

Benjamin M. Adams

CURRICULUM VITAE

October 2020

Post-Doctoral Associate
Geothermal Energy and Geofluids
Department of Earth Sciences
ETH Zürich
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PROFESSIONAL INTERESTS

Thermodynamic design, integration, and techno-economic analysis of renewable electrical power generation systems, especially those utilizing CO₂ refrigerants or combined with carbon capture and sequestration equipment; improvement of engineering curriculum.

EDUCATION

Ph.D., 2015, University of Minnesota, Minneapolis MN, USA. Department of Mechanical Engineering. Dissertation: “On the Power Performance and Integration of Carbon-dioxide Plume Geothermal (CPG) Electrical Energy Production.” Advisor: Thomas H. Kuehn; Co-Advisor: Martin O. Saar. [thesis](#)

M.S.M.E. (Masters of Science in Mechanical Engineering), 2010, University of Minnesota, Minneapolis MN, USA. Department of Mechanical Engineering. Project: “Redesign of the Compressible Flow Laboratory.” Advisors: Peter H. McMurry & William K. Durfee. [presentation](#)

B.A.E.M. (Bachelors of Aerospace Engineering and Mechanics), 2004, University of Minnesota, Minneapolis MN, USA. Department of Aerospace Engineering and Mechanics.

PROFESSIONAL APPOINTMENTS

ETH Zürich, Dept of Earth Sciences. Post-Doctoral Associate. Jan 2018 – Present.

University of Minnesota, Dept of Earth Sciences. Post-Doctoral Associate. Sept 2016 – Jun 2017.

University of Minnesota, Dept of Mechanical Engineering. Post-Doctoral Associate. Jun 2015 – Sept 2016.

LICENSURE

Minnesota Professional Mechanical Engineer (P.E.), License #54249. Dec 2016 – Present.

CONSULTING

- CO2 POWER, Zürich, CH. CO₂-based Power System (CPG) Design and Written Interpretation for Popular Audience. Jan 2018.
- ABV Technology, St Paul, MN, USA. Mechanical Process Design and Fabrication for Distillation Beverage Industry. Sept 2017 – Dec 2017.
- Algenta Technology, Minneapolis, MN, USA. C# Object-Oriented Software Development—User Interface and API/DB Design. Sept 2017 – Dec 2017.
- Dells Duck Tours, Wisconsin Dells, WI, USA. Principal Theme Park Engineer, Automation Design, PointOfSale Software Development. 2004 – Present.
- TerraCOH, Minneapolis, MN, USA. Preliminary Power Simulation of Potential CPG Development Site. 2012.

PATENTS

- ETH Zurich (applicant), Saar, M.O., & Adams, B.M. (2018). Geothermal Energy System. Patent: World Intellectual Property Organization. Approved Application: WO 2020/104327.

PUBLICATIONS ([Google Scholar](#))

Peer-reviewed Journal Articles

- Adams, B.M., Vogler, D., Kuehn, T.H., Bielicki, J.M., Garapati, N., & Saar, M.O. (in preparation). Heat depletion and its effect on the design and electric power output of CO₂ Plume Geothermal (CPG) systems. *Renewable Energy*.
- Adams, B.M., Ogland-hand, J.D., Bielicki, J.M., Schädle, P., & Saar, M.O. (in preparation). GenGeo: A generalizable cost model for geothermal electricity generation. *Joule*.
- Ezzat, M., Vogler, D., Saar, M.O., & Adams, B.M. (in preparation). Simulating the plasma formation in macrocracks filled with water for Plasma Pulse Geo-drilling. *Journal of Rock Mechanics*.
- Ezzat, M., Vogler, D., Saar, M.O., & Adams, B.M. (in preparation). Simulating the plasma formation in microcracks under short electric pulses for Plasma Pulse Geo-drilling. *Journal of Rock Mechanics*.
- Cremonesi, S., Adams, B.M., Saar, M.O., & Vogler, D. (in preparation). Sedimentary geothermal electricity potential for the Netherlands. *Renewable Energy*.
- Hefny, M., Ebigo, A., Adams, B.M. (in preparation). Petrophysical characterization of a Nubian Sandstone reservoir and its potential for geothermal applications in the central Gulf of Suez, Egypt.
- van Brummen, A., Adams, B.M., Wu, R., Fleming, M.R., & Saar, M.O. (in preparation). Meeting site-specific energy demand with a fully renewable power system. *Applied Energy*.
- Adams, B.M., Fleming, M.R., Garapati, N., Saar, M.O., Kuehn, T.H., & Randolph, J.B. (in preparation). An analysis of the demonstration of a carbon dioxide based thermosiphon at the SECARB Cranfield site. *Geothermics*.
- Fleming, M.R., Adams, B.M., Kuehn, T.H., Bielicki, J.M., & Saar, M.O. (in preparation). The performance of a CO₂-Plume Geothermal energy storage system using a low-temperature high-permeability sedimentary reservoir. *Applied Energy*.
- Garapati, N., Adams, B.M., Fleming, M.R., Kuehn, T.H., & Saar, M.O. (submitted). Auxiliary heating of geothermally preheated brine or CO₂ to boost electricity production. *Journal of CO₂ Utilization*.
- Fleming, M.R., Adams, B.M., Kuehn, T.H., Bielicki, J.M., & Saar, M.O. (2020). Increased power generation due to exothermic water exsolution in CO₂ Plume Geothermal (CPG) power plants. *Geothermics*, 88, 101865. <https://doi.org/10.1016/j.geothermics.2020.101865>

- Bielicki, J.M., Adams, B.M., Choi, H., Jamiyansuren, B., Taff, S.J., Buscheck, T.A., Ogland-Hand, J.D., Randolph, J.B., & Saar, M.O. (in review). Cost-competitive geothermal electricity for geologic CO₂ storage. *Energy Conversion and Management*.
- Ezekiel, J., Ebigbo, A., Adams, B.M., & Saar, M.O. (2020). Combining natural gas recovery and CO₂-based geothermal energy extraction for electric power generation. *Applied Energy*, 269, 115012. <https://doi.org/10.1016/j.apenergy.2020.115012>.
- Ogland-Hand, J., Bielicki, J.M., Wang, Y., Adams, B.M., Buscheck, T.A., & Saar, M.O. (2019). The value of bulk energy storage for reducing CO₂ emissions and water requirements from regional electricity systems. *Energy Conversion and Management*, 181, 674-685. <https://doi.org/10.1016/j.enconman.2018.12.019>
- Garapati, N., Adams, B.M., Bielicki, J.M., Schädle, P., Randolph, J.B., Kuehn, T.H., & Saar, M.O. (2017). A hybrid geothermal energy conversion technology—A potential solution for production of electricity from shallow geothermal resources. *Energy Procedia*, 114, 7107-7117. <https://doi.org/10.1016/j.egypro.2017.03.1852>
- Adams, B.M., Kuehn, T.H., Bielicki, J.M., Randolph, J.B., & Saar, M.O. (2015). A comparison of electric power output of CO₂ Plume Geothermal (CPG) and brine geothermal systems for varying reservoir conditions. *Applied Energy*, 140, 365-377. <https://doi.org/10.1016/j.apenergy.2014.11.043>
- Adams, B.M., Kuehn, T.H., Bielicki, J.M., Randolph, J.B., & Saar, M.O. (2014). On the importance of the thermosiphon effect in CPG (CO₂ plume geothermal) power systems. *Energy*, 69, 409-418. <https://doi.org/10.1016/j.energy.2014.03.032>

Doctoral Theses Advised

- Fleming, Mark. (February 2019). (Acting Advisor from 2016; Official Advisor: Thomas Kuehn). Thesis title: The performance of a carbon-dioxide plume geothermal energy storage system. University of Minnesota. [thesis: http://hdl.handle.net/11299/206666](http://hdl.handle.net/11299/206666)

Masters Theses Advised

- Mostafa, Mohamed Ezzat. (expected 2021). (Acting co-Advisor with Daniel Vogler; Official Advisor: Martin Saar). Thesis topic: Fundamental physics of plasma pulse geo-drilling at large temperatures and depths. ETH Zurich.
- Cremonesi, Selene. (expected June 2020). (Acting Co-advisor; Official Advisor: Martin Saar). Thesis title: Assessment of the geothermal economic potential in the sedimentary basins of the Netherlands. Politecnico Milano.
- van Brummen, Anna. (August 2019). (Acting Advisor; Official Advisor: Martin Saar). Thesis title: Optimizing the size of a fully renewable power system to meet historical energy demand. ETH Zurich. [thesis: https://doi.org/10.3929/ethz-b-000383244](https://doi.org/10.3929/ethz-b-000383244)
- Ravilov, Marat. (August 2019). (Acting Advisor; Official Advisor: Martin Saar). Thesis title: Optimization of heat extraction within sedimentary reservoirs for CO₂ Plume Geothermal (CPG) electricity generation. ETH Zurich. [thesis: https://doi.org/10.3929/ethz-b-000387209](https://doi.org/10.3929/ethz-b-000387209)

Conference Proceedings

- Adams, B.M., Sutter, D., Mazzotti, M., & Saar, M.O. (Accepted, 2021). Combining direct air capture and geothermal heat and electricity generation for net-negative carbon dioxide emissions. *World Geothermal Congress*, Reykjavik, 21 May to 26 May, 2021.

- Fleming, M.R., Adams, B.M., & Saar, M.O. (Accepted, 2021). Using sequestered CO₂ as geothermal working fluid to generate electricity and store energy. *World Geothermal Congress*, Reykjavik, 21 May to 26 May, 2021.
- Maldonado, S.B., Bielicki, J.M., Miranda, M.W., Ogland-Hand, J.D., Howard, C., Adams, B.M., Buscheck, T.A., & Saar, M.O. (Accepted, 2021). Geospatial estimation of the electric power potential in sedimentary basin geothermal resources using geologically stored carbon dioxide. *World Geothermal Congress*, Reykjavik, 21 May to 26 May, 2021.
- Adams, B.M., Bielicki, J.M., Ogland-Hand, J.D., & Saar, M.O. (2020). Using geologically sequestered CO₂ to generate and store geothermal electricity: CO₂ Plume Geothermal (CPG). *Proceedings of MIT A+B Applied Energy Symposium*, Aug 12-14, 2020. <https://doi.org/10.3929/ethz-b-000444911>
- Adams, B.M., Bielicki, J.M., Ogland-Hand, J.D., & Saar, M.O. (2020). Using geologically sequestered CO₂ to generate and store geothermal electricity: CO₂ Plume Geothermal (CPG). Video Presentation, *MIT A+B Applied Energy Symposium*, Online, Aug 12-14, 2020. [youtube video](#)
- Sudhoff, R., Glos, S., Wechsung, M., Adams, B.M., & Saar, M.O. (2019). Next Level Geothermal Power Generation (NGP) – A new sCO₂-based geothermal concept. *German Geothermal Congress DGK 2019*, München, Germany, 19-21 Nov 2019.
- Saar, M.O., Adams, B.M., & Kong, X.Z. (2019). CCUUUS: Utilizing CO₂ Capture and Storage for 1) Geothermal Power Generation, 2) Subsurface Energy Storage, and 3) Direct-air CO₂ Capture. 2019 ARMA-CUPB Geothermal International Conference, Beijing, China, 5-8 August, 2019.
- Adams, B.M., Fleming, M.R., Bielicki, J.M., Hansper, J., Glos, S., Langer, M., Wechsung, M., & Saar, M.O. (2019). Grid scale energy storage using CO₂ in sedimentary basins: The cost of power flexibility. *European Geothermal Congress*, Hague, Netherlands, 11-14 June, 2019. [paper](#)
- Hansper, J., Grotkamp, S., Glos, S., Langer, M., Wechsung, M., Adams, B.M., & Saar, M.O. (2019). Assessment of performance and costs of CO₂ plume geothermal (CPG) systems. *European Geothermal Congress*, Hague, Netherlands, 11-14 June, 2019. [paper](#)
- Ezekiel, J., Ebigbo, A., Adams, B.M., & Saar, M.O. (2019). On the use of supercritical carbon dioxide to exploit the geothermal potential of deep natural gas reservoirs for power generation. *European Geothermal Congress*, Hague, Netherlands, 11-14 June, 2019. [paper](#)
- Fleming, M.R., Adams, B.M., Kuehn, T.H., Bielicki, J.M., & Saar, M.O. (2019). Benefits of using active reservoir management during CO₂-plume development for CO₂-plume geothermal systems. *Proceedings, 44th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, CA, February 11-13, 2019*. [paper](#)
- Fleming, M.R., Adams, B.M., Randolph, J.B., Ogland-Hand, J.D., Kuehn, T.H., Buscheck, T.A., Bielicki, J.M., & Saar, M.O. (2018). High efficiency and large-scale subsurface energy storage with CO₂. *Proceedings, 43rd Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, CA, February 12-14, 2018*. [paper](#)
- Bielicki, J.M., Adams, B.M., Choi, H., Jamiyansuren, B., Saar, M.O., Taff, S.J., Buscheck, T.A., & Ogland-Hand, J.D. (2016). Sedimentary basin geothermal resource for cost-effective generation of renewable electricity from sequestered carbon dioxide. *Proceedings, 41st Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, CA, February 22-24, 2016*. [paper](#)
- Buscheck, T.A., Bielicki, J.M., Randolph, J.B., Chen, M., Hao, Y., Edmunds, T.A., Adams, B., & Sun, Y. (2014). Multi-fluid geothermal energy systems in stratigraphic reservoirs: Using brine, N₂, and CO₂ for dispatchable renewable power generation and bulk energy storage (No. LLNL-CONF-650283).

Proceedings, 39th Workshop on Geothermal Reservoir Engineering, Stanford University, Stanford, California, February 24-26, 2014. [paper](#)

Adams, B.M., Kuehn, T. H., Randolph, J.B., & Saar, Martin O. (2013). The reduced pumping power requirements from increasing the injection well fluid density. *Geothermal Resources Council Transactions*, 37: 667-672. [paper](#)

Randolph, J.B., Adams, B., Kuehn, T.H., & Saar, M.O. (2012) Wellbore heat transfer in CO₂-based geothermal systems. *Geothermal Resources Council Transactions*, 36: 549-554. [paper](#)

Adams, B. & Kuehn, T.H. (2012). The complementary nature of CO₂-plume geothermal (CPG) energy production and electrical power demand. *Proceedings of the ASME 2012 International Mechanical Engineering Congress & Exposition*, IMECE2012-88704, November 9-15, 2012, Houston, Texas, USA. [paper](#)

Durfee, W.K., Adams, B.M., Appelsies, A., & Flash, P. (2011). A Writing Program for Mechanical Engineering. *Proceedings of the ASEE 2011 Conference & Exposition.* [paper](#)

Conference Abstracts

Saar, M., Garapati, N., Adams, B., Randolph, J., Kuehn, T. (2016). A hybrid geothermal energy conversion technology: Auxiliary heating of geothermally preheated water or CO₂—a potential solution for low-temperature resources. *European Geosciences Union General Assembly*, Vienna, Austria, April 17-22, 2016. [abstract](#)

Bielicki, J.M., Jamiyansuren, B., Adams, B.M., Choi, H., Saar, M.O., Taff, S.J., Buscheck, T.A., & Ogland-Hand, J.D. (2015). The cost of geothermal electricity generated by sequestered carbon dioxide. *14th Annual Carbon Capture, Utilization, and Storage Conference*, Pittsburgh, PA, April 28-May 1, 2015.

Garapati, N., Adams, B.M., Saar, M.O., Randolph, J.B., & Kuehn, T.H. (2015). Optimizing geothermal system performance through iterative coupling of reservoir and surface plant simulations. *1st Workshop of Numerical Geothermal Simulation*, TU Munich, April 8-9, 2015.

Kong, X., Garapati, N., Adams, B.M., Randolph, J.B., Kuehn, T.H., & Saar, M.O. (2015). Auxiliary Heating of Geothermally Preheated Water or CO₂—A potential solution for low-to-moderate temperature resources. *American Geophysical Union*, San Francisco, CA, USA, December 14-18, 2015. [abstract](#)

Instructional Materials

Adams. B.M. (2012). Basic data acquisition using LabView. *YouTube*. <https://www.youtube.com/watch?v=GBhJk5Tnshc>.

Adams, B.M. & Durfee, W.K. (2011). Student writing guide: How to write a problem set. <http://www.me.umn.edu/education/undergraduate/writing/>.

Adams, B.M. (2010). Wiring a thermistor and acquiring temperatures in LabView. *YouTube*. <https://www.youtube.com/watch?v=7znlYLkk-mw>.

Adams, B.M. (2010). Frequency analysis of microphone data using LabView. *YouTube*. <https://www.youtube.com/watch?v=DKQT4M7M2Fg>.

Adams, B.M. (2010). Plotting XY graphs and linear regression in LabView. *YouTube*. https://www.youtube.com/watch?v=zyYq6K7_WDM.

Adams, B.M. (2010). Creating confidence intervals for linear regression in EXCEL. *YouTube*. <https://www.youtube.com/watch?v=aSOUQKqIYak>.

Adams, B.M. & Durfee, W.K. (2009). Student writing guide: How to write a lab report. <http://www.me.umn.edu/education/undergraduate/writing/>.

Adams, B.M. & Durfee, W.K. (2009). Student writing guide: How to write a design report.
<http://www.me.umn.edu/education/undergraduate/writing/>.

AWARDS and HONORS

Teaching Assistant of the Year, Department of Mechanical Engineering, University of Minnesota, 2009.
Dean's List, Institute of Technology, University of Minnesota, 2003.

CONFERENCE ACTIVITY

Papers Presented

- “Grid scale energy storage using CO₂ in sedimentary basins: The cost of power flexibility,” European Geothermal Congress, Hague, Netherlands, 11-14 June, 2019.
- “The reduced pumping power requirements from increasing the injection well fluid density,” Geothermal Resources Council Annual Meeting, Las Vegas, NV, October 2013.
- “The complementary nature of CO₂-plume geothermal (CPG) energy production and electrical power demand,” ASME Intl. Mechanical Engineering Congress & Exposition, Houston, TX, Nov 2012.
- “Wellbore heat transfer in CO₂-based geothermal systems,” Geothermal Resources Council Annual Meeting, Reno, NV, October 2012.

Topic Presented

- “Grid-scale Electricity Generation and Energy Storage using CO₂ Plume Geothermal (CPG),” Swiss Competence Center for Energy Research: Supply of Energy (SCCER-SOE) Annual Meeting. Lausanne, Switzerland, September 4, 2019.
- “Grid-scale Electricity Generation and Energy Storage using CO₂ Plume Geothermal (CPG),” Gordon Research Seminar on Carbon, Capture, Utilization, and Storage, Les Diablerets, Switzerland, May 5-10, 2019.
- “Keynote: CO₂-Storage-Based Geothermal Electricity Generation Potential of Sedimentary Basins in the United States.” AAPG & SEG International Conference and Exhibition. Excel, London, October 15-18, 2017.
- “Carbon Dioxide as a Geothermal Heat Mining Fluid in Sedimentary Basins—Technical and Economic Analysis of its Use in Hydrocarbon Fields.” AAPG & SEG International Conference and Exhibition. Excel, London, October 15-18, 2017.
- “Development of discipline-specific writing and teaching guides in the mechanical engineering department,” 12th International Writing Across the Curriculum Conference, Mpls, MN, June 2014.
- “The future of WAC is WEC: Infusing relevant writing into diverse undergraduate curricula,” 11th International Writing Across the Curriculum Conference, Savannah, GA, June 2012.

Attended

- ASHRAE Winter Conference, New York, NY, January 2014.
- Supercritical CO₂ Power Cycles Symposium, Pittsburgh, PA, September 2014.
- ASHRAE Winter Conference, Dallas, TX, January 2013.

WORKSHOP ACTIVITY

- “ELEGANCY Task 5.3 Stakeholder Workshop,” Online, hosted by ETH-Zurich, April 2020.
- “ELEGANCY Task 5.3 Stakeholder Workshop,” ETH-Zurich, Zurich, CH, Feb 2019.

“Grid-scale Energy Storage Summit,” HydroVision, Charlotte, NC, USA, June 2018.

“Energy Storage in Sedimentary Basins,” The Ohio State University, Columbus, OH, USA, August 2016.

“Supercritical Carbon Dioxide Brayton Cycle Energy Conversion R&D Workshop,” Department of Energy, Pittsburgh, PA, USA, September 2014.

“Supercritical Carbon Dioxide Power Cycle Development Workshop,” Department of Energy, Washington D.C., USA, June 2014.

TEACHING EXPERIENCE

ETH Zurich

Geothermal Energy (Graduate Course; co-instructor), 2019, 1 sem.

University of Minnesota

Mechanical Engineering Department Teaching Assistant Orientation, 2014, 1 sem.

University-wide Teaching Assistant Writing Workshop, 2014, 1 sem.

Basic Mechanical Measurements Laboratory, 2007-2012, 9 sem.

Introduction to Engineering, 2007-2011, 4 sem.

Departmental Writing Teaching Assistant, 2008-2011, 4 sem.

Thermal Sciences III (Heat Transfer), 2010, 1 sem.

Design Projects (Senior Capstone), 2009, 1 sem.

RESEARCH EXPERIENCE (pre-degree)

Research Assistant, CO₂-Plume Geothermal (CPG) Multi-disciplinary NSF-sponsored Research Project, Department of Mechanical Engineering, University of Minnesota, 2011-2015.

Research Assistant, Undergraduate Measurements Laboratory Redesign Project, Department of Mechanical Engineering, University of Minnesota, 2009-2010.

Participant Researcher, NASA Reduced Gravity Flight Education Program (RGEFP), Department of Aerospace Engineering & Mechanics, University of Minnesota, 2003-2004.

SERVICE TO PROFESSION

Peer Reviewer: *Energy, Applied Energy, Geothermal Energy, J. CO₂ Utilization, ASHRAE*, 2017 – Present.

President, Student branch, American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE), 2013-2014.

Vice President, Student branch, ASHRAE, 2012-2013.

Reviewer, ASHRAE Conference Proceedings, 2013-2014.

DEPARTMENTAL SERVICE

Member, Friday Beer Team, Department of Earth Science, 2018 – Present.

Co-chair and co-founder, Mechanical Engineering Graduate Student Committee (MEGSC), 2011-2014.

President and co-founder, Geek Cinema, Registered UMN Student Group, 2008-2009.

COMMUNITY SERVICE

Minneapolis Reserve Police Officer, 2013-2017.

Instructional Developer and Facilitator, CCEFP Fluid Power Challenge, 2014-2016.

Facilitator, CCEFP Fluid Power Challenge, 2013-2014.

Guest Lecture, “You, too, can be a rocket scientist!” Stevens Point Area Senior High School, 2004.

PROFESSIONAL SOCIETIES

American Society of Heating, Refrigeration, and Air-conditioning Engineers ([ASHRAE](#))

Minnesota ASHRAE Chapter ([MN-ASHRAE](#))

National Society of Professional Engineers ([SPE](#))

Engineering Alliance Minnesota ([EAM \(formerly MnSPE\)](#))

Order of the Engineer [OE](#)

*American Association of Petroleum Geologists ([AAPG](#))

*American Society of Mechanical Engineers ([ASME](#))

*Geothermal Resources Council ([GRC](#))

*membership lapsed

REFERENCES

Available upon request.