

Jeffery B. Greenblatt, Ph.D.

Founder, CEO and Chief Scientist, Emerging Futures LLC

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Summary

Scientist with 15+ years' experience in greenhouse gas and energy system research and modeling, focusing on emerging technologies. Emphasis on space technologies since 2015.

Current interests:

- Modeling of *in situ* propellant production on Mars
- Transport of humans and resources in the Earth-Moon-Mars vicinity
- Materials, energy and cost sustainability assessment of space infrastructure systems
- Space geoengineering using *in situ* resources near the Earth-Sun L1 Lagrange point

Highlights:

- Awarded NASA SBIR Phase II subcontract from Opus 12 in May 2017 to develop mass and energy analysis of a Martian propellant plant using *in situ* resource utilization.
- Published a comparative analysis of human settlement on the Moon and Mars in collaboration with SpaceVault, a space-focused financial services company, in May 2017.
- Presented an analysis of SpaceX's Mars Interplanetary Transport System at the *67th International Astronautical Congress* in Guadalajara, Mexico, in September 2016.
- Attended five other space conferences/workshops since 2015, submitted six other proposals for space research funding to NASA and private entities, and wrote several scientific blogs on space transportation. Featured in Realtor.com article on Mars in 2016.
- Have published 43 peer-reviewed publications since 1995, totaling 1,788 citations and h-index of 21, including two papers in *Nature Climate Change* in 2015 (on shared electric autonomous vehicles) and 2016 (on U.S. climate change commitments). Have published 88 other publications, blogs and interviews, and given 135 professional presentations.

Selected employment history

Emerging Futures, LLC, Berkeley, CA, June 2016-present

Founder, CEO and Chief Scientist. Currently seeking space technology analysis consulting work.

Lawrence Berkeley National Laboratory, Berkeley, CA, 2009-present

Sustainable Energy Systems Group, Energy Analysis and Environmental Impacts Division. Staff Scientist since 2011. Led research in greenhouse gas policy assessment for California and U.S., autonomous vehicles, clean electricity, artificial photosynthesis, appliance efficiency standards.

Google.org, San Francisco and Mountain View, CA, 2008-2009

Climate and Energy Technology Manager, RE<C (“Renewable Electricity Cheaper Than Coal”) Initiative. Lead author of *Clean Energy 2030*, a proposal to reduce U.S. CO₂ emissions.

Environmental Defense Fund, New York, Oakland and San Francisco, 2005-2008

High Meadows Scientist, Office of Science and Policy. Technical and policy analysis of low-carbon energy technologies, and technical editor of *Earth: The Sequel* about the clean tech sector.

Princeton University, Princeton, NJ, 2001-2005

Research Staff Member, Princeton Environmental Institute. Ocean carbon cycle modeling, wind energy/storage economic analysis, and technical support for Pacala and Socolow wedge paper.

NASA Ames Research Center, Moffett Field, CA, 1999-2001

National Research Council Associate, Earth Sciences Division. Calibration and analysis of laser infrared spectrometry measuring N₂O and CH₄ atmospheric trace gases for ozone loss research.

Education

Ph.D., Chemistry, University of California, Berkeley, 1999. Thesis: *Femtosecond photoelectron spectroscopy: A new tool for the study of anion dynamics.*

B.S., Chemistry and Physics, Haverford College, 1993. *Summa cum laude.*

Funding

1. **Thermal management solutions for CO₂ reductions system designed for operation on the Martian surface**, Opus 12, \$42,000 (subcontract from NASA SBIR Phase II award), anticipated start date in May 2017.

Have received \$10 million in research funding while at LBNL from federal, state and local governmental organizations, nonprofit foundations and universities. Recent awards include:

2. **Life-cycle energy and economic analysis of an H₂O/CO₂-based photoelectrochemical fuel plant**, California Institute of Technology, \$60,000, December 2016-November 2017
3. **Smart Mobility: Connected and Automated Vehicles**, U.S. Department of Energy (DOE) Vehicles Technology Office, \$82,500, Nov. 2016-Sept. 2017
4. **Scale-up and life-cycle assessment of artificial photosynthesis H₂O and CO₂ reduction pathway large-scale prototypes**, DOE, \$500,000, Oct. 2013-Sept. 2017
5. **Quadrennial Technology Review**, DOE Office of the Under Secretary for Science and Energy, \$370,000, September 2014-August 2015

Proposals submitted in the space domain (not funded)

6. **Lunar Light: Laser-based launch and propulsion system on the Moon**, NASA Innovative Advanced Concepts Step B, Nov. 2016

7. **Photo-electrochemical device for producing hydrogen and oxygen from lunar polar water and sunlight**, WayPaver Foundation, Oct. 2016
8. **SunShade: Lagrange-point Dust Cloud System Architecture to Reduce Sunlight on Earth for Climate Change Mitigation**, NASA Innovative Advanced Concepts, Oct. 2016
9. **Life-cycle energy and mass analysis of propellant alternatives produced using indigenous resources on Mars**, NASA Innovative Advanced Concepts, Oct. 2015
10. **A Survey-Informed Assessment of Potential Impacts of Near-Term Cost and Performance Progress in Commercial Space Technology**, NASA Economic Research for Space Development, Aug. 2015

Selected papers in peer-reviewed publications¹

Citation indices as of May 8, 2017

Total publications: 43. Total citations: 1,788. h-index: 21, i10-index: 35.

1. **Greenblatt, J. B.**, N. R. Brown, R. Slaybaugh, T. Wilks, E. Stewart, S. T. McCoy, 2017. The future of low-carbon electricity. In press, *Annual Review of Environment and Resources*, 42. DOI: 10.1146/annurev-environ-102016-061138. Pre-publication as a Lawrence Berkeley National Laboratory report LBNL-1007260.
2. **Greenblatt, J. B.**, M. Wei, Assessment of the climate commitments and additional mitigation policies of the United States, *Nature Climate Change* 6: 1090–1093. Coverage in Washington Post, Associated Press, Science, Wired, USA Today among others. 2,849 page views as of May 8, 2016. In the 99th percentile of the 242,800 tracked articles of similar age.
3. Sathre, R., **J. B. Greenblatt**, K. Walczak, I. D. Sharp, J. C. Stevens, J. W. Ager III, F. A. Houle, 2016. Opportunities to improve the net energy performance of photoelectrochemical water-splitting technology, *Energy and Environmental Science*, 9: 803-819.
4. **Greenblatt, J. B.**, S. Shaheen, 2015. On-Demand Mobility, Autonomous Vehicles, and Environmental Impacts, *Current Sustainable/Renewable Energy Reports* 2: 74–81.
5. **Greenblatt, J. B.**, S. Saxena, 2015. Autonomous taxis could greatly reduce greenhouse-gas emissions of US light-duty vehicles, *Nature Climate Change* 5: 860–863. 180+ news articles two weeks after publication. Cited by 42 and 3,424 page views as of May 8, 2017. In the 99th percentile of the 225,844 tracked articles of a similar age. Featured on *National Geographic Channel* in Years of Living Dangerously, “End of The Road,” 7 November 2016.
6. **Greenblatt, J. B.**, 2015. Modeling California policy impacts on greenhouse gas emissions, *Energy Policy* 78: 158–172.
7. Sathre, R., C. D. Scown, W. R. Morrow III, J. C. Stevens, Ian D. Sharp, Joel W. Ager, K. Walczak, F. A. Houle, **J. B. Greenblatt**, 2014, Life-cycle net energy assessment of large-

¹ When I got married in 2000, I changed my name from Benjamin Jefferys Greenblatt to Jeffery Buyers Greenblatt. Publications earlier than 2001 use my old name.

scale hydrogen production via photo-electrochemical water splitting. *Energy and Environmental Science* 7(10), 3264-3278.

8. **Greenblatt, J. B.**, S. Succar, R. H. Williams, D. C. Denkenberger, R. H. Socolow, 2007, Baseload wind energy: Modeling the competition between gas turbines and compressed air energy storage for supplemental generation, *Energy Policy* 35(3): 1474.
9. Socolow, R., R. Hotinski, **J. B. Greenblatt**, S. Pacala, 2004, Solving the climate problem: Technologies available to curb CO₂ emissions, *Environment*, 46(10): 8-19.
10. **Greenblatt, B. J.**, M. T. Zanni, D. M. Neumark, 1997. Photodissociation of I₂⁻(Ar)_n clusters studied with anion femtosecond photoelectron spectroscopy, *Science* 276: 1675.

Selected other publications

Book chapters

1. **Greenblatt, J. B.**, Photo-electrochemical hydrogen plants at scale: A life-cycle net energy assessment, In: *Integrated Solar Fuel Generators*, edited by Ian Sharp, Hans Joachim Lewerenz, and Harry Atwater, *Royal Society of Chemistry*, in press.
2. Morrow, W. R. III, **J. B. Greenblatt**, A. Sturges, S. Saxena, A. Gopal, D. Millstein, and N. Shah, 2014. Key factors influencing autonomous vehicles' energy and environmental outcome. In: *Road Vehicle Automation*, G. Meyer and S. Beiker (eds.), Springer. ISBN 978-3-319-05989-1, DOI: 10.1007/978-3-319-05990-7.

Reports, white papers and conference proceedings

1. **Greenblatt, J. B.**, 2017. *Comparative analysis of human settlements on the Moon and Mars*, Emerging-Futures, LLC. <http://tinyurl.com/la9wt4m>.
2. **Greenblatt, J. B.**, 2016. Energy and Resource Analysis of a Large-Scale Earth-Mars Human Transport System, Paper number IAC-16,D2,8-A5.4,3,x34614, *67th International Astronautical Congress*, Guadalajara, Mexico. <http://tinyurl.com/IACSpaceXpaper>.
3. **Greenblatt, J. B.**, 2016. *Energy and Resource Impacts of an Earth-Mars Human Transport System*, Emerging-Futures, LLC. <http://tinyurl.com/MarsTransportPaper>.
4. U.S. Department of Energy, 2015. *Quadrennial Technology Review*. **Report contributor** and **major author** of Chapter 10: Concepts in Integrated Analysis. <http://energy.gov/quadrennial-technology-review-2015>.
5. **Greenblatt, J.** and J. Long. 2012. *California's Energy Future: Portraits of Energy Systems for Meeting Greenhouse Gas Reduction Targets*, California Council on Science and Technology. <http://ccst.us/publications/2012/2012ghg.pdf>.

6. **Greenblatt, J. B.,** M. Wei, C. Yang, B. Richter, B. Hannegan, H. Youngs, J. C. S. Long, M. John, 2011. *California's Energy Future: The View to 2050*, California Council on Science and Technology. <http://ccst.us/publications/2011/2011energy.php>.
7. **Greenblatt, J.,** et al., 2008, *Clean Energy 2030: Google's Proposal for reducing U.S. dependence on fossil fuels*, Google knol. (URL no longer available; preserved at <https://sites.google.com/site/buygreen/home/clean-energy-2030>.) Blog announcement: <http://googleblog.blogspot.com/2008/10/clean-energy-2030.html>.
8. **Greenblatt, J.,** 2006. California Wedges: Achieving the Governor's 2020 and 2050 Greenhouse Gas Reduction Targets with Current Technologies, *Environmental Defense Fund* analysis.

Scientific blogs

1. **Greenblatt, J. B.,** 2017. The Moon or Mars: Which is better for humans? *Emerging Futures* blog post, May. <http://emerging-futures.com/moon-vs-mars.html>.
2. **Greenblatt, J. B.,** 2016. How many people could the water in Mars' Utopia Planitia support? *Emerging Futures* blog post, Nov. <http://emerging-futures.com/mars-water.html>.
3. **Greenblatt, J. B.,** 2016. How much energy is needed to send one million humans to Mars? *Move Forward* blog, Feb. <https://www.move-forward.com/how-much-energy-is-needed-to-send-one-million-humans-to-mars/>.
4. **Greenblatt, J. B.,** 2016. Space mining: Building the space transportation infrastructure, *Move Forward* blog, Feb. <https://www.move-forward.com/space-mining-building-the-space-transportation-infrastructure/>.
5. **Greenblatt, J. B.,** 2016. New report: Energy and Resource Impacts of an Earth-Mars Human Transport System, *Emerging Futures* blog post, Jan. <http://emerging-futures.com/publications.html>.
6. **Greenblatt, J. B.,** 2015. Space debris and flying garbage trucks, *Move Forward* blog, Nov. <https://www.move-forward.com/space-debris-and-flying-garbage-trucks/>.
7. **Greenblatt, J. B.,** 2015. Fueling stations in the sky, *Move Forward* blog, Oct. <https://www.move-forward.com/fueling-stations-in-the-sky/>.
8. **Greenblatt, J. B.,** 2015. Beyond low Earth orbit: Transportation technologies for getting around the solar system, *Move Forward* blog, Sept. <https://www.move-forward.com/beyond-low-earth-orbit-transportation-technologies-for-getting-around-the-solar-system/>.
9. **Greenblatt, J. B.,** 2015. Leaving home: Transformative technologies for getting into space, *Move Forward* blog, Sept. <https://www.move-forward.com/leaving-home-transformative-technologies-for-getting-into-space/>.

10. **Greenblatt, J. B.**, 2015. Space: The next transportation frontier, *Move Forward* blog, Sept. <https://www.move-forward.com/space-the-next-transportation-frontier/>.

Interviews

1. “Mission to Mars: Will Real Estate on the Red Planet Take Off?” Interview with Clare Trapasso, Realtor.com, 11 Nov. 2016. <http://www.realtor.com/news/trends/housing-on-mars/>.

Twenty-four interviews on climate change mitigation and autonomous vehicles, including:

2. “US not on track to meet 2025 carbon pollution cutting goal,” Interview with Seth Borenstein, *Associated Press*, 26 Sept. 2016. <http://bigstory.ap.org/article/bad3b09fd1694027882aeb2013c44696/us-not-track-meet-2025-carbon-pollution-cutting-goal>.
3. “The U.S. is on track to miss its emissions goals, and one reason is methane,” Interview with Chris Mooney, *Washington Post*, 26 Sept. 2016. <https://www.washingtonpost.com/news/energy-environment/wp/2016/09/26/the-u-s-is-on-course-to-miss-its-emissions-goals-and-one-reason-is-methane/>.
4. “United States will miss Paris climate targets without further action, study finds,” Interview with Warren Cornwall, *Science*, 26 Sept. 2016. <http://www.sciencemag.org/news/2016/09/united-states-will-miss-paris-climate-targets-without-further-action-study-finds>.
5. “These researchers think we’re nearing ‘peak car’ — and the consequences could be dramatic,” Interview with Chris Mooney, *Washington Post*, 22 Sept. 2016. <https://www.washingtonpost.com/news/energy-environment/wp/2016/09/22/these-researchers-think-were-nearing-peak-car-and-the-consequences-could-be-dramatic/>.
6. “California is about to find out what a truly radical climate policy looks like,” Interview with Brad Plumer, *Vox*, 29 Aug. 2016. <http://www.vox.com/2016/8/29/12650488/california-climate-law-sb-32>.
7. “Self-Driving Taxis May Hit the Road within a Year: Lyft and GM will start testing self-driving cars for transportation,” *Scientific American/ClimateWire*, Camille von Kaenel, 6 May 2016. <http://www.scientificamerican.com/article/self-driving-taxis-may-hit-the-road-within-a-year/>
8. Interview on the future of transportation with Ty Burrell in “End of The Road,” *Years of Living Dangerously*, Season 2 (a television series about climate change) Aired 7 Nov. 2016 on National Geographic Channel. <http://yearsoflivingdangerously.com/>.
9. “California Gas Leak Threatens Jerry Brown’s Image as a Climate Change Hero.” Interview with Ian Lovett and Michael Wines, *New York Times*, 4 Mar. 2016.

<http://www.nytimes.com/2016/03/05/us/california-gas-leak-threatens-jerry-browns-image-as-a-climate-change-hero.html>.

10. “RoboCabs: the key to curbing emissions?” Interview with Graihagh Jackson, *The Naked Scientists*, July 2015. <http://www.thenakedscientists.com/HTML/specials/show/20150713-1/>.

Selected professional presentations

1. “Energy and resource analysis of a large-scale Earth-Mars human transport system.” Invited presentation for Session D2.8-A5.4. Space Transportation Solutions for Deep Space Missions, *67th International Astronautical Congress*, Guadalajara, Mexico, 30 Sept. 2016.
2. “Mars resource extraction and transportation to and on Mars.” Presentation at *Mars City Design Power Lab* workshop, Mars City Foundation, University of Southern California, Los Angeles, CA, 21 Sept. 2016. <http://www.marscityfoundation.org/#!workshop/c1han>.
3. “Balance of system considerations in Mars ISRU fuel/oxygen production.” Invited speaker and workshop participant, *Addressing the Mars ISRU Challenge: Production of Oxygen and Fuel from CO₂ using Sunlight*, Keck Institute for Space Studies, Caltech, Pasadena, CA, 29 June 2016. http://kiss.caltech.edu/new_website/workshops/isru/isru.html.
4. “Bringing Star Wars Down to Earth: Energy and Resource Impacts of Real Space Technologies.” Seminar, Lawrence Berkeley National Laboratory, 11 Mar. 2016.

More than 100 climate change-focused presentations, including:

5. “Low Carbon Energy Scenario Insights for a Robust Electricity System: The Importance of Climate Change in Energy Planning and Scenario Analysis,” *Fourth California Climate Change Assessment Symposium*, Sacramento, CA, 26 Jan. 2017.
6. “Analysis of the United States’ Intended Nationally Determined Contributions for Reducing Greenhouse Gas Emissions” (Lynn Price presented in my absence), *21st Conference of the Parties (COP-21) Side Event*, United National Framework Convention on Climate Change, Paris, France, 1 Dec. 2015.
7. “Economic and greenhouse gas benefits of autonomous taxis,” *GoogleX*, Mountain View, CA, 21 July 2015.
8. “Economic and greenhouse gas benefits of autonomous taxis,” *Silicon Valley Autonomous Vehicle Enthusiasts*, Nissan Research Center, Sunnyvale, CA, 15 July 2015. Audio recording at <https://itunes.apple.com/us/podcast/driving-innovation-speaker/id672410323?mt=2>.
9. “Life-Cycle Net Energy Assessment of Large-Scale Hydrogen Production via Photoelectrochemical Water Splitting,” *227th Electrochemical Society Meeting*, Chicago, IL, 27 May 2015. <http://www.electrochem.org/meetings/biannual/227>.

10. "California policy impacts on greenhouse gas emissions through 2050," Informational Hearing on Climate Change, *California State Assembly Budget Subcommittee No. 3: Resources and Transportation*, Sacramento, CA, 8 Apr. 2014.
11. "Quadrennial Technology Review Chapter 12: Integrated Assessment," *Presentation to Secretary Ernest Moniz*, U.S. Department of Energy, Washington, DC, 7 Apr. 2015.
12. "Life-cycle net energy assessment of large-scale hydrogen production via photoelectrochemical water splitting." *20th International Conference on Photochemical Conversion and Storage of Solar Energy (IPS-20)*, Berlin, Germany, 28 July 2014.
13. "The Future of Fuels." Session: Is It Possible to Reduce 80% of Greenhouse Gas Emissions from Energy by 2050?, *American Academy for the Advancement of Science Conference*, Chicago, 15 Feb. 2014. <https://aaas.confex.com/aaas/2014/webprogram/Session7237.html>.
14. "California GHG Inventory Model Results." *Briefing for Edmund J. Brown, Governor of California*, Oakland, CA, 27 Oct. 2013.
15. "California's Energy Future & California's Carbon Challenge projects," *Presentation to Mary Nichols, Chair of the California Air Resources Board*, Berkeley, CA, 26 Sept. 2012.
16. "Portraits of the California Energy System in 2050: Cutting Emissions by 80 Percent," Panelist, *American Academy for the Advancement of Science Annual Meeting*, Washington, DC, 17-21 Feb. 2011. <http://aaas.confex.com/aaas/2011/webprogram/Session2620.html>.
17. "Putting the Squeeze on Carbon: Stabilization Wedges and the Climate Challenge," Invited lecture, *University of Utah, Stegner Symposium on Alternative Energy*, Salt Lake City, 7-8 Mar. 2008. <http://www.ulaw.tv/videos/stegner-symposium-2008-stabilization-wedges-and-the-climate-challenge/389>.
18. "Clean Energy 2030," Google Tech Talk series, *Google*, Mountain View, CA, 18 Dec. 2008.
19. "Baseload wind power: Using energy storage to compete against decarbonized coal power in a climate-constrained world," *American Wind Energy Association Conference*, Pittsburgh, 4-7 June 2006.
20. "'Wedges': early mitigation with familiar technology," *Seventh International Conference on Greenhouse Gas Control Technologies (GHGT-7)*, Vancouver, 5-9 Sept. 2004.