

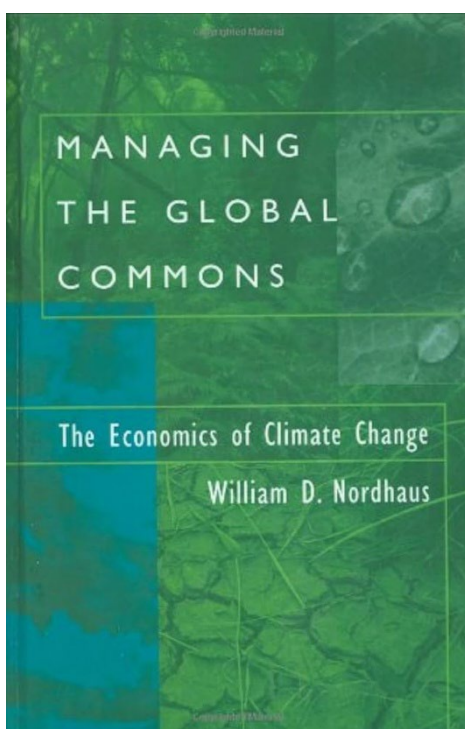
My 1994 ‘Climate Book of the Year’

Nordhaus, W.D. (1994) *Managing the Global Commons: The Economics of Climate Change*. Cambridge, MA: MIT Press. 213pp.

This essay continues my series of monthly posts in which I select one ‘climate’ book to highlight and review from one of the 44 years of my professional career in climate research (starting with 1984, my first year of academic employment). The series will end in September 2027, the month in which I shall retire. [See here for more information](#) about the rationale for this series, and the criteria I have used in selecting my highlighted books.

This ‘1994 essay’ can be [download as a pdf](#).

In 2018, the Nobel Memorial Prize in Economic Sciences was awarded jointly to two American economists, William (‘Bill’) Nordhaus and Paul Romer. The award citations



highlighted their contributions for integrating, respectively, climate change and technological innovations into long-run macroeconomic analysis. For Nordhaus, this award was the culmination of a long academic career, starting in the 1960s, during which he applied the tools of economics to answer resource management questions, related initially to energy and later to climate. In his Banquet Speech following the Nobel Prize ceremony, Nordhaus summarised the contribution of economics to solving the climate problem as “recogniz[ing] that climate change is a harmful unintended side-effect of economic growth, known in economics as an external effect or externality”—in other words, the damages from carbon dioxide emissions are not paid for by the emitters and that the best remedy for this state of affairs is to set a pollution charge, a carbon tax.

Nordhaus was one of the earliest analysts to apply economic theory to climate change and became probably the most widely known climate economist for his contributions, starting in the mid-1970s, to establishing the optimal price of carbon. He did this through modelling and created one of the first climate-energy-economy models in 1975 which then evolved, by the early 1990s, into what he called the [Dynamic Integrated Climate Economy \(DICE\) model](#). In 1994, with a substantial body of work already completed and with the policy debates around climate change becoming sharper by the year, Nordhaus published his first book

devoted to climate economics, ‘*Managing the Global Commons: The Economics of Climate Change*’. I have selected this as my **1994 Climate Book of the Year**.¹

‘Managing the Global Commons’ was the first full-length monograph dealing systematically with climate economics. It describes the design and operation of the DICE model and its application to the “terrible dilemma” posed by climate warming. Nordhaus explained that economic analysis is “an approach that weighs costs and benefits and constantly seeks the middle ground between excessive zeal and indifference, looking for the balance point between the costs of further investments in conservation or prevention and the benefit of damages avoided” (p.ix). On publication of the book, Nordhaus was aged 53 and already an influential figure in the emerging field of climate economics and policy. After gaining his PhD at MIT in 1967, working under another [Nobel Prize winning economist Robert Solow](#), he joined Yale University where he remained for the rest of his career, and today as Sterling Professor of Economics & Professor in the School of the Environment. DICE became a very widely adopted climate-change integrated assessment model (IAM), for example being used by the United States and other governments for calculating the social cost of carbon. Under Nordhaus’s direction, DICE continued to evolve over the subsequent 30 years, the most recent version, released in 2023, being DICE-23.²

Nordhaus first encountered the ‘resource management question’ of climate change—what at the time he referred to as ‘the carbon dioxide problem’—during the year 1974/75, which he spent on leave from Yale at the International Institute for Applied Systems Analysis (IIASA), just outside Vienna. There was an element of chance about how this focus on climate change came about, as Nordhaus explains:

Scholars shared offices at IIASA, and by lottery I joined Allan Murphy, a distinguished climatologist from Oregon State University. We shared stories about our interests, and he encouraged me to think about the impact of the economy on climate systems.

Thus began my study of the economics of climate change.³

During this year at IIASA, Nordhaus developed a simple climate-energy model to explore what level of carbon tax might re-direct the United States’ energy system away from carbon dioxide emitting fossil fuels. Over the next two decades he extended this analytical approach during a period when the question of how to deal with climate change first entered into mainstream international politics. His first formulation of the DICE model was

¹ His first book dealt more widely with the dilemmas of energy resource utilisation, written in the context of the major oil price shocks of the 1970s: Nordhaus,W.D. (1979) *Efficient Use of Energy Resources*. New Haven, CT: Yale University Press.

² See for example: Barrage,L. and Nordhaus,W.D. (2024) Policies, projections, and the social cost of carbon: Results from the DICE-2023 model. *Proceedings of the National Academy of Sciences*. 121 (13): e2312030121. Nordhaus describes this study as updating the 2016 DICE version and introducing approaches for including non-diversifiable risk, a revised carbon cycle, updates for damage estimates, and results of implementing the Paris Agreement and other temperature-limited scenarios.

³ p.11 in: Nordhaus,W.D. (2024) Looking backward, looking forward. *Annual Review of Resource Economics*. 16: 1–20.

published in 1992⁴ and his book, 'Managing the Global Commons', appeared just at the time when the USA and the EU were engaged in a dispute about whether a carbon tax or a carbon emissions-trading mechanism was more effective for exerting downward pressure on carbon emissions. Nordhaus sided with the EU's position (although in the end emissions trading won out). The carbon dioxide externality arises from the fact that the damages caused by carbon emissions are not paid for by the emitters; in Nordhaus's view, a carbon tax offers an efficient remedy to this deficiency.

'Managing the Commons' is an extended user guide and application manual for the DICE model. In the book, Nordhaus uses DICE to examine the implications of several different approaches to climate-change policy: no controls, economic optimization, geoengineering, stabilization of emissions at 1990 levels, and a 10-year delay in undertaking climate-change policies. As the [MIT advertising blurb concludes](#), "the stabilization options would impose significant net costs" to the economy. "Even with major technological breakthroughs and stringent controls, the momentum of past greenhouse gas emissions coupled with great inertia in climate change policy will lead to an inevitable rendezvous with massive climate change."

DICE connects the world's energy–economic system with the Earth's geophysical system, and therefore joins the family of IAMs which had started with the IMAGE model of the late 1980s—[which I reviewed earlier in this series](#). In contrast to DICE, IMAGE was a spatially explicit model, with different world regions represented and geographically differentiated impacts; yet surprisingly, 'Managing the Commons' makes no mention of IMAGE. Lacking real-world geography, the 1992 version of DICE—and hence the book 'Managing the Commons'—had nothing to say about the distributional aspects of climate policy. Nor did Nordhaus engage with the emerging political framing of climate change around the idea of 'common but differentiated responsibility', as had been explored in [Hayes' and Smith's 1993 book which I reviewed last month](#).

Given the model's reductive simplicity, how realistic was the original 1992 DICE model? Environmental economist Bob Costanza pointed out in his 1996 review of the book that although DICE was designed to be a simple model which could easily be run on a PC (the book included the computer code, occupying less than six pages and able to be implemented on GAMS software), these goals of simplicity and useability were "hardly justification for a model intended to be used to set realistic policies on greenhouse warming".⁵ Yet Nordhaus clearly recognised the huge uncertainties involved in climate-economy modelling, "This is largely uncharted terrain, full of subjectivity, largely devoid of an accepted methodology, with little precise data from which to derive useful estimates, and

⁴ The evolution of the DICE model between 1992 and 2017 is reviewed in: Nordhaus,W.D. (2018) Evolution of assessments of the economics of global warming: changes in the DICE model, 1992–2017. *Climatic Change*. 148(4): 623–640.

⁵ p.382 in: Costanza,R. (1996) Review of William D Nordhaus, 'Managing the Commons: The Economics of Climate Change'. *Environment and Development Economics*. 1: 381-386.

with no easy way to assess the potential errors of our estimates”.⁶ He therefore devoted two chapters of the book to sensitivity analysis—exploring the significance of uncertainties in the discount rate, future population growth, the relationship between increased carbon emissions and temperature change, and the climate change damage function—and a further chapter to exploring the (economic) value of (new) information and learning. Nordhaus clearly showed the difference between an optimal carbon tax using best guess parameter values and one embracing a wide range of uncertainties.

Nordhaus and his model became essential points of reference in all debates about the economics of carbon taxes, discount rates, climate change cost-benefit analysis, and what later became referred to as ‘the social cost of carbon’.⁷ ‘Managing the Commons’ has been [cited nearly 2,500 times](#), and continues to be an essential point of reference today. As one senior climate economist has recently written, “DICE has become the iconic stylized model and typical reference point for such analyses—including those from many of its vocal critics ... ‘Everything in economics in regard to climate change is based on DICE’—because economics is about balancing costs and benefits, and DICE provides a standard framework for doing that”.⁸

Yet ever since its construction and first appearance, the DICE model has divided opinion. For example, writing in *The Energy Journal* in 1995, one of the book’s reviewers, Marian Radetzki, remarked that “Nordhaus’ treatise throws some cool skepticism onto an increasingly dogmatic and politically inflamed debate [which had] suggest[ed that] large expenditures [were needed] now to save the world from future pains which may or may not occur”.⁹ And a decade later, Nordhaus publicly challenged the economic analysis of the influential [2006 Stern Review](#) which reached very different conclusions to Nordhaus about an economically optimal climate policy.¹⁰

The Stern Review estimated a 2010 social cost of carbon of about \$300/ton, compared to Nordhaus’ estimate of around \$30. Following the publication of the Stern Review, Nordhaus used his DICE model to show that this order of magnitude difference could be explained by the different ethical choices one made about the relative value of future generations and about the aversion of analysts to economic inequality. This debate usefully highlighted that ethics and values lie at the heart of both economics and climate change policy. These debates continue today and Nordhaus and his model continue to attract criticism, for

⁶ Nordhaus’ words as quoted on p.34 in: Radetzki,M. (1995) Reviewed Work(s): ‘Managing the Global Commons: The Economics of Climate Change’ by William D. Nordhaus. *The Energy Journal*. 16(2): 132-135.

⁷ The social cost of carbon is the estimated damage caused by emitting one ton of carbon dioxide at a point in time and expressed in monetary terms.

⁸ Cited on p.2 in: Grubb,M., et al. (2021) Modeling myths: On DICE and dynamic realism in integrated assessment models of climate change mitigation. *WIREs Climate Change*. 12(3): e698.

⁹ *ibid.*

¹⁰ See: Stern Review (2007) *The Economics of Climate Change: The Stern Review*. Cambridge: Cambridge University Press. 692pp.; Nordhaus,W.D. (2007) Critical assumptions in The Stern Review on climate change. *Science*. 317: 201-202.

example the failure of DICE to adequately include the dynamics of technological learning and cost reduction in renewable energies.¹¹

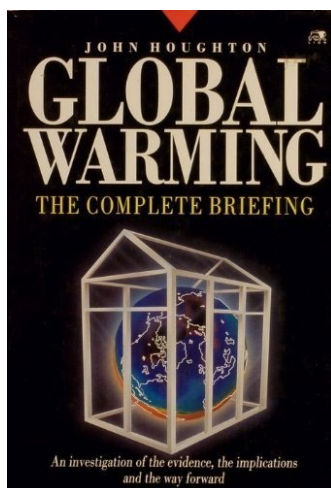
In many ways, Nordhaus' views have not changed in the 30 years since 'Managing the Commons' was published and his imprint on the field is unavoidable. He has remained committed to using the theories and tools of economics to place climate change policy in an economics framework, at the same time as exposing the importance for policy of ethical choices about the distribution of costs and benefits within and between different generations. And Nordhaus has remained a firm believer in the utility of a (global) carbon tax and an advocate for the importance of accelerating technological change. As he concluded his 2018 Nobel Prize lecture,

Current low-carbon technologies cannot substitute for fossil fuels without a substantial economic penalty [a tax] on carbon emissions. Developing economical low-carbon technologies will lower the cost of achieving our climate goals governments must support and the private sector must intensively pursue low-carbon, zero-carbon, and even negative-carbon technologies.¹²

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Other significant climate books published in 1994

Houghton, J.T. (1994) *Global Warming: The Complete Briefing*. (1st Edn.) Oxford: Lion Publishing. 251pp.



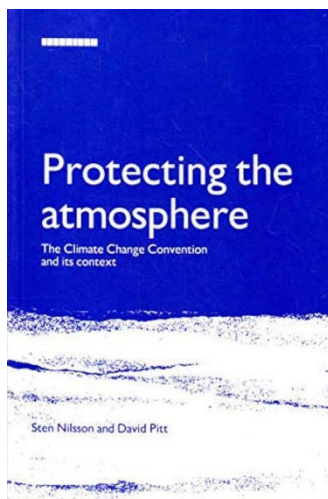
Sir John Houghton (1931-2020) was the first chair of the IPCC's Working Group on the science of climate change, and a former director-general of the UK Met. Office. A few years after the publication in 1990 of the IPCC's First Assessment Report, Houghton published '**Global Warming: The Complete Briefing**', a student text book subtitled 'an investigation of the evidence, the implications and the way forward'. Houghton's concern was to provide the essence of the IPCC's Report, but packaged and re-told "in a way which the intelligent non-scientist can understand" (p.7). For Houghton, the purpose of the IPCC's first report was to "provide the scientific facts about global warming" so that politicians could "develop the requirements for action". His 1994 book followed this science-first linear framing of climate change; in 'The Complete Briefing',

¹¹ Grubb et al., *op. cit.*

¹² p.465 in: '[Climate change: The Ultimate Challenge for Economics](#)', pp.439-466. Prize Lecture, Delivered 8 December, 2018, by William D. Nordhaus.

the narrative moves from the science of climate change, to its impacts, concern and thence to policies. The book was published by Lion Publishing, a Christian publishing company, chosen most likely because of Houghton's own evangelical Christian convictions; he discusses these in Chapter 8—'Why should we be concerned?' Thereafter, copyright transferred to Cambridge University Press, and each of the subsequent (CUP) editions of the book—in 1997, 2004, 2009, 2015—appeared shortly after a new report from the IPCC: respectively the 2nd, 3rd, 4th and 5th IPCC Assessments. The organizational structure of these later editions remained the same, but the book nearly doubled in length—from 250 to 450 pages—and became more luxuriously illustrated with full colour diagrams, maps and photographs. As an accessible and synoptic guide to the first five IPCC reports, Houghton's 'The Complete Briefing' was without parallel.

Nilsson, S.B. and Pitt, D.C. (1994) *Protecting the Atmosphere: The Climate Change Convention and its Context*. London: Earthscan. 209pp.



In the early 1990s, the world was still coming to terms with the challenges of a changing climate. There was new science to understand, a new language to learn, a new politics to participate in and, after 1992, a new international agreement to honour. The UN's Framework Convention on Climate Change, signed in 1992, sought to harness the interests of the world's governments in tackling climate change and, 30 years later, remains the foundational political document for international climate diplomacy. In 1994, Swedish forest economist, Sten Nilsson, and New Zealand sociologist, David Pitt (1938-2016), published '**Protecting the Atmosphere: The Climate Change Convention and its Context**'. The book offered a plain language guide to the Framework Convention (the FC, as they abbreviated it), and how it works. At the time, both Nilsson and Pitt were working at the International Institute for Applied Systems Analysis (IIASA) in Austria, but the inspiration and support for the book came from the UN diplomat and philanthropist Prince Sadruddin Aga Khan. Khan had established the Bellerive Foundation in 1977—and its off-shoot charity Alp Action which sought "the protection of mountain environments" and for which Pitt was a consultant. It was Alp Action which sponsored the publication of 'Protecting the Atmosphere'. Nilsson and Pitt believed that "In many senses ... the UNFCCC is central to the future of the planet" (p.2) and the book was written to widen public awareness and understanding the FC's significance. 'Protecting the Atmosphere' provides both a guide to, and an interpretation of, the FC, the authors arguing that global environmental problems "cannot be handled solely by the command and control mechanisms of traditional government" (p.xi). In 2009, Earthscan, the original publishers, reprinted 'Protecting the Atmosphere' in their International Environmental Governance series.