

## DAVID L. MCCOLLUM

Senior R&D Staff ♦ Oak Ridge National Laboratory

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### PROFESSIONAL EXPERIENCE

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**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**, *IPCC WGIH Technical Support Unit, 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

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**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

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**Integrated assessment and multi-sector dynamics** of global change and its human drivers and impacts

**Analysis of energy, climate, and broader sustainability objectives**, including assessing their inter-linkages

**Energy-economic systems modeling and scenario analysis** to inform policy-making and corporate decision-making  
(global, national, and subnational)

**Transportation sector** modeling and analysis (technology, policy, consumer behavior)

**Electricity sector** modeling and analysis (end-use electrification, systems modeling, and markets and regulation)

**Sustainability finance** (investment needs for achieving energy, climate, and other sustainability goals)

### PEER-REVIEWED PUBLICATIONS (SELECTED)

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Bistline, J.E.T. G. Blanford, J. Grant, E. Knipping, **D.L. McCollum** et al. (2022). “Economy-wide evaluation of CO<sub>2</sub> and air quality impacts of electrification in the United States,” *Nature Communications* (13:1), 1-12.

Zakeri, B., K. Paulavets, L. Barreto-Gomez, L. Gomez Echeverri, S. Pachauri, B. Boza-Kiss, C. Zimm, J. Rogelj, F. Creutzig, D. Ürge-Vorsatz, D.G. Victor, M.D. Bazilian, S. Fritz, D. Gielen, **D.L. McCollum**, L. Srivastava, J.D. Hunt, and S. Pouya (2022). “Pandemic, War, and Global Energy Transitions,” *Energies*, 15 (17).

Yeh, S., J. Gil, P. Kyle, P. Kishimoto, P. Cazzola, M. Craglia, O. Edelenbosch, P. Fragkos, L. Fulton, Y. Liao, L. Martinez, **D.L. McCollum**, J. Miller, R. Pereira, and J. Teter (2022). “Improving future travel demand projections: a pathway with an open science interdisciplinary approach,” *Progress in Energy*, 4.

IPCC Working Group III Contribution to the 6<sup>th</sup> Assessment Report (2022) - Lead Author for *Summary for Policymakers* and *Technical Summary*; and Contributing Author for *Chapter 3 (Mitigation Pathways Compatible with Long-term Goals)*, *Chapter 6 (Energy Systems)*, and *Annex III (Scenarios and Modelling Methods)*

- Bhardwaj, C., J. Axsen, and **D. McCollum** (2022). “Which ‘Second-best’ Climate Policies Are Best? Simulating Cost-effective Policy Mixes for Passenger Vehicles,” *Resource and Energy Economics*, 101319.
- Bhardwaj, C., J. Axsen, and **D. McCollum** (2022). “How to design a zero-emissions vehicle mandate? Simulating impacts on sales, GHG emissions and cost-effectiveness using the AUtomaker-Consumer Model (AUM),” *Transport Policy* (117).
- McCollum, D.L.** and A. Al Khouradajie (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 Khouradajie, 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.
- Knighton, L.T. et al. (2021). “Techno-Economic Analysis of Product Diversification Options for Sustainability of the Monticello and Prairie Island Nuclear Power Plants,” INL/EXT-21-62563-Rev001. US-DOE Office of Nuclear Energy.
- 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. Köberle, **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.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.
- 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.
- 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<sub>2</sub> 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 CO<sub>2</sub> emissions reduction,” *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.** 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).

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

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- DecisionScience@ORNL**, 2021-Present. Leading an internal effort to build a diverse analysis community within ORNL; managing an internal LDRD/PD budget of >\$500k to seed new ideas and establish world-leading capabilities
- E3SM-GCAM Exploration of CDR**, 2022-Present. Exploring the effectiveness of land-based carbon dioxide removal in stringent mitigation pathways using world-leading earth systems and integrated assessment models
- Net Zero World Initiative**, 2021-Present. ORNL Lab Lead and Co-Manager for Partnerships within the cross-lab NZW Action Center. NZW is a partnership between U.S. federal agencies, U.S. national laboratories, foreign governments, and philanthropies to support countries’ rapid achievement of energy systems decarbonization.
- DECARB (Decarbonizing Energy through Collaborative Analysis of Routes and Benefit)**, 2022-Present. ORNL Lab Lead and Core Analysis Team Member; DEARB is a multi-lab effort sponsored by the DOE-EERE Strategic Analysis Team to develop advanced capabilities and workflows for multi-sectoral decarbonization pathways modeling.
- Energy Modeling Forum 37 Exercise (EMF-37): Deep Decarbonization & High Electrification Scenarios for North America**, 2021-Present. Study Team contributions: (1) Transportation, (2) Ancillary Impacts, (3) Hydrogen
- EDITS Consortium (Energy Demand changes Induced by Technological and Social innovations)**, 2019-Present. Led by IIASA and RITE. Study Team contributions: (1) Energy Security, (2) End-Use Energy Demand Data.
- Intergovernmental Panel on Climate Change**  
*Sixth Assessment Report (2022)*: Lead and Contributing Author and WG III Technical Support Unit; Multiple topics  
*Special Report on 1.5 °C (2018)*: Contributing Author; Energy investment needs for deep decarbonization pathways  
*Fifth Assessment Report (2014)*: Lead Author; Co-benefits and risks of climate change mitigation
- 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)
- 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-emissions leakage effects of US biofuels policies, with 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<sub>2</sub> compression, pipeline transport, and geological storage

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

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Review Editor, Second Austrian Climate Assessment Report (AAR2), Chapter 3 on *Settlements, Mobility and Spatial Planning*

Review Editor, Fifth National Climate Assessment (NCA5), Chapter 18 on *Sector Interactions, Multiple Stressors, and Complex Systems*

Co-Chair, Working Group on *Connecting MSD Research to Operations*, Multi Sector Dynamics Community of Practice

Member, Expert Group on Energy's Interlinkages with Other SDGs in the framework of the SDG7 Technical Advisory Group (SDG7 TAG), United Nations Department of Economic and Social Affairs (UN DESA)

Associate Editor, *Renewable and Sustainable Energy Transition* (Elsevier)

Member, U.S. Committee for IASA; National Academies of Sciences, Engineering and Medicine (NASEM); Board on International Scientific Organizations (BISO)

Member, Planning Committee for the *U.S. Research Data Summit 2023*; National Academies of Sciences, Engineering, and Medicine (NASEM), Policy and Global Affairs Division

Scientific Advisory Board, EU Horizon 2020 Project *LOCOMOTION*

Scientific Advisory Board, EU Horizon Europe Project *DIAMOND*

Advisory Team, TEMOA modeling for the project *Open Energy Outlook for the United States*

Steering Committee, National Renewable Energy Laboratory, TEMPO transportation pathways model

Scientific Advisory Group, 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

Reviewer for *Science*, *Nature*, *Nature Climate Change*, *Nature Energy*, *Nature Sustainability*, *Nature Communications*, *Environmental Research Letters*, *Climatic Change*, *Joule*, *Energy and Climate Change*, *Energy Economics*, and others