

**Nordica A. MacCarty, Ph.D.**  
Assistant Professor of Mechanical Engineering  
School of Mechanical, Industrial, and Manufacturing Engineering  
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## EDUCATION

- Ph.D. Mechanical Engineering (GPA 4.0/4.0), Iowa State University, 2015  
Dissertation: “Development and use of an integrated systems model to design technology strategies for energy services in rural developing communities”  
Advisor: Dr. Kenneth Mark Bryden
- M.S. Mechanical Engineering (GPA 4.0/4.0), Iowa State University, 2013  
Thesis: “A zonal model to aid in the design of household biomass cookstoves”  
Advisor: Dr. Kenneth Mark Bryden
- B.S. Mechanical Engineering, minor in Business Administration (GPA core 3.78/4.0), Iowa State University, 2000

## ACADEMIC EXPERIENCE

Assistant Professor, Mechanical Engineering, Oregon State University, 2015-present  
National Science Foundation Graduate Research Fellow, Iowa State University, 2010-2015  
National Merit Scholar, Iowa State University, 1996-2000

## OTHER PROFESSIONAL EXPERIENCE

Laboratory Manager and International Consultant, Aprovecho Research Center, Cottage Grove OR, 2004–2010  
Undergraduate Research Assistant, Ames Laboratory Center for Nondestructive Evaluation, Ames IA, 1999-2000  
Technical Assistant, Wandling Engineering, P.C., Ames IA, 1999-2000  
Corporate Engineering Intern, 3M Abrasive Systems Division, Ames IA, 1997-1999

## HONORS and AWARDS

National Science Foundation Graduate Research Fellowship, 2010-2015  
National Merit Scholar, full merit scholarship to Iowa State University, 1996-2000  
Impact Invention Award, Elevating Impact Summit, Portland Oregon, February 2017

## KEYNOTE and INVITED TALKS

Keynote Speech, “Humanitarian Science and Engineering: Changing Lives and Improving the World with a STEM Degree”, Oregon State University Seniors Exploring Engineering Day for the

Programs for Women and Science in Engineering and LSAMP Bridge, Corvallis, Oregon, January 2016.

Invited Talk, "Proposed Benchmarks for Biomass Cookstoves," U.S. EPA Partnership for Clean Indoor Air Coordination and Partner Preparation Meeting, Bonn, Germany, October 2006.

Invited Talk, "Proposed Benchmarks for Improved Cooking Stoves," International Meeting on Indoor Air Pollution, Fuel-Efficiency Stoves and Sustainable Development, Brasilia, Brazil, October 2006.

## ACADEMIC AREAS OF SPECIALIZATION

Despite significant scientific and engineering advances in the 21<sup>st</sup> century, nearly 40% of the world's population continues to have their most basic needs for energy, water, and livelihoods unmet. My goals are to integrate modern engineering tools with understanding from the social, environmental, and economic sciences to develop effective and appropriate solutions to meet these needs while providing students the opportunities to develop both their technical skillsets and cross-cultural understanding to help bridge the gap between design and reality.

### Research Interests

My primary research interest is in the use of sensing and computational modeling to assist design and decision making in complex energy systems. My work in this area includes

- Development and commercialization of tools and systems to help cleantech and development projects to understand if their interventions are working through independent, inexpensive, external validation.
- The development of an extensible modeling and decision making framework that enables federated model integration across fields and areas that are traditionally regarded as separate. This framework supports energy system design and management that incorporates detailed models, real-world performance, and use-driven factors and supports the use of probabilistic algorithms and multi-objective optimization in decision making.
- In my doctoral research, this framework was applied to determine the most appropriate technologies to meet needs for thermal, luminous, mechanical, and electrical energy in an isolated developing village in order to provide the largest benefits in terms of health, climate, efficiency, cost, and quality of life.
- Master's research focused on design and analysis of heat transfer and combustion in the small energy systems. Included development of a validated zonal model for fluid flow and heat transfer for use during the conceptual design of a small biomass cookstove based on methodology and experimental data from the literature.

In the future I plan to extend this framework to enable the analysis of a number complex energy systems of various scales. I am particularly interested in understanding the connections between energy, society, and the environment.

### Research Awards and Funding

National Science Foundation, Engineering Systems Design: Novel Framework for Incorporating Consumer Preferences and Public Goals into Engineering Design Applied to Energy Technologies, PI, May 2017, \$348,000

Undergraduate Research, Innovation, Scholarship and Creativity (URISC) funding, Laboratory and Field Testing of a High-Efficiency Water Pasteurization System for Developing Communities, Summer 2017, \$4,000

MIME Strategic Innovation Grant, FUEL Sensor development, PI, Winter 2017, \$10,000

MIME Strategic Innovation Grant, Combustion chamber material development, PI, Winter 2017, \$5,000

Venturewell Student Entrepreneurial Team Support, High efficiency biomass fired water pasteurization system, PI, Winter 2017, \$5,000

ESCO Foundation support of sensor prototype development, PI, January 2017, \$7,000

Undergraduate Research Scholarship, and the Arts Engage Fellowship for mentorship of first-year undergraduate student Joshua Erkman, 2016, \$1,250

National Science Foundation Graduate Research Fellowship, 2010-2013. \$95,000 plus \$31,500 cost of education allowance.

### Teaching Interests

My background is in thermal-fluid sciences, engineering design, computational modeling and optimization, and combustion. I have a particular interest in entrepreneurship, the design of energy systems for the developing world, and the use of engineering tools to address poverty and environmental issues in a multi-disciplinary context. I am also working to develop and lead interdisciplinary field courses and research experiences for undergraduate and graduate students.

### Teaching Awards and Funding

Summer session grant to cover instructor travel expenses for HEST 299/599: Household Energy in Guatemala in the amount of \$3,000

### Teaching Experience:

NEW COURSE DEVELOPMENT: HEST 299/599 – Humanitarian Engineering, Science and Technology 299/599: Household Energy in Guatemala: Technology, Environment, and Society. Spring and Summer 2016. This course introduces students to the technical, social, and environmental issues surrounding needs for household energy in developing countries and investigates a variety of technological solutions to meet those needs in both theory and practice. It involves a 10-day faculty-led study abroad experience in June 2016 where students will conduct experiments and surveys in conjunction with ongoing efforts by the US EPA and StoveTeam International.

ME 450/550 – Applied Heat Transfer, Oregon State University, Winter 2016 – full curriculum development based on a syllabus and textbook.

MIME 101 – Introduction to Mechanical, Industrial and Manufacturing Engineering, Oregon State University, Fall 2015.

ME 220 – Globalization and Sustainability, Iowa State University, GTA Spring 2014.

Other Teaching Experience – For a period of 5 years I routinely taught technical classes on biomass cookstove design and cookstove testing protocols to diverse international audiences in groups up to 250 participants in both structured classroom and informal hands-on settings.

### Student Mentoring

Ph.D. Students

Jennifer Ventrella, anticipated 2021

Mohammad Pakravan, anticipated 2019

## M.S. Students

Nicholas Moses, anticipated 2019

Grace Burleson, anticipated 2019

## Undergraduate Honors Students Mentoring/Committee

Connor Parrott, honors college undergraduate thesis advisor, Mechanical Engineering, 2016-2017. Thesis title: Flow Cytometry

Adrian Hinkle, honors college undergraduate thesis advisor, Mechanical Engineering, 2016-2017. Thesis title: Communication Strategies for Latin American Engineers Without Borders Programs

Grace Burleson, honors college undergraduate thesis advisor, Mechanical Engineering, 2015-2016. Thesis title: Water treatment technologies for the developing world

## Undergraduate Students

Elizabeth Andreyka and Joshua Johnson, Venturewell Student E-Team for water pasteurization system, 2017.

Joshua Erkman, first-year undergraduate research mentor, Industrial Engineering: Undergraduate Research Scholarship, and the Arts Engage Fellowship for mentorship, 2016.

## Senior Capstone Projects

Senior Mechanical Engineering Capstone Project Sponsor and Advisor: Design of a thermoelectric generator for a biomass cookstove: Jeffrey Leslie, Edward Hynes, Faisal Alkhaldi, 2017

Senior Mechanical Engineering Capstone Project Advisor to flow cytometry group: Connor Parrott, Davis Raye, Tyler Vonderach, 2016-2017.

Senior Mechanical Engineering Capstone Project Advisor to three groups: Alexander Muschler, Barea Eraqi, Beau Hansen; Bryan Calidonna, Joe Van Kleek, Brendon Allen; Braulio Vasquez, Moayed Alhuwaikim, Mohamed Jarbooa, 2016

## Service

Engineers in Technical Humanitarian Opportunities of Service (ETHOS), Member (2000-present), Board of Directors (2014-present), Treasurer (2016-present).

Society of Women Engineers, Professional Development Planning Committee, November 2016-Present

Partners for Sustainable Schools, secretary of the Board of Directors and volunteer 2<sup>nd</sup>-5<sup>th</sup> grade classroom teacher, August 2013-August 2015.

Aprovecho Research Center, advisor and technical editor, August 2010-present.

## TECHNICAL PUBLICATIONS

### Journal Publications

Submitted

1. S. Suram, **N. MacCarty**, and K.M. Bryden, "A distributed systems approach to engineering modeling" In review for *Advances in Engineering Software*.

2. **N. MacCarty** and K.M. Bryden, “Costs and impacts of potential energy strategies for rural households in developing communities” In revision for *Energy*.
3. Stevenson P, Mattson C, Bryden KM, **MacCarty N**. Toward a Universal Impact Metric for Engineered Products in Developing Countries. In review for *Journal of Mechanical Design*.

#### Published

1. **N. MacCarty** and K.M. Bryden, “An integrated systems model for energy services in rural developing communities” *Energy* 113:536-557, 2016.
2. **N. MacCarty** and K.M. Bryden, “A generalized heat transfer model for shielded-fire household cookstoves” *Energy for Sustainable Development*, 33:96-107, 2016.
3. **N. MacCarty** and K.M. Bryden, “A unified set of experimental data for cylindrical, natural draft, shielded single pot wood-fired cookstoves” *Energy for Sustainable Development*, 26:62-71, 2015.
4. **N. MacCarty** and K.M. Bryden, “Modeling of Household Biomass Cookstoves: A Review,” *Energy for Sustainable Development*, 26:1-13, 2015.
5. **N. MacCarty**, D. Still, and D. Ogle, “Fuel Use and Emissions Performance of Fifty Cooking Stoves in the Laboratory and Related Benchmarks of Performance,” *Energy for Sustainable Development*, 14(3):161-171, 2010.
6. C.A. Roden, T.C. Bond, S. Conway, A.B.O. Pinel, **N. MacCarty**, and D. Still, “Laboratory and Field Investigations of Particulate and Carbon Monoxide Emissions from Traditional and Improved Cookstoves,” *Atmospheric Environment* 43:1170-1181, 2009.
7. **N. MacCarty**, D. Ogle, and D. Still, “A laboratory comparison of the global warming impact of five major types of biomass cooking stoves,” *Energy for Sustainable Development*, 12(2):56-65, 2008.
8. E.A.T. Yuntewi, **N. MacCarty**, D. Still, and E. Jurgen, “Laboratory study of the effects of moisture content on heat transfer and combustion efficiency of three biomass cook stoves,” *Energy for Sustainable Development*, 12(2):66-77, 2008.
9. Bailis, R., Ogle, D., **MacCarty**, N., Still, D., Smith, K.R., Edwards, R. 2007. The Water Boiling Test, Version 3.0. Technical report, University of California, Berkeley. [pciaonline.org/node/1048](http://pciaonline.org/node/1048).

#### Published Technical Reports – Author or Co-Author

1. D. Still, **N. MacCarty**, D. Ogle, T. Bond, K.M. Bryden. *Test Results of Cookstove Performance*, US EPA, Washington D.C., 2012.

#### Peer Reviewed Conference Proceedings

1. **MacCarty N**, Burleson G, Moses N, Mulkey T, Johnson J, Andreyka E, Ogle D, Colgan F, Creighton A, Carter T, Andreatta D. Design and Testing of a high-efficiency rapid throughput community-scale water pasteurization system. *Proceedings of the ASME 2017 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2017*, Cleveland, OH August 2017. DETC2017-67830.
2. Stevenson P, Mattson C, Bryden KM, **MacCarty N**. Toward a Universal Impact Metric for Engineered Products in Developing Countries. *Proceedings of the ASME 2017 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2017*, Cleveland, OH August 2017. DETC2017-67584.

3. **N. MacCarty**, K.M. Bryden, “Investigating the effects of design choice and application of energy technologies in rural developing households using an integrated systems model,” *Proceedings of the ASME 2016 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2016*, Charlotte, NC August 2016. DETC2016-59574. Acceptance rate: 78%.
4. **N. MacCarty**, K.M. Bryden, “Modeling technology strategies for thermal energy services in rural developing communities,” *Proceedings of the ASME 2015 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2015*, Boston, MA August 2015. DETC2015-46806. [**with distinction**] Acceptance rate: 68%.
5. **N. MacCarty**, K.M. Bryden, “Components of a framework for the design of energy services for villages in developing countries,” *Proceedings of the ASME 2014 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2014*, Buffalo, NY August 2014. DETC2014-34687. Acceptance rate: 71%.
6. **N. MacCarty**, K.M. Bryden, “A Heat Transfer Model for the Conceptual Design of a Biomass Cookstove for Developing Countries,” *Proceedings of the ASME 2013 International Design Engineering Technical Conference & Computers and Information in Engineering Conference, IDETC/CIE 2013*, Portland, OR August 2013. DETC2013-12650. Acceptance rate: 82%.

#### Trade Journals and Popular Press

1. **N. MacCarty**, Guest Editor, “Stove Testing Protocols, Facilities, and Standards Development,” Partnership for Clean Indoor Air Bulletin, October, 2009.

#### RECENT TECHNICAL PRESENTATIONS

##### Conference and Technical Meeting Presentations

1. **N. MacCarty**, “Engineering systems modeling and decision-based design tools and their applications for village energy,” presented at the 2016 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2016.
2. **N. MacCarty**, K.M. Bryden, “A Holistic Assessment of Village Energy,” presented at the 2015 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2015.
3. **N. MacCarty**, K.M. Bryden, “A Heat Transfer Model for Conceptual Design of Biomass Cookstoves,” presented at the 2013 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2013.
4. **N. MacCarty**, K.M. Bryden, “Computational Modeling of Biomass Stoves: A Literature Review,” presented at the 2012 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2012.
5. **N. MacCarty**, G. Lanza, K. Heising, “Regional Testing Centers,” presented at the 2010 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2010.

6. **N. MacCarty**, J. Cedar, “The Side-Feed Fan Stove,” presented at the 2010 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2010.
7. **N. MacCarty**, “Aprovecho Research This Year,” presented at the 2008 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2008.
8. **N. MacCarty**, “Results of Stove Testing for Global Warming Potential,” presented at the 2007 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2007.
9. D. Still and **N. MacCarty**, “Benchmark Testing Procedure and Results of Stove Testing,” presented at the 2007 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2007.
10. D. Andreatta and **N. MacCarty**, “The Effects of Carbon Monoxide and Particulate Matter on the Human Body,” presented at the 2006 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2006.
11. **N. MacCarty**, “Advanced Studies in Appropriate Technology Laboratory,” presented at the 2006 International Conference on Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2006.

#### Other Presentations

1. **N. MacCarty**, “Designing Household Energy Systems for Developing Countries,” Invited Talk, Engineers Without Borders Student Chapter Meeting, Oregon State University, January 2016.
2. **N. MacCarty**, “Designing Household Energy Systems for Developing Countries,” Distinguished Speaker, ASHRAE Student Chapter Meeting, Oregon State University, November 2015.
3. **N. MacCarty**, “Engineering: A path with purpose,” Invited Talk, Program for Women and Minorities in Engineering Orientation, Oregon State University, September 2015.
4. **N. MacCarty**, “Designing Household Energy Systems for Developing Countries,” Invited Talk, Design Research Seminar, Oregon State University, November 2015
5. **N. MacCarty**, “Ethics for Village Energy,” NSF & National Institute for Ethics Energy and Society Seminar on Ethics in US Energy Supply, Arizona State University, April 2013.

#### WORKSHOPS/PANELS PRESENTED at INTERNATIONAL CONFERENCES and MEETINGS

1. **N. MacCarty**, “Moving up the biomass ladder and cleaner fuel pathways,” Invited Panelist, Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January, 2016.
2. **N. MacCarty**, “Regional Testing Centers,” Invited Panelist, Engineers in Technical and Humanitarian Opportunities for Service, Seattle, WA January 2010.
3. **N. MacCarty**, “Design Principles for Wood Burning Cookstoves,” Partnership for Clean Indoor Air Forum, Kampala, Uganda, March, 2009.
4. **N. MacCarty**, “Stove Test Library,” Partnership for Clean Indoor Air Forum, Kampala, Uganda, March, 2009.

5. **N. MacCarty**, “The Water Boiling Test,” Partnership for Clean Indoor Air Forum, Kampala, Uganda, March, 2009.
6. **N. MacCarty**, “The Controlled Cooking Test,” Partnership for Clean Indoor Air Forum, Kampala, Uganda, March, 2009.

#### EXTENSION/OUTREACH ACTIVITIES

Technical editor and advisor to Aprovecho Research Center, 2012-present.

Presentations to local organizations such as Rotary clubs and university students on design, testing, and modeling of biomass cookstoves for developing countries, 2005–2014.

#### PATENTS

1. **MacCarty N**, Ventrella J, Walter K. “Low power remote logging weight and temperature sensor and method of use.” Provisional Patent, December 2016.
2. D.K. Hsu, D.J. Barnard, J.J. Peters, and **N. Hudelson**, “Non-destructive inspections and the display of inspection results.” US Patent #6327921, December, 2001.

#### PROFESSIONAL ACTIVITIES

##### Professional Conference Leadership Activities

Symposium Chair, ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference – DAC-9, Design for the Developing World, Cincinnati, OH, 2017

Symposium Chair, ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference – DAC-9, Design for the Developing World, Charlotte, NC, 2016

HEARTH Stove Summit, August 2016-present. Planning.

Board of Directors and Planning, Engineers in Technical and Humanitarian Opportunities of Service International Conference, 2014-present.

##### Professional Journal Activities

Associate Editor, *Energy for Sustainable Development*, October 2015-present.

##### Professional Societies

American Society of Mechanical Engineers, Member 2013-present.

Engineers in Technical and Humanitarian Opportunities of Service, Member 2000-Present; Board of Directors, 2014-present, Treasurer, 2015-present.

##### Review and Advisory Panels

ANSI U.S. Technical Advisory Group to ISO/TC 285, Clean cookstoves and clean cooking solutions, Member, 2013-present.

Panelist, Partnership for Clean Indoor Air, Testing protocol and benchmarks for biomass cookstoves, 2005-2010.

##### Recent Peer Reviewer Activities



### Journals

*Energy for Sustainable Development*, 2008-present

*Environmental Science & Technology*, 2017-present

*ASME Journal of Mechanical Design*, 2016-present

*Renewable Energy*, 2016-present

*Science of the Total Environment*, 2016-present

*Energies*, 2016-present

### Conferences

ASME 43<sup>rd</sup> ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference, Cincinnati, OH, 2017

21st International Conference on Engineering Design (ICED17) – Vancouver, Canada, 2017

ASME 42<sup>nd</sup> ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference, Charlotte, NC, 2016

ASME International Mechanical Engineering Congress and Exposition, Houston, TX, 2015

ASME 41<sup>st</sup> ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference, Boston, MA, 2015

ASME 40<sup>th</sup> ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference, Buffalo, NY, 2014

ASME 39<sup>th</sup> ASME International Design Engineering Technical Conference & Computers and Information in Engineering Conference (IDETC/CIE) -- Design Automation Conference, Portland, OR, 2013

### Proposals

Netherlands Foundation for Fundamental Research on Matter

### OTHER ACTIVITIES

OSU Advantage Accelerator: Accelerate, Winter 2017; Launch, Summer 2017

Partners for Sustainable Schools, volunteer teacher and secretary of the board of directors, August 2013-2015.

National Science Foundation/National Institute for Energy Ethics and Society “Ethics in US Energy Policy” Seminar, Arizona State University, 2013

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