

Dr. S. Julio Friedmann

Leadership in global strategy and vision in clean-energy technology RD&D and analysis.
Accomplishment and strong management in government, academia, and industry.
Partnership in the research, industrial, financial, and policy communities in the U.S.
International leadership in clean energy & climate (specialty in China, Australia & Middle East).

MAJOR PROFESSIONAL EXPERIENCE

Senior Scientist & Head Carbon Wrangler, (2022-pres) Carbon Direct

New company dedicated to creating new CO₂ removal projects and companies while providing CO₂ removal services to public and private customers. <https://carbon-direct.com>

Senior Research Scholar (2018-2021) Center for Global Energy Policy, Columbia Univ.

Leading a new team and new effort, the Carbon Management Research Initiative (CaMRI), focused on creating new knowledge, scholarship, ideas, and partnerships around CCS, CO₂ use, and CO₂ removal as a climate and energy solution. Grew from 1 person to 16 people and from zero budget to \$6M budget in three years. <https://energypolicy.columbia.edu/our-work/topics/carbon-management-research-initiative>

CEO and President, (2017-pres) Carbon Wrangler, LLC

New company dedicated to helping others achieve deep decarbonization through application of advanced technology, practice, and project execution.

Distinguished Associate (2017-2020) Energy Futures Initiative

Providing new scholarship and insight on large-scale carbon management and deep-decarbonization: <https://energyfuturesinitiative.org>

Senior Advisor for Energy Innovation (2016-2017) Lawrence Livermore Natl. Laboratory

New position in Lab Director's Office: to develop and execute strategy around LLNL's entire clean energy and environment enterprise

Principal Deputy Asst. Secretary (2014-2016) Office of Fossil Energy (FE), U.S. DOE

Planned, budgeted and executed ~\$630M fossil energy R&D program: grew budget >\$150M in 3 years. Managed team of >130 technical and administrative staff, including the Strategic Petroleum Reserve. Provided direction and oversight to National Energy Technology Lab (~500 staff; \$1B budget). Liaised with White House, Congress, and other federal agencies on RD&D and energy issues, including policy support and development for science, technology, and finance of clean energy and climate. Led successful efforts to kick-start large-scale CCUS efforts in the US, China, and other countries. Expert on China energy system, companies, policy, and government functions. Served on executive committee and support RD&D across the >\$6 billion Office of Science and Energy, including cross-cutting effort on energy-water, subsurface science, and advanced materials. Advised the Secretary and Deputy Secretary of Energy on technology, science, policy and international affairs related to clean energy technology, energy infrastructure, and climate change.

Deputy Asst. Secretary for Clean Coal and Carbon Management (2013-2014), U.S. DOE

Planned and executed ~\$400M energy research program across FE: successfully grew budget >\$80M. Managed team of ~30 technical and administrative staff, including budget process. Liaised with White House, Congress, and other federal agencies on RD&D and energy issues, including policy support and development for science, technology, and finance of clean energy. Led successful efforts to develop new RD&D programs, including \$130M subsurface science initiative.

Coordinated and partnered with Offices of Energy Efficiency & Renewable Energy and Nuclear Energy. Served on executive steering committee for the >\$6 billion Office of Science and Energy.

Chief Energy Technologist (2011-2013) Lawrence Livermore Natl. Lab, Livermore, CA

*Coordinated and managed the ~\$60M energy research program across LLNL.
Served as primary business, governmental, and media interface on energy issues.
Co-Led a successful \$150M initiative in smart grid tech. development and deployment with CA utilities.
Helping lead new programs in shale gas, renewable integration, and advanced computing for energy.*

Director, Carbon Management Program (2003 – 2011) LLNL, Livermore, CA

*Built a >\$15 million dollar research program in 5 years.
Engaged LLNL in five commercial CCS projects (Weyburn, In Salah, Snohvit, Shenhua, Cranfield)
Managed research staff of >40 investigators
Technical Leader, US-China Clean Energy Research Center (CERC) for Coal and CCUS*

Assistant Research Scientist (2001-2004) University of Maryland, College Park

Award: Best Lecturer, 2003

Sr. Research Geol. (1998-2000) ExxonMobil Upstream Research Co., Houston

Research Geologist (1996-1998) Exxon Production Research Co., Houston

EDUCATION

<u>Ph.D.</u>	<u>Univ. of Southern California</u>	<u>(1995)</u>
<u>M.S.</u>	<u>Massachusetts Institute of Technology</u>	<u>(1990)</u>
<u>B.S.</u>	<u>Massachusetts Institute of Technology</u>	<u>(1988)</u>

AWARDS

Greenman Award (IEA): Significant contributions for CO₂ removal, storage, and utilization (2016)

CONGRESSIONAL TESTIMONY

Congressional testimony, House Science, Space, and Technology committee, Feb 2022
Congressional testimony, Senate Energy and Natural Resources (full committee), July 2020
Congressional testimony, House Energy and Commerce Committee (full committee), Sept. 2019
Congressional testimony, Senate Energy and Natural Resources (full committee), May. 2019
Congressional testimony, Senate Committee on Environment & Public Works, March. 2018
Congressional testimony, Senate Committee on Environment & Public Works, Nov. 2017
Congressional testimony, House Committee on Appropriations, oversight sub-committee, Feb. 2014

SELECT RECENT PUBLICATIONS

Fan Z., Sheerazi H., Bhardwaj A, Corbeau A-S, Longobardi K, Woodall C., Agrawal M, **Friedmann S.J.**, Castañeda, A, Merz A-K, Orozco-Sanchez, S., 2022, Hydrogen leakage: A potential risk for the hydrogen economy, Center on Global Energy Policy Commentary, <https://www.energypolicy.columbia.edu/research/commentary/hydrogen-leakage-potential-risk-hydrogen-economy>

DeFries, R. Ahuja R., **Friedmann, S.J.**, and 6 others, 2022, Land management can contribute to net-zero, Science, v. 376, Issue6598, pp. 1163-1165, <https://www.science.org/doi/10.1126/science.abo0613>

Friedmann, S.J, Maas, W., McCormick, C., Bushman, T., 2022, On the IPCC AR6 WGIII Report: Why Carbon Removal is an Essential Part to Meeting Climate Goals, Commentary, Carbon Direct.

<https://carbon-direct.com/2022/04/ipcc-why-carbon-removal-is-an-essential-part-of-meeting-climate-goals/>

Friedmann, S.J., 2022, Congressional testimony, House Science, Space, and Technology committee, Energy subcommittee, Hearing on hydrogen RD&D. <https://science.house.gov/hearings/h2success-research-and-development-to-advance-a-clean-hydrogen-future>

Joppa, L., Leurs A., Willmott E., **Friedmann** S.J., Hamburg S., Broze R, Microsoft's carbon dioxide removal program – lessons for getting to net-zero, Nature, v.597, Issue 7878
<https://www.nature.com/articles/d41586-021-02606-3>

Fan, Z., Ochu, E.R., Braverman S., Lou Y., Smith, G., Bhardwaj A.A., Brouwer J., McCormick, C.M., **Friedmann**, S.J., 2021, Green hydrogen in a circular carbon economy: opportunities and limits, Center on Global Energy Policy report, https://www.energypolicy.columbia.edu/sites/default/files/file-uploads/GreenHydrogen_CGEP_Report_082521-8.pdf

Friedmann, S.J., Agrawal, M., Bhardwaj, 2021, Evaluating Net-Zero Hubs in the United States: A Case Study in Houston, Center on Global Energy Policy report, <https://www.energypolicy.columbia.edu/research/report/evaluating-net-zero-industrial-hubs-united-states-case-study-houston>

Bhardwaj, A.A., McCormick, C., **Friedmann**, S.J., 2021, Opportunities and limits of CO₂ recycling in a circular carbon economy: techno-economics, critical infrastructure needs, and policy priorities, Center on Global Energy Policy report: <https://www.energypolicy.columbia.edu/research/report/opportunities-and-limits-co2-recycling-circular-carbon-economy-techno-economics-critical>

Fan, Z., and **Friedmann**, S.J., 2021, Low-Carbon Production of Iron & Steel: Technology Options, Economic Assessment, and Policy, Joule, 5, 1-31, April, <https://doi.org/10.1016/j.joule.2021.02.018>

Co-lead, Biomass Carbon Removal and Storage Roadmap, Innovation for a Cool Earth Forum, Dec. 2020, <https://www.icef-forum.org/roadmap/>

Friedmann, S.J., Fan, Z., Ochu, E.R., Byrum, Z.S., Bhardwaj, A.A., Sheerazi, H.A., 2020, Levelized Cost of Carbon Abatement: An improved cost-estimation methodology for a net-zero emissions world, Center on Global Energy Policy Report: <https://www.energypolicy.columbia.edu/research/report/levelized-cost-carbon-abatement-improved-cost-assessment-methodology-net-zero-emissions-world>

Friedmann, S.J., Zapantis, A., Page, B., Consoli, C., Fan, Z., Havercroft, I., Liu, H., Ochu, E.R., Raji N., Rassool, D., Sheerazi, H.A., Townsend, A. 2020, Net-zero and Geospheric Return: Actions today for 2030 and beyond, Center on Global Energy Policy Report: <https://www.energypolicy.columbia.edu/research/report/net-zero-and-geospheric-return-actions-today-2030-and-beyond>

Lott, M. & **Friedmann**, S.J., 2020, Electricity Oversupply: Maximizing zero-carbon power to accelerate the transition from fossil fuels, Center on Global Energy Policy Commentary: <https://www.energypolicy.columbia.edu/research/commentary/electricity-oversupply-maximizing-zero-carbon-power-accelerate-transition-fossil-fuels-0>

Sivaram, V., Hart, D., Cunliff, C., **Friedmann**, S.J. & Sandalow, D., 2020, Energizing America: A Roadmap to Launch a National Energy Innovation, Center on Global Energy Policy Report: 120 p. <https://www.energypolicy.columbia.edu/energizing-america>

Friedmann, S.J., 2020, Congressional Testimony & Technical Addendum, Senate Energy and Natural Resources Committee, Hearing on Carbon Management and Removal, https://www.energy.senate.gov/public/index.cfm/hearings-and-business-meetings?Id=F27BA80E-72A0-4A59-82A8-33C6E2E72C89&Statement_id=A2EBA029-011E-4C6F-867F-DF85BD033E88

Friedmann, S.J., Ochu, E.R., and Brown, J., 2020, Capturing Investment: Policy Design for CCUS Financing and Deployment in the U.S. Power Sector, Center on Global Energy Policy Report: 57 p. <https://energypolicy.columbia.edu/research/report/capturing-investment-policy-design-finance-ccus-projects-us-power-sector>

Co-lead, Industrial Heat Decarbonization Roadmap, Innovation for a Cool Earth Forum, Dec. 2019, <https://www.icef-forum.org/roadmap/>

Friedmann, S.J., Fan Z., Tang K. 2019, Low-Carbon Heat Solutions for Heavy Industry: Sources, Options, and Costs Today, Center for Global Energy Policy Report: 100 p. <https://energypolicy.columbia.edu/research/report/low-carbon-heat-solutions-heavy-industry-sources-options-and-costs-today>

Friedmann, S.J., 2019, Engineered CO2 removal, climate restoration, and humility, Frontiers in Climate, July 26 2019, <https://doi.org/10.3389/fclim.2019.00003>