

EPRI ENERGY SYSTEMS AND CLIMATE ANALYSIS GROUP RESEARCH ON THE SOCIAL COST OF GREENHOUSE GASES

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SOCIAL COST OF GREENHOUSE GASES

- * EPRI Technical Public Comments on U.S. EPA's Draft New Social Costs of Carbon and Other Greenhouse Gases Estimation Methodology and Use of Estimates in EPA's Proposed Oil and Gas Methane Rule. March 2023, EPRI Report 3002026256 https://www.epri.com/research/programs/109396/results/3002026256.
- * EPRI Public Comments on U.S. EPA's Social Costs of Carbon and Other Greenhouse Gases Draft New Methodology Peer Review Process and Candidates. March 2023, EPRI Report 3002026087, <u>https://www.epri.com/research/pro-grams/109396/results/3002026087</u>.
- * Rose, S, 2022. Putting science first in creating and using the social cost of carbon, The Hill, November 18, <u>thehill.com</u>. <u>https://thehill.com/opinion/energy-environment/3741998-putting-science-first-in-creating-and-using-the-social-cost-of-carbon/</u>.
- * **EPRI public comments on EPA's methodology peer review.** EPRI White Paper, December 2022, <u>https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=81659</u>.
- * EPRI's Social Cost of Carbon and Other Greenhouse Gases Educational Webcast Series Summary, December 2022, https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=81679.

- * Rose, S, D Diaz, T Carleton, L Drouet, C Guivarch, A Méjean, F Piontek, 2022. Estimating Global Economic Impacts from Climate Change. In Climate Change 2022: Climate Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the IPCC, Chapter 16. <u>https://www.ipcc.ch/report/ar6/wg2/</u>.
- * Discounting and the Social Cost of Carbon, Webcast, July 2022, https://epri.box.com/s/0y5cjdwfllm7rrvfhikkvgkl5e6g44r4.
- * Guivarch, C, S Rose, A Al Khourdajie, V Bosetti, E Byers, K Calvin, T Carleton, D Diaz, L Drouet, M Grubb, T Hasegawa, AC Köberle, E Kriegler, D McCollum, A Méjean, B O'Neill, F Piontek, J Steinberger, M Tavoni, 2022. *Economic benefits from avoided climate impacts along long-term mitigation pathways. In Climate Change 2022: Mitigation of Climate Change.* Contribution of Working Group III to the Sixth Assessment Report of the IPCC, Chapter 3. <u>https://www.ipcc.ch/report/ar6/wg3/</u>.
- * Rose, S, R Betts, P Wester, A Koutroulis, 2022. Climate Reference Periods, Global Warming Levels, and Common Climate Dimensions. In Climate Change 2022: Climate Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the IPCC, Chapter 1 (Points of Departure and Key Concepts). <u>https://www.ipcc.ch/report/ar6/wg2/</u>.
- Guivarch, C, E Kriegler, JP Pereira, V Bosetti, J Edmonds, M Fischedick, P Havlik, P Jaramillo, V Krey, F Lecocq, A Lucena, M Meinshausen, S Mirasgedis, B O'Neill, G Peters, J Rogelj, S Rose, Y Saheb, G Strbac, AH Strømman, D van Vuuren, N Zhou, 2022. *Annex III: Scenarios and Modelling Methods. In Climate Change 2022: Mitigation of Climate Change.* Contribution of Working Group III to the Sixth Assessment Report of the IPCC. <u>https://www.ipcc.ch/report/ar6/wg3/</u>.
- * Schipper, LF, A Revi, BL Preston, ER Carr, SH Eriksen, LR Fernández-Carril, B Glavovic, NJM Hilmi, D Ley, R Mukerji, MS Muylaert de Araujo, R Perez, SK Rose, PK Singh, 2022. *Climate Resilient Development Pathways. In Climate Change 2022: Climate Impacts, Adaptation, and Vulnerability.* Contribution of Working Group II to the Sixth Assessment Report of the IPCC, Chapter 18 (Climate Resilient Development Pathways). <u>https://www.ipcc.ch/report/ar6/wg2/</u>.
- * EPRI Public Comments on Federal Acquisition Regulation ANOPR: Minimizing the Risk of Climate Change in Federal Acquisitions, EPRI Report 3002023465, February 2022, https://www.epri.com/research/products/000000003002023465.
- * Using the Social Cost of Carbon in Policy and Decisions, Webcast, February 2022 https://epri.app.box.com/s/zb9omn6b2l30984exd8k5jfufcbynukz
- * What does carbon pricing mean for electricity markets? EPRI Report 3002021815, December 2021 https://www.epri.com/research/products/000000003002021815.
- * EPRI Public Comments on the Biden Administration's Interim Social Cost of Carbon, Methane, and Nitrous Oxide Estimates and Technical Document, EPRI Report 3002022316, August 2021, <u>https://www.epri.com/research/pro-</u> grams/109396/results/3002022316.
- * The social cost of carbon and other greenhouse gases getting up to speed and the road ahead, Webcast, June 2022, <u>https://epri.box.com/s/jyaueihpfcjdoems95yjrrlqgw73zldo</u>.
- * Overview of U.S. Government Estimates of the Social Cost of Carbon and Other Greenhouse Gases, June 2021, https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=74373.
- * EPRI Public Comments on the Biden Administration "Interim" SC-GHG Estimates and Technical Document, June 2021, https://esca.epri.com/pdf/EPRI-comments-with-appendices-on-Biden-Interim-SC-GHG-TSD-June21.pdf.
- * Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide, June 2021, https://publicdownload.epri.com/PublicAttachmentDownload.svc/AttachmentId=74371.

- * Repairing the Social Cost of Carbon Framework: Immediate and One Year Steps for Scientifically Reliable Estimates and Use, February 2021, EPRI Report 3002020523, https://www.epri.com/research/products/3002020523.
- * EPRI Comments on Moody's "Proposed framework to assess carbon transition risks for electric power companies, December 2020, EPRI Report 3002020282, <u>https://www.epri.com/research/products/3002020282</u>.
- * EPRI Public Comments on New York State Department of Environmental Conservation's Proposal "Establishing a Value of Carbon: Guidelines for Use by State Agencies, EPRI Report 3002020249, December 2020, <u>https://www.epri.com/re-search/products/3002020249</u>.
- * Review of 1.5°C and Other Newer Global Emissions Scenarios: Insights for Company and Financial Climate Low-Carbon Transition Risk Assessment and Greenhouse Gas Goal Setting, EPRI Report 3002018053, April 2020, <u>https://www.epri.</u> com/research/products/000000003002018053/.
- * Bistline and Rose, 2018. Social Cost of Carbon Pricing of Power Sector CO2: Accounting for Leakage and Other Social Implications from Subnational Policies, Environmental Research Letters 13 014027. <u>https://iopscience.iop.org/article/10.1088/1748-9326/aa9c89/meta</u>.
- * Huppmann, D, E Kriegler, V Krey, K Riahi, J Rogelj, SK Rose, J Weyant, et al., 2018. IAMC 1.5°C Scenario Explorer and Data hosted by IIASA. Integrated Assessment Modeling Consortium & International Institute for Applied Systems Analysis. doi: 10.22022/SR15/08-2018.15429. https://data.ene.iiasa.ac.at/iamc-1.5c-explorer/#/login?redirect=%2Fworkspaces.
- * Cropper, ML, RG Newell, M Allen, M Auffhammer, CE Forest, IY Fung, JK Hammitt, HD Jacoby, RE Kopp, W Pizer, SK Rose, R Schmalensee, JP Weyant, 2017. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. National Academies of Sciences, Engineering, and Medicine, Committee on Assessing Approaches to Updating the Social Cost of Carbon. Washington, DC: National Academies Press. <u>http://www8.nationalacademies.org/onpinews/newsitem.</u> <u>aspx?RecordID=24651</u>.
- * Rose, S.K, D. B. Diaz, G.J. Blanford. *Understanding the Social Cost of Carbon: A Model Diagnostic and Inter-Comparison Study.* Climate Change Economics, June 2017.<u>https://doi.org/10.1142/S2010007817500099</u>.
- * Applying the Social Cost of Carbon: Technical Considerations, EPRI Report 3002004659, July 2016, https://www.epri.com/research/products/00000003002004659.
- * Understanding the Social Cost of Carbon: A Technical Assessment, EPRI Report 3002004657, July 2016, https://www.epri.com/research/products/3002004657.
- * **Carbon Pricing and the Social Cost of Carbon.** EPRI Technical Report 3002011391, December 2017, <u>h</u> <u>ttps://www.epri.com/research/products/00000003002020523</u>.
- * Diaz, Delavane and F Moore, 2017. *Quantifying the Economic Risks of Climate Change*. Nature Climate Change, 7(11): 1-9. <u>https://www.nature.com/articles/nclimate3411.epdf?author_access_token=nu2vByWZU5UkYIVk_h0Y9tRgN0jAjWel9jn-R3ZoTv0PRYrD_dBl6ws-DuQbe3jM128xIsEAPBmbVETF0xZICEUTSrP3IQ11ZJt0xH1Znpg6a6v_u4TH448IO-TPnGTTP.</u>
- * Managing Climate Damages: Exploring Trade-Offs. EPRI Technical Report 3002009659, December 2017, Updated March 2018. #3002009659. <u>https://www.epri.com/research/products/00000003002009659</u>.
- * Applying the Social Cost of Carbon: Technical Considerations. EPRI Technical Report 3002004659, July 2016, https://www.epri.com/research/products/00000003002004659.

- * Cropper, ML, RG Newell, M Allen, M Auffhammer, CE Forest, IY Fung, JK Hammitt, HD Jacoby, RE Kopp, W Pizer, SK Rose, R Schmalensee, JP Weyant, 2016. Assessment of Approaches to Updating the Social Cost of Carbon: Phase 1 Report on a Near-Term Update. National Academies of Sciences, Engineering, and Medicine. Committee on Assessing Approaches to Updating the Social Cost of Carbon, Board on Environmental Change and Society. Washington, DC: National Academies Press. https://www.nap.edu/catalog/21898/assessment-of-approaches-to-updating-the-social-cost-of-carbon.
- * Rose, S.K., D. Turner, G. Blanford, J. Bistline, F. de la Chesnaye, T. Wilson, 2014. *Understanding the Social Cost of Carbon: A Technical Assessment.* EPRI, Palo Alto, CA. EPRI Report <u>3002004657</u>.
- * Waldhoff, S., D. Anthoff, S. Rose, and R.S.J. Tol, 2014. The Marginal Damage Costs of Different Greenhouse Gases: An Application of FUND. Economics: The Open-Access, Open-Assessment E-Journal, 8 (2014-31): 1—33. <u>http://www.economics-ejournal.org/economics/journalarticles/2014-31/</u>.
- Clarke L, K Jiang, K Akimoto, M Babiker, G Blanford, K Fisher-Vanden, J-C Hourcade, V Krey, E Kriegler, A Löschel, D McCollum, S Paltsev, S Rose, PR Shukla, M Tavoni, BCC van der Zwaan, DP van Vuuren, 2014: Assessing Transformation Pathways. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the IPCC [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/report/ar5/wg3/.
- * Rose, S.K., R. Richels, S. Smith, K. Riahi, J. Strefler, D. van Vuuren, 2013. Non-Kyoto Radiative Forcing in Long-Run Greenhouse Gas Emissions and The Role of Non-Kyoto Gas Forcing in GHG Stabilization Scenarios. Climatic Change 123: 511–525. doi: 10.1007/s10584-013-0955-5. <u>https://link.springer.com/article/10.1007/s10584-013-0955-5</u>.
- * Rose, S.K., 2012. The role of the social cost of carbon in policy. WIREs Climate Change 3:195–212. <u>https://onlinelibrary.wiley.</u> <u>com/doi/abs/10.1002/wcc.163</u>.
- van Vuuren, D., K. Riahi, R. Moss, J. Edmonds, A. Thomson, N. Nakicenovic, T. Kram, F. Berkhout, R. Swart, A. Janetos, S.K. Rose and N. Arnell, 2012. A proposal for a new scenario framework to support research and assessment in different climate research communities. Global Environmental Change 1: 21-35. <u>https://www.sciencedirect.com/science/article/abs/</u> pii/S0959378011001191.
- van Vuuren, D.P., J. Edmonds, M. Kainuma, K. Riahi, A. Thomson, K. Hibbard, G.C. Hurtt, T. Kram, V. Krey, J-F. Lamarque, T. Matsui, M. Meinshausen, N. Nakicenovic, S.J. Smith, S.K. Rose, 2011. The Representative Concentration Pathways: An overview, Climatic Change 109: 5-31. <u>https://link.springer.com/article/10.1007/s10584-011-0148-z</u>.
- * Anthoff, David & Rose, Steven & Tol, Richard & Waldhoff, Stephanie, 2011. Regional and Sectoral Estimates of the Social Cost of Carbon: An Application of FUND. Economics Discussion Paper No. 2011-18. <u>https://papers.ssrn.com/sol3/papers.</u> <u>cfm?abstract_id=1972778</u>.
- * Anthoff, David and Rose, Steven and Tol, Richard S. J. and Waldhoff, Stephanie T., 2011. The Time Evolution of the Social Cost of Carbon: An Application of Fund. Economics Discussion Paper No. 2011-44. <u>https://papers.ssrn.com/sol3/papers.</u> <u>cfm?abstract_id=1974112</u>.
- * Rose, S., 2010. "Federal decision-making on the uncertain impacts of climate change: incremental vs. non-incremental climate decisions," Assessing the Benefits of Avoided Climate Change: Cost-Benefit Analysis and Beyond, Pew Center on Global Climate Change. <u>https://www.c2es.org/document/workshop-proceedings-assessing-the-benefits-of-avoided-climate-change-cost-benefit-analysis-and-beyond/</u>.
- Manning, M. R., J. Edmonds, S. Emori, A. Grubler, K. Hibbard, F. Joos, M. Kainuma, R. F. Keeling, T. Kram, A. C. Manning, M. Meinshausen, R. Moss, N. Nakicenovic, K. Riahi, S. K. Rose, S. Smith, R. Swart, D. P. van Vuuren, 2010. Misrepresentation of the IPCC CO2 emission scenarios, Nature Geoscience 3: 376-377. <u>https://www.nature.com/articles/ngeo880</u>.

- Moss, R.H., J.A. Edmonds, K.A. Hibbard, M.R. Manning, S.K. Rose, D.P. van Vuuren, T.R. Carter, S. Emori, M. Kainuma, T. Kram, G.A. Meehl, J.F.B. Mitchell, N. Nakicenovic, K. Riahi, S.J. Smith, R.J. Stouffer, A.M. Thomson, J.P. Weyant, T.J. Wilbanks, 2010. The next generation of scenarios for climate change research and assessment, Nature 463: 747-756, 11 February 2010. <u>https://www.nature.com/articles/nature08823</u>.
- * Clarke, L., J. Edmonds, V. Krey, R. Richels, S. Rose, M. Tavoni, 2009. *International climate policy architectures: Overview of the EMF 22 International Scenarios*, Energy Economics 31 (Supplement 2): S64-S81. <u>https://www.sciencedirect.com/science/article/pii/S0140988309001960</u>.
- Principle Author, 2008. Technical Support Document on Benefits of Reducing GHG Emissions, U.S. Environmental Protection Agency, June 12, 2008, <u>www.regulations.gov</u> (search "Technical Support Document on Benefits of Reducing GHG Emissions").
- * Fisher, BS, N Nakicenovic, K Alfsen, J Corfee Morlot, F de la Chesnaye, J-C Hourcade, K Jiang, M Kainuma, E La Rovere, A Matysek, A Rana, K Riahi, R Richels, S Rose, D van Vuuren, R Warren, 2007. *Issues related to mitigation in the long-term context, In Climate Change 2007: Mitigation.* Contribution of Working Group III to the Fourth Assessment Report of the Inter-governmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. <u>https://www.ipcc.ch/report/ar4/wg3/</u>.

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