

**CHRISTOPH J. MEINRENKEN, PhD**

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**EXPERIENCE**

- July '22 – present **Columbia University, New York.** *Ass. Prof. of Practice, PI (Climate School), Affiliate (Data Science Institute), Program Director (MS Information & Knowledge Strategy).*  
Research: Elucidating and improving the techno-economic performance of low-carbon energy systems (smart buildings, transportation, synfuels); data science for corporate sustainability management.
- Apr. '12 – June '22 **Columbia University, New York.** *Ass. Research Scientist & PI (Climate School), Affiliate (Data Science Inst.), Adj. Prof. & Int. Program Director (School of Prof. Studies).*
- Oct. '09 – March '12 **Columbia University, New York.** *Earth Institute: Lead scientist and program manager.*  
Collaboration between Lenfest Center for Sustainable Energy and PepsiCo Inc. on supply chain management and product carbon footprinting.
- Sept. '02 – Feb. '09 **Oliver Wyman, New York.** *Risk expert, senior project manager.*  
Financial engineering, financial and enterprise risk management, project management, staff development, proposal & contract negotiations (Asia, Africa, Europe, Middle East, North America).
- July '01 - May '02 **Max Planck Institute for Medical Research, Heidelberg, Germany.** *Post Doc.*  
Research on synaptic transmission, applying multiple methods and tools (electrophysiology, fluorescence microscopy, computer modeling).
  - Joint research projects and grant applications with partnering laboratories
- Sept. '96 - Nov. '97 **Oliver, Wyman & Company, London, UK.** *Consultant.*
  - Analyst for macro-econometric modeling and credit risk management (Europe)
- Summer '95 **National Institute of Standards and Technology (NIST), Gaithersburg, MD.**  
*Guest Researcher.*
  - Designed experiment to research IR-absorption in high temp./high pressure CO<sub>2</sub>

**EDUCATION**

- Jan. 98 - June 01 **Max Planck Institute for Medical Research & University of Heidelberg, Germany.**  
Department of Physics. **PhD in physics, June 2001.**  
Dissertation on signal transmission in the central nervous system:
  - Experiments: Electro-physiological recordings ("patch-clamp") of synaptic transmission and short-term memory phenomena in rodents
  - Computational neuroscience: 3-D diffusion and buffering of Calcium*Advisor: Bert Sakmann (Nobel laureate 1991)*
- Sept. 94 - June 96 **Princeton University, Princeton, NJ.** Department of Mechanical and Aerospace Engineering (Applied Physics Group). **M.S.E., June 1996.**  
Master Thesis on the IR-absorption of carbon dioxide:
  - Spectrometry of vibrational/rotational bands at high temperatures and pressures, broadening and narrowing phenomena, and spectral collapse
  - Developed novel, time-domain based computer model to simulate spectrum*Advisor: Richard Miles*
- Oct. 91 - July 94 **University of Heidelberg, Germany.** Undergraduate degrees in **physics and mathematics, July 1993.** Concentration in computer science and statistics.
- Jan. 91 - May 91 **Yale University, New Haven, CT.** *Visiting student.* Classes in physics, psychology, and medical sociology. Volunteer at Yale New Haven Hospital.

## INVITED TALKS/SPEAKING ENGAGEMENTS

- Embodied Carbon Symposium 2022 (Penn State), *Speaker* (29 November 2022)
- U.S. DOE Building Electric Appliances, Devices, and Systems, *Speaker at Expert Panel* (15 June 2022)
- GreenBiz Circularity Conference, *Speaker* (17 May 2022)
- Columbia Data Science Day, *Speaker at Opening Reception* (05 April 2022)
- US Department of Energy, *Speaker in 2021 BTO Peer Review Conference* (17 August 2021)
- Columbia U. & IBM research showcase, *Panelist on "Data Transparency in Sustainability"* (16 June 2021)
- Columbia University & DoE, *Chaired and spoke at "Trends in Residential Electricity Use"* (17 March 2021)
- Inst. for Packaging Professionals (SE Chapter), *Keynote on Fast Life Cycle Assessment* (10 March 2021)
- Georgia Tech, *Invited Seminar Talk on Eco-feedback, Data Science and Policy Lab* (26 February 2021)
- Town & Gown NYC, *Invited Seminar on reducing emissions from demolition waste* (23 Oct 2019)
- American Center for Life Cycle Assessment, *Webinar on carbon in consumer products* (17 July 2019)
- State Grid Corporation of China, *Training Modules on Sustainability Management* (20-22 March 2019)
- Sustainable Brands Conference, San Diego, CA (8 June 2016)
- Zhejiang University, China; *seminar on TEAs of low carbon energy systems* (24 March 2016)
- Arizona State University, *School of Sustainable Engineering and the Built Environment* (8 May 2015)
- IBM Watson Research Center, *Physical Analytics Group* (17 April 2015)
- Columbia University Seminar *Complexity Science, Modeling, and Sustainability* (18 September 2014)
- MIT, *LEAP webinar series on life cycle assessment* (07 December 2012)

## SYNERGISTIC ACTIVITIES AND SERVICE TO THE SCHOLAR & PRACTITIONER COMMUNITY

- Co-Chair, Columbia University Seminar *Complexity Science, Modeling, and Sustainability* (2016-present)
- Peer reviewer (incl., Nature, Applied Energy, J. of Cleaner Prod., Sustainability, J. of Industrial Ecol.)
- Affiliated member, Columbia University's *Data Science Institute* (2012-present)
- Final reviewer, Columbia University Graduate School of Architecture and Urban Planning (2022)
- Co-Editor of the journal *Sustainability's* special issue on *Energy Storage in Smart Buildings* (2022)
- Jury & Program Committee Member, *Association for Public Policy Analysis & Management* (2021)
- Co-Editor for *J. of Applied Energy's* special issue on Demand Response in Smart Energy Systems (2021)
- Reviewer for US Department of Energy's BTO's *BENEFIT* grants (March & April, 2021)
- Adjunct instructor, Columbia School of Professional Studies, *Sustainability Management* (2018-2022)
- Adjunct Assistant Professor, Columbia SEAS Dep. of Earth & Env. Eng., *Industrial Ecology* (2011-2019)
- MBA Lecturer, *Vienna U. of Economics & Business, Environmental Management* (2016-2019)
- Co-Editor for *J. of Applied Energy's* special issue on Smart-Grid Market Mechanisms (2018-2019)
- Jury, *Echoing Green Social Entrepreneurship Fellowships* (February 2018)
- Program Committee, *Int. Workshop on Science of Smart City Ops. and Platforms Eng. (SCOPE)* (2016-2018)

- Advisor, NYC City Climate Braintrust, *Global Shapers NY of World Economic Forum* (29 Sept. 2017)
- Columbia University *MS Carbon Management*, curriculum development, exec. committee (2011-2017)

## AWARDS/RECOGNITION

- Visiting Scholar, **American Academy in Rome** (Sept. 2016 – March 2017)
- PI, **NSF i-Corps** in Clean Tech by NYCRI and PowerBridgeNY (summer 2015 cohort)
- Exhibitor, **NIST/US-Ignite Global City Teams Challenge Expo**, Washington DC (June 2015)
- Demonstration, Innovation & Application @ Columbia, **Columbia DSI** (March 2015)
- Nominee, Resnick Sustainability Institute's (CalTech) **Resonate Award** (2014 & 2015)
- Finalist, **Verizon Powerful Answers**, 30 out of 1,400 global applicants (2013)
- Fellow, **Max Planck Society**, full stipend to pursue Ph.D. studies and research (1998 - 2001)
- Scholar of the **German National Merit Foundation** ("Studienstiftung") (1992 - 1996)
- **Guggenheim Merit Scholarship** for studies at Princeton University (1994 - 1995)

## SELECT MEDIA MENTIONS

- Washington Post (2022) [For a sweltering petrostate, a 'carbon neutral' World Cup is a challenge](#)
- Washington Post (2022) [What does it mean for a hotel to be carbon neutral?](#)
- World Economic Forum (2021) [Net-Zero Challenge: The supply chain opportunity](#)
- New York Times (2020) [The City That Never Sleeps Is Waking Up Later](#)
- NPR (2020) [Summer Heat Amid the Pandemic Raises Concerns About More Blackouts and Brownouts](#)
- Wall Street Journal (2019) [Online Shopping: How to Beat the System](#)
- Sustainable Brands (2019) ( [The World's First Data Visualization of Product Carbon Footprints](#)
- Archinect (2017) ["Indoor City" installation explores dissolving spatial boundaries in an era of climate change](#)
- Harvard Business Review (2012) [A New Algorithm for Fast Carbon Footprinting](#)

## MEMBERSHIPS

- International Society of Industrial Ecologists (since 2013)
- American Physical Society (since 2011)

## RESEARCH FUNDING

- PI, *Review, strengthen, and position the Enel X Sustainability Boosting Program® as best practice among the most authoritative programs in the sector* (**Enel X**, \$105k, 2023)
- Co-PI, *Adapting the Existing Built Environment: Evolving Education toward Decarbonization and Resilience* (Columbia University *Earth Network*, \$15k, 2021-24)
- PI, *Residential Electricity Consumption in 400 NYC apartments before, during, and after Covid-19 related stay-at-home patterns* (US **Department of Energy**, \$163k, 2021-23; special extension to main DoE grant)
- PI, *Towards publicly available, trusted product carbon footprints (PCFs)* (**Columbia-IBM Center for Blockchain & Data Transparency**, \$97k, 2021-23)
- PI, *Reducing plugload electricity footprint of residential buildings through low-cost, non-intrusive sub-metering and personalized feedback technology* (US **Department of Energy**, \$1,850k (federal), 2016-2021)
- PI, *Advanced peak demand forecast and battery dispatch algorithms to integrate storage-based DR with Building Automation Systems*, **NSF EAGER** grant (National Science Foundation, \$234k, 2015-2017)
- PI, *Demonstrate Air Capture Technology*, Columbia University partnering with Electricity de France (EDF) and Arizona State University (**Electricity de France**, \$400k, 2015-17)
- PI, PON2606 Advanced Building Technology Development, *Energy storage based adaptive demand responses* with partners UEP, Siemens Corporate Research, CUNY (**NYSERDA**, \$600k, 2014-15)
- Co-PI, *NSF Research Coordination Network (SEES) on CCUS* (**NSF**, \$650k, 2012-17)
- Co-PI, *Economic and technological feasibility of direct air capture approaches for synthetic fuels* (**ABB Corporate Research**, \$80k, 2013-14)
- PI, *Insights from modeling complex systems in diverse disciplines and implications for understanding Sustainable Human Development* (**AC<sup>4</sup>, Columbia University**, \$10k, in FY14)
- PI, *Implementing fast carbon footprinting* (**PepsiCo Inc.**, \$88k, 2013)
- Co-PI, *Intra- and inter-building control algorithms and smart grid communication links to facilitate electricity storage in buildings* (**National Institute of Standards and Technology**, \$200k, 2012&13)
- Lead scientist & manager, *Corporate Sustainability Plans for PepsiCo* (**PepsiCo Inc.**, \$750k, 2008-12)

**PUBLICATIONS** (Google Scholar: Citations ~1550, h-index = 19)

### Refereed journals

- D. Blitzer, C. Meinrenken, I. George, "The Greenhouse Gas Emissions Associated with Cardiothoracic Surgery", *Annals of Thoracic Surgery Short Reports*, 2023
- C.J. Meinrenken, D. Chen, A. Prasad, R.A. Esparza, V. Iyer, S.P. Paridis, A. Prasad, and E. Whillas, "The Carbon Catalogue, carbon footprints of 866 commercial products from 8 industry sectors and 5 continents", *Nature Scientific Data* 9, 2022
- L. Li, C.J. Meinrenken, V. Modi, and P.J. Culligan, "Impacts of COVID-19 related stay-at-home restrictions on residential electricity use and implications for future grid stability", *Energy and Buildings* 251, 2021

- L. Li, C.J. Meinrenken, V. Modi, and P.J. Culligan, “Short-term apartment-level load forecasting using a modified neural network with selected auto-regressive features”, *Applied Energy* 287, 2021
- C.J. Meinrenken, S. Abrol, G.B. Gite, C. Hidey, K. McKeown, A. Mehmani, V. Modi, E.C. Turcan, W. Xie, and P.J. Culligan, “Residential electricity conservation in response to auto-generated, multi-featured, personalized eco-feedback designed for large scale applications with utilities”, *Energy and Buildings* 232, 2021
- C.J. Meinrenken, N. Rauschkolb, S. Abrol, T. Chakrabarty, V. C. Decalf, C. Hidey, K. McKeown, A. Mehmani, V. Modi, and P.J. Culligan, “MFRED, 10 second interval real and reactive power for groups of 390 US apartments of varying size and vintage”, *Nature Scientific Data* 7, 2020
- C.J. Meinrenken, D. Chen, A. Prasad, R.A. Esparza, V. Iyer, S.P. Paridis, A. Prasad, and E. Whillas, “Carbon emissions embodied in product value chains and the role of Life Cycle Assessment in curbing them”, *Nature Scientific Reports* 10, 2020  
  - \* Top 50 of all 820 earth science papers in *Nature Scientific Reports* 2020 (~15,000 downloads)
- C.J. Meinrenken, S. Zhenyu, and S. Di, “Using GPS-based trip pattern data to determine optimum ranges for electric vehicles geared at different driver types: A Michigan case study”, *Transportation Research Part D: Transport and Environment* 78, 2020
- Y. Song, Y. Ding, P. Siano, C.J. Meinrenken, M. Zheng, and G. Strbac, “Optimization methods and advanced applications for smart energy systems considering grid-interactive demand response”, *Applied Energy* 259, 2020
- C.J. Meinrenken and A. Mehmani, “Concurrent optimization of thermal and electric storage in commercial buildings to reduce operating cost and demand peaks under time-of-use tariffs”, *Applied Energy* 254, 2019
- M. Zheng, J. Sun, C.J. Meinrenken, and T. Wang, “Pathways Toward Enhanced Techno-Economic Performance of Flow Battery Systems in Energy System Applications”, *Journal of Electrochemical Energy Conversion and Storage* 16 (2), 2019
- Y. Amonkar, N. Chowdhury, Y. Son, J.S. Wu, P. Vaidya, and C.J. Meinrenken, “Life Cycle GHG Emission Comparison of Infant Nursing Using Breast Milk Versus Formula”, *Journal of Environmental Accounting and Management* 7(1), 2019
- S. Abroli, A. Mehmani, M. Kerman, C.J. Meinrenken, and P. Culligan, “Data-Enabled Building Energy Savings (D-E BES)”, *Proceedings of the IEEE, Vol. PP No. 99 (Special Issue on Smart Cities)*, 2018
- A. Mehmani, S. Chowdhury, C.J. Meinrenken, A. Messac, “Concurrent Surrogate Model Selection (COSMOS): Optimizing Model Type, Kernel Function, and Hyper-parameters”, *Structural and Multidisciplinary Optimization* 57 (doi.org/10.1007/s00158-017-1797-y), 2018
- M. Zheng, X. Wang, C.J. Meinrenken, and Y. Ding, Meinrenken, Yi Ding, “Economic and environmental benefits of coordinating dispatch among distributed electricity storage”, *Applied Energy* 210, 2018
- C. van der Giesen, C.J. Meinrenken, R. Kleijn, B. Sprecher, K.S. Lackner, and G.J. Kramer, “A Life Cycle Assessment Case Study of Coal-Fired Electricity Generation with Humidity Swing Direct Air Capture of CO<sub>2</sub> versus MEA-Based Postcombustion Capture”, *Environ. Sci. & Technology* 51, 2016
- K.S. Lackner and 45 co-authors, “The promise of negative emissions”, *Science* 354 (6313) Letter, 2016
- M. Zheng, C.J. Meinrenken, and K.S. Lackner, “Smart households: Dispatch strategies and economic analysis of distributed energy storage for residential peak shaving”, *Applied Energy* 147, 2015
- C.J. Meinrenken and K.S. Lackner, “Fleet view of electrified transportation reveals smaller potential to reduce GHG emissions”, *Applied Energy* 138, 2015

- C.J. Meinrenken and K.S. Lackner, "Options to dissociate CO<sub>2</sub> and H<sub>2</sub>O for sustainable sunlight-to-fuel pathways", *Journal of Natural Sciences* 2(2), 2014
- C.J. Meinrenken and K.S. Lackner, "Carbon hotspots in the food and beverage industry: Insights from analyzing the product portfolio of a global packaged consumer goods company", *Journal of Agriculture and Environmental Sciences* 3(4), 2014
- C.J. Meinrenken, A.N. Garvan, B. Sauerhaft, and K. S. Lackner, "Combining LCA with data science to inform portfolio-level value chain engineering: A case study at PepsiCo Inc.", *Journal of Industrial Ecology* 18(5), 2014  
\* Nominated for JIE Senior Author Best Paper Prize (2014)
- M. Zheng, C.J. Meinrenken, and K.S. Lackner, "Agent-based electricity consumption model to evaluate economic viability of tariff arbitrage for residential sector demand response", *Applied Energy* 126, 2014
- C.J. Meinrenken, S.M. Kaufmann, S. Ramesh, and K.S. Lackner, "Fast carbon footprinting for large product portfolios", *Journal of Industrial Ecology* 16(5), 2012
- L. Draucker, S.M. Kaufmann, R. ter Kuile, and C.J. Meinrenken, "Moving forward on product carbon footprinting", *Journal of Industrial Ecology* 15(2), 2011
- C.J. Meinrenken, J.G. Borst, and B. Sakmann, "Hodgkin-Huxley-Katz Prize: Local routes revisited: Fast Ca<sup>2+</sup> signal for phasic transmitter release at the Calyx of Held", *J. Physiol.*, 547.3, 2003  
\* Selected Reading in Eric Kandel et al.'s "Principles of Neural Science" (5<sup>th</sup> edition)
- C.J. Meinrenken, J.G. Borst, and B. Sakmann, "Calcium-secretion coupling at Calyx of Held governed by non-uniform channel-vesicle topography", *Journal of Neuroscience* 22, 2002
- W.D. Gillespie, C.J. Meinrenken, W.R. Lempert, and R.B. Miles, "Interbranch line-mixing in CO<sub>2</sub> (1001) and (0201) combination bands", *J. Chem. Phys.* 107(16), 1997
- C.J. Meinrenken, W.D. Gillespie, S. Macheret, W.R. Lempert, and R.B. Miles, "Time domain modeling of spectral collapse in high density molecular gases", *J. Chem. Phys.* 106(20), 1997

#### **Book chapters**

- L. Widder and C.J. Meinrenken, "Three Windows: Accounting for Embodied Resources and Cultural Value" in *Embodied Carbon*, R. Azari and A. Moncaster ed., Routledge (2023)
- A. Ciroth and C.J. Meinrenken, "Data quality in LCA" in *Environmental Life Cycle Assessment*, R. Schenck and P. White ed., American Center for Life Cycle Assessment (2014)

#### **Patents**

- *US Patent* #9524463 (*Appl.* #13/578,297), 2016, "Methods and Systems for Automating Carbon Footprinting", Columbia University currently licenses the IP rights to a software company
- *US Patent Appl.* #14/001.776, 2014, "Methods and Systems for Converting Gaseous Hydrocarbons to Synthesis Gas"

#### **Published reports/conference proceedings/white papers (selection)**

- G. Leonard, V. Francois-Lavet, E. Damien, C.J. Meinrenken, K. S. Lackner, "Electricity storage with liquid fuels in a zone powered by 100% variable renewables", 12<sup>th</sup> International Conference on the European Energy Market (2015)

- M. Zheng and C.J. Meinrenken, "Electricity storage in buildings for residential sector demand response: [...]", NIST General Contractor's Report NIST.GCR.14-978 (2014)
- C.J. Meinrenken, S. Ramesh, K. S. Lackner, "Fast carbon footprinting and management for large companies", *Proceedings of ELCAS-2 Exergy, LCA, and Sustainability*, Greece (2011)
- K.S. Lackner, C.J. Meinrenken, E. Dahlgren, C. Graves, & T. Socci, "Closing the Carbon Cycle: Liquid Fuels from Air, Water and Sunshine", *White Paper, Lenfest Center for Sustainable Energy* (2010)
- S. Macheret, C.J. Meinrenken, G. Williams, W. Gillespie, W. Lempert, and R. Miles, "Radiative energy addition to high pressure supersonic air", *27th AIAA Fluid Dynamics Conference*, 1996

#### Published abstracts (selection)

- C.J. Meinrenken, "Two years after Covid-19 first hit, the City that never sleeps is back to waking up early", *Bulletin of the American Physical Society* (2023/03/20), 2023
- L. Widder and C.J. Meinrenken, "Three Windows – Carbon embodied in historical buildings and implications for retrofitting", *Gordon Research Conference (Industrial Ecology) [poster]*, 2022
- C.J. Meinrenken et al., "Does Providing Household Residents with Usage Information Prompt Reductions?", *Behavior, Energy, and Climate Change (BECC) Conference [poster]*, 2021
- S. Wang, C.J. Meinrenken, W.R. McGillis, G. Yetman, P.J. Culligan, "Characterizing the impacts of green infrastructure in reducing CSO in New York City based on water data", *AGU Fall Meeting Abstracts (H13I-1797)*, 2019
- E. Komita Moussa, M. Miley, B.J. Mailloux, P.J. Culligan, C.J. Meinrenken, T. Maenza-Gmelch, C. McGillis, "Determination of Growth Rates for New York City Street Trees", *AGU Fall Meeting Abstracts (H13I-1790)*, 2019
- C.J. Meinrenken, "Greenhouse gas (GHG) emissions embedded in consumer and commercial products", *Bulletin of the American Physical Society* (2019/4/13), 2019
- C.J. Meinrenken, C. van der Giesen, J. Schulz, R. Kleijn, "Life cycle environmental impact of humidity-swing direct air carbon capture using desalinated seawater", *Bulletin of the American Physical Society (APRF011065)*, 2018
- C.J. Meinrenken, "Direct air capture versus post combustion capture for coal fired power plants: Energy balance and life cycle environmental assessment", *CO<sub>2</sub> Summit II: Technologies and Opportunities - ECI Symposium Series* (2016)
- C.J. Meinrenken, "Energy requirements for CO<sub>2</sub> capture from ambient air (DAC) competitive with capture from flue-gas (PCC)", pres. S34.1, *Bulletin of the American Physical Society* 60(2) (2015)
- C.J. Meinrenken and K.S. Lackner, "Electrification of the transportation sector offers limited country-wide greenhouse gas reductions", pres. M22.1, *Bulletin of the American Physical Society* 59(1) (2014)
- M. Zheng and C.J. Meinrenken, "Electricity demand and storage dispatch modeling for buildings and implications for the smartgrid", pres. Q15.2, *Bulletin of the American Physical Society* 58(1) (2013)
- C.J. Meinrenken, A.N. Garvan, and K.S. Lackner, "Fast LCA to apply life cycle methodologies and supply chain management at scale", pres. *International Society of Industrial Ecology*, South Korea (2013)
- C.J. Meinrenken and K.S. Lackner, "Gasoline-powered series hybrid cars cause lower life cycle carbon emissions than battery cars", pres. D33.12, *Bulletin of the American Physical Society* 57(1) (2012)
- C.J. Meinrenken, A.N. Garvan, and K.S. Lackner, "Mass-produced product carbon footprints to facilitate business decisions & LCA education in large companies", pres. *LCAXII*, Chicago (2012)

- C.J. Meinrenken and K.S. Lackner, “Of Volts & Leaves: Apples vs. oranges effects distort relative benefits of grid-electricity vs. gasoline powered vehicles“, pres. *ISDRC17*, New York (2011)