

CHRISTOPHER L. HAGEN, PHD, PE

1500 SW CHANDLER AVENUE, BEND, OREGON 97702

TELEPHONE: 541-322-2061

EMAIL: CHRIS.HAGEN@OREGONSTATE.EDU

RESEARCH: Energy systems, power-to-gas, hydrogen, hybrid systems, clean water, unconventional fuels, control systems, optical sensors, applied thermodynamics, and fluid mechanics.

EDUCATION: **PhD, Mechanical Engineering** **University of Wisconsin-Madison, 2006**
Emphasis: Thermal Fluid Sciences & Control Systems **Madison, WI**
Thesis topic: *Optical Measurements in Kinetically Controlled Combustion*

MS, Mechanical Engineering **Colorado State University, 2002**
Emphasis: Energy Conversion **Fort Collins, CO**

BS, Mechanical Engineering **Valparaiso University, 1997**
Minor: Manufacturing Management **Valparaiso, IN**

EXPERIENCE: **Associate Professor** **September 2017 – present**
Assistant Professor **July 2012 – August 2017**
Oregon State University-Cascades ***Bend, OR***

Founder and director of the OSU Energy Systems Laboratory. Lead a team of ~10 undergraduate, graduate, postdoctoral, and technician researchers investigating clean, novel energy conversion technologies while instructing energy systems engineering (ESE) students in the thermal-fluid sciences.

Assistant Research Professor **March 2010 – July 2012**
Colorado State University ***Fort Collins, CO***

Conducted experiments and educational activities with regard to advanced power generation systems. Pursuits included assessing the operability of unconventional fuels such as hydrotreated biofuels and biomass-derived low energy density gaseous fuels in combustion engines, field-testing feedback control systems for stationary engine emissions control, and developing optical sensors for both fuel quality monitoring and quantification of trace combustion emissions in the troposphere.

Lead Fuels Research Engineer **December 2006 – March 2010**
Chevron Energy Technology Company ***Richmond, CA***

Developed and implemented fuel research programs to evaluate unconventional fuel performance in high-efficiency gasoline and diesel engines. Technical and project manager of global programs with universities, national laboratories, contract laboratories, and industry partners.

Designed and constructed a >\$2 million, 1000 SF single-cylinder-engine research facility with advanced emission characterization equipment capable of investigating the combustion performance of both bio- and petroleum-derived fuels.

Graduate Research Assistant **August 2003 – December 2006**
University of Wisconsin Engine Research Center ***Madison, WI***

Developed novel laser-based sensors for collecting chemical kinetic information in harsh environments; specifically, absorption-based microsecond-resolution temperature and species concentrations measurements in n-heptane and isooctane-fueled homogenous charge compression ignition (HCCI) engines.

Application Engineer **February 2001 – August 2003**
Woodward Industrial Controls Inc. ***Fort Collins, CO***

Responsible for fuel delivery system development and analysis. Activities included: fuel system design, fuel flow analysis, component selection, and flow calculations.

Oversaw control system development of 400kW miniturbine generator set located at Walter Aircraft Engines, Prague, Czech Republic.

Onsite control system engineer for 30 MW natural gas-fired turbine generator sets, Pratt & Whitney Power Systems, East Hartford, CT.

Engineer **December 1998 – December 2000**
Enginuity International Inc. **Fort Collins, CO**

Primary test engineer for final engine set-up of large bore (> 35 cm) natural gas compression engine emissions reduction retrofit projects. Commissioned control systems with lean oxides of nitrogen (NO_x) reduction algorithms, high-pressure fuel injection systems, precombustion chambers, high-energy multistrike ignition systems, and upgraded turbochargers.

Graduate Research Assistant **May 1997 – December 1998**
Colorado State University Engines and Energy Conversion Lab. **Fort Collins, CO**

Project manager on the Global Engines Laboratory online test cell, a web-based educational tool that allows the user to remotely run physical engine experiments. Project scope was three engine stands fueled with gasoline, diesel, and natural gas, respectively.

Co-op Engineer **May 1994 – August 1996**
Cincinnati Milacron Inc. **Cincinnati, OH**

Assisted senior engineers with fabrication of a high-speed gantry mill for fuselage machining.

TEACHING AND ADVISING:

Courses Taught

ENGR 112 Introductions to Engineering Computing, 2018
ESE 471 Energy Storage (co-taught), 2018
ME 311 Introduction to Thermal and Fluid Sciences, 2015, 2014, 2013, 2012
ME 312 Thermodynamics, 2018, 2017, 2016, 2014, 2013
ME 331 Introductory Fluid Mechanics, 2012
ME 505 Combustion, Reading and Conference, 2014
ESE 499 Intermediate Thermodynamics, 2017
ME 540 Intermediate Thermodynamics, 2017, 2015
MECH 337 (CSU) Thermodynamics, 2012
MECH 417 (CSU) Control Systems, 2010
Guest Lecturer; MECH 661 (CSU) Int. Comb. Eng., ME 770 (U. of WI) Adv. Exp. Instr.

Research Faculty

Dr. Yibin Deng (12-month visiting prof., Wuhan U. of Tech., Wuhan, Hubei, China) 2016
Dr. Kyle Niemeyer, 2015

Post-Doctoral Researchers

Dr. David Wagner, 2016 – 2018 (Asst. Prof. San Jose State University)
Dr. Shyam Menon, 2014 – 2016 (Asst. Prof. Louisiana State University)
Dr. Kyle Niemeyer, 2014 (Asst. Prof. Oregon State University)

Advisor, Graduate Students

PhDME Zachary Taie
PhDME Shane Daly, 2018 (Enel X)
MSME Kyle Anderson
MSME Alex Herman
MSME James Benbrook, 2020
MSME Khang Tran, 2019

MSME Zachary Taie, 2018
MSME Zoe Lavrich, 2018 (element1)
MSME Sean Brown, 2017 (SpaceX)
MSME Shane Daly, 2015
MSME Robert Elgin III, 2014 (Intel)
MSME Matthew Boley (CSU, 2012)
PhDME Devin Yates (UC Berkeley Chevron Intern Supervisee, 2008)

Member, Graduate Committee

PhDEE David Glennon (graduate council representative)
PhDCS Ryan Gambord (graduate council representative)
MSME Morgan Mayer
PhDEE Leila Ghorban Zadeh (graduate council representative)
MSCS Aashish Adhikari (graduate council representative)
PhDME Benjamin Smucker
PhDME Paige Lorson
MSME Harley Glad
PhDME Jayani Jayasuriya
MSME Davis Chamorro, 2020
MSME Daniel Caplan, 2020
MSME Kenta Noma, 2019
MSME Tejas Mulky, 2018
MSME Ahmand Bukshaisha, 2018
MSME Jonathan Bonebrake, 2018
MSCHE Yige Wang, 2017 (graduate council representative)
MSME Tejas Mulky, 2017
MSEE David Berry, 2017 (graduate council representative)
MSME Matthew Hyder, 2017
MSME Aaron Fillo, 2017
MSME Kyle Zada, 2017
MSEE, David Barry, 2017 (graduate council representative)
MSEE Alex Louie, 2016 (graduate council representative)
MSNSE Kyle Hoover, 2016 (graduate council representative)
PhDME Thomas Mosier, 2015
PhDME Ida Truedsson (Faculty Opponent, Lund University, Sweden, 2014)
MSME student Roshan Kochuparampil (CSU, 2013)

Advisor, Undergraduate Honors

BSESE Gertrude Villaverde, 2019
BSME Sean Brown, 2015
BSME Torres Neuhoff (CSU, 2012)

Advisor, Undergraduate Assistants

BSESE Bridger Cook
BSESE Spencer Scott
BSESE Madeline Kier
BSESE Jennifer Speaks, 2018
BSESE Matthew Blaser, 2018
BSESE Michael Wittenburg, 2018
BSESE Jon Young, 2018
BSESE Gertrude Villaverde, 2018
BSESE Lawandy Agustinus, 2017

BSESE Claire Cushing, 2017
BSESE Zoe Lavrich, 2016
BSESE Raymond Kuhn, 2016
BSESE Ryan Heltemes, 2016
BSESE Walter Beckwith, 2015
BSESE James Malone, 2015
BSESE Nicholas Olson, 2015
BSESE Zachary Taie, 2014
BSESE Josh Tibbitts, 2014
BSESE Dustin Stewart, 2013
BSESE Megan Glenn, 2013

Advisor, Visiting Scholar

BS Physics, Margaret Lane, 2017 - 2018

Advisor, Senior Design Practicum

Academic Year (AY) AY 2015, 2014, AY 2013, AY 2011 (CSU), AY 2010 (CSU)

JOURNAL PUBLICATIONS

1. Daly, S., Tran, K., Niemeyer, K.E., Cannella, W.J., **Hagen, C.L.** Predicting Fuel Low-Temperature Combustion Performance Using Fourier-Transform Infrared Absorption Spectra of Neat Hydrocarbons, *FUEL*, Volume 242, 2019, 343-344, <https://doi.org/10.1016/j.fuel.2019.01.054>.
2. Taie, Z., **Hagen, C. L.**, Experimental thermodynamic first and second law analysis of a variable output 1–4.5 kWe, ICE-driven, natural-gas fueled micro-CHP generator. *Energy Conversion and Management*, 2019, 180, 292–301. <https://doi.org/10.1016/j.enconman.2018.10.075>
3. Daly, S., **Hagen, C.L.**, Cenker, E., Pickett, L., Skeen, S., The Effects of Injector Temperature on Spray Characteristics in Heavy-Duty Diesel Sprays, *SAE International Journal of Engines* 11(6):879–891, 2018, doi:10.4271/2018-01-0284.
4. Lavrich, Z., Wagner, D.R., Taie, T., **Hagen, C. L.**, Design considerations for small scale rotating fluidized beds in static geometry with screens for fine particles, *Chemical Engineering Research and Design*, Volume 137, 2018, Pages 89-100, ISSN 0263-8762, <https://doi.org/10.1016/j.cherd.2018.06.044>.
5. Daly, S.R., Niemeyer, K.E., Cannella, W.J., **Hagen, C.L.**, FACE gasoline surrogates formulated by an enhanced multivariate optimization framework, *Energy and Fuels*, 2018 32 (7), 7916-7932, <https://doi.org/10.1021/acs.energyfuels.8b01313>
6. Taie, Z., West, B., Szybist, J., Edwards, D., Thomas, J., Huff, S., Vishwanathan, G., **Hagen, C.L.**, Detailed Thermodynamic Investigation of an ICE-Driven, Natural Gas-Fueled, 1kwe Micro-CHP Generator, *Energy Conversion and Management*. Volume 166, 2018, Pages 663-673, ISSN 0196-8904, <https://doi.org/10.1016/j.enconman.2018.04.077>.
7. Ganti, H., Menon, S.K., Niemeyer, K.E., **Hagen, C.L.**, Effects of Oil and Water Contamination on the Operation of a Natural Gas Internal Combustion Engine, *Journal of Natural Gas Science and Engineering*, Volume 41, May 2017, Pages 30-39, ISSN 1875-5100, <http://doi.org/10.1016/j.jngse.2017.02.038>.
8. Deng, Y., Menon, S.K., Lavrich, Z., Wang, H., **Hagen, C.L.**, Design, Simulation, and Testing of a Novel Micro-Channel Heat Exchanger for Natural Gas Cooling in Automotive Applications, *Applied Thermal Engineering*, Volume 110, January 2017, Pages 327–334, doi: [10.1016/j.applthermaleng.2016.08.193](https://doi.org/10.1016/j.applthermaleng.2016.08.193).
9. Daly, S., Niemeyer, K.E., Cannella, W.J., **Hagen, C.L.**, Predicting Fuel Research Octane Number using Fourier-Transform Infrared Absorption Spectroscopy of Neat Hydrocarbons, accepted for

publication by *Fuel*. Volume 183, 1 November 2016, Pages 359–365,
doi:10.1016/j.fuel.2016.06.097

10. Daly, S.R., Olson, N. **Hagen, C.L.**, Fourier-Transform Infrared Absorption Spectroscopy in Binary Hydrocarbon-Alcohol Single Droplet Evaporation, *Journal of Spectroscopy*, vol. 2016, Article ID 3619634, 7 pages, 2016. doi:10.1155/2016/3619634.
11. Elgin, R.C., **Hagen, C.L.**, A Semi-Empirical CNG Tank Filling Model Created for a Novel Self-Refueling Vehicle System, *Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering*, published online, January 2016, doi: 10.1177/0954407015623409.
12. Malakoutirad, M., Bradley, T.H., **Hagen, C.L.**, Design Considerations for an Engine-Integral Reciprocating Natural Gas Compressor, *Applied Energy*, Volume 156, 2015, pp. 129-137, ISSN 0306-2619.
13. Elgin, R.C., **Hagen, C.L.**, Development and Operation of a Self-Refueling Compressed Natural Gas Vehicle, *Applied Energy*, Volume 155, 2015, pp. 242-252, ISSN 0306-2619.
14. Niemeyer, K.E., Daly, S.R., Cannella, W.J., **Hagen, C.L.**, Investigation of the LTC Fuel Performance Index for Oxygenated Reference Fuel Blends, *Fuel*, Volume 155, 2015, pp. 14-24.
15. Niemeyer, K.E., Daly, S.R., Cannella, W.J., **Hagen, C.L.** A Novel Fuel Performance Index for LTC Engines Based on Operating Envelopes in Light-Duty Driving Cycle Simulations, *ASME Journal of Engineering for Gas Turbines and Power*, 2015, Volume 137, Issue 10 p.101601.
16. **Hagen, C.L.**, Lee, B.C., Franka, I.S., Rath, J.L., VandenBoer, T.C., Roberts, J.M., Brown, S.S., and Yalin, A.P., Cavity Ring-Down Spectroscopy Sensor for Detection of Hydrogen Chloride, *Atmospheric Measurement Techniques*, Volume 7, 2014, pp. 345–357.
17. Kranendonk, L.A., Caswell, A.W., **Hagen, C.L.**, Neuroth, C.T., Shouse, D.T., Gord, J.R., Sanders, S.T., Temperature Measurements in a Gas-Turbine-Combustor Sector Rig Using Swept-Wavelength Absorption Spectroscopy, *Journal of Propulsion and Power* 2009, Volume 25, Issue 4, pp. 859-863.
18. **Hagen, C.L.**, Sanders, S.T., Investigation of Multi-Species (H₂O₂ and H₂O) Sensing and Thermometry in an HCCI Engine by Wavelength-Agile Absorption Spectroscopy, *Measurement Science & Technology* 2007, Volume 18, Issue 7, 1992-1998.
19. **Hagen, C.L.**, Sanders, S.T., Toward Hyperspectral Sensing in Practical Devices: Measurements of Fuel, H₂O and Gas Temperature in a Metal Homogeneous Charge Compression Ignition Engine, *Journal of Near Infrared Spectroscopy*, Volume 15, Issue 4, 2007, pp. 217-225.
20. **Hagen, C.L.**, Schmidt, J.R., Sanders, S.T., Spectroscopic Sensing via Dual-Clad Optical Fiber, *IEEE Sensors Journal*, Volume 6, Issue 5, 2006, pp. 1227-1231.
21. **Hagen, C.L.**, Walewski, J.W., Sanders, S.T., Generation of a Continuum Extending to the Midinfrared by Pumping ZBLAN Fiber with an Ultrafast 1550-nm Source, *IEEE Photonics Technology Letters*, Volume 28, Issues 1-4, 2006, pp. 91-93.
22. Walewski, J.W., Filipa, J.A., **Hagen, C.L.**, Sanders, S.T., Standard Single-Mode Fibers as Convenient Means for the Generation of Ultrafast High-Pulse-Energy Super-Continua, *Applied Physics B- Lasers and Optics* Volume 83, Issue 1, 2006, pp. 75-79.

PEER-REVIEWED CONFERENCE PROCEEDINGS

1. Tran, K., Niemeyer, K., Cannella, W., and **Hagen, C. L.**, Sensitivity Analysis of the Low Temperature Combustion Index to Driving Cycle and Vehicle Specifications, *SAE 2019 World Congress*, Detroit, Michigan, USA, 2019; Volume 2019-01-0959, 2019, <https://doi.org/10.4271/2019-01-0959>.

2. Lavrich Z., Taie Z., Menon S., Daly S., Halliday D., **Hagen C.L.**, Internal Combustion Engines as Fluidized Bed Reactors. *Proceedings of the ASME Internal Combustion Engine Division Fall Technical Conference*, Seattle, WA, USA, 2017, V001T03A001. doi:10.1115/ICEF2017-3524.
3. Brown, S.P., **Hagen C.L.**, Optimized Engine Performance for a 1 KW UAV Hybrid Powertrain, *Proceedings of the ASME Internal Combustion Engine Division Fall Technical Conference*, Seattle, WA, USA, 2017, Paper No. ICEF2017-3555, V002T05A004. doi:10.1115/ICEF2017-3555.
4. Menon, S.K., Ganti, H., **Hagen, C.L.**, Development and Testing of a Bimodal Internal Combustion Engine for a Self-Refueling Vehicle Application, *SAE 2016 World Congress*, Detroit, Michigan, USA, 2016; Volume 2016-01-1014. doi:10.4271/2016-01-1014
5. Menon, S.K., Weyer, K., Pedersen, D., **Hagen, C.L.**, Self-Regulating System for Natural Gas Cooling in a Bimodal Internal Combustion Engine, *Proceedings of the ASME Internal Combustion Engine Division Fall Technical Conference*, Houston, Texas, USA, 2015, Paper No. ICEF2015-1126, pp. V002T07A010. doi:10.1115/ICEF2015-1126.
6. Menon, S.K., Ganti, H., Wang, H., **Hagen, C.L.**, Development and Analysis of Micro-Channel Heat Exchangers for Natural Gas Cooling, *The 13th International Conference on Nanochannels, Microchannels, and Minichannels*, San Francisco, California, USA, 2015.
7. Elgin, R.C., Daly, S., **Hagen, C.L.**, Experimental Validation Towards a Self-Refueling CNG Vehicle to Provide Home Refueling, *SAE 2014 World Congress*, Detroit, Michigan, USA, 2014; Volume 2014-01-1343.
8. Echter, N.P., Weyer, K.M., Turner, C.W., Babbitt, G.R., **Hagen, C.L.**, Design and Analysis of a Self-Refueling CNG Vehicle to Provide Home Refueling, *SAE 2014 World Congress*, Detroit, Michigan, USA, 2014; Volume 2014-01-1341.
9. Boley, M., **Hagen, C.L.**, Simulation of Turbocharged Marine Diesel Engine for Electrical Power System Trainer, *ASME Internal Combustion Engine Division Spring Technical Conference*, ASME: Torino, Piemonte, Italy, May 2012.
10. Rath, J., Franka, I., Lee, B., **Hagen, C.L.**, Yalin, A., Cappelli, M., Electric Field Measurements in Gases Using Cavity Enhanced Polarimetry, *AIAA Aerospace Sciences Meeting*, AIAA: Nashville, TN, January 2012.
11. Zuehl, J.R., Ghandhi, J.B., **Hagen, C.L.**, Cannella, W.J., Fuel Effects on HCCI Combustion Using Negative Valve Overlap, *SAE 2010 World Congress*, Detroit, Michigan, USA, 2010; Volume 2010-01-0161.
12. **Hagen, C.L.**, Sanders, S.T., Application of a Novel White Laser Sensor to an HCCI Engine, *SAE 2006 World Congress*, Detroit, Michigan, USA, 2006, Volume 2006-01-1200.

CONFERENCE PROCEEDINGS, SELECTED PUBLICATIONS, & POSTERS

1. Tran, K., Niemeyer, K. E., **Hagen, C. L.**, Reduced Chemical Kinetics Model for Low-Speed Pre-Ignition Investigation, *Western States Section Combustion Institute 2019 Fall Meeting*, October 2019, Albuquerque, New Mexico, USA
2. Benbrook, J., **Hagen, C. L.**, Hybrid Powertrain Improvements for Increased Flight Duration in Multirotor Unmanned Aerial Systems, *American Institute of Aeronautics and Astronautics (AIAA) conference on Propulsion and Energy*, August 2019, Indianapolis, Indiana, USA
3. Kier, M., Taie, Z., **Hagen, C. L.**, A Study of the Effect of Hydrogen on Gas Leak Detectors: A Step Towards Injecting Hydrogen into the Natural Gas Pipeline, 5th Annual OSU-Cascades Research and Scholarship Symposium, May 2019, Bend, Oregon, USA
4. Taie, Z., Villaverde, G., Speaks, J., **Hagen, C. L.**, Second law implications of utilizing hydrogen for energy storage, *Western States Section Combustion Institute 2018 Spring Meeting*, March 2018, Bend, Oregon, USA.
5. Lane, M.R., Wager, D.R., Taie, Z., **Hagen, C. L.**, Ethane cracker diagnostic development, *Western States Section Combustion Institute 2018 Spring Meeting*, March 2018, Bend, Oregon, USA.

6. Daly, S., **Hagen, C. L.**, Manin, J., Cenker, E., Pickett, L., Skeen, S., Visualizing fuel mixture fraction via high-speed extinction imaging of C70 Fullerene doped diesel sprays, *Western States Section Combustion Institute 2018 Spring Meeting*, March 2018, Bend, Oregon, USA.
7. Taie, Z., Villaverde, G., **Hagen, C. L.**, Hydrogen for Energy Storage: A Case for Storing Renewable Energy by Leveraging Existing Natural Gas Infrastructure, *Energy Storage Symposium*, November 2017, Corvallis, Oregon, USA, poster.
8. Taie, Z., Wagner, D.R., **Hagen, C. L.**, Kinetic Study of Ethane Pyrolysis in an Internal Combustion Engine, *Western States Section Combustion Institute 2017 Fall Meeting*, October 2017, Laramie, Wyoming, USA.
9. Lavrich, Z., Taie, Z., Wagner, D.R., **Hagen, C. L.**, Light Extinction Based Image Analysis Technique for Rotating Fluidized Beds, *Western States Section Combustion Institute 2017 Fall Meeting*, October 2017, Laramie, Wyoming, USA.
10. Lavrich, Z., Wagner, D.R., Taie, Z., Halliday, D., **Hagen, C. L.**, Dehydrogenation Catalysis in Rotating Fluidized Beds, , American Chemical Society, Northwest Regional Meeting (NORM), June 2017, Corvallis, Oregon, USA, presentation.
11. Wagner, D.R., Lavrich, Z., Taie, Z., Halliday, D., **Hagen, C.L.**, "Partial Oxidation of Hydrocarbons in Novel Fluidized Bed Reactors," [Poster] The Combustion Institute, 10th U.S. National Meeting, 23-26 April 2017, College Park, Maryland, USA, poster.
12. Lavich, Z., Taie, Z., Menon, S.K., Beckwith, W., Daly, S.R., Halliday, D., **Hagen, C.L.**, Internal Combustion Engines as Fluidized Bed Reactors, *69th Annual Meeting of the APS Division of Fluid Dynamics*, Volume 61, Number 20, November 2016, Portland, Oregon, USA, presentation.
13. Taie, Z., Beckwith, W., **Hagen, C.L.**, First and Second Law Thermodynamic Analysis of a Natural Gas Fueled Residential Standby Generator, *Western States Section of the Combustion Institute, Spring Technical Meeting*, Seattle, Washington, USA, 2016.
14. Menon, S.K., Taie, Z., **Hagen, C.L.**, Internal Combustion Engines as Chemical Reactors: Issues and Challenges, *Western States Section of the Combustion Institute, Spring Technical Meeting*, Seattle, Washington, USA, 2016.
15. Brown, S.P., Menon, S.K., **Hagen, C.L.**, Investigation of Scaling Laws for Combustion Engine Performance, *Western States Section of the Combustion Institute, Fall Technical Meeting*, Provo, Utah, USA, 2015.
16. Menon, S.K., Ganti, H., Niemeyer, K.E., **Hagen, C.L.**, Effect of Natural Gas Conditions on Combustion Characteristics and Overall Performance of a Novel Bimodal Internal Combustion Engine, *9th U. S. National Combustion Meeting*, Cincinnati, Ohio, USA, 2015.
17. Brown, S.P., **Hagen, C.L.**, Testing and Analysis of 2-Stroke UAV Engines, *AIAA Region VI Student Conference*, Reno, Nevada, USA, 2015.
18. Taie, Z., Beckwith, W., **Hagen, C.L.**, Home Generator Benchmarking Program: Residential Natural Gas Fired Electrical Generator and MicroCHP, *ARPA-E Energy Summit*, Washington, District of Columbia, USA, 2015, poster.
19. Niemeyer, K., Daly, S., Cannella, W.J., **Hagen, C.L.**, A New Fuel Index for LTC Engines Based on Operating Envelopes in Light-Duty Driving Cycle Simulations, W1P084, *35th Symposium on Combustion*, San Francisco, California, USA, 2014, poster.
20. Taie, Z., **Hagen, C.L.**, Preventing Fuel Tank Oxygen Ingress for a Bimodal CNG Internal Combustion Engine, W1P134, *35th Symposium on Combustion*, San Francisco, California, USA, 2014, poster.
21. Olson, N., **Hagen, C.L.**, Quantified Measurement of Droplet Evaporation Rates of a Two Component Mixture, W3P021, *35th Symposium on Combustion*, San Francisco, California, USA, 2014, poster.

22. Niemeyer, K.E., Cannella, W.J., **Hagen, C.L.**, A New Fuel Index for LTC Engines Based on Operating Envelopes in Light-Duty Driving Cycle Simulations: Primary Reference Fuels, In *Western States Section of the Combustion Institute, Spring Technical Meeting*, Paper 14S-20, Pasadena, California, USA, 2014.
23. Elgin, R.C., Turner, C.W., **Hagen, C.L.**, Combustion Chamber Design Considerations for a Compression Ignition Engine to Spark Ignited Natural Gas Engine Conversion, *Western States Section of the Combustion Institute, Fall Technical Meeting*, Fort Collins, Colorado, USA, 2013.
24. **Hagen, C.L.**, NGV Self-Contained Home Filling Station, *ARPA-E MOVE Kickoff Meeting*, Washington, District of Columbia, December 2012.
25. Cannella, W.J. and **Hagen, C.L.**, Fuels and Advanced Combustion Technology Research Activities, *Chevron Global Downstream Technology Forum*, Lafayette, California, USA, 2008, poster.
26. **Hagen, C.L.**, Fundamentals of Transient Thermal-Light Absorption Spectroscopy and Application to Optical Sensing in HCCI Engines, University of Wisconsin-Madison, PhD Thesis, 2006.
27. **Hagen, C. L.**, Sanders, S.T., Multispecies Sensing with a Single Laser Source in HCCI Combustion, *31st Symposium on Combustion*, Heidelberg, Germany, 2006, poster.
28. Kranendonk, L.A. , Caswell, A.W., **Hagen, C.L.**, Gord, J.R., Fujimoto, J.G., Sanders, S.T., Broadband, High-Resolution Absorption Spectroscopy in Piston and Gas Turbine Engines, Shock Tubes, and Rocket Plumes, *31st Symposium on Combustion*, Heidelberg, Germany, 2006, poster.
29. Cherian, S., **Hagen, C.L.**, Kirkpatrick, A., Willson, B., The Global Engine Laboratory - Data Acquisition and Control Over the Internet, *Proceedings, 9th Technology Based Engineering Education Consortium (TBEEC)*. Nashville, Tennessee, 1997.

MANUSCRIPTS IN REVIEW OR IN PREPARATION

1. Benbrook, J., Hagen, Two-Stroke Engine Mapping with Aerospace Testing Standard AS6971, SAE 2020 Small Powertrain and Energy Systems Technology Conference (SETC), Submitted.
2. Taie, Z., Peng, X., Kulkarni, D., Zenyuk, I., Weber, A., Hagen, C., Danilovic, N., "Pathway to Complete Energy Sector Decarbonization with Available Iridium Resources Using Ultra-Low Loaded Water Electrolyzers," *Nature Communications*, Submitted.
3. Taie, Z., Villaverde, G., Speaks, J., Lavrich, Z., Hagen, C. L., "Hydrogen for heat: utilizing hydrogen for long term energy storage in northern climates," *International Journal of Hydrogen Energy*, Submitted.
4. O'Hern, H., Nikooei, E., Zhang, X., Hagen, C. L., Abbasi, B., "Reducing the Water Intensity of Hydraulic Fracturing: An Introduction to A Novel Thermally-Actuated Nozzle-Demister Treatment and A Review of Wastewater Treatment Technologies," *International Journal of Environmental Science and Technology*, Submitted.
5. Kier, M., Blunck, D., Hagen, C.L., Open-Path Fourier Transform Infrared (OP-FTIR) Analysis of Pyrolysis of Sagebrush, poster abstract submitted to 2020 ASME IMECE conference.

DIVERSITY AND INCLUSION

- OSU Search Advocate Training completion, May 2019, OSU Trained Search Advocate, these are external search committee members who promote equity, validity, and diversity on OSU searches
- Southern University Co-PI on project funded through AFRL "Diverse Collegiate Research & Development, Collaboration Program"

SERVICE TO THE PROFESSION

- Reviewer, IEEE Transactions on Systems, Man and Cybernetics: Systems, 2020
- Reviewer, Heat Transfer Engineering, 2020
- Reviewer, US DOE ARAP-E (program details withheld), 2020
- Reviewer, American Chemical Society - ACS Petroleum Research Fund Grant Proposals, 2020

- Reviewer, ASME Journal of Engineering for Gas Turbines and Power, 2020
- Committee, Society of Automotive Engineers (SAE) E-39 Unmanned Aircraft Propulsion standards committee member
- Session Chair, United State Section of the Combustion Institute (USSCI) Meeting, *Engines Session*, Pasadena, California, USA, March 2019
- Committee, United State Section of the Combustion Institute (USSCI) Bylaws committee member, 2019
- Reviewer, AIAA Journal of Propulsion and Power, 2018
- Reviewer, Journal of Environmental Chemistry, 2018
- Organizer and Host, Western States Section of the Combustion Institute (WSSCI) Spring 2018 meeting at OSU-Cascades, March 2018, 51 papers presented, 2 keynotes (Prof. Ron Hansen Stanford, Prof. Erica Belmont, U of Wyoming) 88 Attendees from all over US.
- Session Organizer: 2018 Society of Automotive Engineers (SAE) World Congress, Detroit, Michigan, USA, April 10-12, Combustion in Gaseous-Fueled Engines
- NSF Ad Hoc Reviewer, 2018
- Reviewer, *The Proc. IMechE, Part D: Journal of Automobile Engineering*, 2017
- Reviewer *Journal of Applied Energy*, 2020, 2019, 2017
- NSF Review Panelist, 2017
- Attendee, ARPA-E High Efficiency Hybrid Vehicle Workshop, October 12, 2017 Southfield, Michigan, USA
- Session Organizer: 2017 Society of Automotive Engineers (SAE) World Congress, Detroit, Michigan, USA, April 4-6, Combustion in Gaseous-Fueled Engines
- Reviewer, Cyclotron Road applications, 2017, 2016
- Reviewer, NASA ASTAR Graduate Fellowships, 2016
- Reviewer, *Energy and Fuels*, 2016
- Session Organizer: 2016 SAE World Congress, Detroit, Michigan, USA, April 12 – 14, Combustion in Gaseous-Fueled Engines
- Reviewer, 2015, *Journal of Applied Thermal Engineering*
- Reviewer, 2015, *Journal of Natural Gas Science & Engineering*
- Executive Committee member, At-Large, Western States Section of Combustion Institute
- U.S. Department of Energy Merit Review Panel, Washington, D.C., USA, April, 2015.
- Session Organizer: 2015 SAE World Congress, Detroit, Michigan, USA, April 21 – 23, Combustion in Gaseous-Fueled Engines
- Reviewer, 2014, ASME Internal Combustion Engine Division Fall Technical Conference
- Session Organizer: 2014 SAE World Congress, Detroit, Michigan, USA, April 8 – 10, Compressed Natural Gas (CNG)/Dual-fuel CNG Engines
- Session Organizer: 2013 SAE World Congress, Detroit, Michigan, USA, April 16 – 18, Natural Gas Engines and Vehicles
- Reviewer, 2013, SAE International Powertrains, Fuels and Lubricants Meeting
- Reviewer, 2013, *International Journal of Energy*
- Reviewer (invited), 2013, Advanced Research Project Agency-Energy, Full Spectrum Optimized Conversion and Utilization of Sunlight (FOCUS) Full Applications
- Session Organizer: 2012 SAE International Powertrains, Fuels and Lubricants Meeting, Malmo, Sweden, September 18 – 20, Alternative and Advanced Fuels
- Session Organizer: 2012 SAE World Congress, Detroit, Michigan, USA, April 24 – 26, Fuel & Additive Effects on SI Engine Performance
- Session Organizer: 2010 SAE International Powertrains, Fuels and Lubricants Meeting, San Diego, California, USA, October 25-27, Alternative Fuels

- Session Organizer: 2009 SAE International Powertrains, Fuels and Lubricants Meeting, San Antonio, Texas, USA, November 2-4, Alternative Fuels
- Session Organizer: 2009 SAE International Powertrains, Fuels and Lubricants Meeting, Florence, Italy, June 15 – 17, Homogenous Charge Compression Ignition (HCCI), Variable Valve Actuation
- Reviewer: 2008 SAE International Powertrains, Fuels and Lubricants Meeting, Session: Alternative Fuels, Homogeneous Charge Compression Ignition Engines
- Reviewer: 2006 SAE World Congress, Session: Combustion and Flow Diagnostics
- Reviewer: 2006 SAE Small Engine Technology Conference
- Reviewer: Optics Communications Journal
- Reviewer: Measurement Science and Technology Journal

INVITED PRESENTATIONS & PANELS

- Mt Bachelor Rotary Club, *The Future of Transportation* (via Zoom), Bend, Oregon, USA, April 10, 2020
- Oregon State University, Science Pub: *Planes, Trains & Automobiles: Future Transportation*, Bend, Oregon, USA, November 9, 2019
- Congressman Peter DeFazio panel on *Renewable Hydrogen in Oregon*, Eugene, Oregon, USA, May 2019
- Colorado State University Energy & Environment Seminar Series, *Fueling Future Mobility*, Fort Collins, Colorado, USA, May 2019
- Chevron Energy Technology Company, *Energy Conversion in Oregon*, Richmond, California, April 2019
- Central Oregon Inventors Network, *Energy Conversion in Oregon*, Bend, Oregon, USA, April 2019
- National Science Foundation, *How to Succeed in I-Corps™ Panel*, Portland, Oregon, USA, January 2019
- National Renewable Energy Laboratory, *Renewable Hydrogen*, Golden, Colorado, USA, May 2018.
- Army Research Laboratory, *Reciprocating Engines: UAV Hybrid-Electric Powertrain Development and Modular Chemical Reactor*, Aberdeen, Maryland, USA, October 17, 2017
- Air Force Research Laboratory, *Reciprocating Engines: UAV Hybrid-Electric Powertrain Development and Modular Chemical Reactor*, Dayton, Ohio, USA, July 7, 2017
- Frontiers in Science, Sisters Science Club, *Biofuels or Fossil Fuels*, Sisters, Oregon, USA, April 26, 2017
- Pacific Crest Middle School, *Engineering?*, Bend, Oregon, USA, April 21, 2017
- OSU Postdoctoral Association presentation, *Mentoring*, February 1, 2017
- Association for Unmanned Vehicle Systems International Workshop Panelist/Presenter, *Unmanned Aircraft System Propulsion: Optimization, Technical Challenges and Future Directions*, Washington, District of Columbia, USA, October 14, 2015.
- Oak Ridge National Laboratory, *Paths toward Natural Gas for Transportation and Residential Power Generation*, Knoxville, Tennessee, USA, August 12, 2015.
- Oregon Public Radio Panelist, *Think Out Loud: The Impact of the OSU-Cascades Campus*, Bend, Oregon, USA, July 10, 2015.
- Lund University, Sweden, *Natural Gas for Transportation: Creating a Self-Refueling Vehicle*, Lund, Sweden, April 24, 2014.
- Professional Engineers of Oregon, Annual Meeting, *Energy Conversion Research with an Eye towards Internal Combustion Engines and Natural Gas*, Wilsonville, Oregon, USA, May 9, 2014.
- Oregon State University, Science Pub: *Natural Gas for Transportation*, Corvallis, Oregon, USA, April 14, 2014.

- University of Alaska-Fairbanks, Alaska Center for Energy and Power (ACEP), *Energy Conversion with an Eye towards Internal Combustion Engines and Natural Gas*, Fairbanks, Alaska, USA, December 2, 2013.
- Portland State University, Mechanical and Materials Engineering Department, *Energy Conversion with an Eye towards Internal Combustion Engines and Natural Gas*, Portland, Oregon, USA, November 8, 2013.
- Pacific Northwest National Laboratory, Natural Gas Technology, Richland, WA, USA, August 2013.
- Professional Engineers of Oregon, Central Chapter Meeting, *Natural Gas Vehicle Research at OSU-Cascades*, Bend, Oregon, USA, April 22, 2013.
- Oregon State University, Science Pub: *Energy Research, What About Natural Gas for Transportation?*, Bend, Oregon, USA, February 19, 2013
- MATHCOUNTS Middle School Students, *Engineering?*, Redmond, OR February 23, 2013.
- Rotary Club, Mt. Bachelor Chapter, *Energy Research, What About Natural Gas for Transportation?*, Bend, Oregon, USA, December 14, 2012.
- Bend Research Incorporated, *Energy Research Areas: Getting More Out of What We Have*, Bend, Oregon, USA, September 13, 2012.

SERVICE TO THE UNIVERSITY

- OSU Faculty Senate Research Council member, 2020
- OSU Committee to Review Promotion & Tenure (P&T) Guidelines for Innovation and Entrepreneurship (I&E) Inclusion, 2020, 2019
- OSU MIME P&T Committee, 2020, 2019
- OSU-Cascades P&T Letters Committee Chair, 2019
- OSU-Cascades Peer Review of Teaching Lead, 2018, 2017
- Faculty Senate Member (Cascade representative), 2018, 2017
- OSU-Cascades Research Committee, 2018
- OSU-Cascades small grant reviewer, 2017
- OSU-Cascades Research Committee, 2017
- OSU-Cascades Associate Academic Dean search committee, 2017
- Energy Systems Engineering faculty search committee, 2017
- OSU School of Mechanical, Industrial, and Manufacturing Engineering (MIME) awards committee, 2018, 2017, 2016
- MIME Design faculty search committee, 2017
- OSU-Cascades Academic Dean search committee, 2016
- Energy Systems Engineering instructor search committee, 2015
- Graduate Council Representative, 2015, 2014, 2013
- Energy Systems Engineering Undergraduate Program Committee, 2018, 2017, 2016, 2015, 2014, 2013, 2012
- MIME School Head Search Committee, 2013
- MIME Thermal Fluid Science Faculty Search Committee, 2014, 2013
- Technical Advisor for OSU Advantage Accelerator Intern Program (student Sean Brown)

PROPOSALS AWARDED AS PRINCIPAL INVESTIGATOR

- 2019 Advanced Research Project Agency for Energy (ARPA-E) OPEN 2018 program, Fresh-Frac (fracking water cleanup), Sponsor: U.S. Department of Energy, \$3,000,000 (Hagen share \$89,000).
- 2019 Chevron Energy Technology Company, Low Speed Preignition Modeling, \$500,000 (Hagen share \$168,000)

- 2019 DOD Strategic Environmental Research and Development Program (SERDP), Live Fuels: Identification of Key Processes Controlling Ignition and Fuel Consumption, \$1,500,000 (Hagen share \$70,000)
- 2018 Solar Energy Technologies Office, Solar Desalination, Sponsor: U.S. Department of Energy, \$2,000,000 (Hagen share \$107,000).
- 2018 AFRL Hybrid UAV Award with Southern U. & LSU, \$300,000 (Hagen share \$100,000).
- 2018 Advanced Internal Combustion Engine Fuel Modeling and Testing Phase IV, Energy Industry Sponsor, \$100,000.
- 2018 NW Natural \$30,000.
- 2018 NSF I-Corps, \$50,000.
- 2018 Gap Grant, Sponsor: OSU Venture Development Fund, \$45,000.
- 2017 Layman Fellowship, \$2,500.
- 2017 Northwest Natural Gas Hydrogen Student Design Challenge Award, \$20,000.
- 2017 Advanced Internal Combustion Engine Fuel Modeling and Testing Phase III, Energy Industry Sponsor, \$100,000.
- 2017 Sandia National Laboratory Combustion Research Facility, \$51,000.
- 2016 Energy System Engineering Graduate Student Fellowship, \$51,000.
- 2016 Advanced Research Project Agency for Energy (ARPA-E) Innovative Development in Energy-Related Applied Science (IDEAS), Sponsor: U.S. Department of Energy, Award Number DE-AR0000681, \$3,200,000 (Hagen share \$600,000)
- 2015 M.J. Murdock Charitable Trust Commercialization Initiation Award, \$60,000.
- 2015 Gap Grant, Sponsor: OSU Venture Development Fund, \$60,000.
- 2015 NASA Graduate Aeronautics Scholarship, Advanced STEM Training and Research (ASTAR) Fellowship Program (student Sean Brown), \$100,000.
- 2015 Advanced Internal Combustion Engine Fuel Modeling and Testing Phase II, Energy Industry Sponsor, \$142,177.
- 2015 Oregon Metals Initiative & Hatch Product Development, \$10,438.
- 2014 Gap Grant, Sponsor: Oregon Nanoscience and Microtechnologies Institute (ONAMI), \$250,000.
- 2014 Gap Grant, Sponsor: Oregon Built Environment & Sustainable Technologies (BEST), \$150,000.
- 2014 Advanced Research Project Agency for Energy (ARPA-E) Innovative Development in Energy-Related Applied Science (IDEAS), Sponsor: U.S. Department of Energy, Award Number DE-AR0000485, \$500,000.
- 2013 Advanced Research Project Agency for Energy (ARPA-E) Methane Opportunities for Vehicular Energy (MOVE), Sponsor: U.S. Department of Energy, Award Number DE-AR0000259, budget increase, \$299,900.
- 2013 Advanced Internal Combustion Engine Fuel Modeling and Testing, Energy Industry Sponsor, \$202,710.
- 2013 Gap Grant, Sponsor: OSU Venture Development Fund, \$25,000.
- 2013 Gap Grant, Sponsor: OSU Venture Development Fund, \$12,000.
- 2012 Advanced Research Project Agency for Energy (ARPA-E) Methane Opportunities for Vehicular Energy (MOVE), Sponsor: U.S. Department of Energy, Award Number DE-AR0000259, \$699,392.
- 2011 University Design Challenge, Sponsor: Air Force Office of Scientific Research, \$60,000.
- 2010 Physics-Based Dynamic Model of Marine Based Power Generation Equipment, Sponsor: Woodward Inc., \$71,000.

- 2009 Strategic Research proposal, topic confidential, Sponsor: Chevron Energy Technology Corporation, \$170,000 per annum.
- 2009 Strategic Research proposal, topic confidential, Sponsor: Chevron Energy Technology Corporation, \$80,000 per annum.
- 2004 Graduate Student author of “Dual-clad fiber optics for single-port absorption spectroscopy sensor,” Sponsor: The Optoelectronics Industry Development Association through the Photonics Technology Access Program (PTAP), \$33,000.

PATENTS

U.S. Patent No. 9,316,178, Hagen, C.L., G. Babbitt, C. Turner, N. Echter, K. Weyer-Geigel. “Internal Combustion Engine for Natural Gas Compressor Operation.” April 19, 2016

U.S. Patent No. 9,528,465 Hagen, C.L., G. Babbitt, C., “Internal Combustion Engine for Natural Gas Compressor Operation.” December 27, 2016

PROFESSIONAL AWARDS, MEMBERSHIPS AND CERTIFICATIONS

SAE Longtime Member Service Award – 10 Years, 2019

OSU Successful Spinout Award, 2019

SAE Ralph R. Teetor Faculty Award, 2017

OSU Faculty Innovator Award, 2016

OSU Excellence in Postdoctoral Mentoring Award, 2016

Popular Science Magazine’s “12 New Faces of Energy,” June, 2015

OSU-Cascades Scholarship & Creative Activity Award, 2015

Member, Society of Automotive Engineers (SAE)

Member, The Combustion Institute

Former Member, American Society of Mechanical Engineering (ASME)

Former Member, Institute for Electrical and Electronics Engineers (IEEE)

Professional Engineer, State of Colorado

Scholarship, Association of Energy Engineers (AEE), 1998

ENTREPRENEURSHIP

Guild Adviser, Hyperdrive.me, Bend, Oregon, April 2019 - present

Founder, Rogue Approach Incorporated, Bend, Oregon, November 2018

Graduate, NSF I-Corps 10 week Training, Austin, TX Cohort, Summer 2018

Graduate, MIT I-Corps Site Program, 3 week entrepreneurship training, July 2018

Graduate, OSU Iterate Program, 4 week entrepreneurship training, January 2018

Founder and former CTO, Onboard Dynamics Incorporated, Bend, Oregon, Oct. 2013 – March 2015

CTO, Crystal Creek Energy, LLC, Fort Collins, Colorado, 2011-2012