



**JACQUELINE A. DOWLING**  
**Postdoctoral Research Fellow**

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**ACADEMIC APPOINTMENT**

Postdoctoral Fellow, *Carnegie Science* | Climate Energy Lab | Stanford, CA, Sept 2023

**EDUCATION**

Ph.D., Chemistry, *California Institute of Technology* | Pasadena, CA, June 2023

Minor: Environmental Science and Engineering

Division of Chemistry and Chemical Engineering

Title: Long-Duration Energy Storage in Reliable Wind and Solar Electricity Systems

Bachelor of Arts, *Carleton College* | Chemistry | Northfield, MN, June 2017

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**PEER-REVIEWED JOURNAL ARTICLES** (850+ citations in Google Scholar, \*co-first author)

Planning reliable solar- and wind-based electricity systems

Ruggles, T.H.\*, Virgüez, E.A.\*, Reich, N.D., **Dowling, J.A.**, Bloomfield, H., Antonini, E., Davis, S.J., Lewis, N.S., Caldeira, K. 2024, *Adv. Appl. Energy*. doi.org/10.1016/j.adapen.2024.100185.

Opportunities and constraints of hydrogen energy storage systems

**Dowling, J.A.**, Ruggles, T.H., Virgüez, E.A., Reich, N.D., Ifkovits, Z.P., Davis, S.J., Li, A.X., Kennedy, K.M., Rinaldi, K.Z., Duan, L., Caldeira, K., Lewis, N.S. 2024, *Environmental Research: Energy*. doi.org/10.1088/2753-3751/ad58e5.

The influence of regional geophysical resource variability on the value of single- and multi-storage technology portfolios

Li, A.X.\*, Virgüez, E.A.\*, **Dowling, J.A.\***, Ruggles, T.H., Wongel, A., Reich, N.D., Lewis, N.S., Caldeira, K. 2024, *Environmental Science & Technology*. doi.org/10.1021/acs.est.3c10188.

Catalysis of the oxygen-evolution reaction in 1.0 M sulfuric acid by manganese antimonate films synthesized via chemical vapor deposition

**Dowling, J.A.\***, Ifkovits, Z.P.\*, Carim, A.I., Evans, J.M., Swint, M.C., Ye, A.Z., Richter, M.H., Li, A.X., Lewis, N.S., 2024, *ACS Applied Energy Materials*. doi.org/10.1021/acsaem.4c00135.

**ACS Front cover.**

Powdered  $\text{Mn}_y\text{Sb}_{1-y}\text{O}_x$  catalysts for cerium-mediated oxygen evolution in acidic environments

Ifkovits, Z.P., Evans, J.M., Kempler, P.A., Pham, K.H., Morla, M.B., **Dowling, J.A.**, Carim, A.I., Lewis, N.S., 2022, *ACS Energy Letters*. doi.org/10.1021/acsenerylett.2c01754.

The role of concentrated solar power with thermal energy storage in least-cost highly reliable electricity systems fully powered by variable renewable energy

Kennedy, K.M., Ruggles, T.R., Rinaldi, K.Z., **Dowling, J.A.**, Duan, L., Caldeira, K., Lewis, N.S., 2022, *Advances in Applied Energy*. doi.org/10.1016/j.adapen.2022.100091.

Opportunities for flexible electricity loads such as hydrogen production from curtailed generation

Ruggles, T.R., **Dowling, J.A.**, Lewis, N.S., Caldeira, K., 2021, *Advances in Applied Energy*. doi.org/10.1016/j.adapen.2021.100051.

Wind and solar resource droughts in California highlight the benefits of long-term storage and integration with the Western Interconnect

Rinaldi, K.Z., **Dowling, J.A.**, Ruggles, T.R., Caldeira, K., Lewis, N.S., 2021, *Environmental Science & Technology*. doi.org/10.1021/acs.est.0c07848.

Would firm generators facilitate or deter variable renewable energy in a carbon-free electricity system?

Yuan, M., Tong, F., Duan, L., **Dowling, J.A.**, Davis, S.J., Lewis, N.S., Caldeira, K., 2020, *Applied Energy*. doi.org/10.1016/j.apenergy.2020.115789.

Role of long-duration energy storage in variable renewable electricity systems

**Dowling, J.A.**, Rinaldi, K.Z., Ruggles, T.R., Davis, S.J., Yuan, M., Tong, F., Lewis, N.S., Caldeira, K., 2020, *Joule*. doi.org/10.1016/j.joule.2020.07.007.

**Cited 400+ times, Joule Front cover.**

Molecular characterization of individual particles from freshly emitted sea spray aerosol: Influence of ocean biology on particle composition and its interactions with water vapor

Laskina, O., Cochran, R.E., Trueblood, J., Estillore, A.D., Morris, H.S., Jayarathne, T., Sultana, C.M., Lee, C., Lin, P., Laskin, J., Laskin, A., **Dowling, J.A.**, Qin, Z., Cappa, C.D., Bertram, T.H., Tivanski, A., Stone, E.A., Prather, K.A., Grassian, V.H., 2017, *Chem*. doi.org/10.1016/j.chempr.2017.03.007.

Heterogeneous chemistry of biological-derived components of sea spray aerosol: The role of acid-base chemistry

Trueblood, J., Estillore, A.D., Lee, C., **Dowling, J.A.**, Prather, K.A., Grassian, V.H., 2016, *Journal of Physical Chemistry A*. doi.org/10.1021/acs.jpca.6b07023.

## **NON-PEER REVIEWED JOURNAL ARTICLES**

Long-duration energy storage for reliable renewable electricity: The realistic possibilities

**Dowling, J.A.**, Lewis, N.S., 2021, *Bulletin of the Atomic Scientists*. doi.org/10.1080/00963402.2021.1989191.

Portfolios all the way down ...

Caldeira, K., **Dowling, J.A.**, 2021, *Joule*. doi.org/10.1016/j.joule.2021.10.008.

## **TECHNICAL REPORT**

America's Zero Carbon Action Plan. Chapter 5.1 Accelerating Deep Decarbonization in the U.S. Power Sector

Bazilian, M.D., Victor, D.G., Castro, C., **Dowling, J.A.**, Dehghanian, P., Gençer, E., Kammen, D., Logan, J., Mauter, M., Tarroja, B., Wagner, G., 2020, *Sustainable Development Solutions Network*. www.unsdsn.org/Zero-Carbon-Action-Plan.

## MANUSCRIPTS IN PREPARATION

Cost-effective approaches to maintaining resource adequacy in renewable electricity systems over decades of weather variability

Reich, N.D., Ruggles, T.H., Virgüez, E.A., **Dowling, J.A.**, Caldeira, K., Lewis, N.S.

Competitiveness of using underground thermal energy storage to repower decommissioned steam turbogenerators

Wongel, A., **Dowling, J.A.**, Duan, L., Vernon, A., McKay, I., Caldeira, K.

Net-zero emissions heat

**Dowling, J.A.**, Saad, D., Wongel, A., Azevedo, I., Caldeira, K., Brandt, A., Davis, S.J.

Clean firm backup power requirements for reliable wind- and solar-based electricity systems

**Dowling, J.A.**, Caldeira, K., Davis, S.J.

How academics and policymakers can work together to achieve a clean energy future

Freese, L. (...) **Dowling, J.A.** et al.

## RESEARCH EXPERIENCE

Graduate Research Collaborator (Gates Ventures funded), Carnegie Science. Advisors: Senior Scientist Emeritus Ken Caldeira and Professor Nathan Lewis | Stanford, CA | 2018 - 2023.

Graduate Research Assistant, California Institute of Technology. Advisor: Professor Nathan Lewis Pasadena, CA | 2017 - 2023.

Undergraduate Senior Thesis, Carleton College. Advisors: Professor Steven Drew and Professor Bruce Parkinson | Northfield, MN | 2017.

*Dyes and Dots: The Chemistry of Harvesting Sustainable Energy. (Photoelectrochemistry)*

Assistant Developer, National Center for Atmospheric Research (NCAR). Advisors: Dr. Charles Bardeen, Dr. Andrew Gettelman | Boulder, CO | Summer 2016.

*Developing Diagnostics for the Whole Atmosphere Community Climate Model (WACCM).*

Undergraduate Researcher (NSF funded), University of California San Diego. Advisor: Professor Kim Prather | San Diego, CA | Summer 2015.

*Reactions of a Marine-Derived Organic Compound with an Urban Air Pollutant.*

Research Assistant, University of Iowa. Advisor: Professor Vicki Grassian | Iowa City, IA | 2014-2015. *Characterization of Molecular and Biological Species in Sea Spray Aerosols.*

## TEACHING EXPERIENCE

**Research Mentor** | Caltech Summer Undergraduate Research Fellowship | 2021-2023.

*Anna X. Li* | Caltech Undergraduate | Co-author of energy system modeling publication.

*Madeleine C. Swint* | Caltech Undergraduate | Co-author of electrocatalysis publication.

**Course Developer & Teaching Assistant** | Caltech | 2019-2022.

*Sustainable Engineering* | Professor Julie Kornfield | Winter 2021, Winter 2022. Teaching assistant. Cross-listed as ChE/ESE/ME/MS 111 in various departments: chemical engineering, environmental science & engineering, mechanical engineering, and material science.

*Sustainable Chemical Engineering* | Professor Julie Kornfield | Fall 2020. Developed curriculum for a new course (ChE 111) including materials for the syllabus, lectures, problem sets, readings, essays, projects, and exams.

*Fundamentals of Sustainability Science and Engineering* | Instructor Mamadou Diallo, Professor Julie Kornfield, and Professor Katherine Faber | Winter 2020. Teaching assistant and guest lecturer. Cross-listed as ChE190, MS150, and ESE100 in chemical engineering, material science, and environmental science & engineering.

*Sustainability at Caltech* | Student-led initiative | Winter 2019. Seminar leader and organizer of student-led sustainability initiatives on campus. Developed the class, listed as ESE 104.

## **AWARDS & HONORS**

Stanford Energy Postdoctoral Fellowship | Stanford University | Awarded on Dec 9, 2024.

The energy-centered postdoctoral research program is nurturing a global community of future leaders to realize sustainable, affordable, and secure energy for the world.

Energy Policy Boot Camp Small Grant Proposal Winner | Washington D.C. | Oct 2024.

Grant to develop a climate-energy research brief web platform for policymakers hosted by University of Maryland's Center for Global Sustainability. Supported by the Sloan Foundation.

Energy Policy Boot Camp Fellow | Washington D.C. | June 2024.

Mason-Maryland Energy and Climate-Tech Innovation Policy Boot Camp for Early Career Researchers funded by the Sloan Foundation.

SoCalGas Fellowship | California Institute of Technology | 2020-22.

Fellowship from SoCalGas in support of low-carbon energy science and policy.

Patricia "Pat" Beckman Graduate Fellowship | California Institute of Technology | 2018-19.

Zeller-Resnick Fellow | California Institute of Technology | 2017-18.

Provides an annual fellowship to an incoming first-year graduate student showing excellent potential in the field of sustainability science or sustainable energy science.

Charles Carlin Prize in Chemistry | Carleton College | 2017.

The prize honors senior chemistry majors whose enjoyment of chemistry and gracious good humor has inspired and assisted others in the field.

Sigma Xi, the Scientific Research Society | 2016-17.

National honor society for students who have demonstrated evidence of research potential in a field of pure or applied science.

## **LEADERSHIP & SERVICE**

Professional Affiliations

Institute for Operations Research and the Management Sciences (INFORMS) | 2022-present

American Geophysical Union (AGU) | 2019-present

Open Energy Modelling Initiative (Openmod) | 2019-present

United States Association for Energy Economics (USAEE/IAEE) | 2019

Journal Referee: *Joule*, *Applied Energy*, *Environmental Science & Technology*, *Environmental Research: Energy*, *Nature Communications*, *Nature Reviews Clean Technology*

Brooke Owens Fellowship Summit | Washington D.C. | 2022

Subject-matter expert for Keeping the Lights On: Power Generation Grand Challenge exercise.

Alpine Club, Co-President | Caltech | 2019-2021

Managed a team of 15 club officers, budget, safety courses, film festivals, and gear rentals for the 250-person club. Supported by the Moore-Hufstedler Fund and Banff Film Festival.

Actor for Giving Voice Vignette | Caltech | 2019

Worked with Professor Melany Hunt on gender equity in STEM, NSF-funded Caltech project.

Sustainability Assistant | Carleton College | Winter 2017

Implemented campus-wide sustainability initiatives & resources for students, faculty, and staff.

Energy Club, President | Carleton College | 2016-17

Organized two campus-wide symposiums, energy-tech lab demos, and community events.

Sustainable Energy Principles and Practice in India | Carleton College | Fall 2016-17

Off-campus study program with the Physics Department, installed a solar array in India.

## CONFERENCES & INVITED TALKS (selected)

Energy Storage Portfolios

*Oral Presenter* | American Geophysical Union | Washington D.C., Fall 2024

Net-Zero Emissions Energy Systems<sup>+</sup> (four sessions), Heat Decarbonization<sup>+</sup>, Opportunities and Constraints of Hydrogen Energy Storage Systems\*

<sup>+</sup>*Session Co-Chair*, \**Oral Presenter* | INFORMS | Seattle, WA, Fall 2024

Impact of Variability and Extremes of Weather in Energy Systems<sup>+</sup>, Multi-Objective Decision

Making Under Uncertainty<sup>+</sup>, The Hydrogen Economy: Challenges and Opportunities<sup>+</sup>,

Representation of Hydrogen in Capacity Expansion Modeling\*

<sup>+</sup>*Session Co-Chair*, \**Oral Presenter* | INFORMS | Phoenix, AZ, Fall 2023

Energy System Flexibility: Considering Daily, Seasonal, and Interannual Weather Variability

*Plenary Speaker* | Next Generation Energy Climate Modelling | United Kingdom, Fall 2022

Earth-Abundant  $\text{Mn}_y\text{Sb}_{1-y}\text{O}_x$  Electrocatalysts for Water Oxidation in Acidic Media

*Poster Presenter* | Electrochemistry Gordon Research Conference | Ventura, CA, Fall 2022

Harnessing Renewable Hydrogen for Long Term Energy Storage

*Oral Presenter* | Institute for Operations Research and the Management Sciences | Fall 2022

*Oral Presenter* | United States Climate Alliance | Summer 2022

*Oral Presenter* | California Council on Science and Technology | Summer 2022

*Oral Presenter* | Renewable Gas 360 | Sacramento, CA | Spring 2021 | **Audience of > 400**

*Oral Presenter* | California Hydrogen Business Council | Fall 2020 | **Audience of > 300**

Role of Long-Duration Energy Storage in Variable Renewable Electricity Systems

*Oral Presenter* | American Geophysical Union | San Francisco, CA, Fall 2020

*Oral Presenter* | United States Association for Energy Economics | Denver, CO, Fall 2019

*Oral Presenter* | Open Energy Modelling Workshop | NREL | Denver, CO, Fall 2019  
Net-Zero Emissions Energy Systems: Geophysical Constraints, Consequences, and Opportunities  
*Session Convener* | American Geophysical Union | San Francisco, CA, Fall 2019, Fall 2021

## REFERENCES

Steve Davis, Professor  
(Postdoctoral co-advisor)  
Stanford University  
Department of Earth System Science  
Stanford, CA  
650-704-5975  
sjdavis@stanford.edu

Ken Caldeira,  
Research Scientist  
(Postdoctoral co-advisor)  
Carnegie Science  
Climate Energy Lab  
Stanford, CA  
650-704-7212  
kcaldeira@carnegiescience.edu

Nate Lewis, Professor  
(PhD research advisor)  
California Institute of Technology  
Department of Chemistry  
Pasadena, CA  
626-395-6335  
nslewis@caltech.edu