Integrated Assessment of Climate Change in the United States 1979 to Present…And, Into the Future

Jae Edmonds

29th Asia Integrated Modeling Meeting

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Presented in remembrance of the 20th anniversary of the passing of our good friend and colleague, Tsuneyuki Morita

Thanks to Ron Sands for helpful input to this presentation.

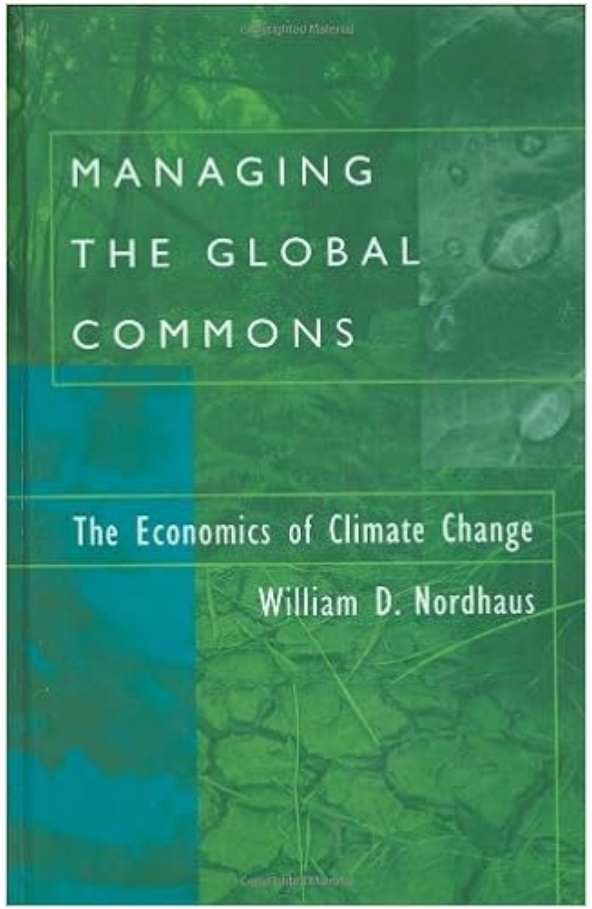
U.S. IAMs Have Been Informing Decisions for Four Decades

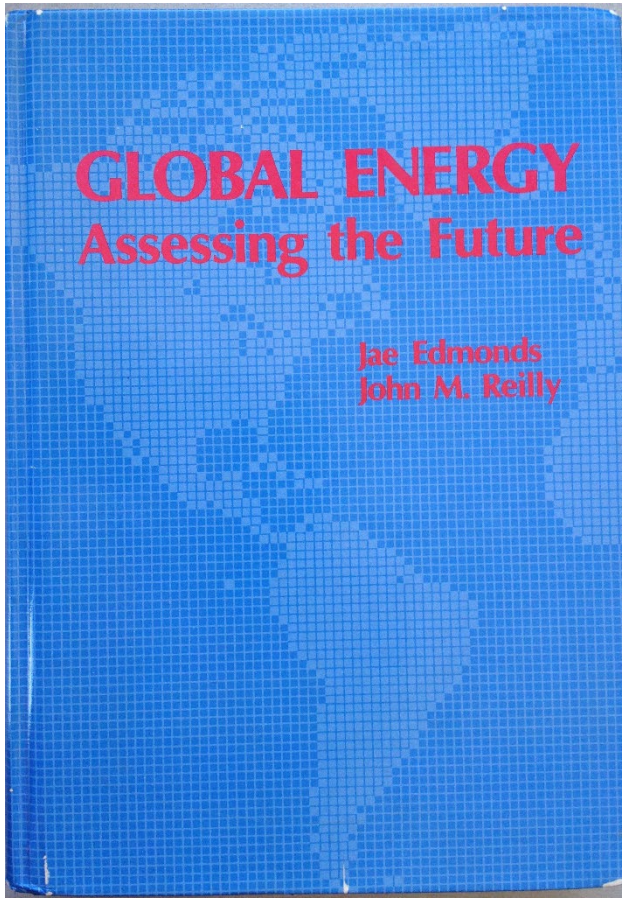
Early work dates to the 1980's.

Nordhaus, William D. "Efficient use of energy resources." (1979).

Edmonds, Jae, and J. M. Reilley. "Global energy-assessing the future." (1985).

The original question was: "Will the concentration of CO_2 double by the year 2000?"



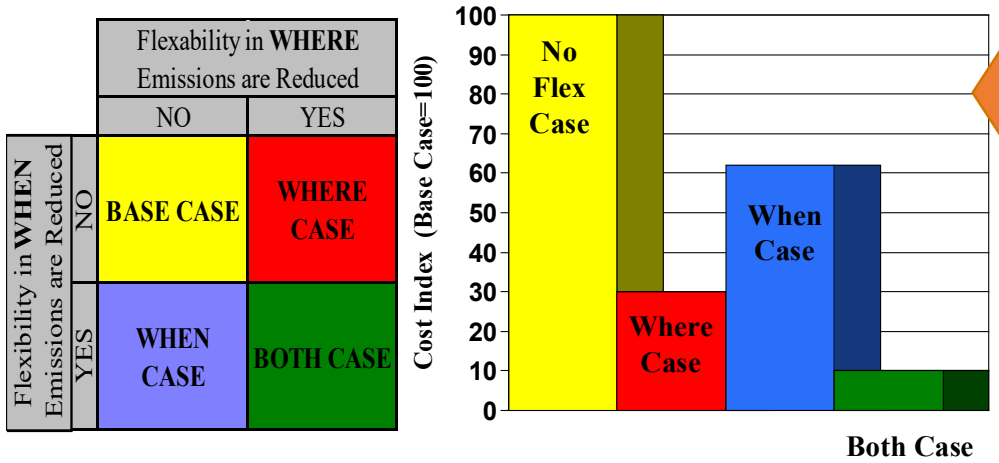


In the 1990's U.S. IAMs Helped Shape the Kyoto Protocol: Where and When Flexibility

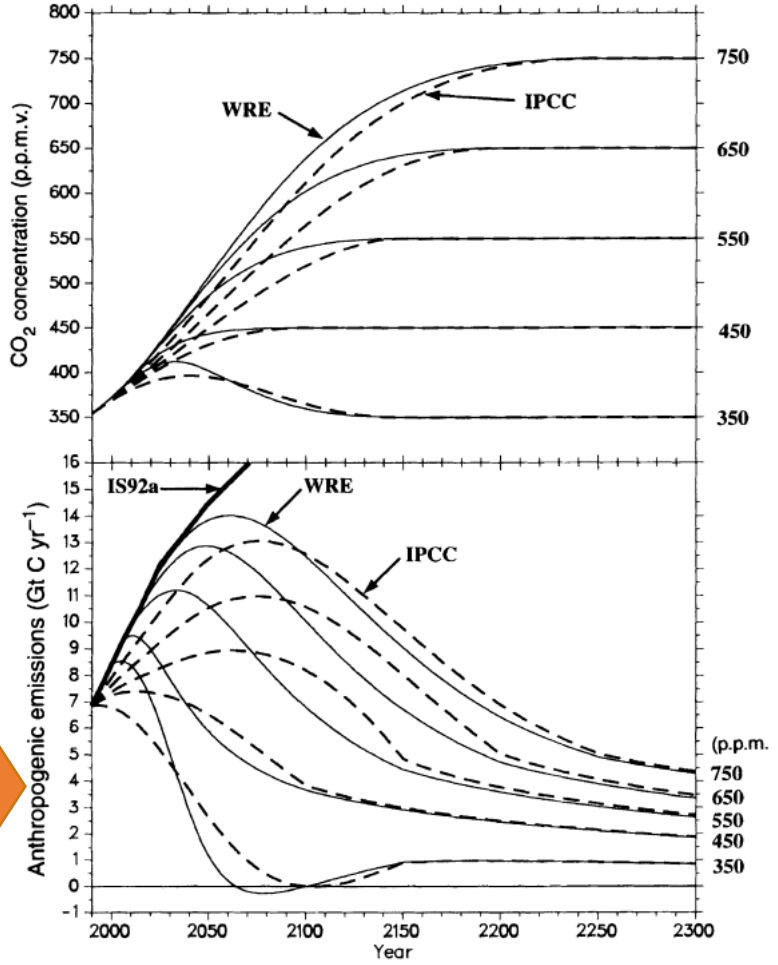
Two major concepts helped shape the Kyoto Protocol of 1997—Where and When Flexibility

In the 1990's U.S. IAMs Helped Shape the Kyoto Protocol: Where and When Flexibility

Where flexibility meant Emissions Trading.



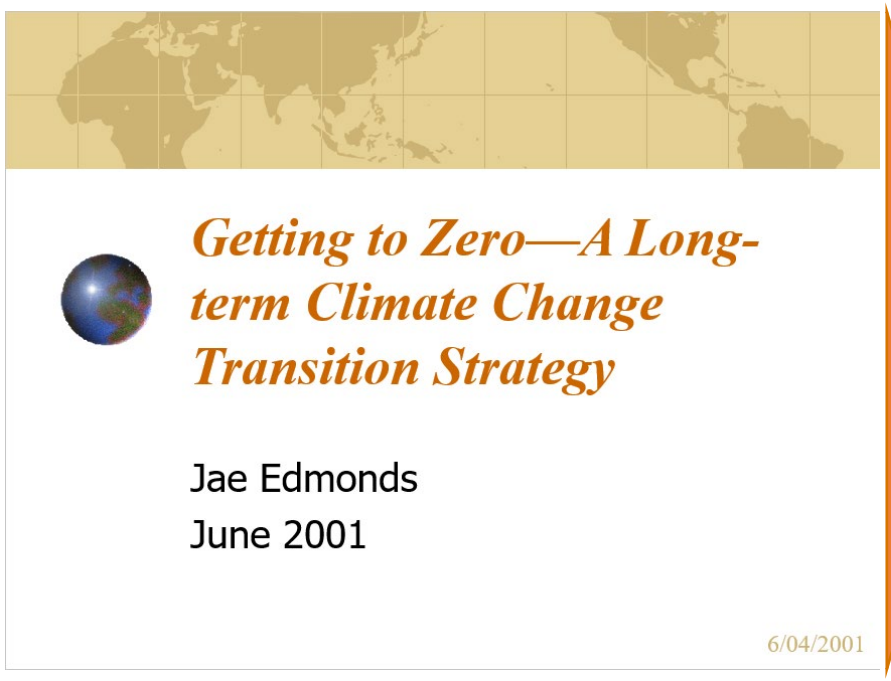
"Where and when flexibilities" introduced into the negotiations COP2, Geneva, July 1996.



Wigley, T.M., Richels, R. and Edmonds, J.A., 1996. Economic and environmental choices in the stabilization of atmospheric CO_2 concentrations. Nature, 379(6562), pp.240-243.

In the 2000's U.S. IAMs Helped Introduce the Idea of Net-zero Emissions

Net-zero emissions is a key concept in the Paris Agreement of 2015.



In the 2000's U.S. IAMs Introduced Identified the Central Role of Electrification in Deep Decarbonization

Edmonds, J., T. Wilson, M. Wise, and J. Weyant. 2006. Electrification of the Economy and CO2 Emissions Mitigation, Journal of Environmental Economics and Policy Studies. (2006) 7:175-203.

Environmental Economics and Policy Studies (2006) 7: 175–203
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Article

Electrification of the economy and CO_2 emissions mitigation*

Jae Edmonds[1], Tom Wilson[2], Marshall Wise[1], and John Weyant[3]
[1]Pacific Northwest National Laboratory, Joint Global Change Research Institute at the University of Maryland, College Park Campus 8400 Baltimore Avenue, Suite 201, College Park, MD 20740-2496, USA
[2]Electric Power Research Institute (EPRI), 3412 Hillview Avenue, Palo Alto, CA 94304-1395, USA
[3]Department of Management Science and Engineering, Terman Engineering Center, Room 406, Stanford University, Stanford, CA 94305-4022, USA

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Abstract In this article, the ratio of central station electricity to final energy is used as a measure of electrification. It is well known that this ratio tends to increase with gross domestic product. We show that not only is electrification a characteristic of a reference case with economic growth, but that it is significantly accelerated by a general limitation on carbon emissions. That is, limits on CO_2 concentrations, implemented efficiently across the whole economy, result in a higher ratio of electricity to total final energy use. This result reflects the relatively greater suite of options available in reducing CO_2 emissions in power generation than in other important components of the economy. Furthermore, electrification is stronger, the more stringent the constraint on CO_2 emissions, although the absolute production of electricity may be either greater or smaller in the presence of a CO_2 constraint, depending on the technologies available to the sector and to end-use sectors. The base technology scenario we examined was purposefully pessimistic about the evolution of central station and distributed electric technologies, lessening the degree of electrification. The better the performance of the set of options for emissions mitigation in power generation, the greater the acceleration of electrification.

Key words Climate change · Electrification · CO_2 emissions mitigation · Energy · Technology

Introduction

Electricity is an energy carrier that is attractive in the provision of end-use energy services ranging from the production of light to the transformation of materials to the storage and transport of information. There are few, if any, end-use energy

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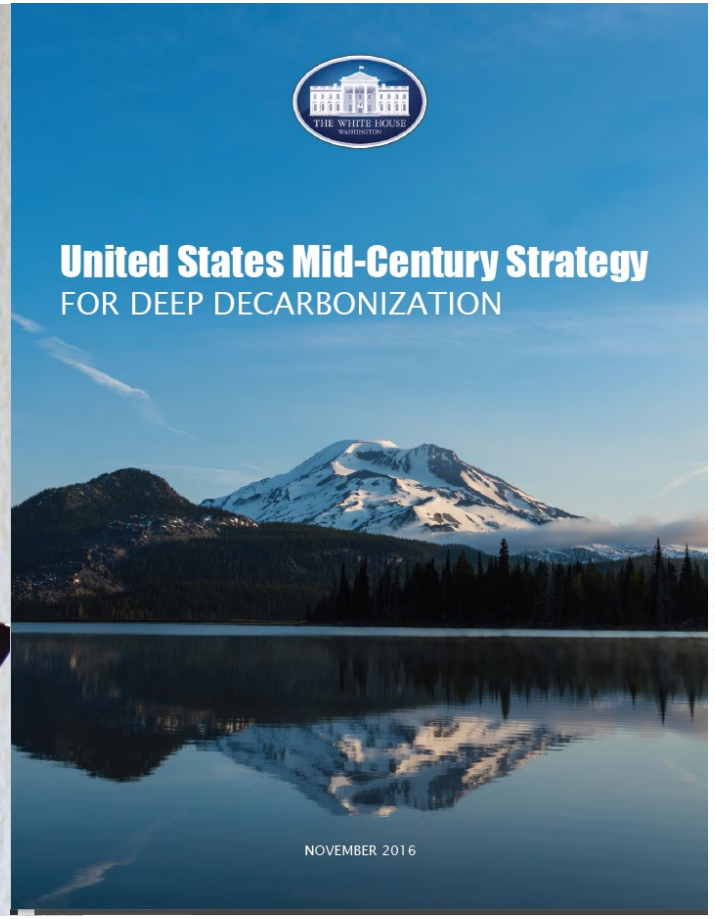
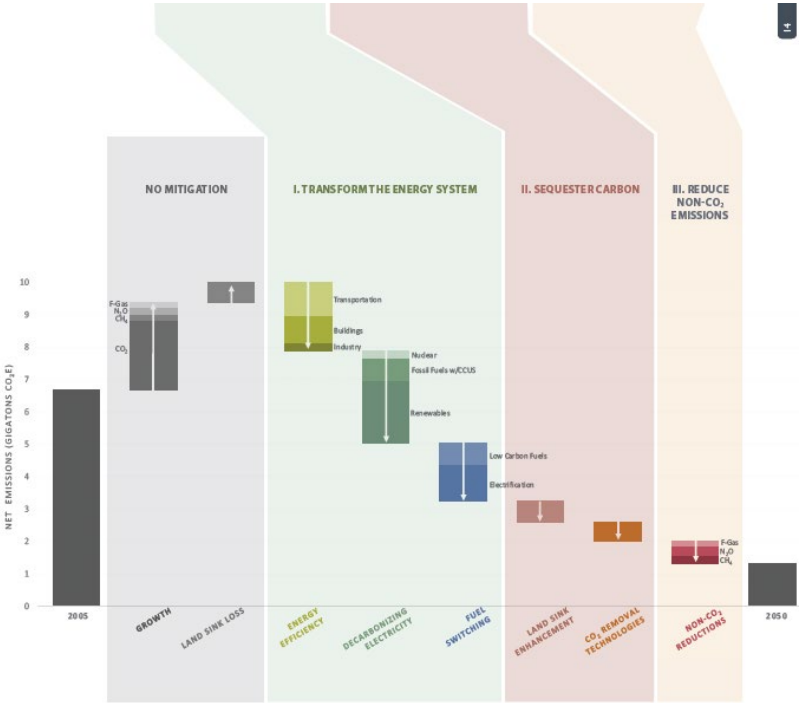
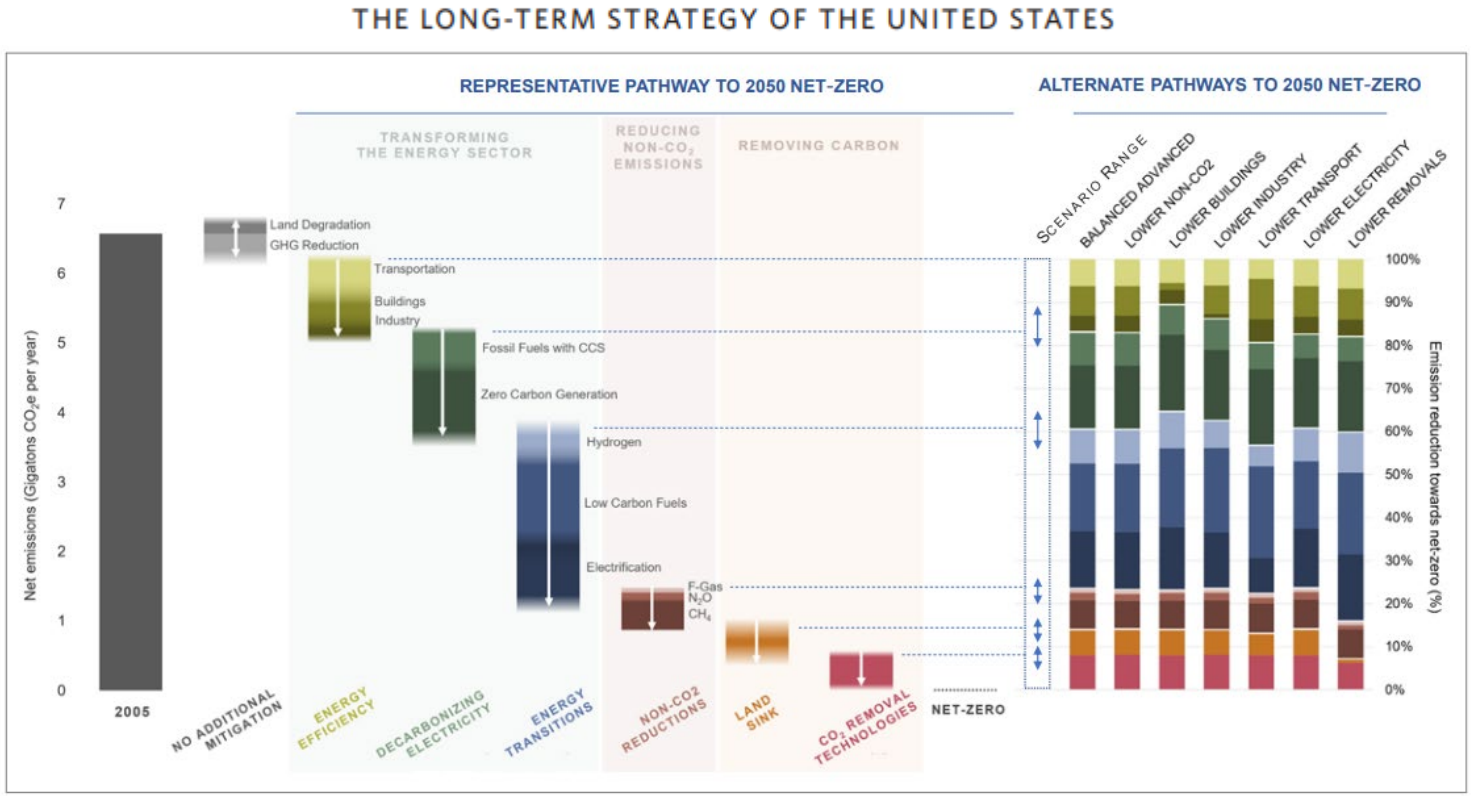
In the 2010's IAMs Helped Shape the U.S. Long-Term Strategy

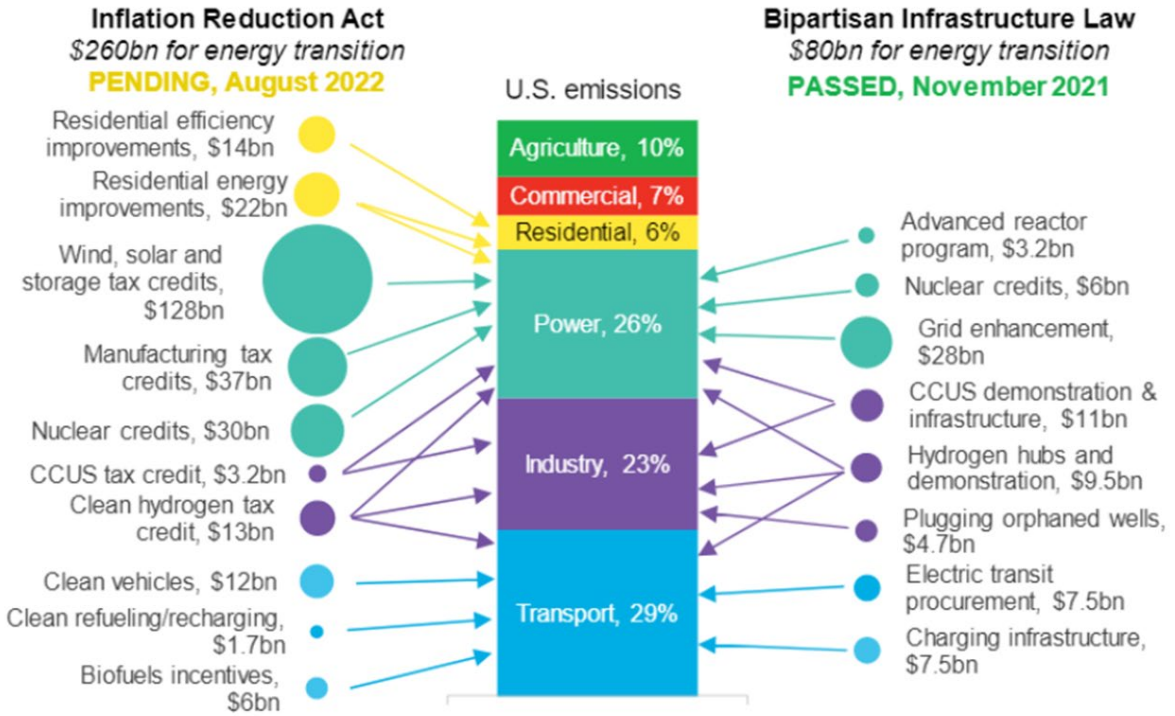




In the 2020's U.S. IAMs Continue to Help Shape the U.S. Long-Term Strategy



The Inflation Reduction Act (IRA) was passed in August of 2022. U.S. IAMs helped shape the overarching goals of the IRA but not the details. IAMs are playing a role in assessing the IRA.



Source: EIA, EPA, Joint Committee on Taxation, BloombergNEF. Note: Chart only captures tax credits and incentives, not grant programs or loans. Bn is billion. CCUS is carbon capture, utilization and storage.

The Future of U.S. IAMs Is Full of Challenges and Promise

Future IAM development will be shaped by society's questions.

The challenge is to build and maintain interdisciplinary groups around the world with deep expertise in the full range of fields to be integrated, and the ability to develop, maintain and deploy the computational tools, infrastructure, and the supporting internally consistent synthetic data sets to continue the work.