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**CURRENT INTERESTS**

- Industrial bottlenecks/constraints that limit the pace of global decarbonization (Rapid Switch).
- Policy-relevant engineering and economic analysis of advanced clean-energy systems for electricity, transport, industrial, and cooking applications
- Advanced process design and simulation for thermochemical conversion of carbonaceous fuels, especially biomass, coal, and natural gas.
- Biomass energy technologies and strategies for the US and other regions.
- Broader communication of climate change mitigation issues

## CURRENT POSITIONS

- **Senior Research Engineer and Head**, Energy Systems Analysis Group, Andlinger Center for Energy and the Environment, Princeton University. (Since July 2015)
- **Affiliated Researcher**, Science, Technology, and Environmental Policy Program of the Princeton School of Public and International Affairs, Princeton University. (Since 2004)
- **Associated Faculty**, Princeton Environmental Institute, Princeton University. (Since 1999)
- **Senior Scientist**, Climate Central, Inc., Princeton, New Jersey. (Since 2008)

## PREVIOUS POSITIONS

- 1999 – 2015: **Senior Research Engineer/Research Engineer**, Princeton Environmental Institute, Princeton University.
- 1991 – 1999: **Research Engineer**, Center for Energy and Environmental Studies, School of Engineering and Applied Sciences, Princeton University.
- 1988-1989 – **Visiting Research Engineer**, Department of Environmental & Energy Systems Analysis, Lund University, Sweden.
- 1983 – 1991: **Research Staff**, Center for Energy and Environmental Studies, School of Engineering and Applied Sciences, Princeton University.

## EDUCATION

- Ph.D., 1983, University of Minnesota, Minneapolis, Mechanical Engineering
- MSE, 1981, University of Minnesota, Minneapolis, Mechanical Engineering
- BSE, 1979, Washington University, St. Louis, Mechanical Engineering.

## BIOSKETCH

Larson's research intersects engineering, environmental science, economics, and public policy. His energy systems modeling and analyses aim at identifying sustainable, engineering-based solutions to major energy-related problems. His work assesses resource, economic, and environmental implications of prospective technology developments and helps inform public and private decision making in the U.S. and elsewhere. He has published extensively on the design and analysis of advanced biomass and fossil fuel conversion technologies with CO<sub>2</sub> capture and storage. He was part of the Princeton team contributing to the National Research Council report, *America's Energy Future: Technology and Transformation* (2009). He was a Co-Convening Lead Author of the fossil energy chapter of the major international study, *The Global Energy Assessment* (2012). He co-leads Princeton's ongoing Net-Zero America project, and he is active in the global Rapid Switch initiative established by the Andlinger Center that aims to identify sector-by-sector and region-by-region key likely bottlenecks to rapid energy-system decarbonization, and associated debottlenecking strategies. In past research, Larson has collaborated on energy and sustainability analyses with colleagues worldwide, including in Australia, Brazil, China, Cuba, India, Italy, Jamaica, Sweden, and elsewhere.

Larson is an Affiliated Faculty member with the High Meadows Environmental Institute and the Center for Policy Research on Energy and Environment in the School of Public and International Affairs at Princeton. He also holds an appointment as a senior scientist with Climate Central, a non-profit, non-partisan science and media organization that informs diverse audiences about climate change and potential solutions. Larson supervises student research and occasionally teaches courses.

## **PUBLICATIONS (chronological in sections)**

### ***Books and book chapters***

1. E.D. Larson and R.H. Williams, "Technical and Economic Analysis of Steam-Injected Gas-Turbine Cogeneration," in *Energy Sources: Conservation and Renewables*, D. Hafemeister, H. Kelly, and B. Levi (eds.) American Institute of Physics, New York, NY, 1985, pp. 402-25.
2. E.D. Larson, P. Svenningsson and I. Bjerle, "Biomass Gasification for Gas Turbine Power Generation," in *Electricity: Efficient End-Use and New Generation Technology, and Their Planning Implications*, T.B. Johansson, B. Bodlund, and R.H. Williams (eds.), Lund University Press, Lund, Sweden, 1989, pp. 697-739.
3. R.H. Williams and E.D. Larson, "Expanding Roles for Gas Turbines in Power Generation," in *Electricity: Efficient End-Use and New Generation Technology, and Their Planning Implications*, T.B. Johansson, B. Bodlund, and R.H. Williams (eds.), Lund University Press, Lund, Sweden, 1989, pp. 503-53.
4. R.H. Williams and E.D. Larson, "Power Generation with Natural Gas-Fired Gas Turbines," Chapter 5 in *Natural Gas: Its Role and Potential in Economic Development*, Vergara, Hay, and Hall (eds.), Westview Press, 1990.
5. R.H. Williams and E.D. Larson, "Advanced Gasification-Based Biomass Power Generation," in *Renewable Energy: Sources for Fuels and Electricity*, T.B. Johansson, H. Kelly, A.K.N. Reddy, and R.H. Williams (eds.), Island Press, Washington, DC, 1993, pp. 729-85.
6. E.D. Larson and R.H. Williams, "Biomass Plantation Energy Systems and Sustainable Development," in *Energy as an Instrument for Socio-Economic Development*, J. Goldemberg and T.B. Johansson (eds.), United Nations Development Program, New York, NY, 1995, pp. 91-106.
7. E.D. Larson, "Modernized Biomass Energy," in L. Gomez-Echeverri (ed.), *Climate Change and Development*, The Yale School of Forestry and Environmental Studies, Yale University, New Haven, CT, 2000, pp. 271-291.
8. S. Kartha and E.D. Larson, *Bioenergy Primer: Modernized Biomass Energy for Sustainable Development*, United Nations Development Program, New York, NY, 2000, 133 pages.
9. E. Larson (Contributing Author), "Renewable Energy Technologies," chapter 7 (W. Turkenburg, Convening Lead Author) in *World Energy Assessment*, pp. 219-272, United Nations Development Program, New York, 2000.
10. E.D. Larson and T.B. Johansson, "Future Demands on Forests as a Source of Energy," chapter 9 in *Forests in a Full World*, G.M. Woodwell (ed.), Yale University Press, New Haven, CT, 2001, pp. 111-160.
11. E.D. Larson, *Biofuel Production Technologies: Status, Prospects, and Implications for Trade and Development*, United Nations Conference on Trade and Development, New York and Geneva, 2008.
12. E.D. Larson and Z. Li (Co-Convening Lead Authors), T. Fleisch, G. Liu, G. Nicolaides, X. Ren, and R.H. Williams, "Fossil Energy Systems," chapter 12, *The Global Energy Assessment*, Cambridge U. Press, Cambridge, UK, 2012. DOI: 10.1017/CBO9780511793677.
13. E.D. Larson and A. Faaij (Lead Authors, Bioenergy), "Renewable Energy Systems," (W. Turkenburg Convening Lead Author), chapter 11, *The Global Energy Assessment*, Cambridge U. Press, Cambridge, UK, 2012.
14. E.D. Larson (Contributing Author), "Energy Pathways for Sustainable Development," (K. Riahi, Convening Lead Author), chapter 17, *The Global Energy Assessment*, Cambridge U. Press, Cambridge, UK, 2012.

### ***Peer-reviewed articles***

1. E.D. Larson, "Heat Transfer From Pin Fins Situated in an Oncoming Longitudinal Flow Which Turns to Crossflow," MS Thesis, Mechanical Engineering Dept., University of Minnesota, Minneapolis, MN, April 1981.
2. E.M. Sparrow, E.D. Larson, and J.W. Ramsey, "Freezing on a Finned Tube for Either Conduction-Controlled or Natural-Convection-Controlled Heat Transfer," *International Journal of Heat and Mass Transfer*, Vol. 24, pp. 273-284, 1981.
3. E.M. Sparrow and E.D. Larson, "Heat Transfer from Pin Fins Situated in an Oncoming Longitudinal Flow Which Turns to Crossflow," *International Journal of Heat and Mass Transfer*, Vol. 25, pp. 603-14, 1982.
4. E.D. Larson and E.M. Sparrow, "Performance Comparisons Among Geometrically Different Pin-Fin Arrays Situated in an Oncoming Longitudinal Flow," *International Journal of Heat and Mass Transfer*, Vol. 25, pp. 723-25, 1982.

5. E.D. Larson, "Freezing Inside a Circular Cylindrical Capsule at Various Angular Inclinations, Initial Liquid Superheats, and Cylinder Wall Subcoolings," Ph.D. Thesis, Mechanical Engineering Dept., University of Minnesota, Minneapolis, MN, June 1983.
6. E.D. Larson and E.M. Sparrow, "Effect of Inclination on Freezing in a Sealed Cylindrical Capsule," *ASME Journal of Heat Transfer*, Vol. 106, pp. 394-401, May 1984.
7. E.D. Larson, D. Abrahamson, and P. Ciborowski, "Effects of Atmospheric Carbon Dioxide on US Peak Electrical Generating Capacity," *IEEE Technology and Society Magazine*, December 1984.
8. M. Ross, E.D. Larson, and R.H. Williams, "Energy Demand and Materials Flows in the Economy," *Energy, The International Journal*, 12(10/11), 1987, pp. 953-67 (special issue: Proceedings of the 1985 Soviet-American Symposium on Energy Conservation). (Also: CEES Report 193, Princeton University, July 1985.)
9. E.D. Larson, M. Ross, and R.H. Williams, "Beyond The Era of Materials," *Scientific American*, 254(6), June 1986, pp. 34-41.
10. R.H. Williams, E.D. Larson, and M.H. Ross, "Materials, Affluence, and Industrial Energy Use," *Annual Review of Energy*, 12, 1987, pp. 99-144. (Also: PU/CEES Report 214, Princeton University, Jan. 1987.)
11. E.D. Larson and R.H. Williams, "Steam-Injected Gas Turbines," Paper No. GT-47-86, *ASME Journal of Engineering for Gas Turbines and Power*, 109(1), 1987, pp. 55-63.
12. R.H. Williams and E.D. Larson, "Steam-Injected Gas Turbines and Electric Utility Planning," *IEEE Technology and Society Magazine*, March 1986.
13. E.D. Larson, J.M. Ogden, R.H. Williams, and M.G. Hylton, "Biomass-Fired Steam-Injected Gas Turbine Cogeneration for the Cane Sugar Industry," in *Proceedings of Research in Thermochemical Biomass Conversion*, Bridgewater and Kuester (eds.), Elsevier Applied Science, London, UK, 1988.
14. E.D. Larson and R.H. Williams, "Biomass-Fired Steam-Injected Gas Turbine Cogeneration," *Proceedings, Cogen-Turbo: Second International Symposium on Turbomachinery, Combined Cycle Technology and Cogeneration*, American Society of Mechanical Engineers, New York, NY, 1988.
15. R.H. Williams and E.D. Larson, "Aeroderivative Turbines for Stationary Power," *Annual Review of Energy*, 13, 1988, pp. 429-89.
16. E.D. Larson, R.H. Williams, J.M. Ogden, and M.G. Hylton, "Biomass Gas Turbine Cogeneration for the Cane Sugar Industry," *Proceedings, XX Congress of the International Society of Sugar Cane Technologists*, São Paulo, Brazil, October 1989.
17. L.J. Nilsson and E.D. Larson, "Liquid Pumping," "Electric Motors," "Variable Speed Drives," and "Pumps" in *The Technology Menu for Efficient End-Use of Energy, Vol. 1: Movement of Material*, Department of Environmental and Energy Systems Studies, Lund University, Lund, Sweden, 1989.
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19. E.D. Larson and R.H. Williams, "Biomass-Gasifier Steam-Injected Gas Turbine Cogeneration," *ASME Journal of Engineering for Gas Turbines and Power*, 112(2), 1990, pp. 157-63.
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21. E.D. Larson, "Biomass-Gasifier/Gas Turbine Cogeneration in the Pulp and Paper Industry," *Journal of Engineering for Gas Turbines and Power*, 114(4): 665-675, 1992.
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25. E.D. Larson and R.E. Katofsky, "Production of Methanol and Hydrogen via Biomass Gasification," in *Advances in Thermochemical Biomass Conversion*, A.V. Bridgwater (ed.), Balckie Academic & Professional Press, London, 1994, Vol. 1, pp. 495-510.
26. R.H. Williams, E.D. Larson, R.E. Katofsky, and J. Chen, "Methanol and Hydrogen from Biomass for Transportation," *Energy for Sustainable Development*, I(5), Jan. 1995, pp. 18-34.
27. R.H. Williams and E.D. Larson, "Biomass-Gasifier/Gas Turbine Power Generating Technology," *Biomass and Bioenergy*, Vol. 10, Nos. 2-3, pp. 149-166, 1996.
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29. S. Consonni and E.D. Larson, "Biomass-Gasifier/Aeroderivative Gas Turbine Combined Cycles, Part B: Performance Calculations and Economic Assessment," *ASME Journal of Engineering for Gas Turbines and Power*, Vol. 118, July 1996, pp. 516-525.
30. C.I. Marrison and E.D. Larson, "A Preliminary Estimate of the Biomass Energy Production Potential in Africa in 2025 Considering Projected Land Needs for Food Production," *Biomass and Bioenergy*, Vol.10, Nos. 5-6, pp. 337-351, 1996.
31. E.D. Larson, E. Worrell, and J.S. Chen, "Clean Fuels from Municipal Solid Waste for Fuel Cell Buses in Metropolitan Areas," *Resources, Conservation, and Recycling*, Vol. 17, 1996, pp. 273-298.
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36. E.D. Larson, T.G. Kreutz, and S. Consonni, 1999, "Combined Biomass and Black Liquor Gasifier/Gas Turbine Cogeneration at Pulp and Paper Mills," *ASME Journal of Engineering for Gas Turbines and Power*, 121: 394-400.
37. E.D. Larson, S. Consonni, and T.G. Kreutz, 2000, "Preliminary Economics of Black Liquor Gasifier/Gas Turbine Cogeneration at Pulp and Paper Mills," *ASME Journal. of Engineering for Gas Turbines and Power*, 122: 255-261.
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40. E.D. Larson and S. Kartha, "Expanding Roles for Modernized Biomass Energy," *Energy for Sustainable Development*, IV(3), 2000, pp. 15-25.
41. E.D. Larson, R.H. Williams, M.R.L.V. Leal, "A Review of Biomass Integrated-Gasifier/Gas Turbine Combined Cycle Technology and its Application in Sugarcane Industries, with an Analysis for Cuba," *Energy for Sustainable Development*, V(1), March 2001, pp 54-76.
42. L.C. Schneider, A.P. Kinzig, E.D. Larson, and S.A. Solorzano, "Method for Spatially-Explicit Calculations of Potential Biomass Yields and Assessment of Land Availability for Biomass Energy Production in Northeastern Brazil," *Agriculture, Ecosystems, and Environment*, 84(3): 207-226, 2001.
43. Z. Wu, P. DeLaquil, E.D. Larson, W. Chen, and P. Gao, "Future Implications of China's Energy-Technology Choices: Summary of a Report to the Working Group on Energy Strategies and Technologies," *Energy for Sustainable Development*, V(4), December 2001, pp. 19-31.

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45. E.D. Larson, Z. Wu, P. DeLaquil, W. Chen, and P. Gao, "Future Implications of China's Energy-Technology Choices," *Energy Policy*, 31(12): 1149-1204, 2003.
46. P. DeLaquil, W. Chen, and E.D. Larson, "Modeling China's Energy Future," *Energy for Sustainable Development*, VII(4): 40-56, December 2003.
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48. E.D. Larson and T. Ren, "Synthetic Fuels Production by Indirect Coal Liquefaction," *Energy for Sustainable Development*, VII(4): 79-102, December 2003.
49. R.H. Williams and E.D. Larson, "A Comparison of Direct and Indirect Liquefaction Technologies for Making Fluid Fuels from Coal," *Energy for Sustainable Development*, VII(4): 103-129, December 2003.
50. J.M. Ogden, R.H. Williams, and E.D. Larson, "Societal Lifecycle Costs of Cars with Alternative Fuels/Engines," *Energy Policy*, 32: 7-27, 2004.
51. E.D. Larson and H. Yang, "Dimethyl ether (DME) from coal as a household cooking fuel in China," *Energy for Sustainable Development*, VIII(3): 115-126, September 2004.
52. X. Wang, D.L. Mauzerall, Y. Hu, A.G. Russell, E.D. Larson, J-H. Woo, D.G. Streets, and A. Guenther, "A High-Resolution Emission Inventory for Eastern China in 2000 and Three Scenarios for 2020," *Atmospheric Environment*, 39(32): 5917-5933, October 2005.
53. C. Azar, K. Lindgren, E.D. Larson, and K. Möllersten, "Carbon capture and storage from fossil fuels and biomass – Costs and potential role in stabilizing the atmosphere," *Climatic Change*, 74(1): 47-79, 2006. DOI: 10.1007/s10584-005-3484-7.
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55. E.D. Larson, S. Consonni, R.E. Katofsky, K. Iisa, and J. Frederick, "An Assessment of Gasification-Based Biorefining at Kraft Pulp and Paper Mills in the United States, Part A: Background and Assumptions," *TAPPI Journal*, 7(11): 8-14, November 2008.
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### **Edited works**

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115. R.H. Williams, E.D. Larson, and H. Jin, "Comparing Climate-Change Mitigating Potentials of Alternative Synthetic Liquid Fuel Technologies Using Biomass and Coal," Proceedings of the Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA, 8-11 May 2006.

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125. K. Iisa, C.E. Courchene, W.J. Frederick, Jr., M. Realff, E.D. Larson, and S. Consonni, "Mill Integration Issues For Black Liquor Gasification Based Biorefineries," Proceedings of the 2007 International Chemical Recovery Conference, Quebec City, Canada, 29 May – 1 June, 2007.
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127. E.D. Larson, G. Fiorese, G. Liu, R.H. Williams, T.G. Kreutz, and S. Consonni, "Co-production of synfuels and electricity from coal + biomass with zero net carbon emissions: an Illinois case study," *Proceedings of the 9<sup>th</sup> International Greenhouse Gas Control Technologies Conference* (Elsevier Energy Procedia), Washington DC, 17-20 November 2008.
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131. T. Kreutz, E.D. Larson, G. Liu, R.H. Williams, and R. Socolow, "An Integrated Framework for Comparative Techno-Economic Evaluations of Plants that Convert Coal and/or Biomass to Power and/or Synthetic Liquid Transportation Fuels", 8<sup>th</sup> Annual DOE/NETL Conference on Carbon Capture and Sequestration, Pittsburgh, PA, 4-7 May, 2009.
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133. R.H. Williams, G. Liu, E.D. Larson, and T.G. Kreutz, "Electricity and Synfuels from Coal and Biomass with CCS: A Strategy for Simultaneously Addressing C Mitigation and Energy Security Challenges," *Proceedings of International Conference on Global Dynamics in the Green Energy Industry, A New Engine of Growth*, East-West Center and Korea Energy Economics Institute, Honolulu, Hawaii, 19-20 August 2010.
134. G.Liu, E.D. Larson, R.H. Williams, and T.G. Kreutz, "Design/economics of low-carbon power generation from natural gas and biomass with synthetic fuels co-production," *Proceedings of the 10<sup>th</sup> International Greenhouse Gas Control Technologies Conference*, Amsterdam, 19-23 September, 2010.
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137. E.D. Larson and A. Kenward, "A Roadmap to Climate-Friendly Cars," Climate Central, 25 April, 2012.
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140. E.D. Larson, "Natural Gas and Climate Change," Climate Central, May 2013.
141. D. Yawitz, A. Kenward, and E.D. Larson, "A Roadmap to Climate-Friendly Cars: 2013," Climate Central, August 2013.
142. E.D. Larson, G. Liu, Q. Li, R.H. Williams, and R. Wallace, "Techno-Economic Analysis of Jet Fuel and Electricity Co-Production from Coal and Biomass in the Ohio River Valley of the United States, with Capture of CO<sub>2</sub> and Storage via Enhanced Oil Recovery," powerpoint paper, 30<sup>th</sup> Pittsburgh Coal Conference, Beijing, 15-18 September 2013.
143. G. Liu, E.D. Larson, R.H. Williams, and X. Guo, "Gasoline from Coal and Biomass with CCS: Performance and Cost Analysis," powerpoint paper, 30<sup>th</sup> Pittsburgh Coal Conference, Beijing, 15-18 September 2013.
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145. G. Liu and E.D. Larson, "Comparison of Coal/Biomass Co-processing Systems with CCS for Production of Low-carbon Synthetic Fuels: Methanol-to-Gasoline and Fischer-tropsch," *Energy Procedia*, 63: 7315-7329, 2014.
146. G. Liu and E.D. Larson, "Gasoline from Coal via DME with Electricity Co-production and CO<sub>2</sub> Capture," *Energy Procedia*, 63: 7367-7378, 2014.
147. A.K. Hailey, J.C. Meerman, E.D. Larson, Y.-L. Loo, "Co-processing Biomass and Natural Gas into Clean Transportation Fuels at Small Scale," poster for ACEE E-affiliates Retreat (Feb. 5, 2015) and for CMI Annual Meeting (April 14-15, 2015).

148. J.C. Meerman, T.G. Kreutz, E.D. Larson, and R.H. Williams, “Sustainable biofuels with net negative greenhouse gas emissions via pyrolysis or gasification,” poster at TCBIomass 2015: Technology for the Bioeconomy, Chicago, IL, November 2015.
149. Meng, J., McCabe, K. Mastro, K., Larson, E.D. and Gangwal, S., “Renewable Fuel Production via Methanol-Assisted Biomass Liquefaction Process,” AIChE Annual Meeting, November 2015.
150. Andlinger Energy Systems Analysis Group (E. Larson, PI) and University of Queensland Energy Initiative (C. Greig, PI), “Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO<sub>2</sub> Capture and Storage via EOR, Milestone 3 Report: Summary of the Final Process Design,” under U.S. DOE grant DE-FE0023697, 15 January 2016.
151. S. Gangwal, J. Meng, K. McCabe, E. Larson, and K. Mastro “Mild Biomass Liquefaction Process for Economic Production of Stabilized Refinery-Ready Bio-oil,” For US DOE Award Number: DE-EE0006062.000, 25 April 2016.
152. E.D. Larson (PI), D. Tilman, C. Lehman, and R.H. Williams, “Sustainable Transportation Energy with Net Negative Greenhouse Gas Emissions: an integrated ecological and engineering systems analysis,” progress report to Stanford University Global Climate and Energy Project, from the Energy Systems Analysis Group (Princeton) and Department of Ecology, Evolution, and Behavior (U Minnesota), 9 May 2016.
153. E. Larson (PI), T. Kreutz, R. Williams, H. Meerman, and C. Greig, “Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO<sub>2</sub> Capture and Storage via EOR, Milestone 4 Report: Summary of Financial Analysis for FOAK LBJ Plant and Prospective NOAK Commercial Plants,” under U.S. DOE grant DE-FE0023697, 2 August 2016.
154. T. Kreutz, E. Larson, R. Williams, “Understanding Challenges with Intermittent Renewable Electricity Expansion,” 2016 Annual Report, Carbon Mitigation Initiative, Princeton University, 2017.
155. K. Paustian, E. Larson, A. Swan, E. Marx, J. Kent, and N. Zenes, “[Carbon Farming – A Working Paper Assessing the Potential for Soil C Sequestration.](#)” July 23, 2017.
156. C. Greig, T.G. Kreutz, E.D. Larson, J.C. Meerman, R.H. Williams, “Lignite-plus-Biomass to Synthetic Jet Fuel with CO<sub>2</sub> Capture and Storage: Design, Cost, and Greenhouse Gas Emissions Analysis for a Near-Term First-of-a-Kind Demonstration Project and Prospective Future Commercial Plants,” Final report to The National Energy Technology Laboratory, U.S. Department of Energy, 1 September 2017.
157. I. Hannula, J.C. Meerman, E.D. Larson, and C. Greig, “Making Sense of Cost and Performance Estimates for Thermochemical Biofuel Plants,” powerpoint paper, TCBIomass2017: International Conference on Thermochemical Conversion Science, Chicago, Sept. 19-21, 2017.
158. E.D. Larson and M. Chen, “Analysis of Contact-Voltage Losses in Low-Voltage Electricity Distribution Systems of the U.K.,” prepared for UK Power Networks, London, England, 30 January 2018.
159. E.D. Larson and J.C. Meerman, “Mid-century advanced biofuel potential for the US: a thought experiment,” 2017 Annual Report, Carbon Mitigation Initiative, Princeton University, February 2018.
160. P. Haro, D. Penalver, M. Suarez-Almeida, E. Larson, A.F. Ghoniem, A. Gomez-Barea, “The Role of Biomass in the Future Development of CSP in Southern Europe: The Case of Spain,” *Proceedings of the 26<sup>th</sup> European Biomass Conference and Exhibition*, Copenhagen, May 2018, pp. 1482-83.
161. E. Larson, R.H. Williams, D. Tilman, and C. Lehman (co-PI), “Sustainable Transportation Energy with Net Negative Greenhouse Gas Emissions: an Integrated Ecological and Engineering Systems Analysis,” final report to Stanford University Global Carbon and Energy Project, 17 December 2018.
162. J. Brady, C. Chu, E. Colter, J. Fielding, L. Hadj-Chikh, E. Larson, T. Melino K. Weber, and J. Zack, “Methodology for Climate Central’s WeatherPower™ (Wind and Solar Electricity Forecaster),” Climate Central, Princeton, NJ, 20 September 2019.
163. E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America:

Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020 (345 pages).

### **TALKS PRESENTED (chronological)**

1. "End-Use Energy Demand Modeling and the Technology Menu as Aids to Energy Policy Analysis," Second End-Use Oriented Global Energy Project Workshop, São Paulo, Brazil, June 4-15, 1984.
2. "Energy and Development," Woodrow Wilson National Fellowship Foundation Summer Workshop on Global Interdependence, Princeton, NJ, July 9-27, 1984.
3. "Material Consumption Patterns and Industrial Energy Demand in Industrialized Countries," special seminar at the Guangzhou Institute for Energy Conversion, Chinese Academy of Science, Guangzhou, China, Dec. 25, 1984.
4. "Some Basic Issues in the Gasification of Biomass and Its Connection to Economic Development," seminar series on the Future Role of Biomass as an Energy Source, School of Forestry and Environmental Studies, Yale University, New Haven, CT, February 6, 1985.
5. "The Use of Biomass for Energy in China," Tuesday Seminar Series, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, February 26, 1985.
6. "The Thermodynamics and Economics of Steam-Injected Gas-Turbine Cogeneration," American Physical Society Short-Course on Energy Conservation, Washington, D.C., April 27-28, 1985.
7. "The Quiet Revolution in Power Generating Technology: Steam-Injected Gas Turbines," Tuesday Seminar Series, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, October 15, 1985.
8. "Overview of Steam-Injected Gas Turbines: Cogeneration and Utility Applications," Energy Policy/Technology Assessment Seminar Series, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, September 17, 1985.
9. "Steam-Injected Gas Turbines," special seminar at the Department of Mechanical Engineering, University of Minnesota, Minneapolis, MN, October 25, 1985.
10. "Biomass Gasification: Research, Development and Application," Energy Policy/Technology Assessment Seminar Series, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, November 22, 1985.
11. "Steam-Injected Gas Turbines," ASME International Gas Turbine Conference, Dusseldorf, Germany, June 8-12, 1986.
12. "Gas Turbine Cycle Concepts for Bagasse-Fueled Cogeneration in Sugar Factories," Eastern Headquarters, Bechtel Power Corp., Gaithersburg, MD, Oct. 15, 1986.
13. "Gas Turbine Options for Bagasse-Fueled Cogeneration in Sugar Factories," Sugar Industry Research Institute, Kingston, Jamaica, Oct. 29, 1986.
14. "Global Potential for Gas Turbine Power Generation in Sugar Factories," Engineering Systems Laboratory, General Electric Corp. Research and Development, Schenectady, NY, Jan. 28, 1987.
15. "Progress at CEES in the Assessment of Biomass-Fueled Gas Turbine Power Generation," Bechtel National, Inc. and of the US Agency for International Development, Princeton, NJ, Feb. 17, 1987.
16. "Steam-Injected Gas Turbine Cogeneration for the Cane Sugar Industry," meeting of Jamaican sugar and petroleum-refining industries, Kingston, Jamaica, March 18, 1987.
17. "New Prospects for Cogeneration in the Cane Sugar Industry," Second Pacific Basin Biofuel Workshop, Kauai, HI, April 22-24, 1987.
18. "Gas Turbine Cogeneration in the Cane Sugar Industry," presentation to representatives of the World Bank, the US Department of Energy, the Inter-American Development Bank, the US Agency for International Development, Bechtel National, and others, Washington, D.C., May 21, 1987.
19. "Biomass-Fired Steam-Injected Gas Turbine Cogeneration for the Cane Sugar Industry," presentation to representatives of the World Bank, US Department of Energy, Inter-American Development Bank, the US Agency for International Development, USTDP, General Electric, Bechtel, and others, Washington, DC, June 19, 1987.

20. "Biomass-Fired Steam-Injected Gas Turbine Cogeneration for the Jamaican Cane Sugar Industry," presentation to representatives of the Jamaican Sugar Industry Authority, Sugar Industry Research Institute, Jamaica Sugar Holdings, Jamaica Public Service Utility, Ministry of Mining, Energy and Tourism, and Petrojam, Kingston, Jamaica, June 30, 1987.
21. "Biomass-Fired Gas-Turbine Cogeneration at Efficient Cane-Sugar Factories: A Jamaican Case Study," Meeting of the Jamaican Association of Sugar Technologists, Ocho Rios, Jamaica, Nov. 6, 1987.
22. "Biomass-Fired Steam-Injected Gas Turbine Cogeneration," special seminar at the Energy Systems Analysis Program, University of Lund, Lund, Sweden, January 14, 1988.
23. "Gas Turbine Cogeneration with Agricultural Residues," Convocation on Rice Residue Utilization Technology, Louisiana State University, Baton Rouge, LA, Jan. 28, 1988.
24. "Biomass-Fired Gas Turbine Cogeneration for the Cane Sugar Industry," West Indies Sugar Technologists Conference, Bridgetown, Barbados, April 21, 1988.
25. "Biomass-Fired Gas Turbine Cogeneration for the Cane Sugar Industry," Research in Thermochemical Biomass Conversion Conference: An International Conference, Phoenix, AZ, May 6, 1988.
26. "Biomass-Fired Aeroderivative Turbines," seminar at the World Bank to representatives of the Household and Renewable Energy and Energy Efficiency Strategies Departments, Washington, DC, May 23, 1988.
27. "Aeroderivative Turbines for Power from Natural Gas and Biomass Fuels in Developing Countries," seminar at Shell International Petroleum Co. to Group Planning, Natural Gas, Non-traditional Business Divisions, London, UK, July 19, 1988.
28. "Biomass-Fired Steam-Injected Gas Turbine Cogeneration," Second International ASME Symposium on Turbomachinery, Combined-Cycle Technologies, and Cogeneration, Montreux, Switzerland, Aug. 30, 1988.
29. "Biomass-Fired Aeroderivative Turbines," seminar at ASEA Brown-Boveri Corporate Research Center, Baden, Switzerland, Sept. 2, 1988.
30. "Advanced Gasifier Gas Turbine Power Systems," special seminar at the Technical Research Center of Finland, Helsinki, May 4, 1989.
31. "Biomass Gasification for Gas Turbine Power Generation," Electricity Congress, sponsored by Vattenfall, the Swedish State Power Board, Gothenburg, Sweden, May 31, 1989.
32. "Biomass Gas Turbine Cogeneration for the Cane Sugar Industry," XX Congress of the International Society of Sugar Cane Technologists, São Paulo, Brazil, October 19, 1989.
33. "Development of Biomass Gasification Systems for Gas Turbine Cogeneration in the Cane Sugar Industry," XX Congress of the International Society of Sugar Cane Technologists, São Paulo, Brazil, October 19, 1989.
34. "Biomass-Fired Gas Turbines at Cane Sugar Factories: A Major Electricity Supply Option," seminar at the State Energy Company of São Paulo (CESP), São Paulo, Brazil, Oct. 17, 1989.
35. "The Technology Menu for Efficient End-Use of Energy," seminar at the State Energy Company of São Paulo, São Paulo, Brazil, Oct. 17, 1989.
36. "Biomass-Fired Gas Turbines at Cane Sugar Factories: A Major Electricity Supply Option," seminar at the Ferdinand Braudel Institute of World Economics, São Paulo, Brazil, Oct. 18, 1989.
37. "Biomass-Fired Gas Turbines at Cane Sugar Factories: A Major Electricity Supply Option," seminar for engineering staff at the Electricity Generating Authority of Thailand, Bangkok, Thailand, Nov. 1, 1989.
38. "Biomass-Gasifier Steam-Injected Gas Turbine Cogeneration for the Cane Sugar Industry," Conference on Energy from Biomass and Wastes XIV, Buena Vista, FL, Jan. 29-Feb. 2, 1990.
39. "Development of Biomass Gasification Systems for Gas Turbine Power Generation," Conference on Energy from Biomass and Wastes XIV, Buena Vista, FL, Jan. 29-Feb. 2, 1990.
40. "A Renewable Electricity Future for Sweden After Nuclear Power?" Tuesday Seminar Series, Center for Energy and Environmental Studies, Princeton University., Princeton, NJ, Feb. 13, 1990.

41. "Biomass-Gasifier Gas Turbine Applications in the Pulp and Paper Industry: An Initial Strategy for Reducing Electric Utility CO<sub>2</sub> Emissions," Ninth EPRI Conference on Coal Gasification Power Plants, Palo Alto, CA, Oct. 17-19, 1990.
42. "Biomass-Gasifier Gas Turbine Applications in the Pulp and Paper Industry: An Initial Strategy for Reducing Electric Utility CO<sub>2</sub> Emissions," Conference on Biomass for Utility Applications, Tampa, FL, Oct. 23-25, 1990.
43. "R&D Issues for Pressurized Fixed-Bed and Fluidized-Bed Biomass Gasifiers for Gas Turbine Applications," Biomass Power Long Range Plan Meeting, Solar Energy Research Institute, Golden, CO., Jan. 22, 1991.
44. "Advanced Biomass-Gasifier/Gas Turbine Cogeneration Systems," Energy Planning for the 90s: Matching Energy Sources to Energy Needs with Concerns for Efficiency, Economics, and the Environment, Bucknell University, Lewisburg, PA, Jan. 25, 1991.
45. "Energy Conservation and the Technology Menu for Efficient End-Use of Energy: A Discussion in the Indian Context," Center for Energy Studies, Indian Institute of Technology, New Delhi, India, April 23, 1991.
46. "Biomass-Gasifier/Gas Turbine Cogeneration in the Pulp and Paper Industry," International Gas Turbine Conference, Orlando, FL, June 5, 1991.
47. "Advanced Gasification-Based Biomass Power Generation and Cogeneration," ESETT'91: International Symposium on Environmentally Sound Energy Technologies and Their Transfer to Developing Countries and European Economies in Transition, Milan, Italy, Oct. 22, 1991.
48. "Trends in the Consumption of Energy-Intensive Basic Materials in Industrialized Countries and Implications for Developing Regions," ESETT'91: International Symposium on Environmentally Sound Energy Technologies and Their Transfer to Developing Countries and European Economies in Transition, Milan, Italy, Oct. 22, 1991.
49. "Environmental and Economic Issues of Biomass-Gasifier/Gas Turbine Cogeneration," Course on Cogeneration Systems: Economic and Environmental Assessment, Test Procedures, Dipartimento di Energetica, Politecnico di Milano, Milan, Italy, Oct. 23, 1991.
50. "Workshop on the Technology Menu for Efficient End-Use of Energy in Indian Industry," National Productivity Council Headquarters, New Delhi, India, Jan. 10, 1992.
51. "Fuels and Electricity from Biomass," 3<sup>rd</sup> US Hydrogen Meeting, Arlington, VA, Mar. 18-20, 1992.
52. "Production of Methanol and Hydrogen via Biomass Gasification," Conference on Advances in Thermochemical Biomass Conversion, Interlaken, Switzerland, May 1992.
53. "India Technology Menu for Efficient Use of Energy," (with K.K. Chakarvarti and D. Pawan Kumar), Office of Energy and Infrastructure, US Agency for International Development, August 12, 1992.
54. "Fuels and Electricity from Biomass," Dept. of Environmental and Energy Systems Studies, Lund University, Lund, Sweden, Sept. 14, 1992.
55. "Demand-Side Management and Least-Cost Electricity Planning," International Energy Initiative Workshop on Integrated Electricity Planning, Bangalore, India, March 8-12, 1993.
56. "The India Technology Menu for Efficient Energy Use," Technology Menu Workshops, Bangalore, Calcutta, Ahmedabad, and New Delhi, India, March 15-22, 1993.
57. "Biomass-Gasifier/Gas Turbine Power Generating Technology," Electric Power Research Institute's Conference on Strategic Benefits of Biomass and Waste Fuels, Washington, March 1993.
58. "Hydrogen and Methanol for Fuel Cell Vehicles: Availability and Economics," US Department of Energy's Annual Automotive Technology Development Contractors' Coordination Meeting, Dearborn, MI, Oct. 18-21, 1993.
59. "Development of Sustainable Biomass Energy Production in Northeast Brazil," at workshop of same title, Brasilia, Brazil, May 3, 1994.
60. "The Potential for Sugarcane Electric Power in Cuba," guest lecture at ISPJAE (Instituto Superior Politecnico Jose Antonio Echeverria), Havana, Cuba, June 22, 1994.
61. "Advanced Biomass Power Generation," Energy Research Corp., Danbury, CT, August 29, 1994.
62. "Farm Forestry in Brazil," Bioresources '94: Biomass Resources: a Means to Sustainable Development, Bangalore, India, Oct. 4, 1994.

63. "Biomass-Gasifier/Aeroderivative Gas Turbine Combined Cycle Power Generation," Bioresources '94: Biomass Resources: a Means to Sustainable Development, Bangalore, India, Oct. 4, 1994.
64. "Biomass-Gasifier/Aeroderivative Gas Turbine Combined Cycles," Weyerhaeuser Corporate Technology Center, Seattle, WA, Oct. 24, 1994.
65. "Methanol and Hydrogen from Biomass for Transportation," at the Biofuels Analysis Technical Review Meeting, White House Conference Center, Washington, DC, Oct. 28, 1994.
66. "Methanol and Hydrogen from Biomass and MSW,□" Air Products and Chemicals, Inc., Princeton, NJ, Dec. 6, 1994.
67. "Long-Term Strategies for Expansive Growth in Advanced, Sustainable Biomass Energy Systems," World Bank and GEF, World Bank, Washington, DC, Dec. 8, 1994.
68. "Biomass Integrated-Gasifier/Gas Turbine Power Generating Systems," Jose Carlos Medeiros, CEPTEL [Brazilian Electric Power Research Institute], Princeton, NJ, Jan. 27, 1995.
69. "Market Opportunities for Hydrogen in Developing Regions," 6th Annual National Hydrogen Association Meeting, Alexandria, Virginia, March 9, 1995.
70. "Advanced Gas Turbine Power Generation with Natural Gas and Biomass as Fuel," guest lecture in MAE 221, Thermodynamics, Engineering School, Princeton University, Princeton, NJ, April 7, 1995.
71. "Electricity Cogeneration in Sugar/Alcohol Industries," Workshop on Perspectives of Ethanol Fuel in Brazil, São Paulo, Brazil, June 28, 1995.
72. "Low GHG Emitting Technologies," Meeting on Future Programming in the Context of the GEF Climate Change Operational Strategy, United Nations Development Program, New York, NY, Nov. 22, 1995.
73. "Research, Development, and Commercialization Needs for Biomass Electricity Systems," Workshop on Energy from Biomass and Wastes, Dublin, Ireland, Dec. 5-7, 1995.
74. "Advanced Technologies for Biomass-Energy Utilization in the Pulp and Paper Industry," Office of Industrial Technologies, US Department of Energy, Washington, DC, Dec. 19, 1995.
75. "Advanced Technologies for Biomass-Energy Utilization in the Pulp and Paper Industry," NOELL, Inc., Herndon, VA, Feb. 15, 1996.
76. "Advanced Gas Turbine Power Generation," guest lecture in MAE 221, Thermodynamics, Engineering School, Princeton University, Princeton, NJ, February 23, 1996.
77. "Biomass Energy," Workshop on Sustainable Energy, United Nations Development Program, New York, NY, April 18, 1996.
78. "Biomass Energy Case Studies," Workshop on Sustainable Energy, United Nations Development Program, New York, NY, April 18, 1996.
79. "Future Prospects for Biomass as a Major Global Energy Source," invited seminar, Dartmouth College, Hanover, NH, May 2, 1996.
80. "International Market Opportunities for Gas Turbine Power Generation with Natural Gas and Biomass Fuels," Energy Daily 3<sup>rd</sup> Annual Conference on Advanced Combustion Turbines: New Strategies and Business Opportunities, Washington, DC, May 9-10, 1996.
81. "Advanced Technologies for Biomass-Energy Utilization in the Pulp and Paper Industry," Union Camp Research and Development Center, Princeton, NJ, May 14, 1996.
82. "Performance Modeling of Aeroderivative Steam-Injected Gas Turbines and Combined Cycles Fueled from Fixed or Fluid-Bed Biomass Gasifiers," ASME Turbo Expo, Birmingham, UK, June 10-13, 1996.
83. "Economic Scales for First-Generation Biomass-Gasifier/Gas Turbine Combined Cycles Fueled from Energy Plantations,□" ASME Turbo Expo, Birmingham, UK, June 10-13, 1996.
84. "Technical Advances in Biomass Conversion for Energy," the Woods Hole-Princeton Workshop on Competing Uses of the Planet's Photosynthetic Product for Food, Fuel, Fiber, Feedstock, and Ecosystem Function, Woods Hole Research Center, Woods Hole, MA, June 27-28, 1996.

85. "GEF Climate Change Activities," Seminario de Disseminacao de Informacoes sobre o GEF, organized by the GEF (World Bank and United Nations Development Program) and government of Brazil, Brasilia, July 3-5, 1996.
86. "Advanced Technologies for Biomass-Energy Utilization in the Pulp and Paper Industry," Air Products and Chemicals, Inc., Princeton, NJ, July 23, 1996.
87. "GEF Operational Strategy for Climate Change," United Nations Development Program Environment Focal Points Workshop, Margarita Island, Venezuela, Nov. 18-20, 1996.
88. "Gasification of Municipal Solid Waste," Meeting on MSW Gasification/Fuel Cells held at the Natural Resources Defense Council Office, New York, NY, Nov. 25, 1996.
89. "Overview of Black Liquor and Biomass Gasification/Gas Turbine Systems," Workshop on Commercialization of Black Liquor and Biomass Gasification for Gas Turbine Applications in the Pulp and Paper Industry, School of Engineering, Princeton University, Princeton, NJ, Jan. 16-17, 1997.
90. "Advanced Technologies for Biomass-Energy Utilization in the Pulp and Paper Industry," Workshop on Commercialization of Black Liquor and Biomass Gasification for Gas Turbine Applications in the Pulp and Paper Industry, School of Engineering, Princeton University, Princeton, NJ, Jan. 16-17, 1997.
91. "GEF Operational Strategy for Climate Change," United Nations Development Program Workshop, Bogota, Colombia, May 21, 1997.
92. "Climate Change and Mitigation Strategies," Seminario Internacional Desarrollo Sostenible, Ministry of the Environment, Bogota, Colombia, 22-23 May 1997.
93. "Effect of Fuel Moisture Content on Biomass-IGCC Performance," Turbo-Expo '97, 42<sup>nd</sup> ASME Gas Turbine and Aeroengine Conference, Orlando, FL, June 2-5, 1997.
94. "Black Liquor-Gasifier/Gas Turbine Cogeneration," Turbo-Expo '97, 42<sup>nd</sup> ASME Gas Turbine and Aeroengine Conference, Orlando, FL, 2-5 June, 1997.
95. "Performance of Black Liquor-Gasifier/Gas Turbine Combined Cycle Cogeneration in the Kraft Pulp and Paper Industry," Third Biomass Conference of the Americas, Montreal, Canada, August 25-29, 1997.
96. "Biomass and Black Liquor Gasifier/Gas Turbine Cogeneration at Pulp and Paper Mills," Third Biomass Conference of the Americas, Montreal, Canada, August 25-29, 1997.
97. "GEF Operational Strategy for Climate Change," Taller Nacional del Fondo para el Medio Ambiente Mundial, Ministerio del Medio Ambiente, Bogota, Colombia, 29 Sept. - 1 Oct. 1997.
98. "The Role of Biomass in the World Context: Potential and Perspectives," invited plenary talk, Conference on Biomass for Electricity Production: Experiences and Perspectives in the European Union and Brazil, Brasilia, Brazil, October 6-8, 1997.
99. "Hydrogen Production, Storage, and End-Use," National Academy of Science, Havana, Cuba, October 24, 1997.
100. "Advanced Technologies for Biomass-Energy Utilization in the Pulp & Paper Industry," US Department of Energy contractors' review meeting, Chicago, IL, December 1, 1997.
101. "Assessing Prospective Costs and Benefits of Black Liquor Gasifier/Combined Cycle Technology," US Department of Energy/Agenda 2020 poster review session, Chicago, IL, December 2, 1997.
102. "Assessment of Gasifier/Fuel Cell Powerplant Systems for Biomass By-Products Utilization in the Forest Products Industry," US Department of Energy/Agenda 2020 poster review session, Chicago, IL, December 2, 1997.
103. "Gasification of Municipal Solid Waste to Run Fuel Cell Buses," Department of Environmental Protection, State of New Jersey, Trenton, NJ, Dec. 16, 1997.
104. "Small-Scale Gasification-Based Biomass Power Generation," Workshop on Small-Scale Electricity Generation from Biomass, Energy Strategies Working Group, China Council for International Cooperation on Environment and Development, Changchun, Jilin Province, China, January 12-13, 1998.
105. "Transport Fuels from MSW for New Jersey," presentation to Commissioner Robert Shinn and others at the Department of Environmental Protection, State of New Jersey, Trenton, Feb. 25, 1998.
106. "Fuel Cell Vehicles and New Jersey," presented at a briefing on Hydrogen Energy for New Jersey Transportation, New Jersey State House, Trenton, NJ, March 11, 1998.

107. "Biomass Energy," guest lecture, Geosciences 524, Princeton University, Princeton, NJ, April 21, 1998.
108. "Preliminary Economics of Black Liquor Gasifier/Gas Turbine Cogeneration at Pulp/Paper Mills," 43<sup>rd</sup> ASME Gas Turbine & Aeroengine Congress, Stockholm, Sweden, June 3, 1998.
109. "Combined Biomass and Black Liquor Gasifier/Gas Turbine Cogeneration at Pulp/Paper Mills," 43<sup>rd</sup> ASME Gas Turbine & Aeroengine Congress, Stockholm, Sweden, June 3, 1998.
110. "Transport Fuels from MSW in New Jersey, Division of Solid Waste," NJ Dept. of Environmental Protection, Trenton, NJ, July 9, 1998.
111. "Advanced Technologies for Biomass-Energy Utilization in the Pulp & Paper Industry," project review meeting, US Department of Energy, Washington, DC, Oct. 20, 1998.
112. "Preliminary Cost Assessment of Black Liquor Gasification," Babcock and Wilcox R&D Center, Barberton, OH, May 25, 1999.
113. "Biomass Gasification in the USA," Brazil Biomass Gasification Project Expert Workshop, The World Bank, Washington, DC, June 3, 1999.
114. "Advanced Technologies for Biomass Conversion to Energy," keynote talk, Second Olle Lindström Symposium on Renewable Energy: Bioenergy, Royal Institute of Technology, Stockholm, Sweden, June 9, 1999.
115. "Biomass Conversion to Fischer-Tropsch Liquids: Preliminary Energy Balances," 4<sup>th</sup> Biomass Conference of the Americas, Oakland, CA, Aug. 29- Sept. 2, 1999.
116. "A Preliminary Assessment of Biomass Conversion to Fischer-Tropsch Cooking Fuels for Rural China," 4<sup>th</sup> Biomass Conference of the Americas, Oakland, California, Aug. 29- Sept. 2, 1999.
117. "Crop-Residue Fueled Trigeneration with Microturbines in Rural China," Technical Training Workshop of the Jilin Biomass Energy Modernization Project, Changchun, Jilin Province, China, 27-28 March 2000.
118. "Commercialization Prospects for Fuel Cell Buses," Workshop on Commercialization of Fuel Cell Buses: Potential Roles for the GEF, United Nations Headquarters, New York, 27-28 April 2000.
119. "Biomass Integrated-Gasifier/Gas Turbine Combined Cycle Technology for Sugarcane Processing Industries: Possibilities for Cuba," International Workshop on Sugarcane Energy, Havana, Cuba, 7-9 November 2000.
120. "Ethanol from Biomass," Atmospheric Environment Institute, Chinese Research Academy of Environmental Sciences, State Environmental Protection Agency, Beijing, China, 14 Dec. 2000.
121. "Creating a Village Biomass-CHP Industry in Jilin Province," Jilin Biomass Energy Modernization Project, Business Seminar, Changchun, Jilin Province, China, 16 December 2000.
122. "Polygeneration Strategies for Clean, Low-Carbon Energy Futures for China," invited lecture, Chalmers Technical University/Goteborg University, Gothenburg, Sweden, 1 February 2001.
123. "Polygeneration: a Fundamental Strategy for Environmentally-Sustainable Future Energy for China?" presented at China headquarters of BP (British Petroleum), Beijing, 19 June 2001.
124. "The Carbon Challenge," presented at the Community Learning Day session on Environmental and Societal Tradeoffs in Meeting Society's Demand for Electrical Power, The College of New Jersey, Ewing, NJ, 17 October 2001.
125. "Socio-Economic and Environmental Impact Assessment for the Jilin Modernized Biomass Energy Project," (presented with John Young), Business Enterprise Workshop, Yanji City, Jilin Province, China, 7 December 2001.
126. "The Carbon Mitigation Initiative at Princeton University and the Tsinghua-Princeton Collaboration," Department of Thermal Engineering, Tsinghua University, Beijing, China, 12 December 2001.
127. "The Princeton-Tsinghua Collaboration on Low Emission Energy Technologies and Strategies for China," Hydrogen Meeting, Carbon Mitigation Annual Review, Princeton University, Princeton, NJ, 16 January 2002.
128. "Future Implications of China's Energy Technology Choices," (presented with Pat Delaquil), invited seminar, US Department of Energy, Washington, DC, 22 January 2002.
129. "Technology Strategies for Addressing China's Energy Challenges," Associated Faculty Forum, Princeton Environmental Institute, Princeton University, 9 April 2002.

130. "Energy Strategies for China," Group Meeting, Carbon Mitigation Initiative, Princeton University, 29 April 2002.
131. "Exploring Implications to 2050 of Energy-Technology Options for China," 6<sup>th</sup> International Conference on Greenhouse Gas Control Technologies (GHGT-6), Kyoto, Japan, 1 Oct, 2002.
132. "Production of Hydrogen and Electricity from Coal with CO<sub>2</sub> Capture," (presentation of paper by Kreutz, Williams, Socolow, Chiesa, and Lozza), 6<sup>th</sup> International Conference on Greenhouse Gas Control Technologies (GHGT-6), Kyoto, Japan, 2 Oct, 2002.
133. "A Cost Benefit Analysis of Black Liquor Gasification in the Southeast United States," (presented with Ryan Katofsky) to the Steering Committee and Review Board of the BLGCC Analysis Project, American Forest and Paper Association, Washington, DC, 5 November 2002.
134. "Global Renewable Energy Resource Estimates for the SAGE Model," (presented with Pat Delaquil), invited seminar, Energy Information Administration, US Department of Energy, Washington, DC, 13 November 2002.
135. "Polygeneration Analysis at Princeton University, 2002," presented at meeting of the Task Force on Energy Strategies and Technologies of the China Council for International Cooperation on Environment and Development, Tsinghua University, Beijing, 10-11 December 2002.
136. "Clean Energy Technologies and Strategies for China," Center for Environmental Research and Technology, Bourns College of Engineering, University of California, Riverside, 3 March 2003.
137. "Synthetic Fuels Production by Indirect Coal Liquefaction," Workshop on Coal Gasification for Clean and Secure Energy (convened by Task Force on Energy Strategies and Technologies, China Council for International Cooperation on Environment and Development), Beijing, 25-26 Aug. 2003.
138. "Cost-Benefit Assessment of Black Liquor Gasification Combined Cycle (BLGCC)," Black Liquor Program Review, U.S. Department of Energy, Morgantown, WV, 21 October 2003.
139. "A Cost-Benefit Analysis of Black Liquor Gasification Combined Cycle Systems," Fall Technical Conference, Technical Association of the Pulp and Paper Industry, Chicago, IL, 29 October 2003.
140. "A Cost-Benefit Analysis of Black Liquor Gasification Combined Cycle Systems," Oak Ridge National Laboratory, 8 December 2003.
141. "Thermochemical Processing of Non-Grain Biomass for Energy," Non-Grain Biomass Meeting, Cargill, Inc., Minneapolis, MN, 22 January 2004.
142. "Production of Electricity and/or Fuels from Biomass by Thermochemical Conversion," Public Meeting of the project, Renewable Biomass Energy for America's Energy Future, American Association for the Advancement of Science, Washington, DC, 23 February 2004.
143. "Biomass Gasification Systems for Electric Power, Cogeneration, Liquid Fuels, and Hydrogen," Global Climate and Energy Project (GCEP) Energy Workshops, Stanford University, Stanford, California, 27 April 2004.
144. "Environmental and Economic Implications of Phasing Out Solid Fuels Used for Cooking in China," Workshop on Mitigation of Air Pollution and Climate Change in China, Norwegian Academy of Science and Letters, Oslo, 17-19 October 2004.
145. "Future Energy Technologies and Strategies for China," Industrial Performance Center, Massachusetts Institute of Technology, Cambridge, Massachusetts, 22 February 2005.
146. "New Value from Residuals and Spent Liquor," American Institute of Chemical Engineers, Spring Meeting, Atlanta, 11 April 2005.
147. "Gasification-based Liquid Fuels and Electricity from Biomass with Carbon Capture and Storage," 4<sup>th</sup> Annual Conference on Carbon Capture and Sequestration, US Dept. of Energy, Alexandria, VA, 2-5 May 2005.
148. "Gasification-based Liquid Fuels and Electricity from Biomass with Carbon Capture and Storage," UOP Research Headquarters, Des Plaines, Illinois, 3 June 2005.
149. "Energy Systems Analysis (Bioenergy Focus) and Related Policy Issues," special seminar, Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 6 July 2005.

150. "Development and Deployment of Biomass Power Generation Systems: a Global Perspective," Conference on Power Generation from Renewable Energy: Practical Approaches, Bangkok, Thailand, 8 July 2005.
151. "Review of LCA Studies on Liquid Biofuel Systems for the Transport Sector," Workshop on Biofuels for the Transport Sector, Science & Technology Advisory Panel, Global Environmental Facility, New Delhi, India, August 30, 2005.
152. "Transportation Energy and Environmental Concerns at Home and Abroad," Physic Department Colloquim, Rutgers University, New Brunswick, 2 November 2005.
153. "The Role of Biomass in America's Energy Future," ECON Analysis, Oslo, Norway, 8 November 2005.
154. "Toward a Global Clean Cooking Initiative," Norwegian Ministry of Foreign Affairs, Oslo, Norway, 8 November 2005.
155. "Evaluating the Impact of Air Pollution on Agriculture and Human Health in China: Implications for future air pollution and energy policies," presented on behalf of X. Wang at D. Mauzerall at A Policy Workshop on Mitigation of Air Pollution and Climate Change in China: co-benefits and co-control, Beijing, 22-23 November 2005.
156. "Low-Carbon Transport Fuels from Coal and Biomass for China and the U.S.," Civil, Architectural, and Environmental Engineering Department, Drexel University, Philadelphia, PA, 30 November 2005.
157. "Lifecycle Analyses of GHG Impacts of Biofuels for Transport," Energy Week, The World Bank, 7 March 2006.
158. "Hydrogen and Electricity from Biomass With and Without Carbon Capture and Storage," Fifth Annual Conference on Carbon Capture and Sequestration, Alexandria, VA, 8-11 May 2006.
159. "DME from Biomass (USA) and Coal (China)," Second International DME Conference, London, 15-17 May 2006.
160. "Low-Carbon Liquid Transportation Fuel from Coal and Biomass," Argonne National Laboratory, Chicago, IL, 2 June 2006.
161. "Fuels and Electricity from Biomass with CO<sub>2</sub> Capture and Storage," poster presentation by R.H. Williams on behalf of Larson, 8<sup>th</sup> International Conference on Greenhouse Gas Control Technologies, Trondheim, Norway, 19-22 June 2006.
162. "Gasification in the Pulp and Paper Industry," Georgia Bioenergy Conference, Tifton, GA, 2 Aug. 2006.
163. "Cost-Benefit Analysis of Gasification-Based Biorefining at U.S. Kraft Pulp Mills," TAPPI 2006 Engineering, Pulping and Environmental Conference, Atlanta, GA 7 Nov. 2006.
164. "Liquid Biofuel Technologies and Technology Issues," Biofuels Workshop, United Nations Conference on Trade and Development, Geneva, Switzerland, 30 Nov 2006.
165. "Cost-Benefit Analysis of Gasification-Based Biorefining at U.S. Kraft Pulp Mills," presentation to the AFPA Agenda 2020 CTO Committee, American Forest & Paper Association, Washington, DC, 7 Dec. 2006.
166. "Making Liquid Biofuels at Kraft Pulp/Paper Mills in the USA: Results of a Detailed Cost-Benefit Assessment," invited lecture, Dept. of Thermal Engineering, Chalmers University, Gothenburg, Sweden, 11 Jan. 2007.
167. "Biofuel Technologies Overview," testimony to Committee on Environment and Natural Resources Finance, Minnesota State House of Representatives, St. Paul, MN, 1 Feb 2007.
168. "Biofuel Technologies Overview," Symposium on Pathways Toward a Renewable Energy Future: Environmental Sustainability Through Technology and Policy, Initiative for Renewable Energy and The Environment, University of Minnesota, St. Paul, 1 Feb 2007.
169. "Making Liquid Biofuels at U.S. Kraft Pulp and Paper Mills," Dept. of Bioproducts and Biosystems Engineering, University of Minnesota, St. Paul, MN, 2 Feb 2007.
170. "Gasification-Based Liquid Biofuels Production," meeting on Coal/Biomass to Liquids Technology, National Energy Technology Laboratory, Pittsburgh, PA, 13 March 2007.

171. "Advanced Gasification-Based System Concepts for Biorefining," Advanced Bioenergy Technologies and Biofuels from Municipal Solid Waste, California Biomass Collaborative 4<sup>th</sup> Annual Forum, Sacramento, California, 28-29 March 2007.
172. "Gasification-Based Biorefineries Integrated with Pulp Mills," First Wednesday Seminar, Resources for the Future, Washington, DC, 4 April 2007.
173. "Gasification-Based Production of Electricity and/or Liquid Transportation Fuels," Seminar on Technologies for Future Production of Ethanol in Brazil, Instituto de Tecnologia Promon, Sao Paulo, Brazil, 17 April 2007.
174. "CO<sub>2</sub> for EOR from Coal Gasification," PetroChina – BP CCS/EOR Seminar, Research Institute of Petroleum Exploration and Development (RIPED), Beijing, 24-25 April 2007.
175. "Pulp Mill Integrated Gasification-Based Liquid Biofuels Production," TAPPI International Conference on Renewable Energy, Atlanta, GA, 10-11 May 2007
176. "Synfuels from Coal and Coal/Biomass: Greenhouse Gas Emissions and Policy Implications," Gasification Technologies Council Spring Meeting, Williamsburg, VA, 17-18 May 2007.
179. "Biofuel Production Technologies: Status and Prospects," Ad hoc expert group meeting on Biofuels: Trade and Development Implications of Present and Emerging Technologies, United Nations Conference on Trade and Development, Geneva, 19 June 2007.
180. "Making Better Use of Biomass for Energy," D.W. Brooks Lecture, College of Agricultural and Environmental Sciences, University of Georgia, Athens, GA, 2 October 2007.
181. "Low-GHG Liquid Fuels from Coal + Biomass," Chewonki Carbon Capture and Storage Seminar, Wiscasset, Maine, 24 October 2007.
182. "Prospects for Second Generation Biofuels Technologies," Conference on Biofuels: An Option for a Less Carbon-Intensive Economy, organized by the United Nations Conference on Trade and Development and the Energy Planning Agency of the Ministry of Mines and Energy of Brazil, Rio de Janeiro, 4-5 December 2007.
183. "China's Energy Challenges," guest lecture in Global Environmental Governance (WWS586d, taught by Michael Oppenheimer), Woodrow Wilson School of Public and International Affairs, Princeton University, 3 April 2008.
184. "China's Energy Challenges," guest lecture in Global Environmental Governance (ORF571, taught by Gregory Chow), Department of Operations Research and Financial Engineering, Princeton University, 3 April 2008.
185. "Low GHG Liquid Fuels (and Electricity) from Coal + Biomass," CTLtec Americas 2008, 23 June 2008, Pittsburgh, PA.
186. "Analysis of Fischer-Tropsch Fuels from Coal and Biomass," Commercial Aviation Alternative Fuels Initiative (CAAFI) Business Team Meeting and Workshop, 8-9 September 2008, Washington, DC
187. "Co-production of synfuels and electricity from coal + biomass with zero net carbon emissions: an Illinois case study," poster presentation at 9<sup>th</sup> International Greenhouse Gas Control Technologies Conference (Elsevier Energy Procedia), Washington DC, 17-18 November 2008.
188. "Biomass-Energy Technologies: Perspectives for Brazil's Sugarcane Industry," presented to the Technical Advisory Committee of the Centro de Tecnologia Canavieira, Piracicaba, Brazil, 24 Nov 2008.
189. "Biomass-Energy Technologies: Perspectives for Brazil's Sugarcane Industry," presented to the Board of Directors of the Centro de Tecnologia Canavieira, Sao Paulo, Brazil, 26 Nov 2008.
190. "Design/Simulation/Costing of Gasoline from Coal and Biomass (work in progress!)," presentation at ExxonMobil Research and Engineering Company, Annandale, NJ, 17 Feb 2009.
191. "Biofuels," commentary as a member of the "Bioenergy Panel" at the Massachusetts Institute of Technology Energy Conference, Boston, MA, 7 March 2009.
192. "Commercializing New Biomass Energy Technologies," Third Meeting of the International Sugarcane Biomass Utilization Consortium of the International Society of Sugarcane Technologists, Shandrani Resort and Spa, Mauritius, 28 June – 1 July 2009.

193. "Perspectives on Energy Supply: 'Green' Transportation Fuels," invited talk, Topsøe Catalysis Forum: Catalysis in New Environmental Processes," Munkerupgaard, Denmark, 28 August 2009.
194. "Princeton CBTL Work," Interagency Life Cycle GHG Benchmark Studies Meeting, MIT, Cambridge, MA, 14-15 October 2009.
195. "Algae Analysis at Princeton (work in progress)," Interagency Life Cycle GHG Benchmark Studies Meeting, MIT, Cambridge, MA, 14-15 October 2009.
196. "Using Coal for Energy Security and Climate Change Mitigation," Lunchtime Energy Seminars, Princeton Environmental Institute, Princeton University, 26 February 2010.
197. "Nuclear in New Jersey: Status and Alternatives," 8<sup>th</sup> Annual Public Affairs Forum, Woodrow Wilson School of Public and International Affairs, Princeton University, 6 May 2011.
198. "Using Biomass Efficiently to Make Hydrocarbon Fuels," Institute for Renewable Energy and the Environment, University of Minnesota, St. Paul, MN, 15 June 2011.
199. "Low-GHG Hydrocarbon 'Biofuels' Using Less Biomass," Risø DTU National Laboratory for Sustainable Energy, Roskilde, Denmark, 27 September 2011.
200. "Resource-Efficient Liquid Hydrocarbon Fuels from Biomass," Department of Chemical Engineering, McMaster University, Hamilton, Ontario, Canada, 6 October 2011.
201. "Decarbonized Electricity and Fuels from Coal and Biomass," Sixth Sino-US Joint Conference on Chemical Engineering, Beijing, China, 8 November 2011.
202. "Decarbonized Electricity and Fuels from Coal and Biomass," School of Energy, Power, and Mechanical Engineering, North China Electric Power University, Beijing, China, 11 November 2011.
203. "Biomass Energy with Carbon Capture and Storage (BECCS): Strategies for Reducing the Carbon Footprint of the Oil Industry," (R.H. Williams, co-author), poster presentation, CMI Annual Meeting, Princeton University, April 17, 2012.
204. "Energy Systems Analysis," Energy, Environment and Climate Policy panel of the Science Policy Careers Symposium, Harvard University, Cambridge, MA, May 2, 2012.
205. "Shale Gas and Global Warming," Energy Lunch seminar, Princeton Environmental Institute, Princeton, NJ, 26 April 2013.
206. "Princeton Prefeasibility Analyses of Coal/Biomass Co-Processing for Electricity and Fuels Co-Production with CO<sub>2</sub> Capture," presentation at Southern Company Headquarters, Birmingham, Alabama, 3 June 2013.
207. "Recent and Prospective ESAG Research," Department of Energy and Environment, Division of Heat and Power Technology, Chalmers University of Technology, Gothenburg, Sweden, 18 November 2013.
208. "Techno-Economic Systems Analysis of Jet Fuel and Electricity Co-Production from Biomass and Coal with CO<sub>2</sub> Capture: an Ohio River Valley (USA) Case Study," System and Integration Aspects of Biomass-Based Gasification Joint Workshop between IEA Bioenergy Task 33 and IEA Industrial Energy-Related Technologies and Systems, Gothenburg, Sweden, 19 November 2013.
209. "Climate Change: How bad is it?" Westminster Place Presbyterian Homes, Evanston, Illinois, 28 Dec. 2013.
210. "Water Challenges for Electricity Generation," guest lecture in Princeton course ELE 547C, *Contemporary Challenges in Electric Power*, 25 Feb 2014.
211. "Energy Systems Analysis Group," presented to T. Johnson, S. Baxley, and G. Gao (Southern Company), Princeton University, April 25, 2014.
212. "Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO<sub>2</sub> Capture and Storage via EOR: Project Kick Off Meeting," Alabama Power Headquarters, Birmingham, AL, December 9, 2014.
213. "Biofuels: Systems Perspectives and Thermochemical Production," Andlinger Center for Energy and the Environment, E-affiliates Retreat, Chauncey Conference Center, Princeton, NJ, February 5, 2015.
214. "Perspectives (USA) on Smaller-Scale Gasification-Based Transportation Fuels from Biomass and Biomass + Fossil Fuels, with Low or Negative CO<sub>2</sub> Emissions," Division of Industrial Energy Systems and Technologies,

Department of Energy and Environment, Chalmers University of Technology, Gothenburg, Sweden, March 30, 2015.

215. “Perspectives on the Energy-Water Nexus,” keynote talk, Annual Meeting of the Princeton University China Energy Group, Princeton, New Jersey, April 2, 2015.

216. “Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO<sub>2</sub> Capture and Storage via EOR,” National Energy Technology Laboratory’s 2015 Gasification Systems and Coal & Coal-Biomass to Liquids Workshop, Morgantown, WV, August 2015.

217. “Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO<sub>2</sub> Capture and Storage via EOR,” 2015 International Pittsburgh Coal Conference, Pittsburgh, PA, October 2015.

218. “Sustainable Transportation Energy with Net Negative Carbon Emissions,” GCEP Research Symposium 2015: Driving Change in the Energy Field, Global Climate and Energy Project, Stanford Univ., Palo Alto, CA, Oct. 2015.

219. “Negative Emissions Initiative,” BP Headquarters, St. James Place, London, 15 Apr., 2016.

220. “US Transportation Energy Challenges,” Panel on Energy Innovations & Transformations for a Livable Climate, CCL/CCE Conference, Washington, DC, 20 Jun 2016.

221. “The Water-Energy Nexus Panel Session Introduction,” Andlinger E-filiates Partnership Annual Meeting, Princeton University, 11 Nov. 2016.

222. “[Deep Decarbonization: What Role for BECCS and Other Negative Emissions?](#)” Energy Express Seminar Series, UQ Energy Initiative, University of Queensland, Brisbane, Australia, 7 Dec. 2016.

223. “Negative Emissions via Bioenergy with CO<sub>2</sub> Capture and Storage (BECCS),” Security and Sustainability Forum webinar: [Restoring the Carbon Balance- Session 2: The Technologies](#), 1 February 2017.

224. “Energy Systems Analysis Group contributions to GCEP project: *Sustainable Transportation Energy with Net Negative Carbon Emissions*,” research collaboration kick-off meeting, Natural Resource Ecology Laboratory, Colorado State University, 14 April 2017.

225. “Potential for climate change mitigation via agriculture-based sequestration of carbon in soils,” joint talk with Keith Paustian (Colorado State University) at a meeting on The Promise of Perennials, McKnight Foundation Headquarters, Minneapolis, MN, 6 July 2017.

226. “Lignite-plus-Biomass to Synthetic Jet Fuel with CO<sub>2</sub> Capture and Storage (“LBJ”): Design, Cost, and Greenhouse Gas Emissions Analysis for a Near-Term, First-of-a-Kind Demonstration Project in Mississippi and Prospective Future Commercial Plants,” 2017 International Pittsburgh Coal Conference, Pittsburgh, PA, September 2017.

227. “An evaluation of negative-emission transportation-energy systems for the US: Mid-Century Potential of Biomass-Based Options,” fall meeting of the American Geophysical Union, New Orleans, LA, Dec. 15, 2017.

228. “Rapid Switch™— an international, cross-disciplinary collaboration applying a new approach to the challenge of global decarbonization,” Advisory Council Meeting, Andlinger Center for Energy and the Environment, Princeton University, April 26, 2018.

229. “The Energy Systems Analysis Group,” Market Operations Group, PJM Headquarters, Audubon, PA, June 28, 2018.

230. “Biomass Energy, Part 1: Sustainability Issues,” São Paulo School of Advanced Science on Renewable Energies, University of São Paulo, São Paulo, Brazil, July 31, 2018.

231. “Biomass Energy, Part 2: Bioenergy with CO<sub>2</sub> Capture and Storage (BECCS),” São Paulo School of Advanced Science on Renewable Energies, University of São Paulo, São Paulo, Brazil, July 31, 2018.

232. “Biomass Energy: Sustainability Issues and BECCS,” Bioenergy Workshop: Advanced Technologies and Sustainability Issues, Instituto de Energia e Ambiente (IEE), University of São Paulo, São Paulo, Brazil, Aug. 1, 2018.

233. “Efficient Electricity Markets and Grid Decarbonization,” Public Service Enterprise Group Headquarters, Newark, NJ, August 13, 2018.

234. “How fast can the world decarbonize?” Annual Meeting, Andlinger Center for Energy and the Environment, Princeton University, November 9, 2018.
235. “Energy storage for the grid using decarbonized H<sub>2</sub>: a work in progress,” Energy Storage Workshop, Department of Chemical and Environmental Engineering, University of Seville, Seville, Spain, November 12, 2018.
236. “The role of energy systems analysis in understanding how rapidly the world’s energy system can be decarbonized,” Department of Chemical and Environmental Engineering, University of Seville, Seville, Spain, November 13, 2018.
237. “The *Rapid Switch* project, and some thoughts on CCS in energy transitions,” keynote talk, Energy Transition Research and Innovation 2019, Research Centre for Gas Innovation, University of São Paulo, SP Brazil, 1 Oct 2019.
238. “US Net-Zero Infrastructure Project,” for Helge Lund (BP Chairman of the Board), 15 Oct 2019, Princeton, NJ.
239. “Planning for a Net-Zero America,” Princeton Energy & Climate Scholars mtg, Princeton, NJ, 30 Jan 2020.
240. “Net-Zero Emissions for the USA by 2050 ?” Symposium on Energy Transitions in Industry, Indian Institute of Technology – Bombay, Mumbai, India, 25-26 Feb 2020.
241. *The Princeton Net-Zero America Project: Planning for net-zero greenhouse gas emissions by 2050*. Eric Larson. Climate Central Brownbag Lunch talk, March 26, 2020.
242. *Net-Zero America by 2050: Potential pathways, deployments & impacts*. Eric Larson (with Chris Greig and Jesse Jenkins), Carbon Mitigation Initiative 19<sup>th</sup> Annual Meeting, April 23, 2020.
243. *Net-Zero America by 2050: Potential pathways, deployments & impacts*. Eric Larson (with Chris Greig and Jesse Jenkins), ExxonMobil Corp. briefing, August 26, 2020.
244. *Net-Zero America by 2050: Potential pathways, deployments & impacts*. Eric Larson (with Chris Greig and Jesse Jenkins), Project consultative group briefing, September 9, 2020.
245. *Net-Zero America by 2050: Potential pathways, deployments & impacts*. Eric Larson, Tsinghua-BP Clean Energy Research and Education Center, September 29, 2020.

## GRANTS RECEIVED

Funder	Larson role	Project Title	Total \$	Start	End
Carbon Mitigation Initiative (Princeton U)	Co-PI	U.S. Low-Carbon Infrastructure Plan	\$200,000	1/1/2020	12/31/2020
ExxonMobil	PI	U.S. Low-Carbon Infrastructure Plan	\$188,000	1/15/2020	12/31/2020
Public Service Enterprise Group	Co-PI	New Jersey’s role in the deep decarbonization of PJM	\$263,000	11/1/19	10/31/20
PU-University of Sao Paolo Partnerships	PI	Carbon abatement and renewable energy perspectives in the context of climate change	\$25,000	9/1/19	8/31/21
Global Collaborative Networks (GCN, PU)	Co-PI	Rapid Switch Network – Collaboration to accelerate low-carbon energy transitions	\$150,000	7/1/2019	6/30/2022
Andlinger Center (cost sharing GCN grant)	Co-PI	Rapid Switch Network – Collaboration to accelerate low-carbon energy transitions	\$47,600	7/1/2019	6/30/2022
Princeton Institute for International & Regional Studies	Co-PI	Rapid Switch India: Sustainable decarbonization pathways...	\$750,000	7/1/2019	6/30/2022
Princeton Institute for International & Regional Studies	Co-PI	Rapid Switch workshop grant	\$10,000	5/1/19	6/30/19

Carbon Mitigation Initiative (Princeton U)	PI	U.S. Low-Carbon Infrastructure Plan	\$550,000	1/1/2019	12/31/2019
ExxonMobil	PI	U.S. Low-Carbon Infrastructure Plan	\$250,000	1/15/2019	1/14/2020
PU Dean for Research	PI	Deep Decarbonization of the Grid - Addressing the Challenge of Intermittent Renewable Electricity	\$750,000	12/1/2018	11/30/2019
NRG Energy, Inc.	PI	General support for ESAG electric grid decarbonization research	\$75,000	11/19/2018	11/18/19
Andlinger Center	Co-PI	The Rapid Switch Initiative	\$300,000	9/1/2018	1/31/2020
PU International Fund	PI	Solar-thermal power systems in future electric grids	\$20,000	9/1/18	8/31/19
Andlinger Center (cost sharing PU IF)	PI	Solar-thermal power systems in future electric grids	\$5,000	9/1/18	8/31/19
ExxonMobil	PI	Applications of carbonate fuel cells in CO <sub>2</sub> capture.	\$178,000	2/1/2018	12/31/2018
UK Power Networks	PI	Contact voltage losses in the U.K.	\$113,400	1/1/2018	8/31/2018
PU Dean for Research	PI	Deep Decarbonization of the Grid - Addressing the Challenge of Intermittent Renewable Electricity	\$100,000	3/1/2017	2/28/2018
Carbon Mitigation Initiative (Princeton U)	PI	Reliable, low-carbon electricity from grids with high penetrations of intermittent renewable generation	\$ 100,000	1/1/2017	12/31/2017
Stanford University	PI	Sustainable Transportation Energy with Net Negative Carbon Emissions: An Integrated Ecological and Engineering Systems Analysis	\$ 706,781	6/1/2015	5/31/2018
US Department of Energy (National Energy Technology Laboratory)	PI	Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO <sub>2</sub> Capture and Storage via EOR	\$ 1,611,614	10/1/2014	3/31/2017
Southern Company Services	PI	Cost share contribution to: Design/Cost Study and Commercialization Analysis for Synthetic Jet Fuel Production at a Mississippi site from Lignite and Woody Biomass with CO <sub>2</sub> Capture and Storage via EOR	\$175,000	10/1/2014	9/30/2016
Andlinger Center for Energy and the Environment (Princeton University)	Co-I	Design and Cost-Analysis of Low-Carbon Transportation Fuel and Electricity Coproduction that Includes Carbon Capture and Storage in Shale Gas Formations	\$ 6,000	7/1/2013	6/30/2014
U.S. Department of Energy (National Energy Technology Laboratory)	PI	Technoeconomic Analysis (TEA) Subtask	\$ 99,998	8/1/2012	2/28/2014
Andlinger Center for Energy the Environment	Co-I	Air Quality and Climate Benefits of Current and Potential Future Wind Energy Penetration in China	\$ 5,500	7/1/2012	6/30/2013

(Princeton University)					
Seibel Grand Challenges (Princeton University)	Co-I	Energy and water	\$ 40,000	10/1/2011	6/30/2012
Edgerton Foundation	Co-I	Analysis and Outreach in Support of Market Establishment of Technologies for Simultaneous Decarbonization of Electricity and Transportation Fuels	\$ 400,000	7/1/2011	6/30/2014
US Department of Energy (National Energy Technology Laboratory)	PI	Energy, Environmental, and Economic Analyses of Design Concepts for the Co-Production of Fuels and Chemicals with Electricity via Co-Gasification of Coal and Biomass	\$ 442,121	10/1/2010	3/31/2012
Air Force Research Lab, Wright-Patterson Air Force Base	PI	Alternative Energy Fuels Analysis Support to AFRL/RZPF	\$ 35,000	2/1/2010	10/31/2010
Net Jets Aviation, Inc.	Co-I	NetJets Next Generation Aircraft Fuel Project	\$ 476,551	3/1/2009	2/28/2010
The William and Flora Hewlett Foundation	Co-I	Exploring Alternative Climate-Change-Mitigating Energy Supply Technologies As Candidate Energy Options for Sustainable Development	\$ 400,528	10/1/2007	9/30/2010

## OTHER PROFESSIONAL ACTIVITIES (chronological in sections)

### General

- Member of PEI team that provided analytical inputs to report prepared by the National Research Council's America's Energy Future Panel on Alternative Liquid Transportation Fuels: *Liquid Transportation Fuels from Coal and Biomass: Technological Costs, Status, and Environmental Impacts*, National Academies Press, Washington DC, 20 May 2009. [http://www.nap.edu/catalog.php?record\\_id=12620](http://www.nap.edu/catalog.php?record_id=12620) (This was one of three panel reports providing input to the main study, *America's Energy Future: Technology and Transformation*, published late 2009, [http://www.nap.edu/catalog.php?record\\_id=12091](http://www.nap.edu/catalog.php?record_id=12091).)
- Co-convening lead author, Global Energy Assessment, (Knowledge Module 12: Fossil Energy Technologies), 2009-2011. ([http://www.iiasa.ac.at/Research/ENE/GEA/index\\_gea.html](http://www.iiasa.ac.at/Research/ENE/GEA/index_gea.html))
- Lead author, Global Energy Assessment, (Knowledge Module 11: Renewable Energy Technologies), 2009-2011. ([http://www.iiasa.ac.at/Research/ENE/GEA/index\\_gea.html](http://www.iiasa.ac.at/Research/ENE/GEA/index_gea.html))
- Co-organizer and panel moderator, US National Academies public workshop on Deployment of Deep Decarbonization Technologies, Washington, DC, July 22-23, 2019.

### Journal manuscripts review and editing

- Peer reviewer for manuscripts submitted to *Applied Energy*, *Biomass and Bioenergy*, *Bioresources Technology*, *Combustion Science and Technology*, *Energy*, *the International Journal*, *Energy Policy*, *Energy for Sustainable Development*, *Environmental Science & Technology*, *Industrial & Engineering Chemistry Research*, *Journal of Engineering for Gas Turbines and Power*, *Journal of Solar Energy Engineering*, *Resources*, *Conservation*, and *Recycling*, *Science*, and other journals.
- Guest editor for special issues of *Energy for Sustainable Development* on topic of Biomass Energy Modernization, I (October 2000); Biomass Energy Modernization, II (March 2001); Coal Gasification for China, co-edited with Li Zheng, Tsinghua University, Beijing (Dec 2003); Clean Cooking Fuels, co-edited with Isaias Macedo, University of Campinas, Brazil (Sept 2004); Liquid Biofuels for Transport, co-edited with

Thomas B. Johansson, University of Lund, Sweden, and Anjali Shanker, Innovation Energie Developpement, France (June 2006)..

- Member of the Board of Associate Editors, *Revista Brasileira de Bioenergia (Brazilian Review of Bioenergy)*, published quarterly in English and Portuguese, June 2002 –
- Associate Editor, *Energy for Sustainable Development*, 2004 –

### ***PhD thesis and examiner committees***

- PhD general examiner for Anna Jacobson on energy systems, Program in Quantitative and Computational Biology, Princeton University, January 2021.
- PhD general examiner for Liqun Peng on energy systems analysis, Woodrow Wilson School (Denise Mauzerall advisor), Princeton University, February 2019.
- Member of MSE thesis committee for Sean Casten, “Advanced Processes for Ethanol and Electricity Co-Production from Lignocellulosic Biomass,” Thayer School of Engineering, Dartmouth College, Hanover, NH (defended, 18 December 1997).
- Member of Ph.D. thesis grading committee for Pål Börjesson, “Biomass in a Sustainable Energy System,” Department of Environmental and Energy Systems Studies, Lund University, Lund, Sweden (defended 5 June 1998).
- “Opponent” for defense by Goran Berndes of Ph.D. thesis, “Biomass in the Energy System: Resource Requirements and Competition for Land,” Department of Physical Resource Theory, Chalmers Technical University/Goteborg University, Gothenburg, Sweden, 2 Feb. 2001.
- “Opponent” for defense by Kenneth Molestrom of Ph.D. thesis, “Opportunities for CO<sub>2</sub> Reductions and CO<sub>2</sub>-Lean Energy Systems in Pulp and Paper Mills,” Department of Chemical Engineering and Technology, Royal Institute of Technology, Stockholm, Sweden, 27 Sept. 2002.
- Member of PhD thesis committee for Xiaoping Wang, “Evaluating Impacts of Air Pollution in China on Agriculture and Public Health: Implications for Air Pollution and Energy Policies,” Woodrow Wilson School of Public and International Affairs, Princeton University, June 2004.
- Member of the “Promotion Committee” evaluating Ph.D. dissertation of Carlo Hamelink, “Outlook for Advanced Biofuels,” Department of Science, Technology and Society, Utrecht University, Utrecht, The Netherlands, June 2004.
- “First Opponent” for defense by Heidi Mestl of Ph.D. thesis, “Air Pollution in China. Impacts on Population Exposure and Health from Industrial and Domestic Energy Use,” Faculty of Mathematics and Natural Sciences, Department of Chemistry, University of Oslo, Norway, 3 November 2006.
- “Opponent” for defense by Eva Andersson of Ph.D. thesis, “Benefits of Integrated Upgrading of Biofuels in Biorefineries,” Heat and Power Technology Division, Department of Energy and Environment, Chalmers University of Technology, Gothenburg, Sweden, 12 January 2007.
- Member of Ph.D. thesis evaluation committee for Lasse Røngaard Clausen, “Biomass in a Sustainable Energy System,” Mechanical Engineering Department, Technical University of Denmark, Lyngby, Denmark, defended September 2011.
- Member of Judgment Committee that evaluated Hans Meerman’s Ph.D. thesis, “Perspectives on Gasification Systems to Produce Energy Carriers and Other Chemicals with Low CO<sub>2</sub> Emissions,” Energy & Resources Section, Department of Innovation, Environmental and Energy Sciences, Faculty of Geosciences, Utrecht University, Utrecht, The Netherlands, defended September 2012.
- “Opponent” for defense by Johan Isaksson of Ph.D. thesis, “Biomass Gasification-based Biorefineries in Pulp and Paper Mills: Greenhouse Gas Mitigation and Economy,” Heat and Power Technology Division, Department of Energy and Environment, Chalmers University of Technology, Gothenburg, Sweden, 30 March 2015.
- “Pre-Examiner” for Ph.D. dissertation of Ilkka Hannula, “Synthetic fuels and light olefins from biomass residues, carbon dioxide and electricity: Performance and cost analysis,” Doctoral Program in Engineering, Aalto University, Aalto, Finland, April 2015.
- “Opponent” for defense by Jim Andersson of Ph.D. thesis, “Systems Analysis of Chemicals Production via Integrated Entrained Flow Biomass Gasification: Quantification and improvement of techno-economic performance,” Division of Energy Science, Department of Engineering Sciences & Mathematics, Lulea University of Technology, Lulea, Sweden, 17 March 2016.

### ***Committee memberships***

- American Society of Mechanical Engineers' Committee on Coal, Biomass and Alternative Fuels Utilization, 1996 –
- Scientific Committee for the World Bioenergy Conference and Exhibition, Jonkoping, Sweden, 2-4 June 2004.
- Selection Committee for Link Energy Fellowships (administered by Dartmouth College), 2004 – 2006.
- Scientific Committee for the World Bioenergy Conference and Exhibition, Jonkoping, Sweden, June 2006.
- Scientific Committee constituted to review the Swedish Environmental Research and Development Foundation (MISTRA) program on black liquor gasification, 17-19 May 2006.
- Scientific Advisory Committee constituted to review a major proposal to Swedish Energy Agency for R&D support for the Varnamo gasification facility to develop technology for liquid fuels production from biomass, 26-28 September 2006.
- Scientific review committee for 10<sup>th</sup> International Conference on Greenhouse Gas Control Technologies, Amsterdam, November 2010.
- U.S. Federal Biomass R&D Technical Advisory Committee to the Departments of Energy and Agriculture, December 2005 - 2010.

### ***Activities with the International Energy Initiative (IEI)***

(The International Energy Initiative is an international, non-governmental, non-profit organization working for efficient production and use of energy in developing countries in support of sustainable development.)

- Invited participant at the IEI Workshop on Catalyzing South/North and South/South Collaborations on Energy Strategies for Sustainable Development, Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, Dec. 3-5, 1998.
- IEI Treasurer from July 1999 to present.
- IEI President from February 2004 – January 2006.
- IEI Board of Directors, member *ex officio* from July 1999 to present

### ***Activities in support of the Global Environment Facility (GEF)***

- Assisted government of Chile in preparing proposal to the UNDP/GEF for reducing Chilean emissions of greenhouse gases, May 1992/93.
- Reviewer for the government of Brazil of Phase I of the GEF-supported biomass-gasifier/gas turbine demonstration project ongoing in Brazil, Sept. 1992.
- Assisted government of Cuba in preparing proposal to the UNDP/GEF relating to energy strategies for the sugarcane industry, Nov. 1994.
- Reviewer for UNDP/GEF of Phase II of the GEF-supported biomass-gasifier/gas turbine demonstration project ongoing in Brazil, Nov. 1994.
- Invited speaker at Seminario de Disseminacao de Informacoes sobre o GEF, organized by the GEF (World Bank and UNDP) and government of Brazil, Brasilia, July 3-5, 1996.
- Invited participant at the UNDP Environment Focal Points Workshop on the GEF, Margarita Island, Venezuela, Nov. 18-20, 1996.
- Assisted governments of Brazil, Colombia, Cuba, India, and Mexico in the development and implementation of proposals to the Global Environment Facility on energy efficiency, fuel cell bus demonstration, efficient production of energy from sugarcane residues, and biomass power generation, 1997- present.
- Invited participant at the Brazil Biomass Gasification Project Expert Workshop, The World Bank, Washington, DC, June 3-4, 1999.
- Co-organizer of the Workshop on Commercialization of Fuel Cell Buses: Potential Roles for the GEF, United Nations Headquarters, New York, NY, April 27-28, 2000.
- Reviewer for World Bank/GEF biomass technology proposal for Brazil, 2005.
- Invited background paper prepared for the Workshop on Biofuels for Transportation, organized by the Science & Technology Advisory Panel, GEF, New Delhi, 29 Aug – 1 Sep, 2005.

- Assisted government of Brazil in developing proposal to GEF for commercialization of the use of sugarcane trash for energy, May-August, 2007.
- Mid-term evaluation report prepared for GEF Project BRA/99/G32: Hydrogen Fuel Cell Buses for Urban Transport in Brazil, August-December, 2013.

***Invited workshop/conference speaker/participant***

- *Workshop on Energy Technology Transfer to China*, US Office of Technology Assessment, Washington, D.C., April 18-19, 1985.
- *Workshop on Energy Technology for Developing Countries: Issues for the US National Energy Strategy*, US Dept. of Energy, Wash., DC, June 20, 1990.
- *Conference on Biomass for Utility Applications*, organized by Electric Power Research Institute, Tampa, Florida, Oct. 23-25, 1990 (summary-panel participant).
- *Energy Efficiency Fellowship Meeting*, sponsored by the Pew Charitable Trust, hosted by International Institute for Energy Conservation, Washington, DC, Jan. 11, 1991.
- *Global Energy Efficiency Meeting*, sponsored by the Rockefeller Foundation, Geneva, Jan. 19-20, 1991 (invited background-paper contributor).
- *Biomass Power Long Range Plan Meeting*, Solar Energy Research Institute, Department of Energy Golden, CO, Jan. 22, 1991.
- *ESETT'91: International Symposium on Environmentally Sound Energy Technologies and Their Transfer to Developing Countries and European Economies in Transition*, Milan, Italy, Oct. 21-25, 1991 (invited overview-paper contributor).
- *International Workshop: Design of a Data System on Technologies That Can Limit Greenhouse Gas Emissions*, Center for Strategic and International Studies, Washington, DC, Feb. 18-19, 1992.
- *Workshop on Forests and Wood-Based Biomass Energy as Rural Development Assets*, co-organized by Winrock International and Yale University School of Forestry & Environmental Studies, Old Saybrook, Connecticut, Feb. 23-27, 1992.
- *Third US Hydrogen Meeting*, National Hydrogen Association, Arlington, VA, March 18-20, 1992 (Invited plenary speaker).
- *Workshop on Perspectives of Ethanol Fuel in Brazil*, São Paulo, Brazil, June 27-28, 1995 (invited speaker).
- *TAPPI Industry Needs Workshop*, organized by the Technical Association of the Pulp and Paper Industry, Raleigh, NC, April 22-24, 1996.
- *Working Group on Impacts on the U.S. Paper and Allied Products Industry of Increased Fuel Prices Resulting from Global Commitments to Mitigate Greenhouse Gas Emissions*, organized by Argonne National Laboratory, Washington, DC, June 20, 1996.
- *Conference on Biomass for Electricity Production: Experiences and Perspectives in the European Union and Brazil*, Brasilia, 6-8 October 1997 (invited plenary speaker).
- *Workshop on Small-Scale Biomass Electricity Generation*, organized by the Working Group on Energy Strategies and Technologies, China Council on International Cooperation on Environment and Development, Changchun, Jilin Province, China, 12-13 Jan. 1998.
- *Second Olle Lindström Symposium on Renewable Energy: Bioenergy*, Royal Institute of Technology, Stockholm, Sweden, 9-11 June 1999 (invited keynote speaker).
- *A Policy Workshop on Mitigation of Air Pollution and Climate Change in China: Co-Benefits and Co-Control*, organized by China State Environmental Protection Agency and Norwegian CICERO, 22-23 November, 2005.
- *IAC International Energy Workshop, Inter-Academy Council, Rio de Janeiro, Brazil, 26-27 March 2006.*
- *Briefing Governor Schweitzer (Montana) on coal/biomass to liquid fuels production technologies*, State House, Helena, Montana, 15 November, 2006.
- Testimony on liquid biofuels before *Committee on Environment and Natural Resources Finance, Minnesota State House of Representatives*, St. Paul, MN, 1 Feb 2007.
- *Symposium on Pathways Toward a Renewable Energy Future: Environmental Sustainability Through Technology and Policy*, Initiative for Renewable Energy and The Environment, University of Minnesota, St. Paul, 1 Feb 2007.

- *Advanced Bioenergy Technologies and Biofuels from Municipal Solid Waste*, California Biomass Collaborative 4<sup>th</sup> Annual Forum, Sacramento, California, 28-29 March 2007.
- *Seminar on Technologies for Future Production of Ethanol in Brazil*, Instituto de Tecnologia Promon, Sao Paulo, Brazil, 17 April 2007.
- *Gasification Technologies Council Spring Meeting*, Williamsburg, VA, 17-18 May 2007.
- *Chewonki Foundation Carbon Capture and Storage Seminar*, Wiscasset, Maine, 24 October 2007.
- *Conference on Biofuels: An Option for a Less Carbon-Intensive Economy*, organized by the United Nations Conference on Trade and Development and the Energy Planning Agency of the Ministry of Mines and Energy of Brazil, Rio de Janeiro, 4-5 December 2007.
- *Promoting the Development and Deployment of IGCC/Co-Production/CCS Technologies in China and the United States*, Joint Workshop of Harvard University, China Ministry of Science and Technology and The Chinese Academy of Sciences, organized by Energy Technology Innovation Policy Project (Harvard Kennedy School) and Research Center for Energy and Power (Chinese Academy of Sciences' Institute of Engineering Thermophysics), 16 April 2009.
- *China-U.S. Stakeholders Meeting on CCS Technologies and Policies*, organized by David Sandalow, Assistant Secretary for Policy and International Affairs, U.S. Department of Energy, Washington DC, July 9, 2009.
- *US-China Clean Energy Centers (CEC)*. I was chair of the proposal review committee which awarded a \$25 million grant for establishing a Clean Coal CEC, August 2010.

### ***Workshops organized***

- New Jersey Energy Conservation Laboratory Workshop on Steam-Injected Gas Turbines for Central Station Power Generation, Princeton, NJ, April 3, 1986 (co-organizer).
- International Workshop on Biomass-Gasifier Steam-Injected Gas Turbines for the Cane Sugar Industry, Washington, DC, June 19, 1987 (co-organizer).
- Thailand Training Workshop on End-Use-Oriented Energy Analysis, Bangkok, Oct. 24-Nov. 3, 1989 (principal organizer and instructor).
- Workshop on Development of Sustainable Biomass Energy Production in Northeast Brazil, Brasilia, May 3, 1994 (organizer).
- Workshop on Commercialization of Black Liquor and Biomass Gasification for Gas Turbine Applications in the Pulp and Paper Industry, Princeton University, Princeton, NJ, Jan. 16-17, 1997 (organizer).

### ***Other***

- Assisted the European Community's "Thermie" program in preparing a call for proposals for the demonstration of advanced technology for producing electricity from plantation-derived biomass, winter 1992/93.
- Organizer of all Coal, Biomass, and Alternative Fuel Sessions for the 45th ASME International Gas Turbine and Aeroengine Congress, Munich, Germany, May 8-11, 2000.
- Invited member, New Jersey Board of Public Utilities' Advisory Council on Renewable Electric Generation Facilities for New Jersey, January 2002.
- Invited peer reviewer of the US Department of Energy's Microturbine Technology and Industrial Gas Turbine Technology Programs, March 2002.
- Invited resource person to the Task Force on Energy Strategies and Technologies of the China Council for International Cooperation on Environment and Development, 2002-2003.
- Visiting Professor, Joint Graduate School of Energy and Environment, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 4-8 July 2005.

### **COURSES TAUGHT AT PRINCETON**

- SPI591f – Rapid Switch India (fall 2020)
- ENE 372 – Rapid Switch: the transition challenge to low-carbon energy (spring 2019, 2020, 2021)
- CBE 335 – The Energy-Water Nexus (fall 2012, spring 2018, spring 2019)
- MAE 328 – Energy for a Greenhouse Constrained World (spring 2011, 2012, 2013, 2014)
- WWS591b – Graduate policy workshop on Deploying Clean Energy in Rural China (2004)
- MAE 554 – The Greenhouse Problem and Hydrogen Energy Solutions (1999, 2000)

- MAE 319 – Renewable Energy Technology (1991, 1993, 1995, 1999)
- PA 592 – Agro-Energy and Third World Development (1988)
- MAE 423 – Heat Transfer (1987, 1990)

## GRADUATE STUDENT RESEARCH SUPERVISED

<i>Name (Level) (project period)</i>	<i>Dept. *</i>	<i>Project Description</i>
Saiby Wong (summer '85)	Chemistry	Development of experiments in biomass gasification.
Anna Protopapas (fall '86)	CBE	Biomass gasification experiments.
Simone Hochgreb (summer '86 + 86/87)	MAE	Biomass-gasifier gas turbine cogeneration in cane sugar factories.
Angel Abbud-Madrid (summer '86 + 86/87)	MAE	Modeling steam turbine cogeneration at a cane sugar factory.
Lars Nilsson (1988-89 in Sweden)	Energy Analysis	Analysis of efficient industrial electricity-using technologies
Alistair Lloyd (1989/90)	MAE	Modeling biomass-gasifiers for gas turbine applications.
Ryan Katofsky (1991-93)	MAE (MSE thesis)	The production of fluid fuels from biomass.
Chris Marrison (1992-1995)	MAE (indep. research)	Cost study of biomass energy systems in Iowa; Biomass energy potential in Africa.
Jeff Chen (1992-1995)	MAE (MSE thesis)	Production of methanol and hydrogen from municipal solid waste.
Niklas Berglin (Spring 1996)	CBE (indep. Research)	Spreadsheet models of energy use in pulp and paper mills.
Wendy Hughes (1992-1998)	MAE (PhD co-adv)	Biomass integrated gasification/gas (turbine power generation in Zimbabwe.
Luis Solorzano (1993-1999)	EEB (indep. research)	Regional land use analysis relating to biomass plantations in Northeast Brazil.
Paul Henderick (1997-1999)	MAE (MSE thesis)	An assessment of biomass-powered micro-turbines and potential application in rural China.
Huiyan Yang (2002-2004)	Geociences (PEI-STEP certif.)	Chinese household energy usage and the black carbon emissions.
Fuat Celik (Fall 2002)	CBE (Research credit)	Aspen Modeling and Cost Analysis of Co-Producing Dimethyl Ether, Acetic Acid, and Electricity from Coal
Zheng Hongtao (2002-2003)	Tsinghua Univ. (Beijing)	Analysis of future energy scenarios for "Syncity", China.
Xiaoping Wang (2000-2004)	WWS (PhD thesis)	Evaluating Impacts of Air Pollution in China on Agriculture & Public Health: Implications for Air Pollution & Energy Policies
Cathy Kunkel ('06-'07 in China)	Physics ('06) Independent work	Grassland and crop residue biomass to energy in China.
Loek Eerhart (9/07-3/08)	Utrecht Univ., (Master thesis)	Modeling of Fischer-Tropsch Liquids Production from Coal and Biomass
Zhe Zhou (2010)	Tsinghua Univ. (Beijing)	Biomass torrefaction for entrained-flow gasification.
Ilkka Hannula (2011)	Aalto University (Finland)	Co-production of olefins and electricity via combined coal and biomass gasification.
Wei Peng (2012-2016)	WWS (PhD co-adv.)	Air quality impacts for scenarios of future increased wind electricity penetration on the Chinese grid.
Anna Hailey (2013-2016)	CBE (PhD co-adv.)	Simulation and analysis of biomass/natural gas co-processing for low-carbon liquid fuels production.
Kasparas Spokas (2018-2019, PEI-STEP)	CEE (co-adv.)	Assessment of CCS for fossil fuel power generation balancing variable renewable electricity.
Liqun Peng (Fall 2018)	WWS (PhD gen exam com)	Energy and electricity systems analysis.
Anna Jacobson (Fall 2020)	QCB (PhD gen exam com)	Energy-system model development

\* CEE = Civil & Environmental Eng; CBE = Chemical & Biological Eng; EE = Electrical Eng.; EEB = Ecology and Evolutionary Biology; MAE = Mechanical and Aerospace Eng.; MoBio = Molecular Biology; QCB = Quantitative and Computational Biology; WWS = Woodrow Wilson School; Econ = Economics.

## UNDERGRADUATE INDEPENDENT RESEARCH SUPERVISED

<i>Name (Level) (project period)</i>	<i>Dept.*</i>	<i>Project Description</i>
Gilberte Sumyeun (Jun) (fall '83-spring '84))	MAE	Bagasse-fired gas-turbine cogeneration for sugar factories in Mauritius.
Drew Bienkowski (Soph) (summer '84)	Politics	A database of basic materials consumption in the U.S.
Ali Reza (Jun)	MAE	Design of a rice hull producer gas generator suitable for cooking use.
Ali Reza (Sen) (fall '85-spring '86)	MAE	Experiments in downdraft biomass gasification.
Anna Protopapas (Sen) (fall '85-spring '86)	ChemE	Thermochemical gasification of biomass: modelling and experiments.
Kaveh Sheibani (Sen) (summer '86)	MechE	Gasifier design and computerized producer – gas database development.
Jocelyn Kaiser (Sen) (summer '86)	ChemE	Design of diagnostic procedures for biomass gasification experiments
Stefan Hamblad (Sen) (spring '90)	ChemE	Analysis of efficient kraft pulp production.
Pramote Piriypoksombut (Fr) (spring '90)	EE	End-use electricity analysis for Thailand.
Jason Mark (Sen) (Summer '90)	MAE	Cogeneration analysis of efficient kraft pulping
Jason Mark (Sen) (fall '90)	MAE	Efficient kraft pulp production.
Robert Gansler (Sen) (summer '91)	MAE	Thermodynamics of hydrogen and methanol production from biomass.
Samta Khandelwal (Sen) ( '91-'92 academic yr)	WWS	ESCo's: Promoting energy conservation in Indian Industry.
Todd Butterfield (Sen) ( '91-'92 academic yr)	MoBio	Biotechnology and eucalyptus energy plantations.
Jennifer Leslie (Sen) ( '92-'93 academic yr)	MAE	Wind-assisted methanol production from biomass.
David Teal (Sen) ( '92-'93 academic yr)	ChemE	Study of scale effects in hydrogen production from biomass and natural gas.
Felipe Valdes-Arrieta (Sen) ( '92-'93 academic yr)	MAE	Technology assessment of electricity conservation in the Chilean copper industry.
Federico Frigerio (Soph) (summer '93)	MAE	Thermodynamic analysis of a Brayton air bottoming cycle.
Howard Shih (Sen) ( '93-'94 academic yr)	MAE	Assessment of a Brayton air bottoming cycle.
Garth Grover (Sen) (summer & fall '94)	MAE	Modeling biomass-gasifier/gas turbine air bottoming cycles and biomass-fired heated gas turbine cycles.
Chris Jones (Sen) ( '94-'95 academic yr)	ChemE	Analysis of ethanol production by enzymatic hydrolysis of biomass.
Chris Larsen (Sen) ( '94-'95 academic yr)	Econ	Economics of biomass energy systems in South-Central Iowa.
David Matheu (Sen) (summer 1995)	ChemE	Analysis of energy use at a kraft pulp mill.
Claus Lorenz (Sen) ( '95-'96 academic yr)	MAE	Renewable energy district heating system design.
Prem Vadlamudi (Sen) ( '95-'96 academic yr)	MAE	Modeling biomass-gasifier/gas turbine cogeneration for an advanced ethanol plant.

\* CE = Civil Eng; Chem = Chemistry; ChemE = Chemical Engineering; CBE = Chemical & Biological Engineering; EE = Electrical Engineering; MAE = Mechanical and Aerospace Engineering; MoBio = Molecular Biology; WWS = Woodrow Wilson School; EEB = Ecology and Evolutionary Biology; Econ = Economics.

Davin Peterson (Sen) (’95-’96 academic yr)	MAE	Design of MSW-hydrogen production and use in New York City bus fleet.
Robert Wright (Sen) (summer 1996)	MAE	Modeling energy use in pulp and paper mills and gas turbine cycle modeling.
Jason Mullins (Sen) (’96-’97 academic yr)	CE	Modeling energy use in linerboard production.
Roselle Safran (Jun) (Summer 1997)	CE	Developing a help manual for GS process modeling software.
Rebecca Blackwell (Senior thesis) (’97-’98 academic yr)	ChemE	An assessment of black liquor gasification for the kraft pulp industry.
Amelia Kaufman (Jun) (Summer 1998)	Chemistry	Assessment of New Jersey’s MSW resources.
Ben Urquhart (Sen) (’97-’98 academic year)	EEB	GIS analysis of biomass energy plantations in Northeast Brazil.
Brad Morgan (Soph) (’99-’00 academic year)	CE	MSW resources of New Jersey.
Emily Johnson (Sen) (’00-’01 academic year)	Geology	Carbon sequestration with alternative land uses in Maranhao state, Brazil.
Laurie Williams (Senior thesis) (’05-’06 academic year)	WWS	Chinese Energy Policies: Implications for U.S. Policy
Eugene Franco (Jun) (’06-’07 academic year)	Geosciences	The energy balance of corn ethanol; The energy balance of cellulosic ethanol.
Joe Vogel (Senior thesis) (’07-08 academic year)	MAE	A Kinetic Model of Cobalt-based Fischer-Tropsch Synthesis
Jimmy Nowicke (Sen) (’07-’08 academic year)	WWS	Potential Economic Impacts of Carbon Policies in the United States
Angus Pacala (Sen) (summer 2009)	Mech Eng (Stanford)	Water use in coal conversion processes.
Dobromir Parushev (Sen) (summer 2009)	MAE	Lifecycle greenhouse gas emissions from Camelina, Jatropha, and algae biofuels.
Haley Thompson (Sen) (summer 2010 and ’10-’11 academic year)	MAE	Case study of combined coal/biomass co-production (electricity and gasoline) in the Powder River Basin of Wyoming
Kevin Steinberger (Senior thesis) (summer 2011 and ’11-’12 academic year)	MAE	Too Good to be True? : The Economic Viability of Carbon-Negative Biochar + Bioenergy Systems
Christina Kirkwood (Senior thesis) (’11-’12 academic year)	MAE	Water and Low-Carbon Energy in Wyoming: Water Demands of an Energy Conversion Plant with Carbon Capture and Storage and the Potential to Meet these Demands with Brine Extracted from CO <sub>2</sub> Storage Formations
Miranda Marks (Sen) (summer 2012)	CBE	Developing a new course on the energy-water nexus
Charlotte Conner (Jun) (summer 2012)	Geosciences	Improving the ESAG framework for techno-economic analyses
Miranda Marks (Senior thesis) (’12-’13 academic year)	CBE	Coproduction of electricity and desalinated water from natural gas using a chemically-recuperated gas turbine with CO <sub>2</sub> capture.
Nicole Businelli (Senior thesis) (’12-’13 academic year)	CBE	Coproduction of electricity and desalinated water using solar energy.
Sarthak Gupta (Sen) (summer 2013)	MAE	Developing a solar PV electricity day-ahead forecasting tool.
Lauren Edelman (Senior thesis) (’13-’14 academic year)	CBE	Techno-economic analysis of catalytic biomass hydrolysis to make transportation fuels.
Jacob Miller (Sen) (summer 2014)	CBE	Biochemical processing routes for production of biomass-sourced transportation fuels
Aditya Trivedi (Jun) (summer 2014)	CompSci	Location-specific wind electricity forecaster
Jaclyn Rambarran (summer 2015)	MAE	Modeling carbon storage and flows for loblolly pine plantations in the Southeastern U.S.

Ejeong Baik (Sen) (summer 2015)	CEE	Assessment of uncertainties in estimates of U.S. methane leakage.
Jacyln Rambarran (Senior thesis) ( '15-'16 academic year)	MAE	Refrigeration from coffee processing wastes: alternative designs for rural Karnataka, India.
Lucy Tang (Jun) ( '15-'16 academic year)	MAE	Modeling carbon storage and flows for loblolly pine plantations in the Southeastern U.S.
Corinne Lowe (summer 2016)	CBE	Assessing biomass production and soil carbon storage potential for the United States.
Ari Mytelka (summer 2016)	CompSci	Development of a wind-energy forecasting tool (Climate Central).
Li Xu (summer 2016)	Engineering Physics (Tsinghua University)	Assessing biomass production and soil carbon storage potential for the United States.
Corinne Lowe (Senior thesis) ( '16-'17 academic year)	CBE	Assessment of non-oxidative glycolysis route to convert corn stover into ethanol.
Frank Nguyen (Senior thesis) ( '16-'17 academic year)	CBE	Design and analysis of advanced biochemical conversion of lignocellulosic biomass to fuels
Erin McCabe (Sen) (summer 2017)	Geosciences	Assessing and visualizing U.S. potential for negative GHG emissions via soil carbon storage
Marissa Webber (Sen) (summer 2017)	CEE	Low net-carbon emission biomass-based transportation scenarios for the U.S.
Nuss Visatemongkolchai (Senior thesis) ( '17-'18 academic year)	CBE	Lifecycle greenhouse gas footprint analysis for electrochromic windows
Samantha Lee (Senior thesis) ( '17-'18 academic year)	CBE	Lifecycle greenhouse gas footprint assessment and mitigation for production of an insulating down.
Charles Copeland (summer 2018)	GEO	Mapping potential sustainable U.S. biomass energy supplies
Christopher Chu (summer 2018)	CEE	Development of a geospatial wind and solar electricity generation forecasting tool
Miriam Buscher (Senior thesis) ( '18-'19 academic year)	CBE	Process simulation and techno-economic assessment of biomass-gasifier Allam cycle
Taylor Bacon (Senior thesis) ( '18-'19 academic year)	CBE	Process simulation and techno-economic assessment of Gen-2 biofuels (Fischer-Tropsch)
Elise Colter (summer 2019)	CompSci	Refining a geospatial wind and solar electricity generation forecasting tool for the U.S.
Jessica Fielding (summer 2019)	CompSci	Refining a geospatial wind and solar electricity generation forecasting tool for the U.S.
Neil Slighton (Senior thesis) ( '19-'20 academic year)	ORFE	Multi-Objective Optimization for Planning and Design of Regional Mini-Grid Development in Rural India
Riley Wagner (Senior thesis) ( '19-'20 academic year)	CBE	Design of sustainable solar-powered microgrids with capacity for grid-integration in India
Joshua Drossman (summer 2020 + '20-'21 ac yr)	ORFE	Net Zero America Project
Kaylee Zecchin (Summer 2020)	Math	Refining a geospatial wind and solar electricity generation forecasting tool for the U.S.
Jaiteg Singh (summer 2020)	CompSci	Refining a geospatial wind and solar electricity generation forecasting tool for the U.S.
Yazan Mimi (summer 2020)	CompSci	Refining a geospatial wind and solar electricity generation forecasting tool for the U.S.
Joseph Gugiure (Senior thesis) '20 – '21 academic year	CEE	Modeling capital investment decision processes in net-zero emissions transitions