the discount rates they use to weigh the needs of present and future generations to conserve energy.

NEPA Requires All Agencies to Recognize Long-Range Effects on Future Generations

NEPA is best known for requiring agencies to prepare environmental impact statements before leasing natural resources, approving interstate pipelines, or taking numerous other actions that could significantly affect the environment. Notably, NEPA requires such impact statements to weigh the

[294] *See* 42 U.S.C. § 6291.

[295] Language added by Pub. L. 95-619 (1978), subsection 325(d) of the National Energy Conservation Policy Act, amending 42 USC 6295(l) to include the "need of the nation to conserve energy."

[296] Pub. L. 95-619. Section 102. Subsequently amended to read "effective measures must continue to be taken" so the United States is "more able to provide energy to meet future needs." 42 U.S.C. § 8201.

[297] 42 U.S.C. §§ 7111-7112 (congressional findings and statement of purpose).

[298] *Cf.* H.R. Rep. 95-543, 3 (1978) ("This legislation is essential to our nation's immediate future."). Modifying "future" with "immediate" could be somewhat limiting, but importantly, the Conference Committee adopted the Senate's definition of "economically justified" over the House version, and the Senate included the broad "need to conserve energy." Conference Report, HR Rep 95-1751 at 116, 95th Cong, 2nd Sess (Oct. 1978).

[299] April 18, 1977 Address to the Nation on the Energy Problem, GAO Legislative History pt. 7; *see also* November 8, 1977, to discuss the National Energy Act, which would include the National Energy Conservation Policy Act, envisioning that the legislation would prompt an energy transition over the course of "a hundred years," for the sake of "our children and for our grandchildren."; April 20, 1977 Address to a Joint Session of Congress ("If successful, this effort will…protect our environment…[and] our future.").

[300] GAO Legislative History PL 95-619 pt 7, Remarks on Signing HR 4018, 5263, 5037, 5146, and 5289 (Nov. 9, 1978).

[301] *Zero Zone, Inc. v. Dep't of Energy*, 832 F.3d 654, 677 (7th Cir. 2016).

[302] *Id.* at 678-79.

[303] Ctr. for Biological Diversity v. Nat'l Highway Traffic Safety Admin., 538 F.3d 1172, 1197-98 (9th Cir. 2008) (holding that due to advancements in "scientific knowledge of climate change and its causes," "[t]he need of the nation to conserve energy is even more pressing today than it was at the time of EPCA's enactment.").

"relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity," as well as "any irreversible and irretrievable commitments of resources."[304] Clearly when conducting environmental assessments under NEPA, agencies must consider future effects.[305]

However, much more broadly than that, NEPA declares a national environmental policy and requires that "to the fullest extent possible[,] the policies, regulations, and public laws of the United States *shall be interpreted and administered* in accordance with the policies set forth in this chapter."[306] In other words, unless otherwise prohibited, agencies should interpret all their statutory authorities in light of NEPA's goals. Those goals include several references to future welfare.

Directly following the broad direction quoted above, NEPA requires that "all agencies of the Federal Government shall…recognize the worldwide and long-range character of environmental problems."[307] "Long-range" could be interpreted to refer either to long distances or long periods of time. Given the same provision goes on to discuss international cooperation, it is possible Congress meant to refer to long distances. Yet "worldwide" would seem to already cover all long distances, and legislative history suggests Congress intended to also cover long-term environmental problems. For example, in an influential *White Paper on National Policy for the Environment* submitted to Congress by the Senate Committee on Interior and Insular Affairs and the House Committee on Science and Astronautics, the legislators recommended adopting the following language: "[E]nvironmental quality…shall be considered in a worldwide context, extending in time from the present to the long-term future."[308]

Other sections of NEPA confirm the national policy of protecting future welfare. NEPA declares "it is the continuing policy of the Federal Government…[to] fulfill the social, economic, and other requirements of present and future generations of Americans.[309] And NEPA instructs "the Federal Government to use all practicable means…to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may fulfill the responsibilities of each generation as trustee of the environment for succeeding generations."[310]

Thus, whenever it is not inconsistent with other legal requirements, NEPA directs all agencies[311] to interpret their statutory authorities to advance the national policy of acting as trustee for future generations. Agencies can cite this directive from NEPA to help justify selecting discount rates that are based on the best available data and that reflect ethical obligations to the future.

III.A.4. Executive Orders Require Consideration of Future Generations

Executive orders confirm that agencies should generally consider future generations when acting to protect public welfare. For instance, President Clinton's Executive Order 12,866 instructs agencies to "assess *all* costs and benefits" in weighing the "well-being of the American people."[312] No distinction is

[304] 42 U.S.C. § 4332(2)(C).

[305] *See* Selkirk Conservation Alliance v. Forsgren, 336 F.3d 944, 962 (9th Cir. 2003) (requiring a reasonable time period); *Scientists' Inst. for Pub. Info., Inc. v. Atomic Energy Comm'n*, 481 F.2d 1079, 1092 (D.C. Cir. 1973); Richard J. Lazarus, *Changing Conceptions of Property and Sovereignty in Natural Resources Law*, 71 IOWA L. REV. 631, 685 n.336 (1986) ("The concern for the interests of future generations is evidence in many environmental cases.").

[306] 42 U.S.C. § 4332(1).

[307] 42 U.S.C. § 4332(2)(F).

[308] "1968 White Paper at 15.

[309] 42 U.S.C. § 4331.

[310] 42 U.S.C. § 4331(b)(1).

[311] Including independent agencies.

[312] Exec. Order No. 12,866 § 1(a) (emphasis added).

drawn between present or future costs and benefits, or between current and future generations of Americans.

Shortly after his inauguration, President Obama signed a *Memorandum on Regulatory Review*, which directed OMB to develop a new Executive Order on regulatory policy.[313] OMB was specifically instructed to "address the role of distributional considerations, fairness, and concern for the interests of future generations."[314] In December 2009, OMB summarized the memorandum as calling attention to "three factors that are not always fully included in cost-benefit analysis: the interests of future generations; distributional considerations; and fairness. If regulation is to be *data-driven and evidence-based, it must include, rather than neglect, the concerns of future generations*."[315] OMB's summary continued on to describe the recent development in 2009 of the Interagency Working Group on the Social Cost of Carbon's first interim guidance, which recognized "the well-established view that a high discount rate for long-term damage could lead to action that might harm future generations."[316]

A year later, President Obama signed Executive Order 13,563, directing agencies "to use the best available techniques to quantify anticipated *present and future* benefits and costs as accurately as possible," and reminding agencies to consider "equity, human dignity, fairness, and distributive impacts."[317] The explicit mention of "future benefits and costs" was surely meant to ensure, as OMB had previewed, that agencies would "include, rather than neglect, the concerns of future generations" and not select discount rates that were so "high" as to "harm future generations."

Similarly, immediately after his inauguration, President Biden issued several document that further inform how agencies should select discount rates. In a *Memorandum on Modernizing Regulatory Review*, President Biden called for OMB to consult with agencies on "concrete" steps to ensure regulatory policies "promote…social welfare…equity, and the interests of future generations."[318] In particular, the *Memorandum* recommended considering revisions to *Circular A-4* to "reflect new developments in scientific and economic understanding."[319] And Executive Order 13,990 specifically calls for agencies to use methodologies that "adequately take account of . . . intergenerational equity" to estimate the social cost of greenhouse gases, to "reflect the interests of future generations in avoiding threats posed by climate change."[320]

Agencies should fulfill these executive instructions by picking discount rates that also give all due weight to inter-generational equity.

III.A.5. Courts Will Give Agencies Considerable, But Not Unlimited, Discretion on Discount Rates

Since most statutes do not directly discuss discounting much less require specific rates, agencies' discount rate choices will normally be reviewed under the Administrative Procedure Act's "arbitrary and capricious" standard.[321] Courts will vacate rulemakings as arbitrary if agencies "entirely failed to

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[313] 74 Fed. Reg. 5977 (signed Jan. 30, 2009; published Feb. 3, 2009).

[314] *Id.*

[315] Unified Agenda, 74 Fed. Reg. 64,131 (Dec. 7, 2009) (emphases added).

[316] *Id.*

[317] Exec. Order No. 13,563 § 1(c).

[318] Memorandum on Modernizing Regulatory Review, 86 Fed. Reg. 7223, 7223 (signed Jan. 20, 2021, published Jan. 26, 2021).

[319] *Id.*

[320] Exec. Order No. 13,990 § 5(b)(ii)(E) & (iii), 86 Fed. Reg. 7037, 7040-41 (signed Jan. 20, 2021, published Jan. 25, 2021).

[321] 5 U.S.C. § 706(2).

consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise."[322] Courts typically defer to agencies' judgments on complex technical issues, and discount rates are a "highly technical" choice on which agencies deserve some deference.[323] Still, administrative law scholars identify several circumstances under which courts might find that discount choices are arbitrarily illegal, including: offering grossly insufficient justifications for their choices; making choices contrary to evidence that affect ultimate policy decisions; failing to explain inconsistent choices; failing to consider uncertainty about the discount rate; and making choices that effectively ignore important factors or interests.[324] Some have called for courts to fulfill their "countermajoritarian function" by more actively protecting future generations.[325]

Actual litigation over discounting has been somewhat rare to date, and courts have often been reluctant to second-guess an agency's discounting choice. In one case, the U.S. Court of Appeals for the District of Columbia Circuit deferred to an agency's discount rate selection as "first and foremost a policy choice," and explained that the agency was free to revisit its discount rates in future rulemakings "so long as it sets forth a reasonable justification."[326] But while judicial review in this area is deferential, there are limits.

First, agencies must explain discount-rate choices and their rejection of alternative discount rates proposed by commenters, particularly if the selected rate departs from prior agency practices.[327] In *Natural Resources Defense Council v. Herrington*, the D.C. Circuit found the Department of Energy (DOE)'s use of a 10% discount rate "fatally unexplained."[328] DOE had previously used a 5% rate to calculate the net present value of consumer savings from more energy-efficient appliances, but in 1982 determined to follow the 10% rate recommended at the time in OMB's *Circular A-94*.[329] Public commenters complained that consumer savings should be discounted at the real, after-tax rates available to consumers, closer to 3%.[330] DOE responded that it saw no reason why the 10% rate from *Circular A-94* could not apply to consumers, and based its decision on that rate even though its analyses showed even a slightly lower rate (like 7%) could have substantially changed its cost-benefit calculations.[331] The court found that OMB's *Circular A-94*, at least as of 1982, did "not explain the reasoning behind the discount rate it recommends," that DOE had failed to sufficiently elaborate on the justification, and that DOE's dismissal of alternative suggestions was "too conclusory to qualify as reasoned decisionmaking."[332] Because the choice of discount rate had "major consequences" for policy

[322] 463 U.S. 29, 43 (1983).

[323] Cass R. Sunstein, *Cost-Benefit Default Principles*, 99 MICH. L. REV. 1651, 1711 (2001).

[324] Sunstein, 99 MICH. L. REV. at 1711, 1712, 1714; Sunstein, *Cost-Benefit Analysis and Arbitrariness Review*, 41 HARVARD L. REV. 1, 21-22 (2017); Cass R. Sunstein & Arden Rowell, *On Discounting Regulatory Benefits: Risk, Money, and Intergenerational Equity*, 74 U. CHI. L. REV. 171, 205–06 (2007); David Weisbach & Cass R. Sunstein, *Climate Change and Discounting the Future: A Guide for the Perplexed,* 27 YALE L. & POL'Y REV. 433, 444 (2009); Morrison, 65 U. CHI. L. REV. at 1358-59.

[325] Bradford C. Mank, *Protecting the Environment for Future Generations: A Proposal for A "Republican" Superagency*, 5 N.Y.U. ENVTL. L.J. 444, 446 (1996).

[326] *State of Ohio v. U.S. Dep't of the Interior*, 880 F.2d 432, 465 (D.C. Cir. 1989). *See also N. Cal. Power Agency v. FERC*, 37 F3d 1517, 1522–23 (D.C. Cir 1994) (deferring to agency's discount-rate selection).

[327] *Cf. FCC v. Fox Television Stations, Inc.*, 556 U.S. 502 (2009) (setting standards for agencies to depart from prior practice).

[328] *Nat. Res. Def. Council, Inc. v. Herrington*, 768 F.2d 1355, 1414 (D.C. Cir. 1985).

[329] *Id.* at 1412.

[330] *Id.* at 1412-13.

[331] *Id.* at 1413-14.

[332] *Id.* at 1413.

outcomes, it was "particularly important" for the agency to "fix the rate carefully and explain its decision intelligibly"—and DOE had failed that test.[333]

Cases on similarly technical valuations confirm that courts may intervene if decisions are wildly inconsistent with the available evidence. For instance, the U.S. Court of Appeals for the Fifth Circuit vacated a regulation that relied on an estimate of the value of a statistical life (*i.e.* the monetary value of mortality risk) that was roughly ten times higher than the valuations supported by the economic literature and previously applied by agencies in cost-benefit analysis.[334] And recently a federal district court struck down a deregulatory rule relying on an "interim" valuation of the social cost of methane that, by ignoring all climate effects outside U.S. borders, was nearly ten times lower than estimates previously endorsed by the Interagency Working Group.[335] Because the agency disregarded "the best available science about monetizing the impacts of greenhouse gas emissions," the court held, its regulation was arbitrary.[336] A similar standard could apply to the choice of discount rates.

Finally, courts may strike down agency actions for unexplained inconsistencies. The Fifth Circuit, for instance, has noted that when an agency discounts costs, it "should discount benefits to preserve an apples-to-apples comparison."[337] And in something of an outlier decision nearly fifty years ago, a federal district court applied a particularly un-deferential review and struck down an agency's determination in part because it used supposedly "unrealistic" discount rates that were inconsistent with the rates applied in other recent regulatory analyses.[338] More generally, courts grow skeptical whenever agencies "inconsistently and opportunistically frame[] the costs and benefits" of their actions.[339]

The fact that agencies should assess impacts fairly and consistently, however, does not mean that they must assess all impacts identically. Rather, courts have recognized that certain impacts may present unique circumstances that could justify different treatment. For instance, the U.S. Court of Appeals for the Seventh Court upheld a cost-benefit analysis that quantified climate benefits over hundreds of years while assessing employment impacts over only thirty years after the defendant agency concluded that the rule "would have long-term effects on the environment but . . . would not have long-term effects on employment."[340] A court might similarly defer to an agency's choice of different discount rates for different effects (such as near-term costs versus long-term climate benefits)—but likely only if the agency adequately explains the special economic, legal, and ethical principles that may justify a different approach to discounting in intergenerational contexts.

III.B. Legal Considerations for Selecting Discount Rates

In the past, when agencies were sometimes reluctant to apply the social cost of greenhouse gases in their environmental impact statements, they often argued that range of values adopted by the Interagency Working Group showed that there was no consensus on the appropriate discount rate and,

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[333] *Id.* at 1414.

[334] *Corrosion Proof Fittings v. EPA*, 947 F.2d 1201, 1222–23 (5th Cir. 1991). Specifically, the agency applied implicit VSL estimates of $43 million–$76 million, whereas available VSL estimates generally fell between $3.8 million–$9 million.

[335] *California v. Bernhardt*, 472 F. Supp. 3d 573, 608–14 (N.D. Cal. 2020).

[336] *Id.* at 611.

[337] *Corrosion Proof Fittings*, 947 F.2d at 1218.

[338] *Montgomery v. Ellis*, 364 F. Supp. 517, 529 (N.D. Ala. 1973).

[339] *Bus. Roundtable v. S.E.C.*, 647 F.3d 1144, 1148–49 (D.C. Cir. 2011); *see also* CBD v. NHTSA, 538 F.3d 1172, 1198 (9th Cir. 2008) (warning not to "put a thumb on the scale by undervaluing the benefits and overvaluing the costs"); *Gen. Chem. Corp. v. United States*, 817 F.2d 844, 857 (D.C. Cir. 1987) ("internally inconsistent" analysis was arbitrary).

[340] *Zero Zone, Inc. v. United States Dep't of Energy*, 832 F.3d 654, 679 (7th Cir. 2016).

as a result, that the social cost estimates were too variable and uncertain to be useful in analysis.[341] Courts sometimes deferred to agencies on this point and agreed that the range of discount rates suggested there was perhaps "no consensus" on the appropriate values.[342]

Litigants have recently adopted similar arguments to attack agencies' choice of discount rates. In a March 2021 challenge in the U.S. District Court for the Eastern District of Missouri against the Working Group's interim estimates, the complaint highlighted that "[t]he indeterminacy and value-laden nature of choosing a discount rate results in a wide range of potential values of the 'social costs' of gases," and concluded that "[t]his wide range . . . reflects the inherently speculative, indeterminate, and policy-laden nature of the task."[343] The argument went on to assert that states and stakeholders had developed "legitimate reliance" on the prior use of 3% and 7% discount rates, and complained that the Working Group had failed to adequately explain the change in the choice of discount rates as compared to the prior administration.[344] An April 2021 challenge in the U.S. District Court for the Western District of Louisiana made similar claims, arguing that the Working Group had failed to explain why "the fundamentals of economics have changed" in a way that would justify not using the 7% rate based on returns to capital.[345] Failing to use a 7% discount rate, the complaint went on, "ignor[es] the private sector" and will so "'crowd[ ] out private investments with a higher rate of return."[346] Furthermore, the lawsuit argues that the Working Group has "usurp[ed] the authority vested in agencies" by determining the discount rates and so "dictat[ing] a specific number" be used by all agencies.[347]

Though such claims are unfounded, agencies can take several steps to help minimize such legal risks. To begin, agencies should ground their choice of discount rates in the best available data, expert elicitations, and literature, and should thoroughly justify their choices as consistent with both legal principles and the best available economics. Agencies should respond adequately to all public comments and suggestions to use alternate rates. Any departure from prior uses of capital-based rates should be thoroughly explained; in doing so, it may be helpful for agencies to note that even during the Trump administration, agencies acknowledged that the 7% capital-based rate did not adequately account for "tradeoffs between improving the welfare of current and future generations," and that discount rates of 3% or lower would be more appropriate in inter-generational contexts.[348]

OMB and the Working Group should both revise their guidance on the appropriate default discount rates for agencies to apply, and should include detailed justifications for agencies to rely upon. While *NRDC v. Herrington* perhaps represented an extreme case in which the court found OMB's explanation too thin for another agency to rely upon without offering more detail, agencies may want to minimize any legal risks by justifying a change in discount rates with more explanation than just a cross-reference to guidance from OMB or the Working Group. Instead, agencies should affirm that the new rates reflect their own judgment of the rates most consistent with the best available evidence. When applicable, agencies should cite to relevant legal standards for considering the best available data and the welfare

[341] See Max Sarinsky et al., *Broadening the Use of the Social Cost of Greenhouse Gases in Federal Policy* (Policy Integrity Report, 2021) (arguing why the social cost of greenhouse gas metrics should be applied broadly to such analyses).

[342] *350 Montana v. Bernhardt*, 443 F.Supp.3d 1185 (D. Mont. 2020) (citing Dr. Thomas Power as saying "there is no consensus on the appropriate social discount rate," and implying that the resulting range of social cost of carbon estimates was too wide); *accord EarthReports v. FERC*, 828 F.3d 949 (D.C. Cir. 2016) (deferring to FERC on conclusion that lack of consensus on appropriate discount rates leads to "significant variation").

[343] Complaint, *Missouri v. Biden*, No. 4:21-cv-00287-AGF at 20-21 (E.D. Mo. filed Mar. 8, 2021).

[344] *Id.* at 26.

[345] Complaint, *Louisiana v. Biden*, No. 2:21-cv-01074 at 37-38 (W.D. La. filed Apr. 2021).

[346] *Id.* at 38 (citing Susan Dudley's work).

[347] *Id.* at 30.

[348] SAFE Vehicles Rule for Model Years 2021–2026 Passenger Cars and Light Trucks, 85 Fed. Reg. 24,174, 24,735 (Apr. 30, 2020) (explaining that the central analysis focused on a 3% rate, and the 7% rate was used only for sensitivity analysis).

of future generations. In particular, NEPA's charge for all agencies to interpret all their statutory authorities consistent with concern for future generations (*see supra* Section III.A.3.c) can provide useful support. When agencies' policies will have costs that are primarily borne through reduced consumption rather than displaced investment; when the costs and benefits of their policies are long-run; or when their policies might induce rather than displace private investment, agencies should consider citing these additional justifications for not using capital-based discount rates (see Section II.B). When use of updated discount rates is important to the agency's ultimate policy decision, the agency should acknowledge the change in rates, justify its reliance on the newly recommended rates,[349] and substantively respond to any comments proposing alternative rates.[350]

III.C. Legal Considerations for Consistency in Discounting

As noted above, courts have sometimes cautioned agencies against inconsistent approaches to discounting in their analyses. Economic principles similarly recommend internally consistent discounting.[351] Agencies should aim for consistency both within analyses and across policy contexts, but if the use of different discount rates remains necessary in some contexts, agencies should be prepared to justify any such differences.

One set of considerations is the different points within a single analysis during which discount rates are applied. To illustrate, consider a policy adopted in 2021 that creates compliance costs in 2022, resulting in carbon dioxide emission reductions in 2023, with those emissions reductions benefiting the climate over the course of centuries. The discount rate comes into play at three different but related points in an analysis of this policy. First, the carbon dioxide emissions reduced in 2023 will generate climate benefits over the course of centuries, and all those climate benefits must first be discounted back to the year of emissions in 2023—this is the discount rate or discount schedule that serves as the basis for calculating the social cost of greenhouse gases. Second, the net climate benefits achieved from that emissions reduction in 2023 must still be discounted back to the present value in 2021, at the time when the analysis is conducted. Optimally, the discount rate or discount schedule applied for this present-day valuation should be the same as the discount rate selected for the calculation of the social cost of greenhouse gases, so that all climate effects are discounted consistently.[352] Third, other non-climate costs and benefits in the same analysis, such as the 2022 compliance costs, must also be discounted to present value in 2021, to the time when the analysis is conducted.

As explained above, to date, agencies have not always adopted wholly consistent practices to discounting within their analyses. Because the Interagency Working Group has so far recommended social cost of greenhouse gas values with a central discount rate of 3%, and sensitivity at 2.5% and 5% rates, while *Circular A-4* still recommends using default rates of both 3% and 7% for other costs and benefits, agencies have often discounted climate effects at a 3% rate even when discounting other costs

[349] The Supreme Court has held that "an unexplained inconsistency in agency policy is a reason for holding an interpretation to be an arbitrary and capricious change from agency practice." *Encino Motorcars, LLC v. Navarro*, 136 S. Ct. 2117, 2126 (2016) (internal quotation marks omitted).

[350] Under the Administrative Procedure Act, agencies must respond to substantive comments received during the notice-and-comment period. *See, e.g.*, *N.C. Growers' Ass'n v. United Farm Workers*, 702 F.3d 755, 769 (4th Cir. 2012) ("[D]uring notice and comment proceedings, the agency is obligated to identify and respond to relevant, significant issues raised during those proceedings.").

[351] 2021 TSD, *supra* note, at 22; NAS, *supra* note 146, at 170, 182; Arrow et al., *supra*.

[352] *See* 2021 TSD, *supra* note, at 25 ("[T]he monetized value of future emission changes should be discounted at the same rate used to calculate the initial SC-GHG to ensure internal consistency—i.e., future damages from climate change using the SC-GHG at 2.5 percent should be discounted to the base year of the analysis using the same 2.5 percent rate.").

and benefits at a 7% within the same analysis.[353] Agencies have also not always adopted wholly consistent practices to discounting across different policy contexts.[354] Many of the same arguments that make a 7% discount rate inapplicable to climate effects would apply with equal force to other long-term effects; and yet, even as agencies have correctly chosen to focus on consumption-based rates for climate change, they have continued to apply capital-based rates to other long-term effects, like the lifetime earning effects from lead or mercury exposure in childhood or before birth.[355]

The most straightforward resolution to all such issues of consistency is, of course, to simply make all discounting choices consistent. Adopting a single schedule of declining discount rates should likely resolve such matters by prescribing an internally consistent schedule of rates, even as the rates will appropriately decline over time. Though the federal government has in the past been reluctant to move to a declining discount rate schedule,[356] such schedules have been estimated for use in U.S. policy (see Section II.D.1), and the goal of analytical consistency weighs strongly in favor of this approach.

Another option for achieving consistency would be to select and justify a single, constant discount rate that is most appropriate given all the costs and benefits under analysis. Note, for example, that *Circular A-94* advises that if a federal action "provides a mix of both Federal cost savings and external social benefits," and if the action's costs cannot be clearly allocated into a portion that leads to federal savings versus a portion that generates social benefits, then the entire investment can be evaluated with a discount rate appropriate for discounting the social benefits.[357] Following that same logic, because it would be inappropriate to apply a very high discount rate to climate effects whereas a lower discount rate is appropriate for non-climate effects (see Section II.B), agencies could justifying picking the best

[353] *E.g.*, 85 Fed. Reg. 24,174, 24,735 (Apr. 30, 2020) ("Throughout the NPRM central analysis, costs resulting from increased emissions of CO_2 were also discounted from the year when those increases in emissions occurred to the present using a 3 percent rate, even when all other future costs and benefits were discounted at a 7 percent rate. Thus the agencies' central analysis for the NPRM did not use SC-CO_2 values for future years that were constructed by applying a 7 percent rate to discount distant future climate-related economic damages, and did not use a 7 percent rate to discount costs of increased CO_2 from the years when they were projected to occur to 2018 (the base year used in the analysis)."); Dept. of Energy, Technical Support Document: Energy Efficiency Program for Consumer Products: Residential Central Air Conditioners and Heat Pumps at 1-3 (2016), https://perma.cc/PDA2-Y2WK (presenting the full range of the Working Group's four social cost of carbon values, but then in tallying net benefits, explaining that "Total Benefits for both the 3% and 7% [discount rate] cases are derived using the series corresponding to average SCC with a 3-percent discount rate"); Bureau of Land Mgmt., Regulatory Impact Analysis for: Waste Prevention and Resource Conservation 6-7 (2016), https://www.regulations.gov/document/BLM-2016-0001-9127 (presenting social benefits only "using model averages of the social cost of methane with a 3% discount rate," and comparing those climate benefits to other costs and benefits discounted at both the 3% and 7% rates).

[354] Agencies also routinely apply different discount rates in different decisionmaking contexts. For example, OMB's *Circular A-94* advises that in cost-effectiveness analysis of government programs, analysis of internal government investments (including, for example, energy-efficiency upgrades for federal buildings), and other contexts like lease-purchase analysis, agencies should generally use Treasury interest rates. OMB, Circular A-94: Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs 8-10 (1992). OMB updates *Appendix C to Circular A-94* every year to show the latest Treasury interest rates; in recent years, the rates have fallen to 0% or even into negative territory. OMB, Table of Past Years Discount Rates from Appendix C of OMB Circular No. A-94 (Dec. 21, 2020), https://perma.cc/5VYS-LAFH.

[355] For example, in 2020 EPA proposed revisions to drinking water standards for lead and copper. EPA found the policy would have large monetized net benefits at a 3% discount rate, but monetized net costs at a 7% rate. In comments submitted by one of the authors of this article (Schwartz), the Institute for Policy Integrity argued that EPA should focus on a 3% or lower discount rate, given the long-term nature of the benefits and the fact that the costs would fall mostly not to private entities, but either to government-owned entities or directly to individual households. Policy Integrity Comments on EPA on National Primary Drinking Water Regulations: Lead and Copper Rule Revisions, Feb. 12, 2020, https://policyintegrity.org/documents/EPA_Lead_Copper_Rule_Comments_2020.02.11.pdf.

[356] 2010 TSD.

[357] Circular A-94 at 10 (recommending that "[t]he net present value of such investments should be evaluated with the 7 percent real discount rate," because when Circular A-94 was drafted in 1992, a 7% discount rate was thought appropriate for investments with external social benefits; updated data and more recent understandings suggest that rate would be inappropriate).

estimate of a constant discount rate suitable for climate effects and apply that rate to all costs and benefits. In adopting such an approach, agencies should be prepared to thoroughly explain why using a lower discount rate for all costs and benefits is justified, drawing from the economic and legal principles described above. Agencies could still also assess non-climate costs and benefits with alternate discount rates in a sensitivity analysis, and doing so may help minimize legal risk.

Indeed, yet another option is to try to make different estimates of constant discount rates as harmonized as possible, while using sensitivity analyses to explore how different discount rates may affect the overall policy outcome. The National Academies of Sciences explored this option in their 2017 report on the social cost of carbon. That report acknowledged the potential tension between applying different discount rates to climate damages versus other regulatory costs and benefits, but still strongly emphasized the need for agencies to base the social cost of greenhouse gases on evidence-based discount rates that account for the specific concerns that arise in the context of intergenerational impacts and long time horizons.[358] As one possible solution, the National Academies suggested trying to match discount rates as closely as possible, such as by "combining other cost and benefit estimates with the [social cost of greenhouse gas] estimate whose near-term discount rate most closely matches that particular discount rate" or "combining other costs and benefits based on a high discount rate with the [social cost of greenhouse gas] estimate based on its highest discount rate, and analogously combining the low discount rate estimates."[359] For example, if the lowest discount rate appropriate for climate change was estimated at 1%, while the lowest discount rate appropriate for non-climate effects was estimated at 2%, agencies would combine such low estimates together, and similarly match estimates using the highest discount rates appropriate for each context. The use of sensitivity analysis could help show the influence of the discount rate on the ultimate policy choice.

As a final option, if it is not feasible or appropriate for agencies to use the same discount rate for all effects, agencies should thoroughly justify their choice to apply different rates in different contexts. Again, this is what many agencies have done to date in applying the social cost of greenhouse gases in regulatory analysis. The Seventh Circuit's ruling in *Zero Zone v. Department of Energy* may provide a useful precedent in justifying this approach. In that case, the litigants argued that the Department of Energy had arbitrarily considered hundreds of years of climate benefits while limiting its assessment of employment impacts and other effects to just a thirty-year time horizon. The court upheld the regulatory analysis, concluding that the difference in time horizons was justified because the rule "would have long-term effects on the environment but . . . would not have long-term effects on employment."[360] The choice of time horizons is related to the choice of discount rate: any cost or benefit occurring beyond the end of the analytical time horizon is effectively discounted at an infinitely high rate.[361] Analogizing from this precedent, a future court may similarly defer to an agency's finding that the long time horizon of climate change justifies a lower discount rate than the rate applied to shorter-term costs and benefits. However, this approach may entail some legal risk, and so agencies taking this route should thoroughly explain the special economic, legal, and ethical considerations that justify selecting a different discount rate for climate effects than for other costs and benefits.

But to summarize, a declining discount rate approach is not only the best choice based on economic principles but also would place agencies on the surest legal footing. A single schedule of declining

[358] NAS, *supra* note 146, at 170, 182.

[359] *Id.* at 181-82.

[360] *Zero Zone, Inc.*, 832 F.3d at 679.

[361] *See* Arden Rowell, *Time in Cost-Benefit Analysis*, 4 U.C. IRVINE L. REV. 1215, 1237-38 (2014) (noting time inconsistencies in different regulatory analyses and advising agencies to identify a temporal break-even point by which a proposed policy will pay for itself).

discount rates could be consistently applied across a range of short-term and long-term policy effects. Guided by legal requirements to consider the best available evidence and the interests of future generations, agencies can justify the choice of a declining discount rate schedule as most consistent with economic literature and their obligations to the future. For many policies, any use of a capital-based rate may be inappropriate, and agencies should begin with a consumption-based estimate of the discount rate around 2% or lower, and decline the rate over time from there. A more conservative approach, appropriate if there is a significant chance that a government action will crowd out some private investment, would start by acknowledging some uncertainty as to whether costs and benefits will affect capital investments or consumption more, and assume a 50-50 split at the start. Agencies could then start in year one of analysis by taking an average of the discount factors based on a consumption-based rate (i.e., 2%) and a capital-based rate corrected for some market distortions (i.e., somewhere in the 3-6% range). The rate would then decline toward the consumption-based rate by around year 30 (as per Li & Pizer (2021)), and afterward would continue to decline based on long-term uncertainty, inter-generational equity, and other factors as explored above.

Conclusion

The discount rate is a key input in many policy analyses, but is an especially powerful parameter in analysis of policies with long-term effects, particularly climate change. The federal government's existing guidance on discount rates is woefully out of date. Not only does recent market data suggest that both default discount rates recommended by OMB's *Circular A-4* should be substantially lower, but the capital-based approach is inapplicable to many policy contexts, including climate change. The federal government should follow the lead of other jurisdictions by factoring uncertainty, growth correlations, risk aversion, the future scarcity of environmental goods, and ethical obligations to future generations into their estimates of the discount rate. Agencies are legally obligated to consider the interests of future generations and to base their decisions on the best available evidence. Though agencies will need to fully explain their discount rate choices—especially any departures from prior practice—moving toward a schedule of declining discount rates will allow agencies to most consistently, defensibly, and fairly balance present public welfare against the value of future welfare.