

Callie W. Babbitt

190 Lomb Memorial Drive - Rochester, NY 14623

Phone: (585) 475-6277 or (480) 773-5461 - Email: cwbgis@rit.edu

Education

Ph.D., Environmental Engineering, University of Florida, 2007

M.S., Environmental Engineering, University of Florida, 2003

B.S., Chemical Engineering, Georgia Institute of Technology, 2001

Appointments and Experience

Associate Professor 2015-present

Assistant Professor 2009-2015

Golisano Institute for Sustainability, Rochester Institute of Technology, Rochester, NY

Postdoctoral Research Associate 2007-2009

Arizona State University, Center for Earth Systems Engineering and Management, Tempe, AZ

Graduate Research Assistant

University of Florida, Environmental Engineering Sciences, Gainesville, FL 2001-2007

University of Florida, Office of Sustainability, Gainesville, FL 2001-2003

Internships and Co-ops

Golder Associates, Inc, Gainesville, FL 2003-2004

Georgia Pacific Corp., Atlanta, GA, 1999-2000

Buckeye Technologies, Inc., Perry, FL 1997-1999

Refereed Publications

*Student co-authors are denoted with a * to reflect an emphasis on student advising and training. Order of authorship is based on level of contribution. Publications have over 1,200 citations.*

Garvey, T.*, Moore, E.A.*, Babbitt, C.W., Gaustad, G. 2018. "Comparing ecotoxicity risks for nanomaterial production and release under uncertainty." Accepted, In press: *Clean Technologies and Environmental Policy*.

Leader, A.*, Tomaszewski, B., Gaustad, G., Babbitt, C.W. 2018. "The Consequences of Electronic Waste Post-Disaster: A Case Study of Flooding in Bonn, Germany," *Sustainability* 10 (11), 4193.

Moore, E.A.*, Babbitt, C.W., Connelly, S.J., Tyler, A.C., Rogalskyj, G. 2018. "Cascading ecological impacts of fullerenes in freshwater ecosystems." Revise and Resubmit. *Environmental Toxicology and Chemistry*.

Babbitt, C.W. and Moore, E.A.* 2018. "Sustainable nanomaterials by design." Invited contribution to *Nature Nanotechnology News and Views*, 13 (8), 621-622.

Ryen, E.G.*, Babbitt, C.W., Gaustad, G., Babbitt, G.A. 2018. "Ecological foraging models as inspiration for optimized recycling systems in the circular economy. *Resources, Recycling and Conservation*, Special Issue on Circular Economy, 135, 48-57.

Moore, E.A.* Babbitt, C.W., Gaustad, G., Moore, S.T. 2018 "Portfolio optimization of nanomaterial use in clean energy technology." *Environmental Sciences & Technology*, 52 (7), 4440-4448.

Kasulaitis, B.V.*, Babbitt, C.W., Krock, A.K. 2018. "Dematerialization and the circular economy: Comparing strategies to reduce material impacts of the consumer electronic product ecosystem." *Journal of Industrial Ecology*. In press, DOI: <https://doi.org/10.1111/jiec.12756>

Smith, B. L.* Babbitt, C.W., Horowitz, K., Gaustad, G., & Hubbard, S. M. 2018. Life Cycle Assessment of III-V Precursors for Photovoltaic and Semiconductor Applications. *MRS Advances*, 3(25), 1399-1404.

- Richa, K.* , Babbitt, C.W., Gaustad, G., 2017. “Eco-efficiency analysis of a lithium-ion battery waste hierarchy inspired by circular economy.” *Journal of Industrial Ecology*, Special Issue on Circular Economy, 21 (3), 715-730.
- Richa, K.* , Babbitt, C.W., Nenadic, N., Gaustad, G. 2017. “Environmental trade-offs across cascading lithium-ion battery life cycles.” *International Journal of Life Cycle Assessment*, Special Issue on Electric Vehicles, 22 (1), 66-81.
- Bustamante, M.L.* , Hubler, B.* , Gaustad, G., Babbitt, C.W. 2016 “Life cycle assessment of jointly produced solar energy materials: Challenges and best practices.” *Solar Energy Materials and Solar Cells*, Special Issue on Life Cycle, Environmental, Ecology and Impact Analysis of Solar Technology, 156, 11–26.
- Wang, X.* , Gaustad, G., Babbitt, C.W. 2016 “Targeting high value metals in lithium-ion battery recycling via shredding and size separation.” *Waste Management*, 51, 204-213.
- Komeijani, M.* , Ryen, E.G.* , Babbitt, C.W. 2016 “Bridging the Gap between Eco-Design and the Human Thinking System.” *Challenges*, Special Issue on Electronic Waste – Impact, Policy and Green Design, 7(1), 1-16.
- Bawden, K.R.* , Williams, E., Babbitt, C.W. 2016 “Mapping product knowledge to life cycle inventory bounds: case study of steel manufacturing.” *Journal of Cleaner Production*, 113, 557-564.
- Kasulaitis, B.V.* , Babbitt, C.W., Kahhat, R., Williams, E., Ryen, E.G.* 2015. “Evolving materials, attributes, and functionality in consumer electronics: case study of laptop computers.” *Resources, Conservation and Recycling*, 100, 1-10.
- Ryen, E.G.* , Babbitt, C.W., Williams, E. 2015. “Consumption-weighted life cycle assessment of a consumer electronic product community.” *Environmental Science & Technology*, 49, 2549–2559.
- Ryen E.G.* , Babbitt, C.W., Tyler, A.C., Babbitt, G.A. 2014. “Community ecology perspectives on the structural and functional evolution of consumer electronics.” *Journal of Industrial Ecology*, 8, 708-721.
- Ebner, J.* , Babbitt, C.W., Winer, M., Hilton, B., Williamson, A. 2014. “Life cycle greenhouse gas (GHG) impacts of a novel process for converting food waste to ethanol and co-products,” *Applied Energy*, 130, 86-93.
- Richa, K.* , Babbitt, C.W., Gaustad, G., Wang, X.* 2014. “A future perspective on lithium-ion battery waste flows from electric vehicles,” *Resources, Conservation, and Recycling* 83, 63-76.
- Wang, X.* , Gaustad, G., Babbitt, C.W., Richa, K.*. 2014. Economies of scale for future lithium-ion battery recycling infrastructure. *Resources, Conservation and Recycling* 83, 53-62.
- Wang, X.* , Gaustad, G., Babbitt, C.W., Bailey, C.* , Ganter, M.* , Landi, B. 2014. “Economic and environmental characterization of an evolving Li-ion battery waste stream.” *Journal of Environmental Management* 135, 126-134.
- Ganter, M.J.* , Landi, B.J., Babbitt, C.W., Anctil, A.* , Gaustad, G. 2014. “Cathode Refunctionalization as a Lithium Ion Battery Recycling Alternative.” *Journal of Power Sources* 256, 274-280.
- Krystofik, M.* , Babbitt, C.W., Gaustad, G. 2014. “When consumer behavior dictates life-cycle performance beyond the use phase: case study of inkjet cartridge end-of-life management.” *International Journal of Life Cycle Assessment* 19, 1129-1145.
- Lobos, A., Babbitt, C.W. 2013. “Integrating emotional attachment and sustainability in electronic product design.” *Challenges* 4, 19-33. <http://dx.doi.org/10.3390/challe4010019>
- Lin, J.* , Babbitt, CW., Trabold, T. 2013. “Life cycle assessment integrated with thermodynamic analysis of bio-fuel options for solid oxide fuel cells,” *Bioresource Technology*, 128, 495-504.
- Anctil, A.* , Babbitt, C.W., Raffaele, R.P., Landi, B.J. 2013. “Cumulative energy demand for small molecule and polymer photovoltaics,” *Progress in Photovoltaics: Research and Applications*, 21 (7) 1541-1554.

- Schauerman, C.M.*, Ganter, M.J.*, Gaustad, G., Babbitt, C.W., Raffaele, R.P., Landi, B.J. 2012. "Recycling single-wall carbon nanotube anodes from lithium ion batteries," *Journal of Materials Chemistry*, 22, 12008-12015.
- Anctil, A.*, Babbitt, C.W., Raffaele, R.P., Landi, B.J. 2011. "Material and energy intensity of fullerene production." *Environmental Science & Technology* 45 (6), 2353–2359.
- Babbitt, C.W.; Williams, E.; Kahhat, R. 2011 "Institutional disposition and management of end-of-life electronics." *Environmental Science and Technology* 45 (12), 5366-5372.
- Deng, L., Babbitt, C.W., Williams, E. 2011. "Economic-balance hybrid LCA extended with uncertainty analysis: case study of a laptop computer." *Journal of Cleaner Production* 19 (11), 1198-1206.
- Babbitt, C.W., Lindner, A.S. 2011. "Effect of nitrogen source on methanol oxidation and genetic diversity of methylotrophic mixed cultures enriched from pulp and paper mill biofilms" *Biodegradation* 22(2), pp. 309-320.
- Babbitt, C.W., Kahhat, R., Williams, E., Babbitt, G.A. 2009. "Evolution of product lifespan and implications for environmental assessment and management: a case study of personal computers in higher education." *Environmental Science and Technology* 43: 5106-5112.
- Babbitt, C.W., Pacheco, A.P., Lindner, A.S. 2009. "Methanol removal performance and microbial ecology of an activated carbon biofilter." *Bioresource Technology*. 100(24): 6207-6216.
- Babbitt, C.W.; Stokke, J.M.; Mazyck, D.W.; Lindner, A.S. 2009. "A design-based life cycle assessment of hazardous air pollutant control options at pulp and paper mills: A comparison of thermal oxidation to photocatalytic oxidation and biofiltration." *Journal of Chemical Technology and Biotechnology* 84: 725-737.
- Babbitt, C.W., Lindner, A.S. 2008. "A life cycle comparison of disposal and beneficial use of coal combustion products in Florida; Part 2: Impact assessment of disposal and beneficial use options." *International Journal of Life Cycle Assessment* 13(7): 555-563.
- Babbitt, C.W., Lindner, A.S. 2008. "A life cycle comparison of disposal and beneficial use of coal combustion products in Florida; Part 1: Methodology and inventory of material, energy, and emissions. *International Journal of Life Cycle Assessment* 13(3): 202-211.
- Babbitt, C.W., Lindner, A.S. 2005. "A life cycle inventory of coal used for electricity production in Florida." *Journal of Cleaner Production*. 13(9): 903-912.

Books and Book Chapters

-
- Trabold, T.A. and Babbitt, C.W., Eds. 2018. *Sustainable Food Waste-to-Energy Systems*. Elsevier Academic Press, Cambridge, MA.
- Armington, W.R.,* Chen, R.B., Babbitt, C.W. 2018. "Challenges and innovations in food waste-to-energy management and logistics." In *Sustainable Food Waste-to-Energy Systems*. Elsevier Academic Press, Cambridge, M.A.
- Ebner, J.H., Hegde, S., Win, S.S., Babbitt, C.W., Trabold, T.A. 2018. "Environmental Aspects of Food Waste-to-Energy Conversion." In *Sustainable Food Waste-to-Energy Systems*. Elsevier Academic Press, Cambridge, M.A.
- Ryen, E.G.*, Babbitt, C.W., Lobos, A. 2017. "Life cycle thinking and sustainable design for emerging consumer electronic product systems." *Routledge Handbook of Sustainable Design*, R.B. Egenhofer, Ed. Routledge International Handbook.

Editorials

-
- Babbitt, C. W. 2018. Communicating science for clean technologies. *Clean Technologies and Environmental Policy*, 20(8) 1735-1736.

- Babbitt, C.W., Gaustad, G., Fisher, A., Chen, W. Q., & Liu, G. 2018. Closing the loop on circular economy research: From theory to practice and back again. *Resources, Recycling and Conservation*, Special Issue on Circular Economy, 135, 48-57.
- Babbitt, C. W. 2017. Foundations of sustainable food waste solutions: innovation, evaluation, and standardization. *Clean Technologies and Environmental Policy*, 19(5) 1255-1256.
- Babbitt, C.W. 2017. A “systems” perspective on clean technology. *Clean Technologies and Environmental Policy*, 19(10) 2341-2342.

Awards and Funding

Principal Investigator on over \$2.3 Million in sponsored research at RIT:

- National Science Foundation, **PI:** \$991,925. “INFEWS/T3: Managing Energy, Water, and Information Flows for Sustainability across the Advanced Food Ecosystem.” Environmental Sustainability Program, 2016-2020.
- Consumer Technology Association, **PI:** \$87,100. “Sustainable Materials Management Metrics for Consumer Technology,” 2018-2019.
- Consumer Technology Association, **PI:** \$90,000. “Sustainable Materials Management for Consumer Technology,” 2017-2018.
- Staples Sustainable Innovation Lab, **PI:** \$36,148. “Resource and waste implications of the evolving electronic product community,” Staples Sustainable Innovation Lab at RIT, 2016-2017.
- New York State Pollution Prevention Institute, **PI:** \$73,778. “Scalable size separation technology to enhance recovery of metals from electronic wastes.” 2015-2016.
- National Science Foundation, **PI:** \$300,854. “Direct and embodied ecological impacts across the fullerene life cycle.” Environmental Health and Safety of Nanotechnology Program, 2014-2018.
- National Science Foundation, **PI:** \$400,355. “CAREER: End-of-Life Material Flows From Emerging Lithium-Ion Battery Systems.” NSF Faculty Early Career Development Program, 2013-2018.
- National Science Foundation, **PI:** \$298,610. “Evaluating sustainable production and consumption dynamics in complex product systems.” Environmental Sustainability Program, 2012-2016.
- Staples Sustainable Innovation Lab, **PI:** \$33,594. “Multi-stakeholder perspectives on sustainable office product design,” Staples Sustainable Innovation Lab at RIT, 2012-2013.
- Staples Sustainable Innovation Lab, **PI:** \$35,875. “Life-cycle environmental assessment of the office product ‘ecosystem’” Staples Sustainable Innovation Lab at RIT, 2012-2013.
- U.S. Environmental Protection Agency, **PI:** \$51,000. “Expanding Industrial Ecology by Applying Community Ecology Principles for Sustainable Product Systems,” 2011-2014.
- AT&T Technology and Environment Award, **PI:** \$25,000. “Sustainable design of evolving ICT devices,” 2011-2012.
- Kodak Corporation, **PI:** \$31,200. “Evaluation of sustainable design tools and processes for Kodak product sectors,” 2010-2011.

Co-Principal Investigator on over \$700,000 in sponsored research at RIT:

- New York State Pollution Prevention Institute, **Joint-PI:** \$150,000. Developing environmentally benign battery recycling processes: characterizing “green” leaching agents. 2011-2014. Responsible for 50% of concept and effort.
- National Science Foundation, **Co-PI:** \$293,000. “Quantifying environmental risks and opportunities for nano-scale LiFePO₄ and LiMnO₂ cathode battery technologies at end-of-life.” Environmental Health and Safety of Nanomaterials Program, 2011-2014. Responsible for research on environmental assessment of end of life alternatives.

New York State Energy Research & Development Authority, Co-PI: \$197,915 “Environmentally Preferable End-Of-Life Management for Li-Ion Batteries,” 2011-2013. Responsible for research on life cycle assessment of EOL management options and logistics required to implement sustainable take-back of Li-ion batteries.

Intel Corporation, Co-PI: \$97,446 “Analysis of E-Waste Material Flows, and Opportunities for Improved Material Recovery,” 2009-2010. Responsible for Phase 1 of the project, including product and material flow analyses for computer products in the U.S., E.U., and Japan.

Science Communication

I aim to translate research to enhance public understanding of science and sustainability.

The Food Waste Dilemma: Video presentation for the 2016 Disruptive Innovation Festival:

<https://www.youtube.com/watch?v=RHO6jmkmtZY>

What Ecology Can Teach Us About Sustainable Design: Presentation at the 2015 TEDxFlourCity:

<http://tedxflourcity.com/?q=speaker/2015-main-event/dr-callie-babbitt>

The Circular Economy: A One Universe at a Time Podcast:

<https://briankoberlein.com/2015/11/14/the-circular-economy/>

Electric Cars and Rare Earth Elements: A One Universe at a Time Podcast:

<https://briankoberlein.com/2015/06/06/electric-carsrare-earth-elements/>

Electronic Waste and Solar Power: A One Universe at a Time Podcast

<https://briankoberlein.com/2015/03/28/electronic-wastesolar-power/>

Student Advising

Student advising and mentoring is a key facet of my research program, where my goal is to train the next generation of research leaders who are able to think critically and creatively about global sustainability challenges and create innovative, interdisciplinary, and high-impact solutions. I have a commitment to recruiting and mentoring female and underserved groups across the STEM pipeline.

- Primary advisor for 16 Ph.D. and M.S. Sustainability students and one post-doc. Students I advised have gone on to careers in industry, consulting, education, national labs, and nonprofit.
- Research advisor and mentor for 8 undergraduate and high school students. While the Sustainability department at RIT does not have undergraduate programs, I mentor students from the Ronald E. McNair Post-baccalaureate Achievement Program (first-generation college students or students from traditionally underrepresented groups) and the ACS Project SEED Program (summer research internship for economically disadvantaged high school students)
- Dissertation and thesis committee member for 20 M.S. and Ph.D students at RIT. I assist students with applying sustainability assessment methods to their research topics, including material flow analysis, life cycle assessment, or circular economy.

Teaching Experience

Research inspires and informs my curriculum development in the “Teacher-Scholar” model. Many of the courses below are unique to RIT and curriculum has been self-developed.

Sustainability courses developed and taught at Rochester Institute of Technology, 2009-present:

- Communicating Sustainability (Graduate elective)
- Sustainable Food, Energy, and Water Systems (Graduate elective)
- Climate Change Science and Solutions (Graduate elective)
- Applied Life Cycle Assessment (Graduate elective)
- Industrial Ecology (Graduate requirement for MS/PhD)
- Sustainable Product Design (Interdisciplinary Sustainability and Industrial Design elective)

- Fundamentals of Sustainability Science (Graduate requirement for MS/PhD)
- Understanding Sustainability (Graduate requirement for MArch)

Nominee (2010, 2012, 2014, 2015, 2016) RIT Richard and Virginia Eisenhart Provost's Award for Excellence in Teaching.

Professional Recognition and Service

Activities focus on engaging broader academic and public communities and supporting and advancing the scholarly goals of the sustainability field, its journals, and its funding agencies.

Editor: Journal of Clean Technology and Environmental Policy, Associate Editor for North America, 2016-present

Editor: Resources, Conservation and Recycling, Managing Guest Editor and Issue Guest Editor for Special Issues on Circular Economy, 2016-present

Jury: “Make our Planet Great Again”, French National Center for Scientific Research, Selection of Awarded research grants. 2017-present

Officer: International Society for Industrial Ecology, Nominating Committee, 2014-2018

Delegate: U.S. Delegation to the 2017 G7 Environmental Ministers Meeting, 2017

Board member: ERASMUS MUNDUS International Master's programme in Industrial Ecology, 2010-2015

Technical resource: Provide expert input to national and international e-waste research including EPEAT Benefits Calculator, EPA WARM Model, EPA E-waste Model, 2017-Present

Technical committee: International Electronics Manufacturing Initiative (iNEMI): Metals Recycling Project, 2013-2014

Grant reviewer: National Science Foundation, NASA, U.S. EPA, Natural Sciences and Engineering Research Council of Canada, Academy of Finland, 2009-present

Conference organizing committee: International Symposium of Sustainable Systems and Technology, Engineering Sustainability, AICHE Sustainable Packaging Symposium, Engineering Strategies for a Sustainable Food Supply Chain Workshop

Journal reviewer: *Environmental Science & Technology*, *Progress in Photovoltaics*; *Nature Nanotechnology*; *Resource, Conservation & Recycling*; *Journal of Hazardous Waste*; *Energy and Environmental Science*, *Environmental Engineering Science*, *Journal of Cleaner Production*; *Journal of Industrial Ecology*, *Journal of Waste Management*, and many others.

Invited speaker: IUPAC World Chemistry Congress (2019); TMS (The Minerals, Metals & Materials Society) REWAS Conference (2019); E-Scrap (2018, 2010); Engineering Sustainability (2017); Consumer Electronics Show (2017, 2018); International Conference on the Environmental Effects of Nanoparticles and Nanomaterials (2016); invited presentations to universities and scholarly presentations at numerous conferences in the field (2008-present).

Institutional Service

Service focuses on growing research and graduate education at RIT and creating policy and practices to recruit and retain female faculty

- Member and Sub-committee Chair, Research & Scholarship Committee 2018-present
This is a committee I proposed and championed after observing a lack of representation for research activities in RIT shared governance.
- Member, Eugene H. Fram Chair in Applied Critical Thinking Advisory Board, 2015-present
- Member, Council on the Representation and Engagement of Women Faculty, 2015-present
- Member, RIT Undergraduate Research Symposium program committee, 2012-present
- Member, RIT Academic Affairs Committee, 2014-2018

- Member, RIT Middle States Self-Study Accreditation Sub-committee, 2015-2016
- Co-Chair, RIT Strategic Plan: Graduate Research and Education Sub-committee, 2014
- Member, RIT Graduate Education Task Force, 2012-2013

Service within the Golisano Institute for Sustainability focuses on developing, evaluating, and improving sustainability curriculum and supporting our graduate population.

- Member and Chair (2018-) GIS curriculum committee, 2009-present
- Mentor, Future Faculty Fellow in Sustainability, 2017-present
- Member, GIS Faculty search committee, 2018-present
- Member, GIS Tenure and Pre-tenure committee, 2016-2018
- Member, Masters of Architecture curriculum committee, 2011-2016
- Member, Masters of Architecture admissions committee, 2011-2014
- Member, GIS Architecture Faculty search committee, 2013-2014
- Member, NanoPower Research Lab Director search committee, 2010-2013
- Chair, GIS Faculty search committee, 2009-2010 and 2010-2011
- Member, GIS Academic Director search committee, 2009-2010

Outreach and Community Engagement

Activities aim to share sustainability advances while engaging diverse and underrepresented groups.

- **K-12 Outreach:** Ongoing partnership (2010-present) with Women in Engineering at RIT (WE@RIT) to develop hands-on engineering experiences for female students in grades 5-12, to raise awareness and interest in sustainability and STEM careers
- **World of Inquiry School:** Ongoing partnership (2014-present) developing Experiential Learning modules for 11th-grade Environmental Science students in this Rochester City School, to raise awareness of sustainability issues and encourage college applications. This effort has led to educational modules (<https://www.rit.edu/gis/nanomaterials-use-or-not-use>) shared with high school teachers nationally, through the National Science Teachers Association and the Cornell Biology Teachers programs
- **French Road Elementary School:** Ongoing service (2014-present) as volunteer with the “FRES Treehuggers” and “Recycling Rangers” in support of school-wide zero-waste initiatives
- **Community presentations:** Invited speaker on sustainability topics to Brighton and Rochester City School Districts, to local religious and community organizations, and to the Little Theatre “Science on Screen” series
- **News coverage:** Research has been profiled in Science News, NPR, Al Jazeera-English, Sierra Club Magazine, Grist, Telemundo, Good Call, and local Rochester TV and news programs