# David L. McCollum

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## PROFESSIONAL EXPERIENCE

**Senior R&D Staff**, *Oak Ridge National Laboratory*, Knoxville, Tennessee, USA, 9/2021-Present
**Guest Senior Research Scholar**, *International Inst. for Applied Systems Analysis*, Laxenburg, Austria, 10/2021-Present
**Honorary Senior Research Fellow**, *Centre for Environmental Policy, Imperial College London*, UK, 7/2020-Present
**Research Fellow** in Energy and Environment, *Baker Center for Public Policy, U. of Tennessee*, USA, 1/2016-Present
**Principal Technical Leader**, *Electric Power Research Institute*, Palo Alto, California, USA, 2/2019-9/2021
**Senior Research Scholar**, *International Institute for Applied Systems Analysis*, Laxenburg, Austria, 2/2011-1/2019
**Graduate Researcher**, *University of California, Davis, Institute of Transportation Studies*, USA, 9/2005-3/2011
**Research Aide**, *Argonne National Laboratory*, Washington, DC, USA, 9-12/2007
**Assistant Language Teacher**, *Japan Exchange and Teaching Program*, Sendai, Japan, 7/2004-7/2005
**Research Intern**, *National Renewable Energy Laboratory*, Golden, CO, USA, 6-8/2003
**Legislative Intern**, *United States Senate Committee on Governmental Affairs*, Washington, DC, USA, 5-8/2001

## EDUCATION

**University of California, Davis**, Davis, CA, USA
Ph.D., Transportation Technology & Policy (2011);
M.S., Agricultural & Resource Economics (2008); M.S., Transportation Technology & Policy (2007)
**The University of Tennessee (UT)**, Knoxville, TN, USA
B.S., Chemical Engineering, Chemistry minor (2004), *summa cum laude and University Honors Scholar*
**Ajou University**, Suwon, South Korea (study abroad, 2002)

## EXPERTISE & INTERESTS

**Integrated assessment** of global change and its human drivers and impacts
**Analysis of energy, climate, and other sustainability policies**, including assessing the inter-linkages between them
**Energy-economic systems modeling and scenario analysis** to inform policy-making and corporate decision-making (at the state, national, and international levels)
**Transportation sector** modeling and analysis (technology, policy, consumer behavior)
**Electricity sector** modeling and analysis (end-use electrification, systems modeling, and markets and regulation)
**Sustainable finance** (investment needs for achieving energy, climate, and other sustainability goals)

## PEER-REVIEWED PUBLICATIONS (SELECTED)

**McCollum, D.L.** and A. Al Khourdajie (2021), "Little room for new fossil fuel development if global temperatures are to stay below 1.5°C," *Joule*, Vol. 5, Issue 10, 2542-2545.

Skea, J., P. Shukla, A. Al Khourdajie, and **D. McCollum** (2021), "Intergovernmental Panel on Climate Change: Transparency and integrated assessment modeling," *Wiley Interdisciplinary Reviews: Climate Change*, Vol. 12, Issue 5.

**McCollum, D.L.** (2021). "Machine learning for energy projections," *Nature Energy*.

Bistline, J.E.T., C.W. Roney, **D.L. McCollum**, and G.J. Blanford (2021). "Deep decarbonization impacts on electric load shapes and peak demand," *Environmental Research Letters*.

Bhardwaj, C., J. Axsen, and **D. McCollum** (2021). "Simulating automakers' response to zero emissions vehicle regulation," *Transportation Research Part D: Transport and Environment*, Vol. 94, 102789.

Bhardwaj, C., J. Axsen, F. Kern, and **D. McCollum** (2020). "Why have multiple climate policies for light-duty vehicles? Policy mix rationales, interactions and research gaps," *Transportation Research Part A: Policy and Practice*, 135.

DeCarolis, J.F., P. Jaromillo, J.X. Johnson, **D.L. McCollum** et al. (2020). "Leveraging Open-Source Tools for Collaborative Macro-energy System Modeling Efforts," *Joule*, 4 (12), 2523-2526.

Andrijevic, M., C.F. Schleussner, M.J. Gidden, **D.L. McCollum**, and J. Rogelj (2020). "COVID-19 recovery funds dwarf clean energy investment needs," *Science*, 370 (6514), 298-300.

**McCollum, D.**, A. Gambhir, J. Rogelj, and C. Wilson (2020). "Energy modellers should explore extremes more systematically in scenarios," *Nature Energy* 5 (2), 104-107.

Zhou, W., **D.L. McCollum** et al. (2020). "Decarbonization pathways and energy investment needs for developing Asia in line with well below 2 °C," *Climate Policy* 20 (2), 232-245.

Bhardwaj, C., J. Axsen, F. Kern, **D. McCollum** (2020). "Why have multiple climate policies for light-duty vehicles? Policy mix rationales, interactions and research gaps," *Transportation Research Part A: Policy and Practice* (135), 309-326.

Zhou, W., **D. McCollum** et al. (2019). "A comparison of low carbon investment needs between China and Europe in stringent climate policy scenarios," *Environmental Research Letters* 14 (5), 054017.

Parkinson, S., V. Krey, D. Huppmann, T. Kahil, **D. McCollum** et al. (2019). "Balancing clean water-climate change mitigation tradeoffs," *Environmental Research Letters* 14 (1): e014009.

van den Berg, N.J., H.L. van Soest, A.F. Hof, M.G.J. den Elzen, D.P. van Vuuren, W. Chen, L. Drouet, J. Emmerling, S. Fujimori, N. Höhne, A.C. Kõberle, **D. McCollum** et al. "Implications of various effort-sharing approaches for national carbon budgets and emission pathways," *Climatic Change*.

Edelenbosch, O.Y., **D.L. McCollum**, H. Pettifor, C. Wilson, and D.P. van Vuuren (2018). "Interactions between social learning and technological learning in electric vehicle futures," *Environmental Research Letters* 13 (12): e124004.

Weber, C, **D.L. McCollum** et al. (2018). "Mitigation scenarios must cater to new users," *Nature Climate Change* 8.

**McCollum, D.L.**, C. Wilson et al. (2018). "Interaction of consumer preferences and climate policies in the global transition to low-carbon vehicles," *Nature Energy* Vol. 3, 664–673.

**McCollum, D.L.**, W. Zhou et al. (2018). "Energy investment needs for fulfilling the Paris Agreement and achieving the Sustainable Development Goals," *Nature Energy*, Vol. 3, 589-599.

Grubler, A., C. Wilson, N. Bento, B. Boza-Kiss, V. Krey, **D.L. McCollum** et al. (2018). "A Low Energy Demand Scenario for Meeting the 1.5°C Target and SDGs without Negative Emission Technologies," *Nature Energy*, Vol. 3, 515-527.

**McCollum, D.L.**, L. Gomez Echeverri, S. Busch et al. (2018). "Connecting the Sustainable Development Goals by their energy inter-linkages," *Environmental Research Letters* 1 (3).

Jewell, J., **D. McCollum** et al. (2018). "Limited emission reductions from fuel subsidy removal except in energy exporting regions," *Nature*, 554: 229-233.

**McCollum, D.**, L. Gomez Echeverri, K. Riahi, and S. Parkinson (2017). "SDG7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All", In: A guide to SDG interactions: from science to implementation. Eds. Griggs, D.J., M. Nilsson, A.S. Stevance, and D. McCollum, pp. 127-173 International Council for Science, Paris.

**McCollum, D.L.**, C. Wilson et al. (2017). "Improving the behavioral realism of global integrated assessment models: An application to consumers' vehicle choices," *Transportation Research Part D: Transport and Environment* 55: 322-342.

Edelenbosch, O.Y., D.P. van Vuuren, C. Bertram, S. Carrara, J. Emmerling, H. Daly, A. Kitous, **D.L. McCollum**, and N. Saadi Failali (2017). "Transport fuel demand responses to fuel price and income projections: Comparison of integrated assessment models," *Transportation Research Part D: Transport and Environment* 55: 310-321.

Yeh, S., G.S. Mishra, L. Fulton, P. Kyle, **D.L. McCollum** et al. (2017). "Detailed assessment of global transport-energy models' structures and projections," *Transportation Research Part D: Transport and Environment* 55: 294-309.

Edelenbosch, O.Y., **D.L. McCollum** et al. (2017). "Decomposing passenger transport futures: comparing results of global integrated assessment models," *Transportation Research Part D: Transport and Environment* 55: 281-293.

Pettifor, H., C. Wilson, **D.L. McCollum**, and O.Y. Edelenbosch (2017). "Modelling social influence and cultural variation in global low-carbon vehicle transitions", *Global Environmental Change* 47: 76-87.

**McCollum, D.L.**, J. Jewell et al. (2016). "Quantifying uncertainties influencing the long-term impacts of oil prices on energy markets and carbon emissions," *Nature Energy*, Vol. 1, Issue 6, Article number: 16077.

Jewell, J., V. Vinichenko, **D. McCollum** et al. (2016). "Comparison and interactions between the long-term pursuit of energy independence and climate policies," *Nature Energy*, Vol. 1, Issue 6, Article number: 16073.

Cameron, C., S. Pachauri, N. Rao, **D. McCollum**, J. Rogelj, and K. Riahi (2016). "Policy tradeoffs between climate mitigation and clean cook stove access in South Asia," *Nature Energy*, Vol. 1, Issue 1, Article number: 15010.

von Stechow, C., J.C. Minx, K. Riahi, J. Jewell, **D. McCollum** et al. (2016). "2°C and SDGs: united they stand, divided they fall?," *Environmental Research Letters*, Vol. 11, Issue 3, 034022.

Creutzig, F., P. Jochem, O.Y. Edelenbosch, L. Mattauch, D.P. van Vuuren, **D. McCollum**, and J. Minx (2015). "Transport: A roadblock to climate change mitigation?," *Science*, Vol. 350, Issue 6263, 911-912.

von Stechow, C., **D. McCollum** et al. (2015). "Integrating Global Climate Change Mitigation Goals with Other Sustainability Objectives: A Synthesis," *Annual Review of Environment and Resources*, Vol. 40, 363-394.

van Sluisveld, M.A.E., J.H.M. Harmsen, N. Bauer, **D.L. McCollum** et al. (2015). "Comparing future patterns of energy system change in 2 °C scenarios with historically observed rates of change," *Global Environmental Change* 35, 436-449.

Lucas, P., J. Nielsen, K. Calvin, **D.L. McCollum** et al. (2015). "Future energy system challenges for Africa: Insights from Integrated Assessment Models," *Energy Policy*, Vol. 86, 705-717.

Lehtveer, M., M. Makowski, F. Hedenus, **D. McCollum**, M. Strubegger (2015). "Multi-criteria analysis of nuclear power in the global energy system: Assessing trade-offs between simultaneously attainable economic, environmental and social goals," *Energy Strategy Reviews*, Vol. 8, 45-55.

Tavoni, M., E. Kriegler, K. Riahi, D.P. van Vuuren, T. Aboumahboub, A. Bowen, K. Calvin, E. Campiglio, T. Kober, J. Jewell, G. Luderer, G. Marangoni, **D. McCollum**, M. van Sluisveld, A. Zimmer, B. van der Zwaan (2015). "Post-2020 climate agreements in the major economies assessed in the light of global models," *Nature Climate Change* 5, 119-126.

Yang, C., S. Yeh, S. Zakerinia, K. Ramea, and **D. McCollum** (2015). "Achieving California's 80% greenhouse gas reduction target in 2050: Technology, policy and scenario analysis using CA-TIMES energy economic systems model," *Energy Policy*, Vol. 77, 118-130.

Bauer, N., V. Bosetti, M. Hamdi-Cherif, A. Kitous, **D. McCollum** et al. (2015). "$CO_2$ emission mitigation and fossil fuel markets: Dynamic and international aspects of climate policies," *Technological Forecasting and Social Change*, Vol. 90.

Johnson, N., V. Krey, **D.L. McCollum** et al. (2015). "Stranded on a Low-Carbon Planet: Implications of Climate Policy for the Phase-out of Coal-based Power Plants," *Technological Forecasting and Social Change*, Vol. 90, Part A, 89-102.

**McCollum, D.L.**, N. Bauer, K. Calvin, A. Kitous, and K. Riahi (2014). "Fossil resource and energy security dynamics in conventional and carbon-constrained worlds," *Climatic Change*, Vol. 123, Issue 3, 413-426.

**McCollum, D.L.**, V. Krey, P. Kolp, Y. Nagai, and K. Riahi (2014). "Transport electrification: a key element for energy system transformation and climate stabilization," *Climatic Change*, Vol. 123, Issue 3, 651-664.

**McCollum, D.L.**, Y. Nagai, K. Riahi, G. Marangoni, K. Calvin, R. Pietzcker, J. van Vliet, and B. van der Zwaan (2013). "Energy investments under climate policy: a comparison of global models," *Climate Change Economics*, Vol. 4, Issue 4.

Calvin, K., M. Wise, D. Klein, **D. McCollum** et al. (2013). "A multi-model analysis of the regional and sectoral roles of bioenergy in near- and long-term CO2 emissions reduction," *Climate Change Economics*, Vol. 4, Issue 4.

Jewell, J., A. Cherp, V. Vinichenko, N. Bauer, T. Kober, **D. McCollum** et al. (2013). "Energy security of China, India, the E.U. and the U.S. under long-term scenarios: Results from six IAMs," *Climate Change Economics*, Vol. 4, Issue 4.

**McCollum, D.L.**, V. Krey, K. Riahi, P. Kolp, A. Grubler, M. Makowski, and N. Nakicenovic (2013). "Climate policies can help resolve energy security and air pollution challenges," *Climatic Change*, Vol. 119, Issue 2, 479-494.

Rogelj, J., **D.L. McCollum**, and K. Riahi (2013). "The UN's 'Sustainable Energy for All' initiative is compatible with a warming limit of 2 °C," *Nature Climate Change*, Vol. 3, 545-551.

Rogelj, J., **D.L. McCollum** et al. (2013). "Probabilistic cost estimates for climate change mitigation," *Nature*, Vol. 1.

Rogelj, J., **D.L. McCollum**, B.C. O'Neill, and K. Riahi (2013). "2020 emissions levels required to limit warming to below 2°C," *Nature Climate Change*, Vol. 3, 405-412.

**McCollum, D.L.**, V. Krey, and K. Riahi (2012). "Beyond Rio: Sustainable energy scenarios for the 21st century," *Natural Resources Forum*, Vol. 36, Issue 4, 215-230.

**McCollum, D.L.**, C. Yang, S. Yeh, J. Ogden (2012). "Deep greenhouse gas reduction scenarios for California - Strategic implications from the CA-TIMES energy-economic systems model," *Energy Strategy Reviews*, Vol. 1, Issue 1, 19-32.

**McCollum, D.L.** et al. (2011). "An integrated approach to energy sustainability," *Nature Climate Change*, Vol. 1.

**McCollum, D.**, G. Gould, and D. Greene (2009). "Greenhouse Gas Emissions from Aviation and Marine Transportation: Mitigation Potential and Policies," Pew Center on Global Climate Change.

**McCollum, D.**, and C. Yang (2009). "Achieving deep reductions in US transport greenhouse gas emissions: Scenario analysis and policy implications," *Energy Policy* 37(12), 5580-96.

Yang, C., **D. McCollum** et al. (2009). "Meeting an 80% Reduction in Greenhouse Gas Emissions from Transportation by 2050: A Case Study in California, USA," *Transportation Research Part D: Transport and Environment*, 14 (3).

**McCollum, D.** and J. Ogden (2008). "Future Impacts of Coal Distribution Constraints on Coal Cost," *Transportation Research Part E: Logistics and Transportation Review* 45(3).

## MAJOR RESEARCH ACTIVITIES & PRINCIPAL INVESTIGATOR ROLES (SELECTED)

**Green Climate Fund**, *2019-2021.* "Scaling up climate finance in the context of Covid-19: A science-based call for financial decision-makers"

**IIASA-ISC**, *2020-21.* "Transformations within reach: Pathways to a sustainable and resilient world – Rethinking energy solutions", International Institute for Applied Systems Analysis, Austria, and International Science Council, Paris

**U.S. Power Sector Transformation and Air Quality Study**, *2020-21*, Energy-economic modeling for six U.S. electric utilities to explore the co-benefits of decarbonization and electrification in their service territories

**U.S. and Canadian Net-Zero Emissions Studies**, *2019-21*, Modeling of economy-wide decarbonization pathways to reach net-zero emissions by 2050; stakeholder engagement with U.S. and Canadian utilities to inform decision making

**COMMIT Project**, *2018-20*, Enhancing the energy transitions and climate policy modeling capacity of G20 developing countries in support of their enhanced NDC submissions and long-term strategies (European Commission DG-CLIMA)

**CD-LINKS Project**, *2016-19*, Exploring technology and policy pathways toward well below 2 °C, with a focus on energy infrastructure investment needs globally and for major economies (European Commission Horizon 2020)

**Intergovernmental Panel on Climate Change**

*Sixth Assessment Report (ongoing)*: Climate change mitigation and sustainable development pathways and models
*Special Report on 1.5 °C (2018)*: Energy investment needs for deep decarbonization pathways
*Fifth Assessment Report (2014)*: Co-benefits and risks of climate change mitigation

**United Nations Environment Programme Finance Initiative (UNEP-FI)**, *2017-18,* Worked with leading international banks to promote use of energy and emissions scenarios for informing risk valuation (motivated by TCFD)

**U.S. Environmental Protection Agency, Office of Transportation and Air Quality Project**, *2016-18*, Designed and carried out modeling analyses of the energy and emissions leakage effects of US biofuels policies, in collaboration with government scientists and RTI International

**International Council for Science (ICSU/ISC)**, *2016-17*, Led a team of energy experts to draft a chapter on energy-related Sustainable Development Goal interactions, and coordinated the overall report as member of the editorial team

**Asian Development Bank (ADB)**, 2015, Co-led energy transitions analysis for the 'Roadmap for Carbon Capture and Storage Demonstration and Deployment in the People's Republic of China'

**United Nations Environment Programme (UNEP), The Emissions Gap Report 2014**, Lead Author of 'Chapter 2: What emission levels will comply with temperature limits?'

**Global Energy Assessment**, *2009-12*, Lead Author of 'Chapter 17: Energy Pathways for Sustainable Development'

**Multi-Path Transportation Futures Study**, *2007*, Argonne National Laboratory, Characterized transport fuel production options by costs, emissions and water use

**Models for Carbon Dioxide Transport and Underground Storage**, *2005-06*, University of California, Davis, Investigated techno-economic models for $CO_2$ compression, pipeline transport, and geological storage

## INTERVIEWS, OUTREACH & MEDIA (SELECTED)

**The Conversation**, *11/17/2020*, "Coronavirus relief funds could easily pay to stop the worst of climate change while rebooting economies"

**World Economic Forum**, *8/21/2020*, "Hybrid physical and virtual meetings are the future for the IPCC"

**Carbon Brief**, *6/18/2018*, "Clean energy investment 'must be 50% higher' to limit warming to 1.5C"

**World Economic Forum**, *6/13/2017*, "This is the UN's secret plan to save the world"

**Süddeutsche Zeitung**, *11/20/2015*, "Wer Klimaschutz ernst nimmt, muss Autos abrüsten"

**ORF FM4 Reality Check**, *11/12/2014*, Radio program on "US-China Climate Change and Clean Energy Cooperation"

**International Business Times**, *11/12/2014*, "US-China Carbon Deal to Prevent Interstellar Apocalypse"
**Scientific American**, *2/25/2013*, "U.N. Sustainable Energy Effort Could Keep Warming Below 2 Degrees Celsius"
**The Guardian (U.K.)**, *12/18/2012*, "At the edge of the carbon cliff"

## LEADERSHIP POSITIONS, ADVISORY BOARDS & COMMITTEES (SELECTED)

Associate Editor, *Renewable and Sustainable Energy Transition* (a peer-reviewed, open-access journal published by Elsevier)
Member, National Academies of Sciences, Engineering and Medicine; Board on International Scientific Organizations
Advisory Team, Open Energy Outlook for the United States
Steering Committee, National Renewable Energy Laboratory, Transportation Energy and Mobility Pathway Options model
Scientific Advisory Committee Member, Science Based Targets Initiative
Steering Committee Member, International Transport Energy Modeling Consortium (iTEM),
Advisory Board Member, International Transport Forum (of the OECD), Decarbonising Transport Initiative
Member, Permanent Committee on Diversity Management and Building a Positive Work Environment at IIASA
Supervisor and mentor to more than 15 junior staff (Ph.D. and post-doctoral students) since 2011

## HONORS & AWARDS (SELECTED)

Sustainable Transportation Center Dissertation Fellowship, UC-Davis & US Department of Transportation
Sustainable Transportation Center's Outstanding Student of the Year for 2010
Fulbright Full Research Grant to Germany, U.S. Department of State [*Declined*]
German Academic Exchange Service (DAAD) Dissertation Grant to Germany [*Declined*]
U.S. National Academy of Sciences Fellowship for IIASA's Young Scientists Summer Program (YSSP)
Ernest E. Hill Fellowship (UC-Davis) for studying Carbon-Neutral Alternative Energy Solutions
Dwight David Eisenhower Graduate Transportation Fellowship, US Department of Transportation

## LANGUAGE & COMPUTER SKILLS

German – *conversant* (*upper intermediate level)* // English - *fluent (native speaker)*
MESSAGEix-GLOBIOM, REGEN, TIMES, MA$^3$T, Matlab, Python, R, SQL Developer, Github, Endnote, Illustrator