

**H. SCOTT MATTHEWS**  
**PRINCIPAL, AVENUE C ADVISORS**  
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## **BIOGRAPHICAL INFORMATION**

Scott is a principal at Avenue C Advisors. He previously was a professor in the Department of Civil and Environmental Engineering at Carnegie Mellon University. Matthews's research and teaching focuses on engineering, economic, and social decision-making under uncertainty via large datasets, computation, and visualization methods. His current interests are in the use of connected vehicle technologies to provide high-resolution data on vehicle performance and use to improve mobility. Examples of particular topics of interest include using such data to improve vehicle safety and emissions, and to implement mileage-based vehicle fees.

Previously, Matthews contributed to development of tools for environmental and energy life cycle assessment (LCA) of products and processes (such as the EIO-LCA model), estimating and tracking environmental effects across global supply chains (such as carbon footprinting), and the sustainability of infrastructure systems.

Matthews has served as chair of the Committee on Sustainable Systems and Technology with the Institute of Electrical and Electronic Engineers and on the Executive Committee for the American Center for Life Cycle Assessment. He participated in the National Research Council study on the Hidden Costs of Energy and was a member of the NRC Board on Environmental Studies and Toxicology. He is currently involved in ASCE and TRB committees related to data and connected vehicles.

At Carnegie Mellon, he was a member of the Green Design Institute, an interdisciplinary research consortium at Carnegie Mellon focused on modeling energy and environmental problems in the developing world. He has taught graduate and undergraduate courses in the Departments of Economics, Civil and Environmental Engineering, Engineering and Public Policy, and Computer Science.

## **CURRENT AND PAST EXPERIENCE**

- 2010-2021: Professor, Civil & Environmental Engineering / Engineering & Public Policy
- 2015-2017, 2019: Associate Department Head, Department of Engineering and Public Policy
- 2010-Present: Principal, Avenue C Advisors, LLC
- 2010-2014: Co-Chair, Green Practices Committee, CMU
- 2006-2010: Assoc. Prof., Civil & Environmental Engineering / Engineering & Public Policy
- 2002-2006: Asst. Professor, Civil & Environmental Engineering / Engineering & Public Policy
- Jan. 2000-2014: Research Director, Green Design Institute
- July 2000-July 2002: Research Assistant Professor, Graduate School of Industrial Administration (now Tepper School of Business), Carnegie Mellon University, Pittsburgh, PA
- Jan. 1999-June 2000: Assistant Department Head (for Undergraduate Affairs), Department of Engineering and Public Policy, Carnegie Mellon
- 1996-2001: Environmental Management Consultant, Quantum Corporation, Milpitas, CA
- 1992-1993: Network Manager, Software Engineering Institute, Pittsburgh, PA
- 1990-1992: Consultant, COM-4 Computer Consulting, Inc., Pittsburgh, PA

## EDUCATION

- Ph.D., Economics; Graduate School of Industrial Administration, Carnegie Mellon, Jan. 1999  
Title: "The External Costs of Air Pollution and the Environmental Impact of the Consumer in the U.S. Economy", Advisors: Lester Lave (chair), Dennis Epple, Chris Hendrickson
- MS, Economics; Graduate School of Industrial Administration, Carnegie Mellon, 1996
- BS, Computer Engineering and Engineering and Public Policy, Carnegie Mellon, 1992

## SELECTED PROFESSIONAL REVIEW ACTIVITIES

Applied Energy, ASCE Journal of Architecture Engineering, ASCE Journal of Infrastructure Systems, ASCE Journal of Professional Practice, ASCE Journal of Transportation Engineering, Atmospheric Environment, Ecological Economics, Ecological Indicators, Energy, Energy and Buildings, Energy Economics, Energy Policy, Energy Research & Social Science, Environmental Impact Assessment Review, Environmental Science and Technology, Global Environmental Change, Greener Management International, IEEE Spectrum, International Journal of Life Cycle Assessment, Joule, Journal of the Air & Waste Management Association, Journal of Cleaner Production, Journal of Environmental Management, Journal of Environmental Sciences, Journal of Green Building, Journal of Industrial Ecology, Journal of Natural Gas Science & Engineering, RAND Corporation, Resources, Conservation, and Recycling, Robotics and Computer Integrated Manufacturing, Transport Policy, Transportation Research Parts A, B, D, Waste Management

## HONORS OR AWARDS

- Reuters list of global top climate scientists, 2021
- Runner up, Best Policy Paper 2010, *Environmental Science & Technology* (ES&T), "Policy Implications of Uncertainty in Modeled Life-Cycle Greenhouse Gas Emissions of Biofuels" (w/ Mullins and Griffin)
- Best Policy Paper 2008, *Environmental Science & Technology* (ES&T), "Food-Miles and the Relative Climate Impacts of Food Choices in the United States", (w/ C.L. Weber)
- Laudise Prize (for significant contributions to the community by a young researcher), International Society of Industrial Ecology (ISIE), 2007.
- AT&T Faculty Fellow in Industrial Ecology (w/ E. Williams), "Energy Use of Households," 2005
- AT&T Faculty Fellow in Industrial Ecology, "Energy Impacts of Voice Telecommunications," 2002
- AT&T Faculty Fellow in Industrial Ecology, "Energy Impacts of Wireless Networking," 2001
- AT&T Faculty Fellow in Industrial Ecology, "Environmental Impacts of E-commerce," 2000
- AT&T Faculty Fellow in Industrial Ecology, "Environmental Impacts of E-commerce," 1999
- Carnegie Bosch Institute Applied International Management Faculty Development Award, 2000-2001
- Outstanding Faculty Teacher Award, Department of Economics, 2000.
- Best Student Teacher, Department of Economics, Carnegie Mellon, 1996
- William Larimer Mellon Doctoral Fellowship, 1993-1996.

## PROFESSIONAL AFFILIATIONS AND ACTIVITIES

American Center for Life Cycle Assessment - Advisory Council 2007-2011

American Society of Civil Engineers (ASCE), Assoc. Member (2002-2009).

ASCE Journal of Infrastructure Systems: Editorial Board (2005-12); Co-edited 2 issues on sustainable infrastructure

Development of Online Course on Life Cycle Sustainability Assessment

Association for the Advancement of Sustainability in Higher Education (AASHE), Steering Committee for Sustainability Tracking and Reporting System (STARS), 2011-13.

Association of Environmental Engineering and Science Professors (AEESP), Member  
Green Electronics Council EPEAT Board of Advisors – 2008-2011  
IEEE, Technical Committee on Sustainable Systems and Technology (formerly Electronics and the Environment), Chair (2009-11)  
IEEE Int'l Symposium on Electronics and the Environment 2002-07, Finance Chair, Program Chair, Conference Co-Chair (various)  
2005-2008, IEEE Distinguished Visitor Program Award (traveling lectures on sustainability)  
International Life Cycle Academy, Member (2016- )  
International Society of Industrial Ecology, Newsletter Contributor (Conference and Activity Reports)  
Journal of Industrial Ecology, Associate Editor (Input-Output Models, LCA)  
National Research Council, Board on Environmental Studies and Toxicology, 2012-  
National Research Council, Committee on “Health, Environmental, and Other External Costs and Benefits of Energy Production and Consumption” (Hidden Costs of Energy report), 2008-9.  
National Research Council, Committee on “Scientific Tools and Approaches for Sustainability”, 2013-14.  
World Resources Institute / World Business Council for Sustainable Development – Member of Executive Committee for Corporate Scope 3 and Product Reporting Protocols

## **BOOKS AND RELATED EDUCATIONAL CONTENT DEVELOPMENT**

1. Chris T. Hendrickson, Lester B. Lave, and H. Scott Matthews, Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach, RFF Press, April 2006.
2. H. Scott Matthews, Chris T. Hendrickson, and Deanna Matthews, Life Cycle Assessment: Quantitative Approaches for Decisions that Matter, 2014. Open access textbook, available via <http://www.lcatextbook.com/> (at least 10,000 downloads to date).
3. Chris Hendrickson and H. Scott Matthews, Civil Systems Investment Planning and Pricing (second edition) - Tentative title, 2017.
4. H. Scott Matthews, “Life-Cycle Analysis for Sustainability: Triple Bottom Line Accounting (LCAS17)”, 16 hour (1.6 CEU) online course developed for American Society of Civil Engineers, <http://mylearning.asce.org/diweb/catalog/item/id/1419764>

## **PATENT**

“Methods And Apparatuses For Monitoring Energy Consumption And Related Operations”, US 9,104,189, Mario E. Berges Gonzalez, Ethan J. Goldman, Lucio Soibelman, Burton W. Andrews, Diego S. Benitez Meijia, H. Scott Matthews, and Michael Hoyneck.

## **CORPORATE AFFILIATIONS**

Avenue C Advisors, LLC (Principal, Co-Founder)  
Data Driven IM (Co-Founder)

## **JOURNAL PUBLICATIONS**

### **SUBMITTED AND/OR WORKING PAPERS**

- Wakeley, Heather, Scott Matthews, Michael Griffin, Chris Hendrickson, “Comparison of Input-Output and Process-based Life Cycle Inventory Results with an Application to Fischer-Tropsch Coal-to-Diesel Fuels”, ASCE Journal of Infrastructure Systems.
- Matthew Kocoloski, W. Michael Griffin, and H. Scott Matthews, “Estimating Impacts of Ethanol Shipping”.
- Rachael Nealer, H. Scott Matthews, and Chris Hendrickson, "Reducing life cycle greenhouse gas emissions related to shopping: a grocery store case study", The Journal of Industrial Ecology, submitted, 2014.

- Russell M. Meyer, Inês M. Lima Azevedo, H. Scott Matthews, "Residential DSM Lighting Programs in Pennsylvania and in Vermont: What can we learn?" Energy Policy, submitted, 2015.
- Sam A. Markolf, H. Scott Matthews, Chris Hendrickson, Inês Lima Azevedo, "The Implications of Climatic Temperature Change on Metropolitan Electricity Demand and Greenhouse Gas", Energy Policy, submitted, 2016.
- Leslie S. Abrahams, Constantine Samaras, W. Michael Griffin, and H. Scott Matthews, "A systems level perspective on Marcellus wastewater management in Pennsylvania", 2017.
- Allante Whitmore, Chris Hendrickson, Costa Samaras, and H. Scott Matthews, "Engineers Roles and Responsibilities in Automated Vehicle Ethics: Exploring Engineering Codes of Ethics as a Guide to Addressing Issues in Socio-technical Systems", submitted to Journal of Transportation Engineering, 2021.
- Alessandro Giordano, H. Scott Matthews, Patricia Baptista, and Paul Fischbeck, "Assessing the external costs of commercial cargo bicycles, electric scooters, and small diesel and battery electric vans in Berlin, Paris, Rome and Lisbon", submitted to Sustainable Cities and Society, 2021.
- Prithvi S. Acharya, H. Scott Matthews, Laila AitBihiOuali, Dan Graham, "The impact of periodic passenger vehicle safety inspection programs on roadway fatalities: Evidence from U.S. states using panel data", submitted to ASCE Journal of Transportation Engineering, Revise and resubmit, 2021.
- TRB 2021 MBUF papers, Rick 2 TRB papers
- Thiago A. Rodrigues et al, "Drone flight data reveal energy and greenhouse gas emissions savings for small package delivery", Nature Energy, submitted, 2021.
- Allante Whitmore et al, "Integrating Public Transportation and Shared Autonomous Mobility for Equitable Transit Coverage: A Cost-Efficiency Analysis in Allegheny County", submitted, Transportation Research: Interdisciplinary Perspectives, 2021.
- Michael Blackhurst, H. Scott Matthews, and Mario Berges, "Comparing Sources of Uncertainty in Community Greenhouse Gas Estimation Techniques", submitted, Environmental Research Letters, 2021.
- Ana Caceres et al, "Power pools for the win: Assessing climate resilience of hydropower resources in African power pools", submitted, Nature Climate Change, 2021.
- Reshmi papers here

**ACCEPTED / PUBLISHED (ACS Direct Downloads current as of March 2018, since Jan. 2009)**

1. Xiaoju Chen, H. Scott Matthews, and W. Michael Griffin, "Representing and visualizing uncertainty in using life cycle impact assessment methods", in press, Resources, Conservation, and Recycling, 2021. DOI: <https://doi.org/10.1016/j.resconrec.2021.105678>
2. Thiago Rodrigues, Jay Patrikar, Arnav Choudhry, Jacob Feldgoise, Vaibhav Arcot, Aradhana Gahlaut, Sophia Lau, Brady Moon, Bastian Wagner, H. Scott Matthews, Sebastian Scherer, and Constantine Samaras, "In-flight positional and energy use dataset of a DJI Matrice 100 quadcopter for small package delivery", Nature: Scientific Data, in press, 2021.
3. Alessandro Giordano, H. Scott Matthews, Patricia Baptista, and Paul Fischbeck, "Impacts of topography and weather barriers on commercial cargo bicycle energy using during urban delivery crowdsourced cycling data", Sustainable Cities and Society, in press, 2021.
4. Ana Caceres, Paulina Jaramillo, H. Scott Matthews, Constantine Samaras, Bart Nijssen, "Hydropower under climate uncertainty: characterizing the usable capacity of Brazilian, Colombian and Peruvian power plants under climate scenarios", Energy for Sustainable Development, in press, 2021.
5. Alessandro Giordano, Paul Fischbeck, H. Scott Matthews, "Effects of Temperature on Economic Attractiveness and Social Benefits of Battery Electric Delivery Vans", Economics and Policy of Energy and Environment, 2020, Issue 1, pp. 95-151. DOI: 10.3280/EFE2020-001006

6. Rick Grahn, Chris T. Hendrickson, H. Scott Matthews, Sean Qian, and Corey Harper, “Societal Impacts Of A Complete Street Project In A Mixed Urban Corridor: A Case Study In Pittsburgh, PA”, ASCE Journal of Infrastructure Systems, Vol. 27, No. 2, 2021.
7. Prithvi Acharya, H. Scott Matthews, and Paul S. Fischbeck, “Data-driven methods can enable selective, remote vehicle emissions inspection programs”, IEEE Transactions on Intelligent Transportation Systems, in press, 2021. DOI: 10.1109/TITS.2020.3010219
8. Rick Grahn, Chris Hendrickson, Sean Qian, and H. Scott Matthews, “Are travelers substituting between transportation network companies (TNC) and public buses? A case study in Pittsburgh”, Transportation, in press, 2020. DOI: <https://doi.org/10.1007/s11116-020-10081-4>
9. Rick Grahn, Corey D. Harper, Chris T. Hendrickson, Sean Qian, and H. Scott Matthews, “Socioeconomic and Usage Characteristics of Transportation Network Company (TNC) Riders”, Transportation, in press, 2019. DOI: <https://doi.org/10.1007/s11116-019-09989-3>
10. Joule A. Bergerson, Adam Brandt, Joe Cresko, Michael Carbajales-Dale, Heather L. MacLean, H. Scott Matthews, Sean McCoy, Marcelle McManus, Shelie A. Miller, William R. Morrow III, I. Daniel Posen, Thomas Seager, Timothy Skone, and Sylvia Sleep, “Life Cycle Assessment of Emerging Technologies: Evaluation Techniques at Different Stages of Market and Technical Maturity”, The Journal of Industrial Ecology, 2019. DOI: <https://doi.org/10.1111/jiec.12954>
11. Vinod Krishnappa, H. Scott Matthews, and Yi Liu, “Data-Driven Analysis to Support Revised Tire Tread Inspection Standards”, Transportation Research Record, 2019. DOI: <https://doi.org/10.1177/0361198119851456>
12. Sam A. Markolf, H. Scott Matthews, Inês L. M. Azevedo, and Chris T. Hendrickson, "The implications of scope and boundary choice on the establishment and success of metropolitan greenhouse gas reduction targets in the United States", Environmental Research Letters, Vol. 13, No. 12, 2018. DOI: <https://doi.org/10.1088/1748-9326/aaea8c>
13. Xiaoju Chen, W. Michael Griffin, H. Scott Matthews, “Representing and visualizing data uncertainty in input-output life cycle assessment models”, Resources, Conservation, and Recycling, Volume 137, October 2018, pp. 316-325. DOI: <https://doi.org/10.1016/j.resconrec.2018.06.011>
14. Alessandro Giordano, Paul Fischbeck, and H. Scott Matthews, “Environmental and Economic Comparison of Diesel and Battery Electric Delivery Vans to Inform City Logistics Fleet Replacement Strategies”, Transportation Research Part D, Volume 64, October 2018, Pages 216-229, DOI: <https://doi.org/10.1016/j.trd.2017.10.003>
15. Stephanie M. Seki, W. Michael Griffin, Chris Hendrickson, and H. Scott Matthews, "Refueling and infrastructure costs of expanding access to E85 in Pennsylvania", ASCE Journal of Infrastructure Systems, Vol. 24, No. 1, 2018. DOI: [https://doi.org/10.1061/\(ASCE\)IS.1943-555X.0000408](https://doi.org/10.1061/(ASCE)IS.1943-555X.0000408)
16. Jeffrey Morris, Sally Brown, Matthew Cotton, H. Scott Matthews, “LCA Harmonization and Soil Science Rankings Results on Food Waste Management Methods”, Environmental Science and Technology, in press, 2017. DOI: 10.1021/acs.est.6b06115 Downloads: 449
17. Leslie S. Abrahams, Constantine Samaras, W. Michael Griffin, and H. Scott Matthews, “Effect of Crude Oil Carbon Accounting Decisions on Meeting Global Climate Budgets”, Environment, Systems and Decisions, in press, 2017. DOI:10.1007/s10669-017-9638-5
18. Sam A. Markolf, H. Scott Matthews, Inês Lima Azevedo, and Chris Hendrickson, “An Integrated Approach For Estimating Greenhouse Gas Emissions From 100 U.S. Metropolitan Areas”, Environmental Research Letters, Vol. 12, No. 2, 2017. DOI: 10.1088/1748-9326/aa5731
19. Ranjani B. Theregowda, Radisav Vidic, Amy E. Landis, David A. Dzombak, and H. Scott Matthews, "Integrating External Costs with Life Cycle Costs of Tertiary Treatment of Municipal Wastewater for Reuse in Cooling Systems", Journal of Cleaner Production, Vol. 112, Pt 5, 2016, pp. 4733–4740. DOI: 10.1016/j.jclepro.2015.06.020
20. Rachel Hoesly, H. Scott Matthews, and Chris Hendrickson, "Energy and GHG Emissions from US Population Shifts and Implications for Regional GHG Mitigation Planning", Environmental Science and Technology, Vol. 49 (21), pp. 12670–12678, 2015. DOI: 10.1021/acs.est.5b02820 Downloads: 438

21. Dana Peck, H. Scott Matthews, Chris Hendrickson, and Paul Fischbeck, "An Analysis of Vehicle Safety Inspection Data in Pennsylvania: Expected Failure Rates", Transportation Research Part A, Volume 78, August 2015, Pages 252–265, 2015. **DOI:** 10.1016/j.tra.2015.05.013
22. Abrahams, Leslie, Samaras, Constantine, Griffin, W. Michael, Matthews, H. Scott, "Life Cycle Greenhouse Gas Emissions From U.S. Liquefied Natural Gas Exports: Implications for End Uses", Environmental Science and Technology, 2015, 49 (5), pp 3237–3245. **DOI:** 10.1021/es505617p  
Downloads: 3,184
23. I. Daniel Posen, W. Michael Griffin, H. Scott Matthews, Inês M. L. Azevedo, "Changing the Renewable Fuel Standard to a Renewable Material Standard: Bio-Ethylene Case Study", Environmental Science and Technology, 2015, 49 (1), pp 93–102. **DOI:** 10.1021/es503521r  
Downloads: 1,241
24. Leslie S. Abrahams, W. Michael Griffin, and H. Scott Matthews, "Assessment of Policies to Reduce Core Forest Fragmentation from Marcellus Shale Development in Pennsylvania", Ecological Indicators, Volume 52, May 2015, Pages 153–160 2014. **DOI:**10.1016/j.ecolind.2014.11.031
25. Mili-Ann Tamayao, M F Blackhurst, and H S Matthews, "Do US metropolitan core counties have lower scope 1 and 2 CO2 emissions than less urbanized counties?", Environmental Research Letters, 2014, Volume 9, No. 10. **DOI:**10.1088/1748-9326/9/10/104011
26. Gwen DiPietro, Chris T. Hendrickson, and H. Scott Matthews, "Estimating Economic and Resilience Consequences of Potential Navigation Infrastructure Failures: A Case Study of the Monongahela River", Transportation Research Part A, 2014, pp. 142-164. **DOI:**10.1016/j.tra.2014.08.009
27. Jorge Vendries Algarin, Troy R. Hawkins, Joe Marriott, H. Scott Matthews, and Vikas Khanna, "Disaggregating the power generation sector for input-output life-cycle assessment", The Journal of Industrial Ecology, Volume 19, Issue 4, pp. 666–675, August 2015. **DOI:** 10.1111/jiec.12207
28. Kimberley A. Mullins, H. Scott Matthews, W. Michael Griffin, Robert Anex, "Impacts of Variability in Cellulosic Biomass Yields on Energy Security", Environmental Science and Technology, 2014, 48 (13), pp 7215–7221. **DOI:** 10.1021/es404174h - Downloads 236
29. Stefan Schwietzke, W. Michael Griffin, H. Scott Matthews, Lori M. P. Bruhwiler, "Natural gas fugitive emissions rates constrained by global atmospheric methane and ethane", Environmental Science & Technology, 2014, 48 (14), pp 7714–7722. **DOI:** 10.1021/es501204c Downloads: 919
30. Stefan Schwietzke, W. Michael Griffin, H. Scott Matthews, Lori M. P. Bruhwiler, "Global bottom up fossil fuel and methane inventory for use in atmospheric modeling", ACS Sustainable Chemistry and Engineering, 2014, 2 (8), pp 1992–2001. **DOI:** 10.1021/sc500163h - **Special Recognition: Editor's Choice** Downloads 1,489
31. W. Michael Griffin, Jeremy Michalek, H. Scott Matthews, and Mohd Nor Azman Hassan, "Availability of Biomass Residues for Co-firing in Peninsular Malaysia: Implications for Cost and GHG Emissions in the Electricity Sector", Energies, 2014, 7(2), 804-823; **DOI:** 10.3390/en7020804
32. Mangmeechai, Aweewan, Jaramillo, P., Griffin, M., & Matthews, H. Scott, "Life cycle consumptive water use for oil shale development and implications for water supply in the Colorado River Basin. The International Journal of Life Cycle Assessment, Vol. 19, pp. 677–687, 2014. **DOI:** 10.1007/s11367-013-0651-8
33. Yeganeh Mashayekh, Chris Hendrickson, H. Scott Matthews, "LEED Certified Residential Brownfield Development as a Travel and Greenhouse Gas Emission Reduction Strategy", ASCE Journal of Urban Planning and Development, 2014. **DOI:**10.1061/14 (ASCE)UP.1943-5444.0000218
34. Derrick Carlson, H. Scott Matthews, and Mario Bergés, "One size does not fit all: Averaged data on household electricity is inadequate for residential energy policy and decisions", Energy and Buildings, Vol. 64, Sept. 2013, Pages 132–144, **DOI:**10.1016/j.enbuild.2013.04.005

35. Amy Nagengast, Chris Hendrickson, H. Scott Matthews, "Variations in photovoltaic performance due to climate and low-slope roof choice," Energy and Buildings, (2013), pp. 493-502, **DOI:** 10.1016/j.enbuild.2013.05.009
36. Morris, Jeffrey, H. Scott Matthews, and Clarissa Morawski, "Review and Meta-Analysis of 82 Studies on End-of-Life Management Methods for Source Separated Organics", Waste Management, Vol. 33(3):545-51, March 2013, **DOI:** 10.1016/j.wasman.2012.08.004
37. Marla Sanchez, H. Scott Matthews, and Paul Fischbeck, "How much is United States Greenhouse Gas Emissions Certainty Worth?", Energy Policy, Vol. 51, December 2012, pp. 259-263, **DOI:** 10.1016/j.enpol.2012.07.045
38. Venkatesh, Aranya; Jaramillo, Paulina; Griffin, W.; Matthews, H. S., "Implications of near-term coal power plant retirement for SO<sub>2</sub> and NO<sub>X</sub>, and life cycle GHG emissions", Environmental Science & Technology, 2012, 46 (18), pp. 9838–9845, **DOI:** 10.1021/es3023539 Downloads 730
39. Venkatesh, Aranya; Jaramillo, Paulina; Griffin, W.; Matthews, H. S., "Implications of changing natural gas prices in the United States electricity sector for SO<sub>2</sub>, NO<sub>X</sub> and life cycle GHG emissions", Environmental Research Letters, 7, 034018, 2012, **DOI:** 10.1088/1748-9326/7/3/034018
40. Venkatesh, Aranya; Jaramillo, Paulina; Griffin, W.; Matthews, H. S., "Uncertainty in Life Cycle Greenhouse Gas Emissions from United States Coal", Energy & Fuels, 2012, 26 (8), pp. 4917–4923. **DOI:** 10.1021/ef300693x Downloads 579
41. Yeganeh Mashayekh, Chris T. Hendrickson, H. Scott Matthews, The Role of Brownfield Developments in Reducing Household Vehicle Travel, ASCE Journal of Urban Planning and Development, 138(3), pp. 206–214, 2012. **DOI:** 10.1061/(ASCE)UP.1943-5444.0000113
42. Rachel Hoesly, Mike Blackhurst, H Scott Matthews, Jeffery F. Miller, Amy Maples, Matthew Pettit, Catherine Izard, Paul Fischbeck, "Historical Carbon Footprinting and Implications for Sustainability Planning: a Case study of the Pittsburgh Region", Environmental Science & Technology, 2012, 46 (8), pp 4283–4290, **DOI:** 10.1021/es203943q Downloads 724
43. Yeganeh Masayekh, Paulina Jaramillo, Constantine Samaras, Chris T. Hendrickson, Michael Blackhurst, Heather Maclean, and H. Scott Matthews, "Potentials for Sustainable Transportation in Cities to Alleviate Climate Change Impacts", Environmental Science & Technology, 2012, 46 (5), pp. 2529–2537, **DOI:** 10.1021/es203353q Downloads 2,226
44. Rachael Nealer, H. Scott Matthews, and Chris Hendrickson, "Assessing the Energy and Greenhouse Gas Emissions Mitigation Effectiveness of Potential US Modal Freight Policies", Transportation Research Part A: Policy and Practice, Volume 46, Issue 3, March 2012, Pages 588–601, **DOI:** 10.1016/j.tra.2011.11.010
45. Stefan Schwietzke, W. Michael Griffin, and H. Scott Matthews, "Relevance of emissions timing in biofuel greenhouse gases and climate impacts", Environmental Science & Technology, 2011, 45 (19), pp. 8197–8203. **DOI:** 10.1021/es2016236 Downloads 898
46. Aranya Venkatesh, Paulina Jaramillo, W. Michael Griffin, H. Scott Matthews, "Uncertainty in Life Cycle Greenhouse Gas Emissions from United States Natural Gas End-Uses and its Effects on Policy", Environmental Science & Technology, 2011, Vo. 45, No. 19, pp. 8182–8189, **DOI:** 10.1021/es200930h Downloads 2,447
47. Michael Blackhurst, H. Scott Matthews, Aurora L. Sharrard, Chris T. Hendrickson, and Inês Lima Azevedo, "Preparing U.S. community greenhouse gas inventories for climate action plans", Environmental Research Letters, Vol. 6, No. 3, 2011. **DOI:**10.1088/1748-9326/6/3/034003
48. Michael Blackhurst, Inês Lima Azevedo, H. Scott Matthews, and Chris T. Hendrickson, "Designing Building Energy Efficiency Programs for Greenhouse Gas Reductions", Energy Policy, Vo. 39, No. 9, September 2011, Pages 5269-5279. **DOI:**10.1016/j.enpol.2011.05.037
49. Christine Costello, W. Michael Griffin, H. Scott Matthews, and Christopher Weber, "Inventory Development and Input-Output Model of U.S. Land Use: Relating Land in Production to Consumption", Environmental Science & Technology, 2011, 45, pp. 4937–4943, **DOI:**10.1021/es104245j Downloads 842

50. Matthew Kocoloski, W. Michael Griffin, and H. Scott Matthews, “Estimating national costs, benefits, and potential for cellulosic ethanol production from forest thinnings”, Biomass and Bioenergy, Vol. 35, Iss. 5, May 2011, pp. 2133-2142. DOI:10.1016/j.biombioe.2011.02.010
51. Mario Berges, Ethan Goldman, H. Scott Matthews, Lucio Soibelman, Kyle Anderson, “User-centered Non-Intrusive Electricity Load Monitoring for Residential Buildings”, ASCE Journal of Computing in Civil Engineering, Vol, 25, No. 1, 2011. DOI:10.1061/(ASCE)CP.1943-5487.0000108
52. Kimberley A. Mullins, W. Michael Griffin, and H. Scott Matthews, “Policy Implications of Uncertainty in Modeled Life-Cycle Greenhouse Gas Emissions of Biofuels”, Environmental Science & Technology, 2011, 45 (1), pp 132–138, DOI: 10.1021/es1024993 **Runner-up, Best Policy Analysis Paper, ES&T, 2010**. Downloads: 2,621
53. Aranya Venkatesh, Paulina Jaramillo, W. Michael Griffin, and H. Scott Matthews, “Uncertainty Analysis of Life Cycle Greenhouse Gas Emissions from Petroleum-Based Fuels and Impacts on Low Carbon Fuel Policies”, Environmental Science & Technology, 2011, 45 (1), pp 125–131, DOI: 10.1021/es102498a. Downloads 2,712
54. Rachael Nealer, Christopher L. Weber, Chris Hendrickson and H. Scott Matthews, “Modal freight transport required for production of US goods and services”, Transportation Research Part E: Logistics and Transportation Review, Volume 47, Issue 4, July 2011, Pages 474-489. DOI: 10.1016/j.tre.2010.11.015
55. Mario Berges, Ethan Goldman, Lucio Soibelman, and H. Scott Matthews, “Enhancing Electricity Audits in Residential Buildings with Non-Intrusive Load Monitoring”, Journal of Industrial Ecology, Special Issue: Environmental Applications of Information & Communication Technology, Volume 14, Issue 5, pages 844–858, October 2010. DOI: 10.1111/j.1530-9290.2010.00280.x
56. Matthew Kocoloski, W. Michael Griffin, and H. Scott Matthews, “Impacts of Facility Size and Location Decisions on Ethanol Costs”, Energy Policy, Vol. 39, pp.47-56, 2011.
57. Catherine F. IZARD, Christopher L. Weber, H. Scott Matthews, “Primary and embedded steel imports to the U.S.: Implications for the design of Border Tax Adjustments”, Environmental Science & Technology, 2010, 44 (17), pp 6563–6569, DOI: 10.1021/es101010u Downloads 611
58. H. S. Matthews, T. Morawski, A. Nagengast, G. O’Reilly, D. Picklesimer, R Sackett, P. Wu, “Planning Energy Efficient and Eco-Sustainable Telecommunications Networks”, BELL LABS TECHNICAL JOURNAL 15, no. 1 (June 2010): 215-236. DOI:10.1002/bltj.20434.
59. Michael Bigrigg, H. Scott Matthews, and James Garrett, “Fault Perturbations in Building Sensor Networked Data Streams”, International Journal of Sensor Networks, Vol.7 No. 3, 2010. DOI: 10.1504/IJSNET.2010.033117
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61. Michael Blackhurst, Chris Hendrickson, H. Scott Matthews, “Cost Effectiveness of Green Roofs”, Journal of Architectural Engineering, Vol. 16, No. 4., pp. 136-143 (December 2010). DOI: 10.1061/(ASCE)AE.1943-5568.0000022
62. Cliff I. Davidson, Chris T. Hendrickson, H. Scott Matthews, Michael W. Bridges, David T. Allen, Cynthia F. Murphy, Braden R. Allenby, John C. Crittenden, and Sharon Austin, “Preparing future engineers for challenges of the 21st century: Sustainable engineering”, Journal of Cleaner Production, 2010, Vol 18, no. 7 (May): 698-701. DOI: 10.1016/j.jclepro.2009.12.021
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#### **GRADUATE STUDENTS ADVISED**

Ruth Reyna (Ph.D. 2002), Luis Ochoa (Ph.D. 2004), Gyorgyi Cicas (PhD 2005)\*, Luis Aguirre (Ph.D. 2005), Ping Chen (Ph.D. 2006), William Morrow (Ph.D. 2006), Vipul Singhvi (Ph.D. 2006), Joe Marriott (Ph.D. 2006)\*, Aurora Sharrard (Ph.D. 2006), Melissa Bilec (U. Pittsburgh, 2007), Troy Hawkins (Ph.D. 2006), Corinne Scown (MS 2007), Cortney Higgins (Ph.D., 2007), Paulina Jaramillo (Ph.D. 2007)\*, Chris Weber (PhD 2007)\*, Constantine Samaras (Ph.D., 2008), Heather Wakeley (PhD 2008), Melissa Chan (PhD 2008), Aweewan Mangmeechai (PhD 2009), Chung Yan Shih (PhD 2009), YuShan Anny Huang (PhD 2009), Matt Kocoloski (PhD 2010)\*, Mario Berges (PhD 2010), Chris Costello (PhD 2010), Michael Bigrigg (PhD 2011), Michael Blackhurst (PhD 2011)\*, John Matsumura (PhD 2012), Mohd Nohr Azman Hassan (PhD 2012), Aranya Venkatesh (PhD 2012), Kim Mullins (PhD 2012)\*, Amy Nagengast (PhD 2012)\*, Catherine IZard (PhD 2013), Enes Hosgor (PhD 2013), Derrick Carlson (MS

2009, PhD 2013), Stefan Schwietzke (PhD 2013), Rachel Hoesly (PhD 2014)\*, Gwen DiPietro (PhD 2014), Dana Peck (MS 2012, PhD 2015)\*, Sam Markolf (PhD 2015), Leslie Abrahams (PhD 2016), Xiaoju (Julie) Chen (MS 2014, PhD 2017), Soumyajit Paul (MS 2017), Vinod Krishnappa (MS 2018) Michelle Liu (MS 2018), Xiaojue Chen (MS 2020), Alessandro Giordano (PhD 2020)\*, Chenyu Yuan (MS 2020), Yaqi Fan (MS 2020), Lin Lyu (MS 2020), Zhufeng Gan (MS 2020), Kaiwen Zhang (MS 2020), Prithvi Acharya (PhD 2021), Reshmi Ghosh (PhD 2021).

Total PhD Students: 43. Asterisks note students also supervised as post-docs. Total post-docs: 9.

#### **PhD THESIS COMMITTEE MEMBERSHIP**

Octavio Juarez Espinosa (Ph.D. 1999), Shannon Lloyd (Ph.D. 2004), Don Coffelt (PhD 2008), Sharon Wagner (PhD 2011), Ranjani Theregowda (PhD 2012), Brinda Thomas (PhD 2012), Marco Vincenzi (PhD 2012), Yeganeh Mashayekh (PhD 2013), Russell Meyer (PhD 2014), Emre Kara (PhD 2014), Mili-Ann Tamayao (PhD 2014), Kyle Borgert (PhD 2015), Nathaniel Horner (PhD 2015), Jorge Vendries (UPitt PhD 2017), Carl Malings (PhD 2017), Yu Gan (PhD 2017), Manuel Loreiro (PhD 2017), Corey Harper (PhD 2017), Greg Schivley (PhD 2018), Xuejiao (Fiona) Zhang (PhD 2018), Miranda Gorman (PhD 2019), Pinchao Zhang (PhD 2019), Shugyan Yang (PhD 2019), Henning Lange (PhD 2019), Adam Stein (PhD 2021), Abdullah Al Faraj (PhD 2021)

#### **PEER-REVIEWED PROCEEDINGS**

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  11. Singhvi., V., Bigrigg, M., Matthews, H., Garrett, J., 2005, "Continuous Commissioning using Embedded Sensors", International Conference on Computing in Civil Engineering, Cancun, Mexico, July 2005. (doi 10.1061/40794(179)47).
  12. Hui Min Chong and H. Scott Matthews, "Comparative Analysis of Traditional Telephone and Voice-over-Internet Protocol (VoIP) Systems", Proceedings of the 2004 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 10-13, 2004, Scottsdale, AZ, USA.
  13. Junbeum Kim, Yongwoo Hwang, H. Scott Matthews, and Kwangho Park, "Methodology for Recycling Potential Evaluation Criterion of Waste Home Appliances Considering Environmental and Economic Factor", Proceedings of the 2004 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 10-13, 2004, Scottsdale, AZ, USA.
  14. Akinci, Burcu, Mikhail Chester, Chris Hendrickson, H. Scott Matthews, and Kevin McCloskey, "Automated Photologging and Retrieval for a Digital Photograph Library," Proc. Of the Transportation Research Board Annual Meeting, 2004.
  15. "Electricity Use of Wired and Wireless Telecommunications Networks in the United States ", H. Scott Matthews, SETAC/ISIE Symposium, Geneva Switzerland, December 3-5, 2003.
  16. H. Scott Matthews, "Information and Communications Technologies and Sustainability", Proceedings of 2003 IEEE Conference on Systems, Man, and Cybernetics, Washington, DC, USA, Oct. 5-8, 2003.
  17. H. Scott Matthews, Woon Sien Loh, and Hui Min Chong, "Electricity Use of Wired and Wireless Telecommunications Networks in the United States", Proceedings of the 2003 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 19-22, 2003, Boston, MA, USA.
  18. H. Scott Matthews, Chris T. Hendrickson, Hui Min Chong, and Woon Sien Loh, "Energy Impacts of Wired and Wireless Networks", Proceedings of the 2002 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 6-8, 2002, San Francisco, CA, USA.
  19. H. Scott Matthews and Chris T. Hendrickson, "Economic and Environmental Implications of Online Retailing in the United States", Proceedings of the 15th International Symposium Informatics for Environmental Protection, October 10-12, 2001, Zurich, Switzerland.
  20. H. Scott Matthews, Chris T. Hendrickson, and Denise Soh, "The Net Effect: Environmental Implications of E-Commerce and Logistics," Proceedings of the 2001 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 5-9, 2001, Denver, CO, USA.
  21. Elizabeth Jimison, Ed Pennington, and H. Scott Matthews, "Assessing the Results of a Worldwide Packaging Takeback System," Proceedings of the 2000 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 8-10, 2000, San Francisco, California.
  22. H. Scott Matthews and Gregory Chambers, "Use versus Manufacture Life Cycle Energy and Environmental Impacts for Tape Drives," Proceedings of the 2000 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 8-10, 2000, San Francisco, California.
  23. Chris Hendrickson, N. Conway-Schempf, H. Scott Matthews and Francis McMichael, "Green Design Educational Modules and Case Studies," Proceedings of the 2000 ASEE Conference, St. Louis, 2000.



24. H. Scott Matthews and Gregory C. Chambers, "Unraveling the Environmental Product Design Paradox", Proceedings of the 1997 Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Electronics and the Environment, May 3-5, 1997, San Francisco.
25. Lester B. Lave and H. Scott Matthews, "Price Setting for Green Design", Proceedings of the 1995 IEEE International Symposium on Electronics and the Environment, May 1-3, 1995, Orlando.

#### **OTHER WORKING PAPERS OR UNPUBLISHED MANUSCRIPTS**

1. Aurora L. Sharrard and H. Scott Matthews, "A Civil Engineering Perspective of Green Building Standards", submitted, Journal of Green Buildings, 2005.
2. Chris T. Hendrickson and H. Scott Matthews, "Use of Green Design Educational Modules," submitted to Journal of Engineering Education, February 2002.
3. H. Scott Matthews, Benoit Morel, and Tim Shimeall, "Unsafe at Any Speed: Why Software Should be Treated Like Automobiles", submitted to Issues in Science and Technology.
4. H. Scott Matthews, Chris T. Hendrickson, and Lester B. Lave, "Correcting Consumer and Producer Prices for Air Pollution Emissions," submitted to Journal of Environmental Economics and Management, 2000.
5. H. Scott Matthews and Lester B. Lave, "External Costs of Air Pollution from U.S. Industrial Sectors: Life Cycle Effluent Fees," submitted to American Economic Review, 2000.
6. H. Scott Matthews, "A Case Study of Hazardous Material Substitution", Working Paper, Aug 1998.
7. H. Scott Matthews and Lester B. Lave, "Accounting for Environmentally Conscious Design and Manufacturing", Working Paper, January 1996.

#### **CONFERENCE PAPERS AND INVITED PRESENTATIONS**

1. Rick Grahn, Corey D. Harper, Chris T. Hendrickson, Zhen Qian, and H. Scott Matthews, "Socioeconomic and Usage Characteristics of Transportation Network Company (TNC) Riders", Proceedings of the Transportation Research Board Conference, 2019.
2. "Carbon Management for Companies", ASCE Pittsburgh Section, March 27, 2008.
3. "Introduction to Input-Output Models for Transportation Modeling", UC Berkeley (Workshop on Biofuels LCA), July 1, 2008.
4. Seattle Public Utilities – "Infrastructure Implications of Alternative Fuels", July 2007.
5. Wash. State Dept of Ecology, "Development of the Consumer Environmental Index", July 2007.
6. University of New Hampshire, "Infrastructure Implications of Alternative Fuels", April 2007.
7. "A Cause Of Data Perturbations in Building Sensors", Michael Bigrigg and H. Scott Matthews, Int'l Conf. on Computing in Civil Engineering, Montreal, Canada, 2006.
8. "Motivating Environmental Systems and Life Cycle Thinking for High School Students", H. Scott Matthews, Chris Hendrickson, Troy Hawkins, Joseph Marriott, and Aurora Sharrard, 2005 Association of Environmental Engineering and Science Professors Research and Education Conference, July 26, 2005, Potsdam, NY.
9. "Sustainability Engineering at Carnegie Mellon: A New Sequence of Graduate Courses", Cliff I. Davidson, H. Scott Matthews, and Chris T. Hendrickson, 2005 Association of Environmental Engineering and Science Professors Research and Education Conference, July 26, 2005, Potsdam, NY.
10. "Life Cycle Assessment Using Input-Output Models", 9<sup>th</sup> Annual Green Chemistry and Engineering Conference, Washington, DC, June 23, 2005.
11. "Environmental Cost Accounting", National Association of Environmental Management, Chicago, December 2004.

12. Hawkins, Troy, H.S. Matthews, 'IO MFA Analysis of the Relationship between Cadmium Recycling and Zinc Production.' Fourth SETAC World Congress / 25th Annual Meeting in North America, Portland, Oregon, 14-18 November 2004.
13. "Computers and the Environment", United Nations, March 8, 2004.
14. "Electricity Use of US Telecom Networks", International Conference on Life Cycle Assessment (InLCA), Seattle, September 2003.
15. "Implications of New Economic Classification Systems on Input-Output Based LCA Models", International Conference on Life Cycle Assessment (InLCA), Seattle, September 2003.
16. "Using Life Cycle Assessment for Corporate Benchmarking ", National Association of Environmental Management, Baltimore, October 2003.
17. "Overview and Preview of NAEM/Carnegie Mellon Executive Education Course", NAEM Atlanta Chapter, December 8, 2003.
18. "Assessing Knowledge Needs for Critical Infrastructure Protection", ICES Knowledge Management Forum, October 30, 2003.
19. H. Scott Matthews, Woon Sien Loh, and Hui Min Chong, "Energy Consumption of Wired and Wireless Communications Networks", International Society for Industrial Ecology Second International Conference, Ann Arbor, Michigan, June 29-July 2, 2003.
20. H. Scott Matthews and Joseph Marriott, "A Source Generation Comparison of Electricity Consumption in US Production Sectors", International Society for Industrial Ecology Second International Conference, Ann Arbor, Michigan, June 29-July 2, 2003.
21. "Input-Output based Life Cycle Analysis for New Economy Models", with Chris T. Hendrickson, 14th International Conference on Input-Output Techniques, Montreal, Canada, Oct 11-15, 2002.
22. "Pollution Prevention via Life Cycle Analysis", Keynote, Ohio EPA Hazardous Waste Management Conference, July 2002.
23. "What is the Information Technology Sector, and how does it affect Economic Growth?", with Thomas Grahame (U.S. Department of Energy), Electric Utilities Environmental Conference, Tucson, AZ, January 22-25, 2002.
24. "Economic and Environmental Implications of Online Retailing in the United States and Japan", International Society for Industrial Ecology Conference, Amsterdam, Nov. 2001.
25. "Environmental Implications of the Growth of the Information and Communications Technology Sector", OECD Environmental Policy Directorate, Paris, November 7, 2001
26. "Environmental Life Cycle Assessment: Theory and Examples", Alfred University Center for Environmental and Energy Research, Keynote Speaker, October 24, 2001.
27. "Economic and Environmental Implications of the New Economy," Organisation for Economic Co-Operation and Development World Forum, Plenary Speaker, May 14-16, 2001, Paris.
28. Economic and Environmental Implications of E-commerce," Silicon Valley Conference on Solutions for Sustainability: Evaluating Our Global Performance, Feb. 28-Mar. 1, 2001, Foster City, CA, USA.
29. H. Scott Matthews, Chris T. Hendrickson, and Lester B. Lave, "Economic Input-Output Based Life Cycle Assessment for Sustainability," Society of Environmental Toxicology and Chemistry (SETAC) 21st Annual Meeting, Nashville, TN, November 12-16, 2000.
30. "Environmental Implications of E-Commerce: Book Publishing Case Study," Industrial Ecology 2000 (IE2000) Conference, Berkeley, CA, October 5-7, 2000.
31. "External Costs and Externalities of Production", NATO Advanced Research Workshop on Green Engineering and Management, Budapest, Hungary, May 26-28, 2000.
32. "Estimating The External Costs of Air Pollution using Input-Output Models," Pollution Abatement and Control Expenditures (PACE) Workshop on Survey Design, Resources for the Future, March 9-10, 2000, Washington, DC.
33. "The Carnegie Mellon Life Cycle Analysis of Alternative Fuel Options," Silicon Valley Conference on Solutions for Sustainability: Evaluating Our Global Performance, February 23-24, 2000, Foster City, CA.

34. H. Scott Matthews, Chris T. Hendrickson, Arpad Horvath, and Lester Lave, "Life Cycle Assessment with Economic Input-Output Models: eiolca.net," Society of Environmental Toxicology and Chemistry, November 14-18, 1999, Philadelphia, PA.
35. H. Scott Matthews, "Environmental Management of Electronic Products," How Green is Silicon Valley Conference, Center for Environmental Journalism, Berkeley, Oct. 9, 1999, Berkeley, CA.
36. "Life Cycle Analysis: A Practical Tool for Pollution Prevention," SAE Southern Automotive Manufacturing Conference and Exposition, September 28-30, 1999, Birmingham, AL.
37. "Life Cycle Analysis of Alternative Automobile Fuels and Technologies (2000-2010)," SAE Southern Automotive Manufacturing Conference and Exposition, September 28-30, 1999, Birmingham, AL.
38. "An Introduction to eiolca.net", Silicon Valley Conference on Environment, Health, and Safety in Tomorrow's Marketplace, February 24-25, 1999, Foster City, CA.
39. H. Scott Matthews, Chris T. Hendrickson, and Arpad Horvath, "The External Costs of Transportation Goods and Services", Transportation Research Board Annual Conference, January 10-14, 1999, Washington, DC.
40. H. Scott Matthews, "Air Pollution Costs of Industrial Production", Informs: Partnering for Global Technology Management Conference, Seattle, October 25-28, 1998.

#### COURSES TAUGHT AT CARNEGIE MELLON

Course / Level	Year	Dept. <sup>1</sup>	Teacher Rating <sup>2</sup>	Course Rating <sup>2</sup>
Infrastructure Management	Spring 2003	CEE/EPP	4.7	4.8
Benefit-Cost Analysis	Fall 1995	ECON	4.6	4.5
Civil Systems Pricing / Benefit-Cost Analysis	Fall 1997	CEE/ECON	4.5	4.3
Civil Systems Pricing / Benefit-Cost Analysis	Fall 1998	CEE/ECON	4.3	4.0
Civil Systems Pricing / Benefit-Cost Analysis	Fall 1999	CEE/ECON	4.3	4.0
Civil Systems Pricing / Benefit-Cost Analysis	Fall 2000	CEE/ECON	4.8	4.8
Civil Systems Pricing / Benefit-Cost Analysis	Fall 2001	CEE/ECON	4.9	4.8
Civil Systems Pricing / Benefit-Cost Analysis	Fall 2002	CEE/ECON	4.8	4.8
Civil Systems Pricing / Benefit-Cost Analysis	Fall 2003	CEE/ECON	4.6	4.5
Case Studies in Engineering and Public Policy	Fall 1999	EPP	4.7	4.4
Information Warfare and Security	Spring 2000	EPP	4.6	4.6
Information Warfare and Security	Spring 2001	EPP/SCS	4.2	4.1

**Legend:**

<sup>1</sup>ECON = Undergraduate Economics Department, EPP=Department of Engineering and Public Policy, CEE/ECON= Jointly Offered and Listed in Undergraduate Economics and Graduate Civil and Environmental Engineering Department, EPP/SCS=Joint Between EPP and Computer Science

<sup>2</sup> - Teacher and Overall Course Ratings on 5-point scale, as surveyed from students by University

#### EXECUTIVE EDUCATION / TUTORIAL COURSES

- "Economic Input-Output Life Cycle Assessment: Using it to Teach Systems and Life Cycle Concepts", 2005 Association of Environmental Engineering and Science Professors Research and Education Conference, July 24, 2005, Potsdam, NY.
- "Applied EH&S Topics – Full Cost Accounting, Valuation, and Corporate Sustainability", National Association of Environmental Managers 'Foundations for Management Excellence', June 2003-05.
- Arpad Horvath, H. Scott Matthews, and Harald Florin, "Using Life Cycle Assessment Tools and Models", University of California Extension Campus, January 12-13, 2001, Berkeley, CA.

- Arpad Horvath, H. Scott Matthews, and Harald Florin, "An Introduction to Life Cycle Assessment Tools and Models", National Fuel Cell Research Center, 1999, 2000, Irvine, CA.

## **SPONSORED RESEARCH AND PROJECTS**

- Michalek, Jeremy; Samaras, Costa; Scherer, Sebastian; Jacquillat, Alexandre; Qian, Zhen, and H. Scott Matthews, "Drones, Delivery Robots, Driverless Cars, and Intelligent Curbs for Increasing Energy Productivity of First/Last Mile Goods Movement", US Department of Energy, \$1.8 million, 2018-2021.
- H. Scott Matthews, "Industry Data Gap Analysis", National Renewable Energy Laboratory, \$50k, 2018-19.
- Michalek, Jeremy Joseph; Qian, Zhen; Young, Stanley; Sperling, Joshua; Garikapati, Venu; Hendrickson, Chris T; Samaras, Costa, and H. Scott Matthews, "Understanding and Improving Energy Efficiency of Regional Mobility Systems Leveraging System-Level Data", \$1.8 million, 2018-2021.
- Samaras, Costa; Lima De Azevedo, Ines Margarida; Zhai, Haibo, and H. Scott Matthews, "Development of the Power Sector Emissions Index", Mitsubishi Hitachi Power Systems, \$400k, 2017-2019.
- W. Michael Griffin and H. Scott Matthews, "Science and Technology Policy and Innovation Analysis to Maximize the Economic, Environmental and Social Benefits of Oil and Gas Development in the South Atlantic Region", Portuguese National Science Foundation (FCT) via CMU-Portugal Program, \$650k, 2016-2020.
- H. Scott Matthews and Deanna H. Matthews, "Incorporating Standards Education into Courses on Environmental Management and Sustainability", NIST, \$60k, 2016-17.
- H. Scott Matthews, "Continued Funding for Assessment Of Existing Pennsylvania Safety Inspection Data And Creation Of Web-Based Analytics Warehouse For Modified Program", T-SET/UTC, \$40k, 2016.
- H. Scott Matthews, "Technical Support for American Jobs Project in Pennsylvania", via UC Berkeley, \$20k, 2016.
- W. Michael Griffin and H. S. Matthews, "Assessment of Life Cycle Cost, GHG Emissions, and Water Use for Shale Gas Treatment Options", ExxonMobil, \$140,000, 2014-15.
- H. Scott Matthews, "Assessment Of Existing Pennsylvania Safety Inspection Data And Creation Of Web-Based Analytics Warehouse For Modified Program", T-SET/UTC, \$25k, 2014-15.
- H. Scott Matthews, "Assessment Of Existing Pennsylvania Safety Inspection Data And Creation Of Web-Based Analytics Warehouse For Modified Program", Pennsylvania Infrastructure Technology Alliance, \$50k, 2014-15.
- H. Scott Matthews and Jennifer Mankoff, Web Based Decision Support for Carbon Footprinting, Heinz Endowments, \$50k, 2011-12.
- L. Soibelman, H. S. Matthews, J. Moura (CMU), D. Benitez, B. Andrews (Bosch), GOALI/CPS: A Framework for Enabling Energy-Aware Smart Facilities, NSF, 2009-2012, \$1.5M.
- H. S. Matthews, W. M. Griffin, and C. Weber, "Analysis, Allocation, and Assessment of Land Use for Sustainability", NSF, \$300k, 2009-12.
- H. Scott Matthews and Catherine Izard, Second Symposium on Industrial Ecology for Young Professionals (for workshop attendance support for side event at ISIE 2011), NSF, 2011, \$48,000.
- C. Weber and H. S. Matthews, "Life Cycle Energy Assessment of Online Music", Microsoft/Intel, 2009, \$45k.
- J. Mankoff and H S. Matthews, "Environmental Impacts of Consumers via Sensing", PITA, 2009, \$40,000.

- H. S. Matthews and L. Soibelman, “Learning based systems for residential electricity use monitoring”, \$150,000, Bosch, 2007-2009.
- W. M. Griffin and H. S. Matthews (via Penn St), “Assessment of Impacts of Electricity Generation in Pennsylvania”, PA Dept of Environmental Protection, \$75,000, 2009.
- Horvath (Berkeley), E. Masanet (Berkeley Lab), and H. S. Matthews, “Retail Climate Change Mitigation: Life-Cycle Emission and Energy Efficiency Labels and Standards”, California Air Resources Board, \$265k, 2008-2011 (CMU Share \$135k).
- J. Mankoff, H. S. Matthews, and S. Fussell, “HCC-Medium: StepGreen: Mobilizing social networks and context awareness to motivate reduced energy consumption”, NSF, \$450k, 2008-11.
- H. S. Matthews, “Sustainable Power Generation for Telecommunications Networks”, Alcatel-Lucent, \$85k, 2009-10.
- H. S. Matthews and C. Hendrickson, “Life Cycle Energy and Materials Analysis for Solid State Lighting Products”, DOE, \$220,000, 2008-09.
- H. S. Matthews, C. Hendrickson, “Estimation and Assessment of Life Cycle Freight and Passenger Transportation for US Goods and Services”, NSF, 2008-2011, \$450k (including 2 GRS Supplements).
- H. S. Matthews, L. Soibelman, and M. Bigrigg, “Coordination of Campus Sensing and Diagnostic Platforms for Long-term Sensor Network Project”, Pennsylvania Infrastructure Technology Alliance, 2007, \$30,000.
- H. S. Matthews, Supply Chain Carbon Footprinting, SAP, \$150k, 2008.
- H. Scott Matthews and Granger Morgan, “Assessing Future Supply Curves for Coal in Light of Economic, Technological and Environmental Uncertainties”, NETL, \$180,000, 2006-08.
- H. Scott Matthews, Cliff Davidson, Eric Williams, Mike DeKay, “Sustainable Consumption, Globalization and Information: Impacts and Opportunities”, NSF CTS-0628232, \$100,000, 2006.
- Lester Lave, Chris Hendrickson, Scott Matthews, Jeremy Michalek, and Michael Griffin, “Material Use, Infrastructure Change, and Environmental Impacts for Alternative Fuels and Vehicles”, NSF CTS-0628084, \$1,500,000, 2006-11.
- H. Scott Matthews, “Life Cycle Analysis Of Alternative Pathways For Production And Delivery Of Hydrogen For Vehicles”, \$40,000, Subcontract to NETL, 2006.
- Lucio Soibelman, H. Scott Matthews, and James P. Garrett, “Knowledge Management and Visualization in Support of Vulnerability Assessment of Electricity Production”, National Energy Technology Laboratory (NETL), 2005-2007, \$230,000.
- W. Michael Griffin and H. Scott Matthews, “Infrastructure Effects of Expanded Liquefied Natural Gas Use”, PITA, \$60,000, 2005-06.
- Cliff Davidson, Chris Hendrickson, and Scott Matthews (with co-PIs Allen (UTexas), Crittenden and Allenby (ASU), “Sustainability Science and Engineering Education”, NSF/EPA, \$2,000,000, 2004-07.
- James Garrett, Burcu Akinci, David Greve, H. Scott Matthews, Irving Oppenheim, Hoon Sohn, and Lucio Soibelman, "Funds for Establishment of an AIS Sensors Lab", Pennsylvania Infrastructure Technology Alliance, 2005, \$100,000.
- H. S. Matthews and C. Hendrickson, "Economic Assessment of US-VISIT Program", Department of Homeland Security (via US Army Corps of Engineers), 2005, \$100,000.
- H. S. Matthews and Chris T. Hendrickson, " Visualization & Management of Interdependencies for Critical Infrastructure Protection", Pennsylvania Infrastructure Technology Alliance, 2005, \$50,000.
- H. S. Matthews and James H. Garrett, "Integration of Pervasive Sensor Networks for Embedded Building Commissioning", Pennsylvania Infrastructure Technology Alliance, 2005, \$22,000.
- H. S. Matthews and Eric Williams, " Effects of computer usage patterns on the life cycle energy consumption of IT infrastructure", AT&T Foundation Faculty Fellow in Industrial Ecology, 2003, \$25,000.

- M. Bigrigg and H. S. Matthews, “Continuing Research into Sensor Deployment and Networking for Building and Facility Management”, Pennsylvania Infrastructure Technology Alliance, October 2003-September 2004, \$50,000.
- R. Lifset (Yale), D. Rejeski (Smithsonian Institution), and H. S. Matthews, “Workshop on Information Technology and the Environment”, National Science Foundation, Fall 2003, \$45,000.
- L. B. Lave, H. S. Matthews, C. T. Hendrickson, and M. Small, “Tracking Heavy Metal Life Cycle Pathways with Input-Output Methods”, National Science Foundation, 2003-2007, \$1,200,000. NSF CTS-0328870, REU Supplement \$12,500 and Other Supplement \$15,000 in 2004.
- C. T. Hendrickson and H. S. Matthews, “Assessment Tool and Visualization for Regional Supply Chain Impacts”, National Science Foundation, August 2003-July 2006, \$375,000. NSF REU Supplement \$12,000 in 2004.
- H. S. Matthews and R. Ries (University of Pittsburgh), “Assessment and Re-design of Processes for Green Construction”, National Science Foundation, October 2003-September 2006, \$375,000. NSF REU Supplement \$5,000 in 2004.
- C. T. Hendrickson, H. S. Matthews, and Jim Garrett, “Analyzing Critical Infrastructure Interdependencies: Security and Survivability Effects in the Service Sector”, NSF, October 2002-September 2004, \$150,000. NSF REU Supplements \$7,500 in 2003, 2004.
- B. Akinci, C. Hendrickson, and H. S. Matthews, “Exploring the use of automatic, real-time photographic data acquisition and archival for construction project documentation”, Pennsylvania Infrastructure Technology Alliance, September 2002-August 2003, \$40,000.
- M. Bigrigg and H. S. Matthews, “Exploratory Research into Sensor Deployment and Networking for Building and Facility Management”, Pennsylvania Infrastructure Technology Alliance, September 2002-August 2003, \$30,000.
- H. S. Matthews, “Enhancements to Internet-based Input-Output Modeling”, Department of Commerce, January – September 2003, \$20,000.
- H. S. Matthews and Z. Istvan, Advanced Research Workshop, “Life Cycle Energy and Environmental Implications of Information Technology”, North Atlantic Treaty Organization (NATO) Science Programme, Budapest, Hungary, Sept 1-3, 2003, \$40,000 (co-funding from Carnegie Bosch Institute).
- H. S. Matthews, "Energy Impacts of Voice Telecommunications," AT&T Foundation Faculty Fellow in Industrial Ecology, 2002, \$25,000.
- A. Horvath (UC Berkeley), "Computer-Aided Hybrid Models for Environmental and Economic Life Cycle Assessment", U.S. Environmental Protection Agency, September 2002-August 2005, \$275,000 (Faculty Associate, CMU portion \$125,000)
- H. S. Matthews, "Electricity Use of Data Centers", AT&T Corporation, May–July 2001, \$15,000.
- H. S. Matthews and C. Hendrickson, "Energy Impacts of Wireless Networks," AT&T Foundation Faculty Fellow in Industrial Ecology, 2001, \$25,000.
- E. Williams (UN Univ.), H. S. Matthews, S. Mori (Sci. Univ. of Tokyo), Y. Baba (Univ. of Tokyo), and M. Fujimoto (Sumitomo Marine Research Institute, Tokyo), "The Digital Economy and Energy Efficiency: Comparative Studies of Production, Distribution and ICT Infrastructure," The Japan Foundation Center for Global Partnership, April 2001- March 2003, \$200,000.
- C. Hendrickson and B. Akinci, “Multi-Disciplinary Exploratory Research to Exploit Motor Vehicle Information and Communications Technology”, National Science Foundation, August 2001-July 2002, \$100,000.
- H. S. Matthews, C. T. Hendrickson and L. B. Lave, AT&T Foundation Faculty Fellow in Industrial Ecology, "Environmental Impacts of E-commerce," 2000, \$25,000.
- H. S. Matthews, C. T. Hendrickson and L. B. Lave, AT&T Corporation, "Environmental Impacts of E-commerce", 2000, \$10,000.
- H. S. Matthews, C. T. Hendrickson and L. B. Lave, AT&T Foundation Faculty Fellowships in Industrial Ecology, "Environmental Impacts of E-commerce," 1999, \$25,000.

- H. S. Matthews, C. T. Hendrickson and L. B. Lave, "Environmental Impacts of E-commerce", AT&T Corporation, 1999, \$25,000
- C. Hendrickson and H. S. Matthews, "Life Cycle Product Information Systems for Scalable and Sustainable Enterprises", National Science Foundation, August 2000- July 2001, \$95,000.

**SELECTED CONSULTING / EXTERNAL PROJECTS (most recent first)**

- CompuSpecctions (Ongoing data analytics of vehicle safety inspection data)
- GenerationIM (Study comparing bricks and mortar retail with e-commerce and omnichannel)
- Various LCA Peer Review Activities (Chairperson of Committees, Member of Review Committees)
- US DOE and US EPA (Peer review of Energy LCA studies and LCA Tools developed by national labs)
- ASCE (Continuing Education Course on LCA)
- Carbon Disclosure Project (CDP) – Data Analytics on Estimating GHG Emissions of Global Firms)
- Nike, via PWC (Carbon Footprints of Apparel and Footwear Products)
- General Services Administration (GSA) – Development of Tool for Analysis of Environmental Impacts of Federal Procurement (subcontractor to FSG)
- Palm, Inc. (Sustainable Management of Products)
- US EPA Office of Solid Waste, subcontract via Industrial Economics, Inc. (Assessment of Waste LCA models)
- Washington State Department of Ecology (Creation of Consumer Footprint Index)
- CH2M Hill (Assessment of Erie Runway Expansion Project)
- Aliah, Inc. (Analytic Hierarchy Process Decision Making Tool Support)
- Organization for Economic Cooperation and Development (OECD)
- Quantum Corporation (Environmental Management)
- Chipcenter.com / echips.com (had bi-weekly online column on "Information Warfare")