Molly K. Macauley

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Macauley is Vice President for Research and Senior Fellow at Resources for the Future, Inc. (RFF), a research organization established in 1952 at the request of the President of the United States. RFF conducts independent research, primarily in economics and other social science, on environmental, energy, and natural resources issues. As Vice President for Research, Macauley provides intellectual leadership for a research staff comprised of world-renown experts in the economics of natural resources and the environment, maintains standards of academic quality and independence, and helps to secure financial support for the work of her colleagues. She reports directly to the RFF President and RFF Board of Directors. As a Senior Fellow at RFF, Macauley has initiated and led RFF's research in the field of natural resources and new technology, emphasizing the role of technical innovation in global resource measurement, monitoring, and management.

Education

Ph.D. Economics 1983 The Johns Hopkins University, Baltimore, Maryland.
M.A. Economics 1981 The Johns Hopkins University, Baltimore, Maryland.
B.A. Economics 1979 The College of William and Mary, Williamsburg, Virginia.

Positions Held

2011 – present	Vice President for Research, Resources for the Future, Washington, DC
2009 – 2011	Research Director, Resources for the Future, Washington, DC
1995 – 2009	Director of Academic Relations and Programs, Resources for the Future, Washington, DC
1993 – present	Senior Fellow, Resources for the Future, Washington, DC
1983 – 1993	Fellow, Resources for the Future
1989 – 2008	Visiting Professor, Johns Hopkins University, Department of Economics
1979 – 1983	Policy Analyst, Communications Satellite Corporation, Washington, DC

Selected Awards

2014 *United Nations Secretary-General Global Pulse Award, "Project to Watch,"* Megacities Carbon Project (with collaborators)

2014 *Distinguished International Visitor, Government of Quebec*: Selected for week-long diplomatic visit to discuss research and research applications in natural resources with corporate and government officials and the research community

2012 *The Carolyn and Edward Wenk, Jr Lecture in Technology and Public Policy*: Selected by the Johns Hopkins University, Department of Civil Engineering

2006 *Federal Aviation Administration*: Award for outstanding support of the rulemaking on licensing and safety requirements for the commercial space launch industry

2002 *National Aeronautics and Space Administration*: Award for contributions to policy development for US earth observations

2001 *International Academy of Astronautics* (elected to Full Membership)

1994 *Top 25 "Rising Stars," National Space Society*

1984 *Resources for the Future*, Investment in People and Ideas Award

Major Professional Activities

Offices and Memberships on Boards of Directors and Other Boards:

- National Oceanic and Atmospheric Administration, Science Advisory Board, 2014-2017
- National Research Council/National Academy of Sciences: Committee on Earth Science and Applications from Space, 2013-2016; Space Studies Board, 2007 – 2013; also Executive Committee, Space Studies Board, 2008 - 2013
- National Research Council/National Academy of Sciences: Aeronautics and Space Engineering Board, 2004 – 2007
- University Corporation for Atmospheric Research Trustee-at-large, 2010-2014
- American Astronautical Society: Board of Directors, 2007-2016; Executive Committee 2013- 2016
- College of William and Mary, Board of Advisors, Thomas Jefferson Public Policy Program, President, 1997-2005; Advisor 2005 - present
- Women in Aerospace, Board of Directors, 1996-2003, 2006-2009; Vice-Chair 2006-2007; Chair, Scholarship Committee, 2013-present
- Columbia University, NASA Socioeconomic Data and Applications Center (SEDAC), Chair, User Working Group, 2011-2014
- National Socio-Environmental Synthesis Center, External Advisory Board, 2011-present

Appointments:

- Advisory Committee for the 1988 ITU World Administrative Radio Conference, Federal Communications Commission
- Panels convened by the Committee on Science and Technology of the U.S. House of Representatives and the American Institute of Aeronautics and Astronautics
- Organizing Committee for 1988 and 1989 of the Annual Telecommunications Policy Research Conference; Chair, 1989-1990
- Review panel, NASA Remote Sensing Commercialization Research Announcement
- Panels by the Space Studies Board, National Research Council
- Task Force on Priorities in Space Research, Space Studies Board, National Research Council
- Review panel, Congressional Budget Office, Spectrum Management Workshop

- Advisory panel, Earth Observations Project, U.S. Congress, Office of Technology Assessment
- Ad Hoc Group on Data Exchange and Charging, American Meteorological Society
- Subcommittee on Space Debris, International Astronautical Association
- Planning Committee, National Meeting, American Astronautical Society
- Space for America Committee, American Astronautical Society
- Space Activities and Society Committee, International Academy of Astronautics
- Study Group, John Heinz III Center for Science, Economics, and the Environment
- Chair, Congressionally mandated "Economic Study of Space Solar Power"
- NASA Space Science Advisory Committee
- NASA Space Science Outreach and Public Education Committee
- National Research Council, Board on Physics and Astronomy, Helium Reserve Committee
- National Research Council, Space Studies Board, Steering Group on Space Applications and Commercialization
- National Research Council, Aeronautics and Space Engineering Board, Committee for Independent Assessment of the NASA Investment Strategy in Space Solar Power
- National Research Council, Review of a Technology Assessment on Concentrating Solar Power Energy Systems
- National Research Council, Aeronautics and Space Engineering Board, Steering Committee for Workshops on Human and Robotic Exploration and Development of Space
- National Research Council, Space Studies Board, Workshop Study on Earth Observations and Applications from Space: A Community Assessment and Strategy for the Future
- National Research Council, Space Studies Board, Review Team for Science Roadmaps for the National Aeronautics and Space Administration
- International Futures Program, Organization of Economic Cooperation and Development (OECD), Paris, France: (with David Chen), contribution on earth observations and energy security
- Interagency Modeling and Atmospheric Assessment Center Senior Advisory Group, US Department of Homeland Security
- National Research Council, Space Studies Board, Use of Spectrum for Scientific Purposes
- NASA Applied Sciences Advisory Group
- NOAA Climate Working Group
- US Carbon Cycle Science Steering Group
- National Research Council, Committee on Space Debris
- National Research Council, Committee on Interim Review of the Earth Sciences Decadal Survey

Member:

- American Economic Association
- Editorial Board, *Space Policy*
- Editorial Board, *Astropolitics*
- Women in Aerospace
- International Academy of Astronautics
- American Institute of Aeronautics and Astronautics
- American Astronautical Society
- International Womens' Forum, Washington DC (elected 2012)

Congressional Testimony and Briefings

- "Offshore Deepwater Drilling and Incentives to Invest in Containment," US House of Representatives, Committee on Science, Space, and Technology, Subcommittee on Energy and the Environment, 6 April 2011
- "Earth Observations in a National Space Strategy," Senate Committee on Commerce, Science and Transportation, 18 March 2011 (at invitation of AIAA)
- "Calibrating Data, Calibrating Results: Using Earth Observations Information in Quantitative Elements of Climate Policy Design and Evaluation," Senate Committee on Commerce, Science, and Transportation, 21 September 2009 (at invitation of AIAA)
- "Space and Economic Growth," Senate Committee on Commerce, Science and Transportation, 27 July 2009 (at invitation of AIAA)
- "Commercial Space." U.S. House of Representatives, Subcommittee on Space and Aviation, April 20, 2005.
- "Advantages and Disadvantages of Prizes in a Portfolio of Financial Incentives for Space Activities." U.S. House of Representatives, Committee on Science, July 15, 2004.
- "The Economics of Satellite Solar Power." U.S. House of Representatives, Committee on Science, Subcommittee on Space and Aeronautics, September 7, 2000 (delivered by John S. Fini).
- "Financing Commercial Space Ventures." U.S. House of Representatives, Committee on Science, Subcommittee on Space and Aeronautics, July 18, 2000.
- "The Commercial Space Act of 1997: Commercial Remote Sensing." U.S. House of Representatives, Committee on Science, Subcommittee on Space and Aeronautics, May 21, 1997.
- "The Omnibus Space Commercialization Act of 1996 and the Space Business Incentives Act" H.R. 1953. U.S. House of Representatives, Committee on Science, March 5, 1996.

Agency Reviewer: National Science Foundation; National Academy of Sciences; National Aeronautics and Space Administration; Federal Aviation Administration Office of Commercial Space Transportation; U.S. Congress, Office of Technology Assessment; U.S. Congress, Congressional Budget Office; Federal Communications Commission, US Geological Survey.

Academic Reviewer: *American Economic Review, RAND Journal, Land Economics, Contemporary Economic Policy, Journal of Industrial Organization, Journal of Environmental Management, Bulletin of the American Meteorological Society, Space Policy, Energy Policy, Astropolitics, Climate Policy, Journal of Environmental Economics and Management, CLIPORE*

Consultant: Benner, Burnett and Coleman, Washington, DC; Conner and Winters, Tulsa, Oklahoma; Shooshan and Jackson, Washington, DC; Space Development Services, Washington, DC; National Aeronautics and Space Administration; EUROCONSULT, Paris; U.S. Congress, Office of Technology Assessment; Boeing Corporation; SAIC; Federal Aviation Administration; Jackson Kelly LLC.

Special projects: October 1998 -- Spearheaded joint effort of Mount Vernon and Women in Aerospace for U.S. space shuttle flight of replica flag flown by George Washington during the Revolutionary War; flag now on display at Mount Vernon.

Recent Presentations:
Academic: Stanford University, MIT, Princeton University, Johns Hopkins University School of Advanced International Studies, University of California-San Diego, University of California-Berkeley, US Air Force Academy, University of Washington, College of William and Mary, George Mason University, George Washington University, International Space University, University of Colorado, Widener University, University of Maryland-College Park, University of Pennsylvania, Carnegie Mellon University, Wharton School of the University of Pennsylvania, Cal Tech, University of Alabama, American Economic Association, Southern Economic Association, Western Economic Association, Eastern Economic Association

US Nongovernmental: National Academy of Sciences, Center for Strategic and International Studies, American Meteorological Society, American Enterprise Institute, National Economists' Club, National Bureau of Economic Research, Women's Council on Energy and Environment, The White House Project

International Governmental: UNESCO, GEO, UNFAO, Government of Japan, Embassy of Finland, OECD, European Commission, Joint Research Center, Government of Quebec

US Government: US Congress (testimony and briefings), US Department of Energy, US Department of Commerce, US Department of Transportation, NOAA, NASA, USGS, FAA, National Institute of Standards and Technology, Goddard Space Flight Center, Dryden Space Flight Center, Huntsville Space Flight Center, US Global Change Research Program, US Department of Interior Office of Policy Analysis, Cal Tech Jet Propulsion Laboratory

Other: Ditchley Foundation (United Kingdom), Electric Power Research Institute, ARCS Foundation

Recent Keynote Presentations:
National Academy of Sciences, NASA, USGS, Earth Science Information Partnerships, US Global Change Research Program National Assessment, National Institute of Standards and Technology, Joint Research Center (Stresa, Italy), Johns Hopkins University Edward Wenk Lecture

Grants and Other Research Support:

1987 – 1995: $990,000 Earth Science Valuation Research, US National Aeronautics and Space Administration
1989: $50,000 The Economics of a "Launch Voucher," US Department of Transportation, Resources for the Future, and the Lockheed Martin Corporation
1989-1990: $110,000 Economic Incentives for Regulating Toxic Substances (co-investigator), US Environmental Protection Agency
1995-1997: $300,000 Modeling the Prospective Value of Investment in Space Technology (co-investigator), California Institute of Technology
1999-2002: $600,000 Electronic Waste, Waste Shipments, and Recycling Policy (co-investigator), Government of Japan
2000: $150,000 Modeling Interstate Shipments of Municipal Solid Waste (co-investigator), US Environmental Protection Agency
2000-2001: $70,000 Commercial Space Transportation Third-Party Liability, US Department of Transportation, Federal Aviation Administration under auspices of SAIC, Incorporated

2003-2005: $300,000 Earth Science Valuation Studies and Modeling for Energy, Water and Oceans, and Public Policy, US National Aeronautics and Space Administration under auspices of SAIC, Incorporated
2003: $105,000 Measuring Investment in New Energy Technologies, US Department of Energy
2004-2005: $25,000 Commercial Space Transportation Third-Party Liability, Volpe National Transportation Systems Center under auspices of The Aerospace Corporation
2004: $20,000 International Agreements and the Earth Observation Summit, American Meteorological Society Summer Policy Colloquium
2005: $20,000 Environmental Risks, American Meteorological Society Summer Policy Colloquium
2005: $20,000 Modeling the Societal Value of the Multi-Angle Imaging SpectroRadiometer, Jet Propulsion Laboratory
2004-2006: $275,000 Space, Energy, Climate, National Science Foundation/National Aeronautics and Space Administration/Electric Power Research Institute
2006-2007: $100,000 Earth Observations and Climate, US National Aeronautics and Space Administration under subcontract with SAIC, Incorporated
2007: $100,000 Sustainable Waste Management and Recycling Policies, Standards, and Practices under subcontract with the RAND Corporation
2007-2008: $95,000 Modeling the Valuation of Moderate Resolution Earth Observations Imagery in Application to Regulation and Management of Natural Resources, US Department of Interior
2002-2007: $100,000 for administration of Andrew W. Mellon Foundation Grant to Resources for the Future for Fellowship Awards
2007-2009: $500,000 Climate Modeling Conferences (co-investigator), US Environmental Protection Agency
2007-2008: $45,000 Technology and Innovation, Jackson Foundation
2007: $20,000 Cost Estimation and Cost Overruns for Natural Resources Infrastructure, American Meteorological Society Summer Policy Colloquium
2008-2009: $360,000 Modeling Benefits from Earth Observations (principal investigator), US National Aeronautics and Space Administration
2007-2009: $965,000 Domestic Policy for Adapting to a Changing Climate (co-investigator), Smith Richardson Foundation
2009: $365,000 Improving Forest Measurement and Monitoring (principal investigator), Alfred Sloan Foundation
2009 – 2005: $983,000 Incorporating MODIS Data into Water Quality Monitoring (principal investigator), US National Aeronautics and Space Administration
2009-2013: $961,400 US National Aeronautics and Space Administration, Improving Water Quality Management: Use of Earth Observations in SPARROW (principal investigator)
2009-2010: $330,000Alfred P. Sloan Foundation, Measurement and Monitoring of Global Forests (principal investigator).
2010: $89,750 Water Quality and Economic Valuation (co-investigator), US Geological Survey
2010: $50,000 Value of Information Workshop (principal investigator), US National Aeronautics and Space Administration
2011: $75,000 US Department of Energy, The Economics of Rare Earths.
2011: $128,250 Great Lakes Restoration Fund, Land Use and Extreme Precipitation Events: A Case Study in Green Bay.
2012-2013: $250,331.28 US Centers for Disease Control, Return on Investment in the Public Health Tracking Network
2011-2013: $200,000 US Geological Survey, Science and Economic Valuation of Ecosystem Services in the Framework of Adaptive Management

2011-2014: $75,000 US National Aeronautics and Space Administration, Public Policy for Carbon Monitoring
2012-2015: $1,275,549 US National Aeronautics and Space Administration, Measuring Performance in Space Station Science
2015-2016: $133,600 US National Aeronautics and Space Administration, Anchoring and Black Swans: Reconsidering Risk Aversion and the Future of Commercial Space

Selected Peer-Reviewed Publications: Books, Journal Articles, and Book Chapters

Books:

The Value of Information: Methodological Frontiers and New Applications (ed., with Ramanan Laxminarayan), Springer, 2012.

Using Economic Incentives in Regulating Toxic Substances (with Karen Palmer and Michael Bowes) (Washington, DC, Resources for the Future), 1992.

Economics and Technology in U.S. Space Policy (ed.) (Washington, DC, Resources for the Future), 1987.

Articles and Book Chapters:

"Assessing the Role of Renewable Energy Policies in Landfill Gas to Energy Projects" (with Shanjun Li, Han Kyul Yoo, Karen Palmer, and Jhih-Shyang Shih) *Energy Economics*, 14 April 2015 on-line at http://www.sciencedirect.com/science/article/pii/S0140988315001140

"Strategically Placing Green Infrastructure: Cost-Effective Land Conservation in the Floodplain" (with Carolyn Kousky, Sheila Olmstead, and Margaret Walls) *Environmental Science and Technology* 47(8): 3563-3570, April 2013 doi: 10.1021/es303938c.

Earth Observations and Space Strategy, in *Space Strategy in the 21st Century* (Eligar Sadeh, ed.) Chapter 9, New York: Routledge, 2013.

"Policy for Robust Space-Based Earth Science, Technology and Applications" (with Molly E. Brown, Vanessa M. Escobar, Josef Aschbacher, Maria Pilar Milagro-Perez, Bradley Doorn, and Lawrence Friedl), *Space Policy* 29(1): 76-82, February 2013.

"Forest Carbon Economics: What We Know, What We Do Not, and Whether It Matters" (with Nathan Richardson), *Climate Change Economics* 3(4), December 2012.

"Forest Carbon Offsets: Measuring, Monitoring and Verifying Challenges" (with Roger Sedjo), *Environment Magazine* 54(4): 16-23, July/August 2012.

"Seeing the Forests and the Trees: Technological and Regulatory Impediments for Global Carbon Monitoring" (with Nathan Richardson) *Berkeley Technology Law Journal* 26(3): 1387-1408, 2011.

"Forest Carbon Offsets: Possibilities and Limitations" (with Roger Sedjo) *Journal of Forestry* 109(8): 470-473, December 2011.

"Managing Risk through Liability, Regulation, and Innovation: Organizational Design for Spill Containment in Deepwater Drilling Operations" (with Nathan D. Richardson, Mark. A. Cohen, Robert Anderson, and Adam Stern) *Risk, Hazards, and Crisis in Public Policy* 2(2), 2011.

"Forests in Climate Policy: Technical, Institutional, and Economic Issues in Measurement and Monitoring" (with Roger Sedjo), *Mitigation and Adaptation Strategies for Global Change* 16(5): 499-513, June 2011 doi: 10.1007/s11027-010-9276-4

"National Security and the Environment: The Role of Earth Observations" in *Strategic Issues in Space Policy* (Eligar Sadeh, ed.) New York: Routledge, 2011.

"Measurement Issues for Forests in Climate Policy," *Greenhouse Gas Emission Modeling and Measuring (*Washington, DC*:* National Academies Press*)*, March 2011.

"Earth Observations in a National Space Strategy" *Astropolitics* 8(2-3): 205-219, Fall 2010 doi:10.1080/14777622.2010.523298

"The Value of Information: Methodological Frontiers and New Applications for Realizing Social Benefits" *Space Policy* (with Ramanan Laxminarayan) 26(4): 249-251, November 2010 doi:10.1016/j.spacepol.2010.08.007

"Public-Private Co-Production of Risk: Government Indemnification of the Commercial Space Launch Industry" (with Carolyn Kousky and Tim Brennan) *Risk, Hazards, and Crisis in Public Policy* 1(1) 2010.

"From Science to Applications: Determinants of Diffusion in the Use of Earth Observations" (with Joe Maher and Jhih-Shyang Shih) *Journal of Terrestrial Observation* 2(1) Spring 2010.

"Commercial Space Actors" (with David Chen), in *The Politics of Space: A Survey,* Eligar Sadeh, ed. (New York: Routledge) 2010.

"Economics and Technology in Space Policy" (with David Chen), encyclopedia entry in *Space Exploration and Humanity, Volume 2 (*Stephen B. Johnson, ed.) California: ABC Clio 1075-1079, 2010.

"The U.S. Department of Commerce and the US Aerospace Industry" encyclopedia entry in *Space Exploration and Humanity, Volume 1 (*Stephen B. Johnson, ed.) California: ABC Clio 477, 2010.

"Waste Not, Want Not: Economic and Legal Challenges of Regulation-Induced Innovation in Waste Technology and Management" *Journal of Solid Waste Technology and Management* 37(2):113-128.

"Earth Observations in Social Science Research for Management of Natural Resources and the Environment: Identifying the Landsat Contribution" *Journal of Terrestrial Observation* 1(2) 2009: 31-53.

"Space Infrastructure: Issues in the Theory and Practice of Estimating Costs" *Space Policy* 24 (2) 70-79, 2008 doi:10.1016/j.spacepol.2008.02.003

"Uses and Limitations of Observations, Data, Forecasts, and Other Projections in Decision Support for Selected Sectors and Regions" *US Climate Change Science Program, Synthesis and Assessment Report Product 5.*1 (co-editor, with Fred Vukovich), September 2008. At http://www.climatescience.gov/Library/sap/sap5-1/final-report/

"Earth Observations and its Economic Value in Agriculture Decision Support," in *US Climate Change Science Program, Synthesis and Assessment Product 5.1*, "Uses and Limitations of Observations, Data, Forecasts, and Other Projections in Decision Support for Selected Sectors and Regions," September 2008. At http://www.climatescience.gov/Library/sap/sap5-1/final-report/

*"*United States Civil Space Policy: Report of a Workshop*"* (with Joseph Alexander), National Research Council, Washington, DC, 31 March 2008.

"Environmentally Sustainable Human Space Activities: Can Challenges of Planetary Protection be Reconciled?" *Astropolitics*, September – December 2007, 5(3), 209-236. doi:10.1080/14777620701662345

"Ascribing Societal Benefit to Applied Remote Sensing Data Products: An Examination of Methodologies Based on the Multi-angle Imaging SpectroRadiometer Experience," (with David J. Diner), *Journal of Applied Remote Sensing*, Vol. 1, September 2007.

"Satellite Solar Power: Renewed Interest in an Age of Climate Change?" (with Jhih-Shyang Shih), *Space Policy*, May 2007. doi:10.1016/j.spacepol.2007.02.010

"The Value of Information: Measuring the Contribution of Space-Derived Earth Science Data to Resource Management," *Space Policy*, v. 22, no. 4, November 2006, pp. 274-282. doi:10.1016/j.spacepol.2006.08.003

"Flying in the Face of Uncertainty: Human Risk in Space Activities," 6 *Chicago Journal of International Law 131*, Summer 2005.

"Public Policy: Inducing Investments in Innovation," Chapter 11 in R. David Simpson, Michael A. Toman, and Robert U. Ayres (eds.), *Scarcity and Growth Revisited: Natural Resources and the Environment in the New Millennium,* Washington, DC: RFF Press, 2005, pp. 225-249.

"A Herculean Task? Economics, Politics, and Realigning Government in the Case of U.S. Polar-Orbiting Weather Satellites," *Space Policy*, vol. 19, 2005, pp. 249 - 259. doi:10.1016/j.spacepol.2003.08.001

"Private Markets, Contracts, and Government Provision: What Explains the Organization of Local Waste and Recycling Markets?" (with Margaret Walls and Soren Anderson), *Urban Affairs Review*, May 2005. doi:10.1177/1078087404273342

"Advantages and Disadvantages of Prizes in a Portfolio of Financial Incentives for Space Activities," *Space Policy*, vol. 21, no. 2, May 2005, pp. 121 - 128. doi:10.1016/j.spacepol.2005.02.004

"Is the Vision of the Earth Observation Summit Realizable?" *Space Policy*, vol. 21, February 2005, pp. 29-39. doi:10.1016/j.spacepol.2004.11.002

"Smarter Budgeting for Space Missions," in *New Approaches on Energy and the Environment: Policy Advice for the President,* Richard D. Morgenstern and Paul R. Portney, eds (Washington, DC: Resources for the Future), Chapt. 19, 2004.

"Regulation on the Final Frontier," *Regulation Magazine*, vol. 26, no. 2, Summer 2003, 36-41.

"Dealing with Electronic Waste: Modeling the Costs and Environmental Benefits of Computer Monitor Disposal," with Karen Palmer and Jhih-Shyang Shih, *Journal of Environmental Management*, vol. 68, no.1, May 2003, pp. 13-22 doi:10.1016/S0301-4797(02)00228-1

"Spatially and Intertemporally Efficient Waste Management: The Costs of Interstate Trade Restrictions" (with Eduardo Ley and Stephen Salant), *Journal of Environmental Economics and Management*, vol. 43, no. 2, March 2002, pp. 188-218. doi:10.1006/jeem.2000.1179

"An Economic Assessment of Space Solar Power as a Source of Electricity for Space Based Activities" (with James F. Davis), *Space Policy*, February 2002. doi:10.1016/S0265-9646(01)00056-X

"Economics of Space," Chapter 10 in *Space Politics and Policy*, Eligar Sadeh (ed.), Boston, MA: Kluwer Academic Publishers, 2002, pp. 181-200.

"Cutting through Environmental Issues: Technology as a Double-Edged Sword" (with David Austin), *Brookings Review*, Winter 2001, vol. 19, no. 1, pp. 24-27.

"Enforcing Environmental Regulation: Implications of Remote Sensing" (with Timothy J. Brennan), in *Improving Regulation: Cases in Environment, Health and Safety*, Paul Fishbeck and Scott Farrow, (eds.), Washington, DC: Resources for the Future, 2001.

"Estimating Future Benefits from ATP Funding of Digital Data Storage" (with David Austin), in *The Advanced Technology Program: Assessing Outcomes*, Charles W. Wessner (ed.) (Washington, DC, National Academy Press), 2001.

"Solid Waste Reduction and Resource Conservation: Assessing Goals of Government Policy" (with Margaret Walls), in *Public Policies for Environmental Protection*, Paul Portney and Robert Stavins (eds.), Resources for the Future, 2000.

"Report: Can Power from Space Compete?" *Space Policy*, February 2000, vol. 16, no. 4, pp. 283-285. doi:10.1016/S0265-9646(00)00038-2

"Restricting the Trash Trade" (with Eduardo Ley and Stephen Salant), *American Economic Review*, May 2000, vol. 90, no. 2, pp. 243-246.

"NASA's Affiliated Research Center Program: Bridging Basic Research and the Quality of Life" (with Bruce A. Davis), *Journal of Photogrammetry and Remote Sensing*, November 2000.

"Heredity or Environment: Why is Automobile Longevity Increasing?" (with Bruce Hamilton), *Journal of Industrial Economics*, June 1999, vol. 47. doi: 10.1111/1467-6451.00100

"Allocation of Orbit and Spectrum Resources for Regional Communications: What's At Stake?" *Journal of Law and Economics*, October 1998, pp. 737-764. doi: 10.1086/467411

"Managing Foreign Participation in Government-Funded Applied Space Research and Product Development" (with David Austin, David Simpson, and Mike Toman), *Space Policy*, August 1997, pp. 203-214. doi:10.1016/S0265-9646(97)00015-5

"Technology and Coordination: Antitrust Implications of Remote Sensing Satellites" (with Tim Brennan), *Antitrust Bulletin*, Summer 1997, pp. 477-502.

"The effects of environmental liability on industrial real estate development" (with Jim Boyd and Winston Harrington), *Journal of Real Estate Finance and Economics*, Spring 1996, vol. 12, no. 1. doi: 10.1007/BF00127765

"Exchanging Environmental Resource Management for Peaceful Space Practices: Blue Sky or 'Blue Sky?'," in *Space Power Interests*, Peter Hayes (ed.), Westview Press, 1996.

"Remote Sensing Satellites and Privacy: A Framework for Policy Assessment" (with Tim Brennan), *Law, Computers, and Artificial Intelligence*, vol. 4, no. 3, 1995. doi:10.1080/13600834.1995.9965723

"NASA's Earth Observations Commercialization Application Program: A Model for Government Promotion of Commercial Space Opportunities," *Space Policy*, February 1995, vol. 11, no. 1, pp. 53-66. doi:10.1016/0265-9646(95)93234-C

"Close Encounters of the Trash Kind," *Journal of Policy Analysis and Management*, vol. 13, no. 3, 1994, pp. 560-564. doi:10.2307/3325392

"In Pursuit of a Sustainable Space Environment: Economic Issues in Regulating Space Debris," in *Preservation of Near-Earth Space for Future Generations*, John A. Simpson (ed.), Cambridge University Press, 1994.

"Land Remote Sensing Policy Act—Analysis Reveals Deficiencies, Implications," *GIS World*, vol. 6, no. 7, July 1993, pp. 42-47.

"In Pursuit of Cost Effective Regulation of Toxic Chemicals," in *Enhancing Environmental Quality through Economic Growth*, American Council on Capital Formation, December 1993.

"Collective Goods and National Sovereignty: Conflicting Values in Global Information Acquisition," in *Space Monitoring of Global Change*, Sally Ride and Gordon MacDonald (eds.), 1992.

"Advanced Materials," in *Competitiveness in Metals: The Impact of Public Policy*, Merton J. Peck, Hans H. Landsberg, and John E. Tilton (eds.), London, Mining Journal Books, 1992.

"The NASA Budget: For Whom, For What, and How Big?" in *Space Policy Alternatives,* Radford Byerly (ed.), San Francisco, Westview Press, 1992.

"Highway Robbery: Social Costs of Hazardous Materials Incidents on the Capital Beltway" (with Theodore Glickman and Paul R. Portney), *Transportation Research Record*, No. 1313, 1992.

"Supplying Earth Observation Data from Space," (with Michael A. Toman), *Space Policy*, February 1992. doi:10.1016/0265-9646(92)90006-H

"Providing Earth Observation Data from Space: Economics and Institutions" (with Michael A. Toman), *American Economic Review*, vol. 81, no. 2, May 1991, pp. 38-41.

"Determinants and Consequences of the Private- Public School Choice" (with Bruce Hamilton), *Journal of Urban Economics*, vol. 29, no. 3, May 1991. doi:10.1016/0094-1190(91)90002-O

"Communications in Space: Economics and Public Policy Issues," in *Telecommunications, Values, and the Public Interest,* Sven Lundstedt (ed.), Ablex Press, 1990.

"Consumption of Fuelwood and Other Household Cooking Fuels in Indian Cities," (with J. Dunkerley, M. Naimuddin, and P.C. Agarwal), *Energy Policy*, vol. 18, no. 1, January/February 1990. doi:10.1016/0301-4215(90)90175-4

"Rethinking Space Policy: The Need to Unearth Economics," in *Space Policy Reconsidered*, Radford Byerly (ed.), Westview Press, 1989.

"Fuelwood in Urban Areas: A Case Study of Raipur, India" (with M. Naimuddin, P.C. Agarwal, and J. Dunkerley), *The Energy Journal*, vol. 10, no. 3, July 1989, 157-180.

"Launch Vouchers for Space Science Research," *Space Policy*, vol. 5, no. 4, November 1989, 311-320. doi:10.1016/0265-9646(92)90006-H

"No Free Launch: Efficient Space Transportation Pricing" (with Michael A. Toman), *Land Economics*, vol. 65, no. 2, May 1989, 91-99.

"Tracing News Orbits: Cooperation and Competition in Global Satellite Development" (book review), *Information Economics and Policy*, September 1988.

"Economic Issues in Innovation in Satellite Communications" in *Space Communications Research and Development R&D*, Washington, DC, Space Applications Board, National Research Council, March 1988, pp. 191-197.

"The Contribution of a Partnership between Economics and Technology," in *Economics and Technology in U.S. Space Policy*, M. K. Macauley (ed.), Washington, DC, Resources for the Future, 1987.

"Space Transportation Policy: Commercial Policies and International Competition," in *Economics and Technology in U.S. Space Policy* (see above) (with Michael A. Toman), 1987.

"Out of Space? Regulation and Technical Change in Communications Satellites," *American Economic Review*, vol. 76, no. 1, May 1986.

"Risk Aversion and the Insurance Value of Strategic Oil Stockpiling" (with Michael A. Toman), *Resources and Energy*, vol. 8, no. 2, 1986. doi:10.1016/0165-0572(86)90015-0

"Estimation and recent behavior of urban population and employment density gradients" *Journal of Urban Economics*, vol. 18, September 1985. doi:10.1016/0094-1190(85)90021-X

"Slicing the Geostationary Pie: Property Rights in Orbit" (with Paul R. Portney), *AEI Journal on Regulation*, July/August 1984.

"Ras Maden Koentjaraningrat" (book review), *Third World Anthropology Research Bulletin*, Spring 1979.

Other Selected Publications
(Government Reports, Short Articles, Op-Eds and Commentaries, Discussion Papers)

Op-eds and Commentary:

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