

Michael Carbajales-Dale

CONTACT INFORMATION

Environmental Engineering & Earth Sciences
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SUMMARY

- Assistant Professor with an established reputation of attracting and managing large grants from federal agencies.
- Highly motivated researcher with extensive knowledge of modeling the coupled energy-economy-environment systems.
- Expert with over ten years experience in energy systems analysis, life cycle assessment, net energy analysis and sustainability.
- Exceptional communicator with advanced problem-solving and teaching skills.

CURRENT POSITION

Assistant Professor
Environmental Engineering & Earth Sciences, Clemson University

EDUCATION

- **PhD** in Mechanical Engineering Aug 2007 to Jan 2011
University of Canterbury, Christchurch, New Zealand
Thesis: *Global Energy Modeling - a Biophysical Approach*
- **MSci** in Physics & Philosophy (First class honors) Oct 2001 to Jun 2006
University of Bristol, Bristol, United Kingdom

RESEARCH EXPERIENCE

Stanford University

Research Associate — Energy Systems Analysis Feb 2011 to Jan 2014

Research projects:

- Review of estimates of energy embodied in photovoltaic energy systems;
- Review of estimates of energy embodied in wind energy systems;
- Review of estimates of energy embodied in solar thermal energy systems;
- Energy analysis of whole photovoltaic industry, including the time taken to reach positive net energy yield under a variety of scenarios for system growth and technological learning;
- Energy analysis of global wind-PV-storage system, including net energy yield of whole system and storage component under a variety of storage policy scenarios;
- Analysis of water consumption and land use implications of California Energy Future 2050 report;
- Development of foundational mathematical structure for physical input-output model of global economy incorporating accumulation within economic sectors;
- Development of matrix-based ‘bottom-up’ process model for calculating energy return ratios;
- Review of historical, conceptual and methodological issues relating to net energy analysis.

University of Canterbury

Graduate Researcher Aug 2007 to Aug 2010

Research projects included:

- Investigation of the physical effects of large-scale transition to renewable energy on the physical resource economy.
- Literature review encompassing global context of energy transition, an historical overview of global energy supply, standard economic and alternative approaches to energy modeling, energy analysis of energy supply chains and global resource estimates.

- Development of dynamic systems model to understand the complex interactions of elements comprising the global energy supply system.
- Understand and expound economic and policy implications of insights gained from modelling procedure.
- Attended and presented at numerous conferences

MENTOR &
TEACHING
EXPERIENCE

Clemson University

Undergraduate and Graduate Courses

Aug 2014 to Present

- Environmental Sustainability - EES 4860/6860
- Environmental Systems Analysis - EES 8200
- Process and Facility Design for Environmental Control Systems - EES 8060

Undergraduate and Graduate Research

Aug 2014 to Present

- *Current:*
 - Amir Asif - PhD committee: Manufacturing PV devices for local DC nanogrids
 - Hareesh Bhathini Balakrishnan - MS (thesis) chair:
 - Robert Bickhart - PhD chair: Energize!
 - Henry Busch - MS (thesis) chair:
 - Raeanne Clabeaux - MS (thesis) chair: An industrial ecosystem model of Clemson University campus
 - Amanda Farthing - BE: Solar electricity potential for South Carolina
 - Sai Gayatri Ramanan - MS (thesis) chair:
 - Hadi Karimi - PhD committee: Optimizing supply chains for biomass co-firing
 - Ted Langoise - MS (thesis) co-chair:
 - Roksana Mahmud - PhD co-chair: An integrated techno-economic-environmental assessment tool
 - Palak Matta - MS (thesis) chair:
 - Sheikh Moni - PhD co-chair: Life cycle assessment for early-stage technologies
 - Emily Murawski - MS/BS (thesis) chair:
 - John Sherwood - PhD chair: Agent-based models of adaptive resource management strategies
- *Graduated:*
 - Ben Douglass - MS (non-thesis) chair: Human-powered electricity generation
 - Elizabeth Miller - MS (non-thesis) committee: Climate impacts on Florida's mangrove ecosystems
 - Kayla Quinter - MS (thesis) committee: Water withdrawals for thermoelectric power in the Eastern Interconnect
 - Zikai Zhou - MS (thesis) chair: Efficiency vs. EROI—a photovoltaic technology assessment

Stanford University

Undergraduate and Graduate Courses

Jan 2012 to Dec 2013

- Energy? Understanding the challenge, developing solutions - Think 39 - 2013
- Quantitative environmental assessment of energy systems - Energy 295 - 2013
- Energy and the Environment - Energy 101 - 2012

University of Canterbury

Managing French Exchange Students

Aug 2008 to Aug 2009

Research projects included:

- Pierre Queyras and Laurent Lefort (2009) Feasibility of renewable powered transportation system for Canterbury
- Julie Ginestet (2008) Adaptation of travel behavior to constrained energy resources

OTHER
EXPERIENCE

- **Managing Editor** Apr 2015 to Present
Springer - Journal of Biophysical Economics & Resource Quality
- **Member** Sept 2016 to Present
Education Committee - American Center for Life Cycle Assessment
- **Founding member and Faculty Chair of Advisory Board** June 2015 to Present
Clemson Green Revolving Fund
- **Organizing Committee** Sept 2014 to Apr 2015
Global Climate and Energy Project Workshop on Net Energy Analysis 2015
- **Organizing Committee** Jan 2016 to Sept 2016
LCA XVI Conference 2016
- **Reviewer** Ongoing
 - **Academic journals:** *Energies; Energy Policy; Energy & Environmental Science; Environmental Research Letters; Environmental Science & Technology; Frontiers Energy Systems and Policy International Journal of Life Cycle Assessment; Philosophical Transactions; Proceedings of the ASME; Science of the Total Environment; Sustainable Production & Consumption; Sustainability; The Energy Journal*
 - **External graduate theses:** *University of Bilbao, Spain; UT Austin; Lincoln University, New Zealand*
 - **Books:** *CRC Press; Post Carbon Institute*
 - **Funding agencies:** *NSF Environmental Sustainability; NSF SBIR/STTR; Masdar Institute*
 - **Reports:** *UK Department for International Development; International Energy Agency, PVPS Task 12*

MEMBERSHIP

- American Center for Life Cycle Assessment Aug 2014 - Present
- International Society for Industrial Ecology Nov 2016 - Present
- International Society for Ecological Economics Jun 2013 - Present
- New Zealand Society for Sustainability Engineering & Science Jan 2008 - Jul 2010

PUBLICATIONS

2017

1. Raugei, M., Sgouridis, S., Murphy, D., Fthenakis, V., Frischknecht, R., Breyer, C., Bardi, U., Barnhart, C., Brandt, A., Buckley, A., **Carbajales-Dale, M.**, Csala, D., de Wild-Scholten, M., Heath, G., Jaeger-Waldau, A., Jones, C., Keller, A., Leccisi, E., Mancarella, P., Pearsall, N., Siegel, A., Sinke, W., and Stolz, P. (2017) Energy Return on Energy Invested (ERoEI) for photovoltaic solar systems in regions of moderate insolation: A comprehensive response. *Energy Policy*, 102, 377-384

2016

2. **Carbajales-Dale, M.** (2016) Life cycle assessment: meta-analysis of cumulative energy demand for wind energy technologies, in Letcher, T. ed., *Wind Energy Engineering: a Handbook on On-shore Turbines*, Elsevier, IN PRESS
3. Farthing A, **Carbajales-Dale M.** and Mason, S. (2016) Utility-Scale Solar PV in South Carolina: Analysis of Suitable Lands and Geographical Potential. *Journal of Biophysical Economics & Resource Quality*, 1(2)
4. Murphy, D. and **Carbajales-Dale M.** (2016) Comparing Apples to Apples: Why the Net Energy Analysis community needs to adopt the LCA framework. *Energies*, 9(11), 917
5. King, C. W. and **Carbajales-Dale, M.** (2016) Food-energy-water metrics across scales: project to system level, *Journal of Environmental Studies and Sciences*, 6(1), 39-49

2015

6. Salkeld, D. J., Nieto, N. C., Carbajales-Dale, P., **Carbajales-Dale, M.**, Cinkovich, S. S., and Lambin, E. F. (2015). Disease Risk & Landscape Attributes of Tick-Borne Borrelia Pathogens in the San Francisco Bay Area, California. *PloS one*, 10(8), e0134812.
7. **Carbajales-Dale, M.**; Raugei, M.; Fthenakis, V. and Barnhart, C. J. (2015) Energy return on investment (EROI) of solar PV: an attempt at reconciliation, [*Point of View*]. *Proceedings of the IEEE*, 103(7), 995-999.
8. Heun, M. K.; **Carbajales-Dale, M.** and Haney, B. R. (2015) Beyond GDP: National Accounting in the Age of Resource Depletion, *Springer*
9. Raugei, M.; **Carbajales-Dale, M.**; Barnhart, C. J. and Fthenakis, V. (2015) Rebuttal: “Comments on ‘Energy intensities, EROIs (energy returned on invested), and energy payback times of electricity generating power plants’ — Making clear of quite some confusion” *Energy*, dx.doi.org/10.1016/j.energy.2014.12.060

2014

10. **Carbajales-Dale, M.** (2014). Investing in a sustainable future. *International Innovation*, 159, 84-86.
11. **Carbajales-Dale, M.**; Barnhart, C. J.; Brandt, A. R. and Benson, S. M. (2014). A better currency for investing in a sustainable future. *Nature Climate Change*, 4(7), 524-527.
12. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2014) Can we afford storage? A dynamic net energy analysis of renewable electricity generation firming by energy storage, *Energy and Environmental Science*, 7(5), 1538–1544.

2013

13. Barnhart, C. J.; **Dale, M.**; Brandt, A. R. and Benson, S. M. (2013) The energetic implications of curtailing or storing wind and solar generated electricity, *Energy and Environmental Science*, 6(10), 2804–2810
14. Brandt, A.R.; **Dale, M.** and Barnhart, C. (2013) Calculating systems-scale energy efficiency and energy returns: a bottom-up matrix-based approach *Energy*, 62, 235–247
15. Barnhart, C. and **Dale, M.** (2013) Informing the transition to low-carbon energy systems through energy systems analysis of energy storage for the power grid, *Stanford Energy Journal*, June 2013
16. **Dale, M.** (2013) A comparative analysis of energy of photovoltaic, solar thermal, and wind electricity generation technologies *Applied Sciences*, 3(2), 325-337
17. **Dale, M.** and Benson, S. M. (2013) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *Environmental Science & Technology*, 47(7), 3482-3489

2012

18. **Dale, M.** and Barnhart, C. (2012) Fundamentals of Energy, *Encyclopedia of Energy*, Golson Publishing
19. Krumdieck, S.; **Dale, M.** and Page, S. (2012) Design and Implementation of a Community-based Sustainable Development Action Research Method *Social Business*, 2, 291-337
20. Murphy, D.; Nelder, C.; Jefferson, M.; Hall, C.; Laherrere, J.; Baldauf, J.; Kuperus-Heun, M. and **Dale, M.** (2012). Peak Oil is Affecting the Economy Already. *Nature* 483 (541), Correspondence.
21. **Dale, M.** (2012) Meta-Analysis of Non-Renewable Energy Resource Estimates, *Energy Policy*, 43, 102-122

22. **Dale, M.**; Krumdieck, S. and Bodger, P. (2012) Global Energy Modelling - a Biophysical Approach (GEMBA) Part 1: An overview of biophysical economics, *Ecological Economics*, 73, 152-157

23. **Dale, M.**; Krumdieck, S. and Bodger, P. (2012) Global Energy Modelling - a Biophysical Approach (GEMBA) Part 2: Methodology and Results, *Ecological Economics*, 73, 158-167

2011

24. **Dale, M.**; Krumdieck, S. and Bodger, P. (2011) Net Energy Yield from Production of Conventional Oil. *Energy Policy*, 39 (11), 7095-7102

25. **Dale, M.**; Krumdieck, S. and Bodger, P. (2011) A Dynamic Function for EROI, *Sustainability*, 3 (10), 1972-1985

26. Murphy, D. J.; Hall, C. A. S.; **Dale, M.** and Cleveland, C. (2011) Order from Chaos: A Preliminary Protocol for Determining the EROI of Fuels, *Sustainability*, 3 (10), 1888-1907

27. Brandt, A.R.; **Dale, M.** (2011) A General Mathematical Framework for Calculating Systems-Scale Efficiency of Energy Extraction and Conversion: Energy Return on Investment (EROI) and Other Energy Return Ratios. *Energies*, 4, 1211-1245.

PAPERS UNDER REVIEW

1. Sherwood, J., Clabeaux, R. and **Carbajales-Dale, M.** (2016) An Extended Environmental-Input-Output Lifecycle Assessment Model to Study the Urban Food-Energy-Water Nexus, *Environmental Research Letters*, IN REVIEW

2. Sherwood, J., Haney, B. R., Haarsma, L., Ditta, A. J. and **Carbajales-Dale, M.** (2016) Resource Depletion and Sustainability in Industrialized Economies, *Journal of Biophysical Economics & Resource Depletion*, IN REVIEW

3. Haney, B. R., Haarsma, L., Ditta, A. J., Sherwood, J. and **Carbajales-Dale, M.** (2016) The Kuznets Curve & Technology: An Agent-Based Model of Innovation, Interdependence and Inequality, *Journal of Artificial Societies and Social Simulation*, IN REVIEW

4. Raugei, M., Sgouridis, S., Murphy, D., Fthenakis, V., Frischknecht, R., Breyer, C., Bardi, U., Barnhart, C., Brandt, A., Buckley, A., **Carbajales-Dale, M.**, Csala, D., de Wild-Scholten, M., Heath, G., Jaeger-Waldau, A., Jones, C., Keller, A., Leccisi, E., Mancarella, P., Pearsall, N., Siegel, A., Sinke, W., and Stolz, P. (2016) Energy Return on Energy Invested (ERoEI) for photovoltaic solar systems in regions of moderate insolation: A comprehensive response. *Energy Policy*, IN REVIEW

HONORS AND FUNDING AWARDS

- 2017-2021: *Industrial Assessment Center: Energy efficiency for the growing South Carolina manufacturing industries*, DOE 1,511,076 USD
- 2016-2021: *NRT-DESE: Preparing Resilient + Operationally Adaptive Communities through an Interdisciplinary Venture-based Education (PROACTIVE)*, NSF 2,999,965 USD
- 2016-2019: *Energize! An interactive evaluation tool for disseminating complex systems information to the general public*, DOE 799,999 USD
- 2015-2018: *GAANN: Model Validation Analytics in Support of High-Consequence Decision Making*, Department of Education 1,229,816 USD
- 2015-2017: *Pollution Prevention*, EPA 160,000 USD
- 2015: *Best Paper Award 2015*, Sustainability Journal 600 CHF
- 2014-2015: *A Net Energy Analysis Toolkit*, Institute of Integrated Economic Research 100,000 USD
- 2007-2010: *Keith Laugesen Scholarship*, University of Canterbury 75,000 NZD
- 2007-2010: *International Doctoral Scholarship*, University of Canterbury 30,000 NZD

CONFERENCE
SESSION
CHAIR

2016

1. Developing Robust Methods for Prospective Life Cycle Assessment for Early-Stage Technologies (2016) *LCA XVI*, Charleston, SC, September 27th-29th, 2016
2. Wealth Dynamics - Statistical/Mathematical Economics (2016) *ISEE 2016. Transforming the Economy: Sustaining Food, Water, Energy and Justice*, Washington DC, June 26th-29th, 2016
3. WC-1 Models, Metrics and Data (2016) *16th National Conference and Global Forum on Science, Policy and the Environment: The Food-Energy-Water Nexus*, Washington DC, January 19th-21st, 2016

2015

4. Biophysical Economics - Measurement (2015) *CANUSSEE 2015. Pathways for Change: Towards a Just and Sustainable Economy*, Vancouver, BC, October 1st-4st, 2015
5. Modeling for Biophysical and Ecological Economics (2015) *CANUSSEE 2015. Pathways for Change: Towards a Just and Sustainable Economy*, Vancouver, BC, October 1st-4st, 2015

INVITED
LECTURES

2016

1. **Carbajales-Dale, M.** (2016) An overview of energy-economy-environment (E3) systems analysis, *Basque Centre for Climate Change (BC3)*, June 2nd, 2016

2015

2. **Carbajales-Dale, M.**; Barnhart, C. J.; Brandt, A. R. and Benson, S. M. (2015) A better currency for investing in a sustainable future, *GCEP Net Energy Analysis Workshop*, Stanford CA, March 31st-April 1st
3. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2015) Fueling the energy transition: the net energy perspective, *GCEP Net Energy Analysis Workshop*, Stanford CA, March 31st-April 1st
4. Heun, M. K.; **Carbajales-Dale, M.** and Haney, B. R. (2015) Beyond GDP: National Accounting in the Age of Resource Depletion, *Calvin College*, February 27th 2015

2014

5. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2014) Fueling the energy transition: the net energy perspective, *UC Berkeley*, May 22nd 2014
6. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2014) Fueling the energy transition: the net energy perspective, *Environmental Engineering & Earth Sciences departmental seminar*, Clemson University, April 10th 2014
7. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2014) Fueling the energy transition: the net energy perspective, *Institute of Environmental Sciences (CML)*, Leiden University, Holland, March 17th 2014

2013

8. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2013) Fueling the energy transition: the net energy perspective, *Tesla Motors*, Palo Alto, CA, October 4th 2013
9. **Carbajales-Dale, M.**; Barnhart, C. J. and Benson, S. M. (2013) Fueling the energy transition: the net energy perspective, *Global Energy Systems 2013*, Edinburgh, Scotland, June 26th-28th, 2013
http://glocast.com/webcasts/global_energy_systems_conference_2013/3.5_Michael_Dale.html

2012

10. **Dale, M.** and Benson, S. M. (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *GCEP Annual Symposium*, October 11th 2012, <http://gcep.stanford.edu/events/symposium2012/presentations.html>

11. **Dale, M.** and Benson, S. M. (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *Stanford Student Energy Lectures*, July 23rd 2012
12. **Dale, M.** and Benson, S. M. (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *GCEP Management Committee Meeting*, May 15th 2012
13. **Dale, M.** and Benson, S. M. (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *Stanford Energy Seminar*, April 2nd 2012, <http://energyseminar.stanford.edu/node/431>
14. **Dale, M.** and Benson, S. M. (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *Energy Resources Engineering departmental seminar*, Stanford University, January 17th 2012

2010

15. **Dale, M.;** Krumdieck, S. and Bodger, P. (2010) Global Energy Modelling - a Biophysical Approach, *Mechanical Engineering departmental seminar*, Canterbury University, New Zealand, June 16th 2010

2008

16. **Dale, M.;** Krumdieck, S. and Bodger, P. (2008) Global Energy Modelling - a Biophysical Approach, *Mechanical Engineering departmental seminar*, Canterbury University, New Zealand, November 12th 2008

CONFERENCE
PRESENTATIONS

2016

1. **Carbajales-Dale, M** (2016) Lifecycle Assessment and Net Energy Analysis: birds of a feather or uncomfortable bedfellows?, *ISEE 2016. Transforming the Economy: Sustaining Food, Water, Energy and Justice*, Washington DC, June 29th, 2016
2. Panelist: S-A5 Metrics for Food-Energy-Water Projects (2016) *16th National Conference and Global Forum on Science, Policy and the Environment: The Food-Energy-Water Nexus*, Washington DC, January 19th-21st, 2016

2015

3. **Carbajales-Dale, M** (2015) Lifecycle Assessment and Net Energy Analysis: birds of a feather or uncomfortable bedfellows?, *LCAXV 2015*, Vancouver, BC, October 6th-8th, 2015
4. **Carbajales-Dale, M** (2015) Beyond GDP: National Accounting in the Age of Resource Depletion, *CANUSSEE 2015. Pathways for Change: Towards a Just and Sustainable Economy*, Vancouver, BC, October 1st-4th, 2015
5. **Carbajales-Dale, M** (2015) Beyond GDP: National Accounting in the Age of Resource Depletion, *Engineering Sustainability 2015: Innovation and the Triple Bottom Line*, Pittsburg, PA, April 19th-21st, 2015

2013

6. **Carbajales-Dale, M** (2013) Net Energy Analysis & Energy Return on Investment, *World Future Conference*, Chicago, IL, July 20th-21st, 2013
7. **Dale, M** (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *EcoSummit*, Columbus, OH, September 30th-October 5th, 2012

2012

8. **Dale, M** (2012) The Energy Balance of the Photovoltaic (PV) Industry - Is the PV Industry a Net Energy Provider? *34th International Geological Congress*, Brisbane, Australia, August 5th-10th, 2012

2011

9. **Dale, M** (2011) Net energy yield of renewable energy resources. *Biophysical Economics Conference (3rd)*, April 15th-16th 2011
- 2010
10. **Dale, M.**; Krumdieck, S. and Bodger, P. (2010) Global Energy Modelling - a Biophysical Approach, *World Energy Congress XXI*, Montreal, Canada, September 12th-16th, 2010
- 2009
11. **Dale, M.**; Krumdieck, S. and Bodger, P. (2009) Global Energy Modelling - a Biophysical Approach, *Massey University Centre for Energy Research (MUCER) Conference*, Massey University, Wellington, New Zealand, November 26th-27th, 2009
- 2008
12. **Dale, M.**; Krumdieck, S.; Page, S.; Mulligan, K. and Rendall, S. (2008) An Ecological Approach to Community-Based Sustainable Development, *3rd International Conference on Sustainability Engineering and Science*, Auckland, New Zealand, December 9th-12th, 2008
 13. **Dale, M.**; Krumdieck, S.; Page, S.; and Mulligan, K. (2008) TransitionScape: Generating Community-Based Sustainable Transport Initiatives, *NERI Energy Transport and Sustainability Symposium*, Wellington, New Zealand, June 26th-27th, 2008
 14. **Dale, M.**; Krumdieck, S.; Page, S.; Mulligan, K. and Rendall, S. (2008) An Ecological Approach to Community-Based Sustainable Development, *MUCER Conference*, Massey University, Wellington, New Zealand, June 3rd-5th, 2008

MEDIA ATTENTION

1. Heun, M. K.; **Carbajales-Dale, M.** and Haney, B. R. (2015) Time to replace the GDP with a measure that accounts for natural resources, *Upstate Business Journal*, <http://upstatebusinessjournal.com/innovate/time-to-replace-the-gdp-with-a-measure-that-accounts-for-natural-resources>
2. **Carbajales-Dale, M.** (2015) Managing the transition to a sustainable energy future, *Adjacent Government*, 7, 306-308, <http://edition.pagesuite-professional.co.uk//launch.aspx?eid=b90ebf25-2861-48d5-a11a-14dfc69c988a>
3. **Carbajales-Dale, M.** (2014) Investing in a sustainable future, *International Innovation*, 159, 84-86, <http://www.internationalinnovation.com/investing-in-a-sustainable-future/>
4. Shwartz, M (2014) Net energy analysis should become a standard policy tool, *GCEP News*, June 25, 2014, <http://gcep.stanford.edu/news/NetEnergy.html>
5. Shwartz, M (2014) Wind farms can provide a surplus of reliable clean energy to society, Stanford study finds, *GCEP News*, March 20, 2014, <http://gcep.stanford.edu/news/windfarms.html>
6. Shwartz, M (2013) Stanford scientists calculate the energy required to store wind and solar power on the grid, *GCEP News*, September 9, 2013, <http://gcep.stanford.edu/news/windsolaronthegrid.htm>
7. Golden, M (2013) Global solar photovoltaic industry is likely now a net energy producer, Stanford researchers find, *GCEP News*, April 2, 2013, <http://gcep.stanford.edu/news/photovoltaic-industry.html>
8. Wayne Freedman (2013) Stanford students build net zero home with solar panels, *ABC 7 News San Francisco*, April 2, 2013, <http://abc7news.com/archive/9050661/>

COMPUTER SKILLS

- Mathematical Packages: MATLAB, Maple
- Programming Languages: VBA, MATLAB, R, Python
- LCA packages: OpenLCA, GaBi, Simapro
- Other applications: LaTeX, Microsoft Office, Tableau, ArcGIS