



Mark Z. Jacobson

Professor of Civil and Environmental Engineering and Senior Fellow at the Woods Institute for the Environment

Bio

BIO

Mark Z. Jacobson's career has focused on better understanding air pollution and global warming problems and developing large-scale clean, renewable energy solutions to them. Toward that end, he has developed and applied three-dimensional atmosphere-biosphere-ocean computer models and solvers to simulate air pollution, weather, climate, and renewable energy. He has also developed roadmaps to transition states and countries to 100% clean, renewable energy for all purposes and computer models to examine grid stability in the presence of high penetrations of renewable energy.

ACADEMIC APPOINTMENTS

- Professor, Civil and Environmental Engineering
- Senior Fellow, Stanford Woods Institute for the Environment

ADMINISTRATIVE APPOINTMENTS

- Director, Atmosphere/Energy Program, Department of Civil and Environmental Engineering, (2004- present)

HONORS AND AWARDS

- Top 100 people globally who "have made the most significant impact on the world this year", Worth Magazine, "Worthy 100" (2023)
- #1 most impactful scientist in world in Meteorology & Atmos Sci among those 1st publishing past 1985, Ioannidis, JPA, Mendeley Data, V4, doi: 10.17632/btchxktyw.4 (2022)
- #6 most impactful scientist in world in Energy among those 1st publishing past 1980, Ioannidis, JPA, Mendeley Data, V4, doi: 10.17632/btchxktyw.4 (2022)
- World Visionary CleanTech Influencer of the Year, CleanTech Business Club (2022)
- World's 100 most influential people in climate policy, Apolitical (2019, 2022)
- #1 academic influencer worldwide on smart grids, Onalytica (2019)
- #2 sustainability influencer worldwide on environmental sustainability, Onalytica (2019)
- All-electric showcase award, Silicon Valley Clean Energy (2019)
- Judi Friedman Lifetime Achievement Award, People's Action for Clean Energy (PACE) (2018)
- Cozzarelli Prize, National Academy of Sciences (2016)
- Grist50, Innovators, organizers, and visionaries who will lead us toward a more sustainable future, Grist (2016)
- Ascent Award, American Geophysical Union (2013)
- Atlas Award Honoring Climate Heroes, Atlas Awards (2013)
- Editors' Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres (2013)
- Global Green Policy Design Award, Global Green (2013)

- Partial share of the 2007 Nobel Peace Prize as a research contributor and reviewer for IPCC, Norwegian Nobel Committee (2007)
- Editors' Citation for Excellence in Refereeing, Journal of Geophysical Research-Atmospheres (2005)
- Henry G. Houghton Award, American Meteorological Society (2005)
- New Investigator Award, NASA (1999-2002)
- Career Early Development Award, National Science Foundation (1995-1998)

PROFESSIONAL EDUCATION

- PhD, University of California, Los Angeles , Atmospheric Sciences (1994)
- MS, University of California, Los Angeles , Atmospheric Sciences (1991)
- MS, Stanford University , Environmental Engineering (1988)
- BS, Stanford University , Civil Engineering (1988)
- BA, Stanford University , Economics (1988)

LINKS

- <https://web.stanford.edu/group/efmh/jacobson/>: <https://web.stanford.edu/group/efmh/jacobson/>

Teaching

COURSES

2024-25

- 100% Clean, Renewable Energy and Storage for Everything: CEE 176B, CEE 276B (Spr)
- Atmosphere/Energy Seminar: CEE 263S (Win, Spr)
- Weather and Storms: CEE 263C, CEE 63 (Win)

2023-24

- 100% Clean, Renewable Energy and Storage for Everything: CEE 176B, CEE 276B (Spr)
- Air Pollution and Global Warming: History, Science, and Solutions: CEE 263D, CEE 64 (Win)
- Atmosphere/Energy Seminar: CEE 263S (Aut, Win, Spr)
- Weather and Storms: CEE 263C, CEE 63 (Aut)

2022-23

- 100% Clean, Renewable Energy and Storage for Everything: CEE 176B, CEE 276B (Spr)
- Air Pollution and Global Warming: History, Science, and Solutions: CEE 263D, CEE 64 (Win)
- Atmosphere/Energy Seminar: CEE 263S (Aut, Win, Spr)
- Weather and Storms: CEE 263C, CEE 63 (Aut)

2021-22

- 100% Clean, Renewable Energy and Storage for Everything: CEE 176B, CEE 276B (Spr)
- Air Pollution and Global Warming: History, Science, and Solutions: CEE 263D, CEE 64 (Win)
- Atmosphere/Energy Seminar: CEE 263S (Aut, Win, Spr)
- Weather and Storms: CEE 263C, CEE 63 (Aut)

STANFORD ADVISEES

Postdoctoral Faculty Sponsor

Dan Sambor

Master's Program Advisor

Mary Boyer, Anna Edmonds, Bryana Gastelum, Ruby Gates, Katrina Hagedorn, Iris Hwang, Tom-Eliot Jullien, Bryan Kendall, Paul Lesur, Hannah Lipman, Adelya Makhankova, Zachary Meyer

Doctoral Dissertation Co-Advisor (AC)

Kirat Singh

Doctoral (Program)

Fred Fan, Andreas Mühlbauer

Publications

PUBLICATIONS

- **Effects of firebricks for industrial process heat on the cost of matching all-sector energy demand with 100% wind-water-solar supply in 149 countries.** *PNAS nexus*
Jacobson, M. Z., Sambor, D. J., Fan, Y. F., Mühlbauer, A.
2024; 3 (7): pgae274
- **Batteries or hydrogen or both for grid electricity storage upon full electrification of 145 countries with wind-water-solar?** *iScience*
Jacobson, M. Z.
2024; 27 (2): 108988
- **Particulate Filters for Combustion Engines to Mitigate Global Warming. Estimating the Effects of a Highly Efficient but Underutilized Tool** *EMISSION CONTROL SCIENCE AND TECHNOLOGY*
Mayer, A. R., Mayer, J., Wyser, M., Legerer, F., Czerwinski, J., Lutz, T. W., Johnson, T. V., Jacobson, M. Z.
2024
- **"Impacts of green hydrogen for steel, ammonia, and long-distance transport on the cost of meeting electricity, heat, cold, and hydrogen demand in 145 countries running on 100% wind-water-solar"(vol 11, 100106, 2023)** *SMART ENERGY*
Jacobson, M. Z., von Krauland, A., Song, K., Krull, A. N.
2023; 12
- **Should Transportation Be Transitioned to Ethanol with Carbon Capture and Pipelines or Electricity? A Case Study.** *Environmental science & technology*
Jacobson, M. Z.
2023
- **United States offshore wind energy atlas: availability, potential, and economic insights based on wind speeds at different altitudes and thresholds and policy-informed exclusions** *ENERGY CONVERSION AND MANAGEMENT-X*
von Krauland, A., Long, Q., Enevoldsen, P., Jacobson, M. Z.
2023; 20
- **Impacts of green hydrogen for steel, ammonia, and long-distance transport on the cost of meeting electricity, heat, cold, and hydrogen demand in 145 countries running on 100% wind-water-solar** *SMART ENERGY*
Jacobson, M. Z., von Krauland, A., Song, K., Krull, A. N.
2023; 11
- **Energy optimization of a food-energy-water microgrid living laboratory in Yukon, Canada** *ENERGY NEXUS*
Sambor, D. J., Penn, H., Jacobson, M. Z.
2023; 10
- **No miracle required** *NEW SCIENTIST*
Jacobson, M.
2023; 246 (3426): 27
- **Reply to the 'Comment on "Low-cost solutions to global warming, air pollution, and energy security for 145 countries"'** *ENERGY & ENVIRONMENTAL SCIENCE*
Jacobson, M. Z., von Krauland, A., Coughlin, S. J., Dukas, E., Nelson, A. H., Palmer, F. C., Rasmussen, K. R.

2023

- **Toward battery electric and hydrogen fuel cell military vehicles for land, air, and sea** *ENERGY*
Katalenich, S. M., Jacobson, M. Z.
2022; 254
- **Low-cost solutions to global warming, air pollution, and energy insecurity for 145 countries** *ENERGY & ENVIRONMENTAL SCIENCE*
Jacobson, M. Z., von Krauland, A., Coughlin, S. J., Dukas, E., Nelson, A. H., Palmer, F. C., Rasmussen, K. R.
2022
- **Reply to comment on "How Green is Blue Hydrogen?"** *ENERGY SCIENCE & ENGINEERING*
Howarth, R. W., Jacobson, M. Z.
2022
- **Optimizing demand response of a modular water reuse system in a remote Arctic microgrid** *JOURNAL OF CLEANER PRODUCTION*
Sambor, D. J., Bishop, S. M., Dotson, A., Aggarwal, S., Jacobson, M. Z.
2022; 346
- **Zero air pollution and zero carbon from all energy at low cost and without blackouts in variable weather throughout the US with 100% wind-water-solar and storage** *RENEWABLE ENERGY*
Jacobson, M. Z., von Krauland, A., Coughlin, S. J., Palmer, F. C., Smith, M. M.
2022; 184: 430-442
- **On the History and Future of 100% Renewable Energy Systems Research** *IEEE ACCESS*
Breyer, C., Khalili, S., Bogdanov, D., Ram, M., Oyewo, A., Aghahosseini, A., Gulagi, A., Solomon, A. A., Keiner, D., Lopez, G., Ostergaard, P., Lund, H., Mathiesen, et al
2022; 10: 78176-78218
- **The cost of grid stability with 100 % clean, renewable energy for all purposes when countries are isolated versus interconnected** *RENEWABLE ENERGY*
Jacobson, M. Z.
2021; 179: 1065-1075
- **Renewable energy and energy storage to offset diesel generators at expeditionary contingency bases** *JOURNAL OF DEFENSE MODELING AND SIMULATION-APPLICATIONS METHODOLOGY TECHNOLOGY-JDMS*
Katalenich, S. M., Jacobson, M. Z.
2021
- **How green is blue hydrogen?** *ENERGY SCIENCE & ENGINEERING*
Howarth, R. W., Jacobson, M. Z.
2021
- **On the socio-technical potential for onshore wind in Europe: A response to critics** *ENERGY POLICY*
Enevoldsen, P., Permien, F., Bakhtaoui, I., Von Krauland, A., Jacobson, M. Z., Xydis, G., Sovacool, B. K., Valentine, S. V., Luecht, D., Oxley, G.
2021; 151
- **Data investigation of installed and output power densities of onshore and offshore wind turbines worldwide** *ENERGY FOR SUSTAINABLE DEVELOPMENT*
Enevoldsen, P., Jacobson, M. Z.
2021; 60
- **On the correlation between building heat demand and wind energy supply and how it helps to avoid blackouts** *SMART ENERGY*
Jacobson, M. Z.
2021; 1: 100009
- **Development of a Tool for Optimizing Solar and Battery Storage for Container Farming in a Remote Arctic Microgrid** *ENERGIES*
Sambor, D. J., Wilber, M., Whitney, E., Jacobson, M. Z.
2020; 13 (19)
- **Transitioning All Energy in 74 Metropolitan Areas, Including 30 Megacities, to 100% Clean and Renewable Wind, Water, and Sunlight (WWS)** *ENERGIES*

- Jacobson, M. Z., von Krauland, A., Burton, Z. M., Coughlin, S. J., Jaeggli, C., Nelli, D., Nelson, A. H., Shu, Y., Smith, M., Tan, C., Wood, C. D., Wood, K. D.
2020; 13 (18)
- **Optimizing the layout of onshore wind farms to minimize noise** *APPLIED ENERGY*
Wu, X., Hu, W., Huang, Q., Chen, C., Jacobson, M. Z., Chen, Z.
2020; 267
 - **How much wind power potential does Europe have? Examining European wind power potential with an enhanced socio-technical atlas (vol 132, pg 1092, 2019)** *ENERGY POLICY*
Enevoldsen, P., Permien, F., Bakhtaoui, I., von Krauland, A., Jacobson, M. Z., Xydis, G., Sovacool, B. K., Valentine, S. V., Luecht, D., Oxley, G.
2020; 138
 - **Optimal operational strategy for an offgrid hybrid hydrogen/electricity refueling station powered by solar photovoltaics** *JOURNAL OF POWER SOURCES*
Xu, X., Hu, W., Cao, D., Huang, Q., Liu, W., Jacobson, M. Z., Chen, Z.
2020; 451: 227810
 - **Co-optimized trading of hybrid wind power plant with retired EV batteries in energy and reserve markets under uncertainties** *ELECTRICAL POWER AND ENERGY SYSTEMS*
Zhan, S., Hou, P., Enevoldsen, P., Yang, G., Zhu, J., Eichman, J., Jacobson, M. Z.
2020; 117: 105631
 - **The health and climate impacts of carbon capture and direct air capture** *ENERGY & ENVIRONMENTAL SCIENCE*
Jacobson, M. Z.
2019; 12 (12): 3567–74
 - **How much wind power potential does europe have? Examining european wind power potential with an enhanced socio-technical atlas** *ENERGY POLICY*
Enevoldsen, P., Permien, F., Bakhtaoui, I., von Krauland, A., Jacobson, M. Z., Xydis, G., Sovacool, B. K., Valentine, S. V., Luecht, D., Oxley, G.
2019; 132: 1092–1100
 - **Short-Term Impacts of the Aliso Canyon Natural Gas Blowout on Weather, Climate, Air Quality, and Health in California and Los Angeles** *ENVIRONMENTAL SCIENCE & TECHNOLOGY*
Jacobson, M. Z.
2019; 53 (10): 6081–93
 - **Short-Term Impacts of the Megaurbanizations of New Delhi and Los Angeles Between 2000 and 2009** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
Jacobson, M. Z., Nghiem, S. V., Sorichetta, A.
2019; 124 (1): 35–56
 - **Impacts of Green New Deal energy plans on grid stability, costs, jobs, health, and climate in 143 countries** *ONE EARTH*
Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., Coughlin, S. J., Hay, C., Manogaran, I. P., Shu, Y., von Krauland, A.
2019; 1: 449-463
 - **Carbon emissions and costs associated with subsidizing New York nuclear instead of replacing it with renewables** *JOURNAL OF CLEANER PRODUCTION*
Cebulla, F., Jacobson, M. Z.
2018; 205: 884–94
 - **100% clean and renewable Wind, Water, and Sunlight (WWS) all-sector energy roadmaps for 53 towns and cities in North America** *SUSTAINABLE CITIES AND SOCIETY*
Jacobson, M. Z., Cameron, M. A., Hennessy, E. M., Petkov, I., Meyer, C. B., Gambhira, T. K., Maki, A. T., Pflieger, K., Clonts, H., McEvoy, A. L., Miccioli, M. L., von Krauland, A., Fang, et al
2018; 42: 22–37
 - **Matching demand with supply at low cost in 139 countries among 20 world regions with 100% intermittent wind, water, and sunlight (WWS) for all purposes** *RENEWABLE ENERGY*
Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., Mathiesen, B. V.
2018; 123: 236–48

- **World estimates of PV optimal tilt angles and ratios of sunlight incident upon tilted and tracked PV panels relative to horizontal panels** *SOLAR ENERGY*
Jacobson, M. Z., Jadhav, V.
2018; 169: 55–66
- **Roadmaps to Transition Countries to 100% Clean, Renewable Energy for All Purposes to Curtail Global Warming, Air Pollution, and Energy Risk** *EARTHS FUTURE*
Jacobson, M. Z.
2017; 5 (10): 948–52
- **The United States can keep the grid stable at low cost with 100% clean, renewable energy in all sectors despite inaccurate claims.** *Proceedings of the National Academy of Sciences of the United States of America*
Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., Frew, B. A.
2017; 114 (26): E5021-E5023
- **100% Clean and renewable wind, water, and sunlight all-sector energy roadmaps for 139 countries of the world** *JOULE*
Jacobson, M. Z., Delucchi, M. A., Bauer, Z. A., Goodman, S. C., Chapman, W. E., Cameron, M. A., et al
2017; 1 (1): 108-121
- **Optimizing investments in coupled offshore wind-electrolytic hydrogen storage systems in Denmark** *J. Power Sources*
Hou, P., Enevoldsen, P., Eichman, J., Hu, W., Jacobson, M. Z., Chen, Z.
2017; 359: 186-197
- **An intercomparative study of the effects of aircraft emissions on surface air quality** *JOURNAL OF GEOPHYSICAL RESEARCH: ATMOSPHERES*
Cameron, M. A., Jacobson, M. Z., Barrett, S. R., Bian, H., Chen, C. C., Eastham, S. D., Gettelman, A., Khodayari, A., Liang, Q., Selkirk, H. B., Unger, N., Wuebbles, D. J., Yue, et al
2017; 122 (15): 8325-8344
- **Temporal and spatial tradeoffs in power system modeling with assumptions about storage: An application of the POWER model** *ENERGY*
Frew, B. A., Jacobson, M. Z.
2016; 117: 198-213
- **Reply to Bistline and Blanford: Letter reaffirms conclusions and highlights flaws in previous research.** *Proceedings of the National Academy of Sciences of the United States of America*
Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., Frew, B. A.
2016; 113 (28): E3989-90
- **Flexibility mechanisms and pathways to a highly renewable US electricity future** *ENERGY*
Frew, B. A., Becker, S., Dvorak, M. J., Andresen, G. B., Jacobson, M. Z.
2016; 101: 65-78
- **IMPACT OF AVIATION ON CLIMATE FAA's Aviation Climate Change Research Initiative (ACCRI) Phase II** *BULLETIN OF THE AMERICAN METEOROLOGICAL SOCIETY*
Brasseur, G. P., Gupta, M., Anderson, B. E., Balasubramanian, S., Barrett, S., Duda, D., Fleming, G., Forster, P. M., Fuglestvedt, J., Gettelman, A., Halthore, R. N., Jacob, S. D., Jacobson, et al
2016; 97 (4): 561-583
- **A 100% wind, water, sunlight (WWS) all-sector energy plan for Washington State** *RENEWABLE ENERGY*
Jacobson, M. Z., Delucchi, M. A., Bazouin, G., Dvorak, M. J., Arghandeh, R., Bauer, Z. A., Cotte, A., de Moor, G. M., Goldner, E. G., Heier, C., Holmes, R. T., Hughes, S. A., Jin, et al
2016; 86: 75-88
- **Low-cost solution to the grid reliability problem with 100% penetration of intermittent wind, water, and solar for all purposes** *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA*
Jacobson, M. Z., Delucchi, M. A., Cameron, M. A., Frew, B. A.
2015; 112 (49): 15060-15065
- **Comparison of low-carbon pathways for California** *CLIMATIC CHANGE*
Morrison, G. M., Yeh, S., Eggert, A. R., Yang, C., Nelson, J. H., Greenblatt, J. B., Isaac, R., Jacobson, M. Z., Johnston, J., Kammen, D. M., Mileva, A., Moore, J., Roland-Holst, et al

2015; 131 (4): 545-557

- **Ring of impact from the mega-urbanization of Beijing between 2000 and 2009** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
Jacobson, M. Z., Nghiem, S. V., Sorichetta, A., Whitney, N.
2015; 120 (12): 5740-5756
- **Ocean Acidification Science Needs for Natural Resource Managers of the North American West Coast** *OCEANOGRAPHY*
Boehm, A. B., Jacobson, M. Z., O'Donnell, M. J., Sutula, M., Wakefield, W. W., Weisberg, S. B., Whiteman, E.
2015; 28 (2): 170-181
- **Renewable build-up pathways for the US: Generation costs are not system costs** *ENERGY*
Becker, S., Frew, B. A., Andresen, G. B., Jacobson, M. Z., Schramm, S., Greiner, M.
2015; 81: 437-445
- **100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States** *ENERGY & ENVIRONMENTAL SCIENCE*
Jacobson, M. Z., Delucchi, M. A., Bazouin, G., Bauer, Z. A., Heavey, C. C., Fisher, E., Morris, S. B., Piekutowski, D. J., Vencill, T. A., Yeskoo, T. W.
2015; 8 (7): 2093-2117
- **Variability and uncertainty of wind power in the California electric power system** *WIND ENERGY*
Stoutenburg, E. D., Jenkins, N., Jacobson, M. Z.
2014; 17 (9): 1411-1424
- **A roadmap for repowering California for all purposes with wind, water, and sunlight** *ENERGY*
Jacobson, M. Z., Delucchi, M. A., Ingraffea, A. R., Howarth, R. W., Bazouin, G., Bridgeland, B., Burkart, K., Chang, M., Chowdhury, N., Cook, R., Escher, G., Galka, M., Han, et al
2014; 73: 875-889
- **Features of a fully renewable US electricity system: Optimized mixes of wind and solar PV and transmission grid extensions** *ENERGY*
Becker, S., Frew, B. A., Andresen, G. B., Zeyer, T., Schramm, S., Greiner, M., Jacobson, M. Z.
2014; 72: 443-458
- **Effects of biomass burning on climate, accounting for heat and moisture fluxes, black and brown carbon, and cloud absorption effects** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
Jacobson, M. Z.
2014; 119 (14): 8980-9002
- **Taming hurricanes with arrays of offshore wind turbines** *NATURE CLIMATE CHANGE*
Jacobson, M. Z., Archer, C. L., Kempton, A.
2014; 4 (3): 195-200
- **Comparison of model estimates of the effects of aviation emissions on atmospheric ozone and methane** *J. Geophys. Res.*
Olsen, S. C., Brasseur, G. P., Wuebbles, D. J., Barrett, S. R.H., Dang, H., Eastham, S. D., Jacobson, M. Z.
2014; 40: 6004-6009
- **Effects of plume versus grid-scale treatment of aircraft exhaust photochemistry** *Geophys. Res. Lett.*
Cameron, M. A., Jacobson, M. Z., Naiman, A. D., Lele, S. K.
2014; 40: 5815-5820
- **Geographical and seasonal variability of the global "practical" wind resources** *APPLIED GEOGRAPHY*
Archer, C. L., Jacobson, M. Z.
2013; 45: 119-130
- **Comparison of model estimates of the effects of aviation emissions on atmospheric ozone and methane** *GEOPHYSICAL RESEARCH LETTERS*
Olsen, S. C., Brasseur, G. P., Wuebbles, D. J., Barrett, S. R., Dang, H., Eastham, S. D., Jacobson, M. Z., Khodayari, A., Selkirk, H., Sokolov, A., Unger, N.
2013; 40 (22): 6004-6009
- **Effects of plume-scale versus grid-scale treatment of aircraft exhaust photochemistry** *GEOPHYSICAL RESEARCH LETTERS*
Cameron, M. A., Jacobson, M. Z., Naiman, A. D., Lele, S. K.

2013; 40 (21): 5815-5820

- **Response to comment on paper examining the feasibility of changing New York state's energy infrastructure to one derived from wind, water, and sunlight** *ENERGY POLICY*
Jacobson, M. Z., Howarth, R. W., Delucchi, M. A., Scobie, S. R., Barth, J. M., Dvorak, M. J., Klevze, M., Katkhuda, H., Miranda, B., Chowdhury, N. A., Jones, R., Plano, L., Ingraffea, et al
2013; 62: 1212-1215
- **US East Coast offshore wind energy resources and their relationship to peak-time electricity demand** *WIND ENERGY*
Dvorak, M. J., Corcoran, B. A., Ten Hoeve, J. E., McIntyre, N. G., Jacobson, M. Z.
2013; 16 (7): 977-997
- **Meeting the world's energy needs entirely with wind, water, and solar power** *BULLETIN OF THE ATOMIC SCIENTISTS*
Delucchi, M. A., Jacobson, M. Z.
2013; 69 (4): 30-40
- **Bounding the role of black carbon in the climate system: A scientific assessment** *JOURNAL OF GEOPHYSICAL RESEARCH-ATMOSPHERES*
Bond, T. C., Doherty, S. J., Fahey, D. W., Forster, P. M., Berntsen, T., DeAngelo, B. J., Flanner, M. G., Ghan, S., Kaercher, B., Koch, D., Kinne, S., Kondo, Y., Quinn, et al
2013; 118 (11): 5380-5552
- **Response to Trainer's second commentary on a plan to power the world with wind, water, and solar power** *ENERGY POLICY*
Jacobson, M. Z., Delucchi, M. A.
2013; 57: 641-643
- **Examining the feasibility of converting New York State's all-purpose energy infrastructure to one using wind, water, and sunlight** *ENERGY POLICY*
Jacobson, M. Z., Howarth, R. W., Delucchi, M. A., Scobie, S. R., Barth, J. M., Dvorak, M. J., Klevze, M., Katkhuda, H., Miranda, B., Chowdhury, N. A., Jones, R., Plano, L., Ingraffea, et al
2013; 57: 585-601
- **Comment on "Radiative Absorption Enhancements Due to the Mixing State of Atmospheric Black Carbon"** *SCIENCE*
Jacobson, M. Z.
2013; 339 (6118)
- **Measuring and modeling the hygroscopic growth of two humic substances in mixed aerosol particles of atmospheric relevance** *ATMOSPHERIC CHEMISTRY AND PHYSICS*
Zamora, I. R., Jacobson, M. Z.
2013; 13 (17): 8973-8989
- **The effects of aircraft on climate and pollution. Part II: 20-year impacts of exhaust from all commercial aircraft worldwide treated individually at the subgrid scale.** *Faraday discussions*
Jacobson, M. Z., Wilkerson, J. T., Naiman, A. D., Lele, S. K.
2013; 165: 369-382
- **Roadmaps for powering the world, U.S., and individual states for all purposes with wind, water, and sunlight, U015.**
Jacobson, M., Z.
2013
- **Effects of aviation on global climate, Aviation Emissions Characterization Roadmap**
Jacobson, M., Z.
2013
- **Taming hurricanes with arrays of offshore wind turbines**
Jacobson, M., Z.
2013
- **The effects of aircraft on climate and pollution. Part II: 20-year impacts of exhaust from all commercial aircraft worldwide treated individually at the subgrid scale** *Faraday Discussions*
Jacobson, M., Z., Wilkerson, J., T., Naiman, A., D., Lele, S., K.

2013

- **Powering individual states, countries, and the world with WWS**
Jacobson, M., Z.
2013
- **Powering the world, the U.S., and individual states with wind, water, and sunlight**
Jacobson, M., Z.
2013
- **Carbon dioxide domes, effects of cross-polar flights, and taming hurricanes with offshore wind**
Jacobson, M., Z.
2013
- **Examining the feasibility of converting New York State's all-purpose energy infrastructure to one using wind, water, and sunlight** *Energy Policy*
Jacobson, M., Z., Howarth, R., W., Delucchi, M., A., Scobies, S., R., Barth, J., M., Dvorak, M., J.
2013; 57: 585-601
- **Assessing the impact of aviation on climate**
Jacobson, M., Z.
2013
- **Powering New York State with Wind**
Jacobson, M., Z.
2013
- **The Future of Energy**
Jacobson, M., Z.
2013
- **Powering the states, the U.S., and world for all purposes with wind, water, and sunlight**
Jacobson, M., Z.
2013
- **The natural gas goldrush and the future of renewables**
Jacobson, M., Z.
2013
- **Roadmaps for powering the world, U.S., and individual states for all purposes with wind, water, and sunlight**
Jacobson, M., Z.
2013
- **Powering individual states and the world with wind, water, and sunlight**
Jacobson, M., Z.
2013
- **Effects of aviation on surface air quality**
Jacobson, M., Z.
2013
- **Interview**
Jacobson, M., Z.
2013
- **Roadmaps to power California and the world with wind, water, and the sun**
Jacobson, M., Z.
2013
- **A plan to power the world for all purposes with wind, water, and the sun**
Jacobson, M., Z.

2013

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