

# Darshan Mukesh Arvinda Karwat

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## WORK

### AAAS Science and Technology Policy Fellow

Sept. 2013-Present

*US Department of Energy*

Sept. 2014-

Present

Wind and Water Power Technologies Office

Washington, DC

Areas of work: wave energy conversion • challenges and prizes

- Technical Lead on the \$8 million DOE Wave Energy Prize
  - *Designing a two-year design-build-test prize competition to promote the development of radical wave energy converters (WECs) and establish strong pathways to reduce the cost of electricity generated by WECs*

*US Environmental Protection Agency*

Sept. 2013-

Aug. 2014

Innovation Team, Office of Research and Development

Washington, DC

Areas of work: climate change resilience • air pollution sensors and community science • challenges and prizes

- Co-writer of EPA NCER STAR Funding Opportunity EPA-G2014-STAR-K1, [Air Pollution Monitoring for Communities](#)
  - *A funding opportunity under the EPA's Science to Achieve Results program to solicit research on community empowerment through reducing air pollution exposure using low-cost portable air pollution sensors by focusing on how communities and individuals interact with, manage, and network air pollution sensor data*
- Sponsor of two challenges in 2014 NASA International Space Apps Challenge
  - [Cool It!](#): *A challenge to bring together hardware builders, coders, engineers, social scientists, teachers, and community members. Promoted the creation of sensor kits to measure temperature and relative humidity in real time; real-time micronets of sensor kits and use the data generated to understand local environmental conditions; and community education modules about the urban heat island effect, weather, and climate.*
  - [Community Visions of Climate Adaptation](#): *Promoted the creation of apps, web interactives, maps, 3D models, or visualizations for actionable community plans about climate adaptation to better enable communities to prepare for weather and climate patterns.*

### Postdoctoral Research Fellow

Sept. 2012-Present

*University of Michigan, Ann Arbor, MI*

Combustion and Environmental Research Laboratory, Department of Mechanical Engineering

Areas of research: synergistic effects of fuel blends • homogeneous charge compression ignition engines • *ab initio* kinetics

## Adjunct Lecturer

Jan. 2015-Present

*Howard University, Washington, DC*

Department of Sociology and Anthropology

Teaching a self-made interdisciplinary (sociology and chemical engineering) course for undergraduate and graduate students:  
SOCI 144/CHEG 432/CHEG 632: Climate, Energy and Social Justice

## RESEARCH INTERESTS

Energy systems for climate change mitigation  
Community-based technological development  
Climate change adaptation and resilience  
Combustion chemistry

Environmental and sustainability ethics  
Social and environmental justice  
History and philosophy of technology  
Urban revitalization and service learning

## EDUCATION

### University of Michigan, Ann Arbor, MI

College of Engineering

***Ph.D. in Aerospace Engineering and Sustainability Ethics***

Jan. 2008-

Aug. 2012

G.P.A. 8.42/9.00

*Dissertation title: On the Combustion Chemistry of Biofuels and The Activist Engineer*

*Dissertation advisor: Professor Margaret Wooldridge*

***B.S.E. in Aerospace Engineering***

Aug. 2003-

May 2007

G.P.A. 3.86/4.00 *summa cum laude*

## SCIENTIFIC, ENGINEERING, SOCIAL SCIENCE RESEARCH AND EXPERIENCE

### Experimental Investigation of the Combustion Chemical Kinetics of Aviation Fuel and Biofuel Blends

*Doctoral Student (Dept. of Aerospace Engineering) + Postdoctoral Fellow (Dept. of Mechanical Engineering)*

***University of Michigan, Ann Arbor, MI***

Jan.

2008-Present

- Using chemical kinetic mechanisms to understand how blends of different classes of fuel molecules react in combustion environments to produce chemical kinetic behavior different than individual fuels
- Studying the intermediate radical pool developed in fuel blends, and its influence on toxic, particulate, and greenhouse gas emissions using gas chromatography and laser diagnostics

- Understanding the performance of advanced internal combustion engine strategies—homogenous charge compression ignition—through fuel kinetics
- Experimentally studying the influence of air intake temperature, spark timing and load on spark-assist ignition and consequently on lean HCCI operating limits

## Ethical Considerations of the Use of Biofuels in Aviation in Response to Climate Change + Activist Engineering

*Doctoral Student (Dept. of Aerospace Engineering) + Postdoctoral Fellow (Dept. of Mechanical Engineering)*

**University of Michigan, Ann Arbor, MI**

Jan.

2008-Present

- Combining the history, philosophy, and ethics of technology and the environment and with interviews of practicing engineers to investigate whether or not socioecological issues like climate change have changed the way engineers think about problem solving and technological development
- (Re)introducing the concept of *praxis*, to understand what it means to be an *activist engineer*, someone who steps back from their work and tackles the question, What is the real problem? This reevaluation of the problems that engineers deal with can fundamentally change the nature of technologies developed, and raises a radical alternative rarely considered—not "engineering a solution." Activist engineering goes to the heart of the problems with and offers a solution to contemporary engineering practice that results in social injustice and ecological degradation by asking not, Can we do this? but instead, Should this be done?

## Social Justice and Environmental Sustainability in Impoverished Urban Contexts

*Researcher, Course Developer and Instructor, with graduate students in Geology, Urban Planning, Organizational Theory, Environmental Psychology, and an Urban Planning professor*

**University of Michigan, Ann Arbor, MI**

May 2011-

Aug. 2012

- Researched how social justice concerns affect environmental outcomes, empowering oppressed neighborhood residents to tackle local concerns
- Researched how experiential, service, and immersion learning makes theoretical concepts of sustainability and justice more tangible for students

## Phase Doppler Particle Analysis of Liquid Jets in Hypersonic Crossflow

*Student researcher*

**von Kármán Institute for Fluid Dynamics, Belgium**

Aug. 2007-Nov. 2007

- Using Phase Doppler measurements to study atomization of liquid jets injected in Mach 6 flow

## Far-Infrared Spectroscopy of the Earth's Troposphere

*NASA Langley Aerospace Research Student Scholar*

**NASA Langley Research Center, Hampton, VA**

June 2007-

Aug. 2007

- Studying the Earth's lower atmosphere to determine greenhouse gas concentrations based on far-infrared radiation spectra

## **Supernova Acceleration Probe (SNAP)**

*Student researcher, Dept. of Physics*

**University of Michigan, Ann Arbor, MI**

Jan. 2005-

Dec. 2005

SNAP—A next-generation space telescope, which can view both visible and near infrared regions of the electromagnetic spectrum, being built to observe Type 1A supernovae

- Determining performance characteristics of focal plane arrays in visible and infrared spectra using Indium-Gallium-Arsenic photodiodes and grating monochromators
- Designing casings for filters of charge-couple-devices and spectrometers

## **PROFESSIONAL CONFERENCE ORGANIZING**

### **Climate Change Resilience: Governance and Reforms, Washington, DC**

5-6 June, 2014

Sponsor: Science and Technology Policy Fellowship Program of the American Association for the Advancement of Science

Co-organized (with Dr. James Nachbaur, Dr. Elise Lipkowitz, and Dr. Irina Feygina [all AAAS Fellows]) a two-day summit for 200+ federal, state and local government staff, academics, climate change professionals and activists

Summit program and session videos at [www.resiliencesummit.org](http://www.resiliencesummit.org)

Sessions included:

- Arenas for preparedness and resilience action
- Current federal efforts
- How conflicts are handled today
- Enabling and regulating corporate actions
- Making water systems more resilient
- Lessons from disasters
- Benefits and perils of disaster thinking
- Should the rules be changed?

Speakers and participants included Gar Alpertovitz • David Orr • David Titley • Michael Dorsey • Harriet Tregoning • The Office of Science and Technology Policy • Greensburg GreenTown • Zurich Re • US EPA • US DOE • Georgetown Climate Center • Columbia Law School, among many others

## **TEACHING AND MENTORING EXPERIENCE**

**Climate, Energy and Social Justice – Department of Sociology and Anthropology (SOCI 144) + Department of Chemical Engineering (CHEG 432/CHEG 632)**

*Howard University, Washington, DC*

Spring 2015

- Developed and teaching an interdisciplinary class on energy, climate change and social justice for undergraduate and graduate students
  - Topics covered include: the physics of climate change • climate justice • energy justice • science and technology studies • climate change mitigation, adaptation and resilience • disasters • geoengineering

## **Designing Quantitative Solutions for Energy (BioE 110)**

*University of Maryland, College Park, MD*

Spring 2014

- Mentored one transitioning veteran in an experimental, online, asynchronous undergraduate course designed to engage students in design thinking around energy
  - Project focus: the environmental implications of a sodium sulfur battery backup source for wind energy

## **Sustainable Neighborhoods: Experiential Learning & Active Engagement in Detroit (Program in the Environment 302/Urban Planning 403)**

*University of Michigan, Ann Arbor, MI*

Winter 2011

- Co-developed and co-taught with Krista Badiane (Organizational Theory), Paul Coseo (Urban Planning), Laura Sherman (Geology), Laura Smith (Environmental Psychology) and Professor Larissa Larsen (Urban Planning)
  - Topics covered: food systems • urban agriculture • the built environment • transportation and social justice in urban planning • the concept and realities of sustainability and social justice in urban environments • ways communities and neighborhoods can respond to changing environments • Detroit's history and culture

# **ENVIRONMENTAL ACTIVISM, SCIENCE AND ENVIRONMENTAL POLICY**

## **[Student Sustainability Initiative](#)**

Co-founder

*University of Michigan, Ann Arbor, MI*

Aug. 2008-Aug. 2012

- Founded and guaranteed long-term funding for a strategically placed student group with institutional memory and the ability to interact directly with university administrators, facilities and operations staff, and faculty
- Hired and managed graduate and undergraduate student staff for project management and student organizing
- SSI has been integral in, among other things:
  - the Campus Integrated Assessment in which the University committed \$14 million to sustainability efforts
  - setting green building standards for large (>\$10 million) construction projects
  - instituting zero-waste varsity sporting events
  - the creation of an office of sustainability and a sustainability position at the administrative level
  - educating faculty on how to incorporate sustainability issues into curricula
  - building a corps of residence hall advisors that engage freshmen in sustainable behavior
  - creating a student-led and student-run \$150,000 green revolving fund

## Environmental Issues Commission

Michigan Student Assembly

*University of Michigan, Ann Arbor, MI*

2004-2007

- Advocated for renewable energy certificate purchasing to offset University of Michigan energy consumption from fossil fuel sources

## American Meteorological Society Summer Policy Colloquium

Washington, D.C.

June 2008

- Selected and sponsored by the National Science Foundation to participate in a ten-day immersion for scientists and engineers to learn about federal science and technology policy and politics

## FELLOWSHIPS AND HONORS

- [AAAS Science and Technology Policy Fellow](#) (Sept. 2013-Present)
- [Graham Environmental Sustainability Institute Doctoral Fellow](#) (Jan. 2010–Aug. 2012)
- Michigan Memorial Phoenix [Energy Institute](#) Doctoral Fellow (Jan. 2008-Dec. 2009)
- [NASA Langley Aerospace Summer Scholar](#) (May-Aug. 2007)
- University Honors, Dean's List, University of Michigan (2004-2006)

## PUBLICATIONS

### *Journal*

- Fatouraie, M., **Karwat, D.M.A.**, Wooldridge, M.S. (submitted) "Understanding HCCI performance through PRF chemical kinetics" *Combustion and Flame*
- **Karwat, D.M.A.**, Wooldridge, M.S., Klippenstein, S.J., Davis, M.J. (2015) "Effects of new *ab initio* rate coefficients on predictions of species formed during *n*-butanol ignition and pyrolysis" *Journal of Physical Chemistry A*
- **Karwat, D.M.A.**, Eagle, W.E., Wooldridge, M.S. (2014) "Are there ecological problems that technology cannot solve? Water scarcity and dams, climate change and biofuels" *International Journal of Engineering, Social Justice, and Peace*, pp 7-25
- Wagon, S.W., **Karwat, D.M.A.**, Wooldridge, M.S., Westbrook, C.K. (2014) "An experimental and modeling study of methyl *trans*-3-hexenoate autoignition" *Energy & Fuels*, pp 7227-7234, doi: 10.1021/ef501806s
- **Karwat, D.M.A.**, Eagle, W.E., Wooldridge, M.S., Princen, T.E. (2014) "Activist Engineering: Changing Current Engineering Practice By Deploying Praxis" *Science and Engineering Ethics*, doi: 10.1007/s11948-014-9525-0
- Larsen, L.S., Sherman, L.S., Smith, L.B., **Karwat, D.M.A.**, Badiane, K.C., Coseo, P.J. (2014) "Social Justice and Sustainability in Poor Neighborhoods: Service Learning in Southwest Detroit" *Journal of Planning Education and Research*
- **Karwat, D.M.A.**, Sherman, L.S., Smith, L.B., Badiane, K.C., Coseo, P.J., Larsen, L.S. (2013) "A Lesson in Service Learning and Community Engagement" *Michigan Journal of Sustainability*
- **Karwat, D.M.A.**, Wagon, S.W., Wooldridge, M.S., Westbrook, C.K. (2013) "Low temperature chemical kinetic and speciation studies of *n*-heptane" *Combustion and Flame*, 160, 12, pp 2693-2706

- **Karwat, D.M.A.**, Wagnon, S.W., Wooldridge, M.S., Westbrook, C.K. (2012) "On the combustion chemistry of *n*-butanol and *n*-heptane blends" *Journal of Physical Chemistry A*, 116, 51, pp 12406-12421, doi: 10.1021/jp309358h
- Parson, E.A., **Karwat, D.M.A.** (2011) "Sequential Climate Change Policy" Wiley Interdisciplinary Review, *WIREs Climate Change*, doi:10.1002/wcc.128
- **Karwat, D.M.A.** (2011) "Trash, waste, and time" *Kinesis*, 38, 2, pp 51-58, ISSN 0023-1568
- Teini, P.D., **Karwat, D.M.A.**, Atreya, A. (2011) "Observations of nascent soot: Molecular deposition and particle morphology" *Combustion and Flame*, 150, 10, pp 2045-2055, doi:0.1016/j.combustflame.2011.03.005
- **Karwat, D.M.A.**, Wagnon, S.W., Teini, P.D., Wooldridge, M.S. (2011) "On the chemical kinetics of *n*-butanol—ignition and speciation studies" *Journal of Physical Chemistry A*, 115, 19, pp 4909-4921, doi:10.1021/jp200905n
- Teini, P.D., **Karwat, D.M.A.**, Atreya, A. (2011) "The effect of CO<sub>2</sub>/H<sub>2</sub>O on the formation of soot particles in the homogenous environment of a rapid compression facility" *Combustion and Flame*, 159, 3, pp 1090-1099, doi:10.1016/j.combustflame.2011.10.002
- Walton, S.M., **Karwat, D.M.A.**, Teini, P.D., Wooldridge, M.S. (2011) "Speciation studies of methyl butanoate ignition" *Fuel*, 90, 5, pp 1796-1804

## Conference

- **Karwat, D.M.A.**, Eagle, W.E., Wooldridge, M.S., Princen, T.E. (2013) "Activist Engineering: Changing Current Engineering Practice Through Innovative Praxis" *Engineering Education for Sustainable Development*, University of Cambridge, UK, September 22-25
- **Karwat, D.M.A.**, Wagnon, S.W., Wooldridge, M.S., Westbrook, C.K. (2013) "A speciation study of *n*-heptane chemical kinetics" *8th Joint Meeting of the U.S. Section of the Combustion Institute*, Salt Lake City, UT, May 19-22
- Wagnon, S.W., **Karwat, D.M.A.**, Wooldridge, M.S. (2011) "On the Chemical Kinetics of an Unsaturated C7 Ester: Ignition and Speciation Studies" *International Conference on Chemical Kinetics*, Cambridge, MA
- **Karwat, D.M.A.**, Wagnon, S.T., Teini, P.T., Wooldridge, M.S. (2011) "On the chemical kinetics of *n*-butanol—ignition and speciation studies" *7th Joint Meeting of the U.S. Section of the Combustion Institute*, Atlanta, GA, March 20-23
- Teini, P.D., **Karwat, D.M.A.**, Atreya, A. (2011) "Molecular realignment during soot particle maturation" *7th Joint Meeting of the U.S. Section of the Combustion Institute*, March 20-23
- Wagnon, S.W., **Karwat, D.M.A.**, Wooldridge, M.S. (2011) "Chemical Kinetics of an Unsaturated Ester: Methyl Trans-3-hexenoate" *7th Joint Meeting of the U.S. Section of the Combustion Institute*, Atlanta, GA, March 20-23
- **Karwat, D.M.A.**, Wagnon, S.W., Teini, P.D., Lai, J.Y., Wooldridge, M.S., Westbrook, C.K. (2010) "An Experimental and Computational Investigation of *n*-Dodecane Ignition and Chemical Kinetics" *49th AIAA Aerospace Sciences Meeting*, Orlando, FL
- Walton, S.M., **Karwat, D.M.A.**, Teini, P.D., Wooldridge, M.S. (2009) "Speciation studies of methyl butanoate ignition" *6th Joint Meeting of the U.S. Section of the Combustion Institute*, Ann Arbor, MI
- Zigler, B.T., Walton, S.M., **Karwat, D.M.A.**, Assanis, D., Wooldridge, M.S., Wooldridge, S.T. (2007) "A Multi-Axis Imaging Study of Spark-Assisted Homogeneous Charge Compression Ignition Phenomena in a Single-Cylinder Research Engine" *Proceedings of the 2007 Fall Technical Conference of the ASME Internal Combustion Engine Division*, p 395-405

## INVITED PRESENTATIONS AND TALKS

- "Reimagining Science and Engineering for 21<sup>st</sup> Century Struggles" at *Converge for Climate*, New York City (2014)
- "Where do we go from here? SftP 2.0" at *Science for the People: The 1970s and Today*, University of Massachusetts Amherst (2014)

- [Presentation video](#)
- [Script of presentation](#)
- [“Lessen Our Burden On The World—The Power of Individual Action”](#) *TEDxUofM: Encouraging Crazy Ideas*, Michigan Theater, Ann Arbor (2011)
- “Ongoing work in the Combustion and Environmental Research Laboratory” at the Indian Institute of Technology, Mumbai (2010)
- "Far-Infrared Spectroscopy of the Earth's Troposphere" at NASA Langley Research Center (2007)

## MEDIA AND OTHER WRITINGS

- [Minimizing Entropy](#): Thoughts on ecological degradation and sustainability, and what you can do about them, April 2010-August 2014
- [It's Hot in Here](#), WCBN 88.3 FM Ann Arbor
  - with Merry Walker and Zakiyah Sayyed, Student Sustainability Initiative, 12 October, 2009
  - individually, 18 April, 2011
- [Issues of the Environment](#), WEMU (NPR affiliate) 89.1 FM, 8 June, 2011
- [University of Michigan student halfway through 'year without waste'](#) [annarbor.com](#), 10 October, 2010
- [Why Trash?](#) The Michigan Daily, 10 November, 2010
- University of Michigan Rackham Graduate School [blogger](#), 2011-2012

## PROFESSIONAL ASSOCIATIONS

American Association for the Advancement of Science  
The Combustion Institute  
American Meteorological Society  
Sigma Gamma Tau, National Aerospace Engineering Honor Society  
The Epeians, Engineering Leadership Honor Society

## LANGUAGES

Fluent in Hindi, Gujarati, and Marathi; proficient in French

## REFERENCES

*Contact information available upon request*

Dr. Margaret Wooldridge

Arthur F. Thurnau Professor  
Department of Mechanical Engineering  
Department of Aerospace Engineering  
University of Michigan

Jennifer Gustetic

Assistant Director for Open Innovation  
Executive Office of the President  
Office of Science and Technology Policy

Jay Benforado



Deputy Innovation Officer  
Office of Research and Development  
US Environmental Protection Agency

Dr. Michael Shriberg  
Education Director  
Graham Sustainability Institute  
University of Michigan

Dr. Rubin Patterson  
Professor and Chair  
Department of Sociology and Anthropology  
Howard University

Dr. Alison LaBonte  
Technology Manager  
Wind and Water Power Technologies Office  
Office of Energy Efficiency and Renewable Energy  
US Department of Energy