

Wildfire Risk Reduction, Carbon Dioxide Removal, and Biochar: The Challenges of Scaling Up

(Virtual Colloquium) – October 4, 2023 11:00 am-2:30 pm ET



WEDNESDAY, OCTOBER 4, 2023

11:00–11:10 Introduction and objectives

Robin Schoen, *National Academies Board on Agriculture and Natural Resources (BANR)*

Al Sample, *BANR and George Mason University*

11:10–11:30 Wood biomass supply estimates

Maggie Davis, *Oak Ridge National Laboratory*

Jeremy Fried, *Pacific Northwest Research Station*

11:30–11:50 Biochar production technology development and economics

Deborah Dumroese, *Rocky Mountain Research Station*

John Sessions, *Oregon State University*

11:50–12:20 Biochar utilization in agriculture and other markets

Johannes Lehmann, *Cornell University*

Joseph Blankinship, *University of Arizona*

12:20–12:30 Break

12:30–1:00 Status and trends in US wood biochar production: case studies

Josiah Hunt, *Pacific Biochar*

Tom Marrero, *Wakefield Biochar*

1:00–1:30 Current and potential role of CDR credits markets in biochar production and utilization

Lucas Joppa, *Haveli Investments*

Amrith Ramkumar, *Wall Street Journal*

1:30–2:00 Knowledge gaps and future research needs

Jim Amonette, *Pacific Northwest National Laboratory/ Washington State University*

2:00–2:30 Public policy actions needed to scale up biochar production and utilization capacities

Chuck Hassebrook, *National Center for Appropriate Technology*

Sean Babington, *USDA Office of the Secretary*

MEETING ADJOURNS

Speaker Biosketches



Robin Schoen is Director, Board on Agriculture and Natural Resources (BANR), the major program unit of the National Research Council responsible for organizing and overseeing studies on agriculture, forestry, fisheries, wildlife, and the use of land, water, and other natural resources. The National Research Council is the operational arm of the not-for-profit National Academy of Sciences, Engineering, and Medicine (NASEM), which was established by Congress in 1863 to be a source of independent, nongovernmental advice on science and technology.



Al Sample is Adjunct Professor of Environmental Science and Policy at George Mason University and a member of the NASEM Board on Agriculture and Natural Resources. His current research is focused on the integration of climate change mitigation, adaptation, and resilience into the evolving institutional, legal, and policy framework for natural resource management.



Maggie Davis is a Natural Resource Data Scientist at the Oak Ridge National Laboratory with over 10 years R&D experience in energy transition analysis. She specializes in Nature based Solutions markets and decarbonization strategies using biomass. Specifically, she has been a lead contributor to the "Billion Ton" reports for agricultural energy crops (USDOE 2016), and forest-based biomass (forthcoming BT23).



Jeremy Fried is a Research Forester at the Pacific Northwest Research Station of the USDA Forest Service. His research addresses problems and opportunities relating to the management of U.S. forests, informed by inventory science and data. His research has evaluated, at landscape scale, the trajectories of stand-level forest fire hazard with and without management using the BioSum modeling framework. This framework also provides insights on the potential supply of merchantable wood and submerchantable wood suitable for biomass-based bioenergy, transportation fuels or biochar in connection with landscape fuel treatments, and the greenhouse gas mitigation implications of treatment alternatives.

Speaker Biosketches



Deborah Page-Dumroese is a Soil Research Scientist at the USDA Forest Service's Rocky Mountain Research Station. Her research is focused on maintaining soil productivity during and after land management activities and include the following: carbon sequestration, harvest methods, site preparation, and fire impacts on soil chemical, biological, and physical properties. Her current research concentrates on biochar impacts, biomass utilization, nutrient cycling, long-term productivity, organic matter, and how temperature and moisture regulate decomposition processes.



John Sessions is University Distinguished Professor and Strachan Chair of Forest Operations Management at Oregon State University. His research is focused on developing techniques for transportation planning, tactical forest planning, strategic forest planning, decision support systems for road management, biomass collection and transport.



Johannes Lehmann, Liberty Hyde Bailey Professor of soil biogeochemistry and soil fertility management at Cornell University, received his graduate degrees in Soil Science at the University of Bayreuth, Germany. His research focuses on nano-scale investigations of soil organic matter, the biogeochemistry of pyrogenic carbon, sustainable soil management, climate change, biochar systems and the circular economy. He authored more than 250 journal publications, has been named Highly-Cited Researcher by Thomson Reuter/Clarivate since 2014, is member of the U.S. National Academy of Sciences and German National Academy of Sciences (Leopoldina), of the board of the International Biochar Initiative, and Fellow of the Soil Science Society of America, he was named Humboldt Fellow at the Freie Universität Berlin and Hans-Fischer Senior Fellow of the Institute of Advanced Studies at the Technical University of Munich.



Joseph Blankinship is an Associate Professor in the Department of Environmental Science at the University of Arizona. He is a soil ecologist who grew up in suburbia south of Richmond, Virginia. He earned his Bachelor's degree in Environmental Sciences from the University of Virginia followed by a PhD in Biology from Northern Arizona University. Now at the University of Arizona, he addresses desert soil health problems and solutions. His team's current research tackles urgent environmental and agricultural challenges in drylands that are linked to soil health, including dust mitigation, ecological restoration, soil carbon sequestration, enhancing crop nutrient density, and improving the efficiency of water and fertilizer use in desert croplands and urban areas.

Speaker Biosketches



Josiah Hunt is founder and CEO of Pacific Biochar Benefit Corporation, where he has, since 2008, helped to innovate methods for biochar production, processing, and application in carbon sequestering pathways.



Tom Marerro is President at Wakefield Biochar. Wakefield Biochar provides sustainable, organic biochar for soil health and remediation services for agriculture by using low nutrient value biomass (e.g., cleared trees and paper mill waste material) and returning biomass to the soil to improve crop production, reclaim urban land for farming, reduce contaminants in stormwater, and decrease greenhouse gas emissions.



Lucas Joppa is Chief Sustainability Officer & Senior Managing Director at Haveli Investments. He is an honorary Fellow at the UN Environment Program World Conservation Monitoring Center, and he serves on the boards of leading scientific organizations. His research interests include climate change, biodiversity, ecology, artificial intelligence, scaling environmental data. Previously, Dr. Joppa was Chief Environmental Officer at Microsoft, where he led the company's investments in clean energy and carbon dioxide removal technologies.



Amrith Ramkumar is the Wall Street Journal's climate finance reporter. He covers how investors are paying for the transition to clean energy for the finance team in Washington, D.C. His stories include deals and fundraising rounds tied to green energy and sustainability as well as trend pieces exploring how the government's climate spending programs are rippling through the private sector. Two of his main coverage areas are green hydrogen and carbon removal. Ramkumar joined the Wall Street Journal in 2017.

Speaker Biosketches



Jim Amonette is a soil chemist with four decades of research experience in the areas of environmental geochemistry and soil mineralogy. He has been with the Pacific Northwest National Laboratory (PNNL) since 1986 and has held a Joint Appointment with CSANR at Washington State University since 2017. His primary scientific interest is to find ways of sustainably harnessing the large carbon flux passing through the terrestrial ecosystem to help mitigate global climate change. For the last 15 years he has focused on assessing the potential climate-mitigating contributions of biochar technology at global, national and local levels.



Chuck Hassebrook directs the Biochar Policy Projects of the National Center for Appropriate Technology, working to advance federal policies that support development of a carbon negative biochar and biofuel industry. He previously served 36 years with the Center for Rural Affairs, including 17 years as its Executive Director, and 18 years as a member of the University of Nebraska Board of Regents, including two terms as Chair.



Sean Babington is the Senior Advisor for Climate in the Office of the Secretary at the U.S. Department of Agriculture. In addition to managing climate efforts across the department, Sean also handles forestry and natural resources issues in the Secretary's office. Before joining the Biden-Harris Administration in November of 2021, Babington served as Senior Professional Staff to Chairwoman Debbie Stabenow on the U.S. Senate Committee on Agriculture, Nutrition and Forestry, where he handled committee business pertaining to forestry, pesticides, and climate change. He is an adjunct lecturer for Georgetown University's Environmental Studies program.

Further Readings

Wood biomass supply projections

Pacific Northwest Biochar Atlas

<https://www.climatehubs.usda.gov/hubs/northwest/tools/pacific-northwest-biochar-atlas>

Biochar production technology development and economics

[Sahoo, K., Upadhyay, A., Runge, T., Bergman, R., Puettmann, M. and Bilek, E., 2021. Life-cycle assessment and techno-economic analysis of biochar produced from forest residues using portable systems. *The International Journal of Life Cycle Assessment*, 26, pp.189-213.](#)

[Maroušek, J. and Trakal, L., 2022. Techno-economic analysis reveals the untapped potential of wood biochar. *Chemosphere*, 291, p.133000.](#)

[Sahoo, K., Bilek, E., Bergman, R. and Mani, S., 2019. Techno-economic analysis of producing solid biofuels and biochar from forest residues using portable systems. *Applied Energy*, 235, pp.578-590.](#)

Agegnehu, G., Srivastava, A. K., & Bird, M. I. 2017. The role of biochar and biochar-compost in improving soil quality and crop performance: A review. *Applied soil ecology*, 119, 156-170.

Omondi, M. O., Xia, X., Nahayo, A., Liu, X., Korai, P. K., & Pan, G. 2016. Quantification of biochar effects on soil hydrological properties using meta-analysis of literature data. *Geoderma*, 274, 28-34.

Thomas, S. C., & Gale, N. 2015. Biochar and forest restoration: a review and meta-analysis of tree growth responses. *New Forests*, 46(5-6), 931-946.

Page-Dumroese, D. S., Coleman, M. D., & Thomas, S. C. 2016. Opportunities and uses of biochar on forest sites in North America. *Biochar: a regional supply chain approach in view of mitigating climate change*, 15, 315-336.

[Ganguly, A., Brown, R.C. and Wright, M.M., 2022. Techno-economic and greenhouse gas emission assessment of carbon negative pyrolysis technology. *Green Chemistry*, 24\(23\), pp.9290-9302.](#)

Biochar utilization in agriculture and other markets

[Beusch, C., 2021. Biochar as a soil ameliorant: how biochar properties benefit soil fertility—a review. *Journal of Geoscience and Environment Protection*, 9\(10\), pp.28-46.](#)

[Conte, P., 2014. Biochar, soil fertility, and environment. *Biology and Fertility of Soils*, 50, pp.1175-1175.](#)

[Ding, Y., Liu, Y., Liu, S., Li, Z., Tan, X., Huang, X., Zeng, G., Zhou, L. and Zheng, B., 2016. Biochar to improve soil fertility. A review. *Agronomy for sustainable development*, 36, pp.1-18.](#)

[Igalavithana, A.D., Ok, Y.S., Usman, A.R., Al-Wabel, M.I., Oleszczuk, P. and Lee, S.S., 2016. The effects of biochar amendment on soil fertility. *Agricultural and environmental applications of biochar: Advances and barriers*, 63, pp.123-144.](#)

Melo LCA, Camps-Arbestain M, Carneiro JSS and Lehmann J 2022 Biochar-based fertilizer effects on crop productivity: a meta-analysis. *Plant and Soil* 472, 45–58.

Joseph S, Cowie AL, Van Zwieten L, Bolan N, Budai A, Buss W, Cayuela ML, Graber ER, Ippolito J, Kuzyakov Y, Luo Y, Ok YS, Palansooriya KD, Shepherd J, Stephens S, Weng Z and Lehmann J 2021. How biochar works, and when it doesn't: A review of mechanisms controlling soil and plant responses to biochar. *Global Change Biology - Bioenergy* 13, 1731-1764.

Lehmann J, Cowie A, Masiello CA, Kammann C, Woolf D, Amonette JE, Cayuela ML, Camps-Arbestain M and Whitman T 2021 Biochar in climate change mitigation. *Nature Geoscience* 14, 883–892.

Roe S, Streck S, Beach R, Busch J, Chapman M, Daioglou V, Deppermann A, Doelman J, Emmet-Booth J, Engelmann J, Fricko O, Frischman C, Funk J, Grassi G, Griscom B, Havlik P, Hanssen S, Humpenöder F, Landholm D, Lomax G, Lehmann J, Mesnildrey L, Nabuurs GJ, Popp A, Rivard C, Sanderman J, Sohngen B, Smith P, Stehfest E, Woolf D and Lawrence D 2021 Land-based measures to mitigate climate change: potential and feasibility by country. *Global Change Biology* 27, 6025-6058.

[Sessions, J., Smith, D., Trippe, K.M., Fried, J.S., Bailey, J.D., Petitmermet, J.H., Hollamon, W., Phillips, C.L. and Campbell, J.D., 2019. Can biochar link forest restoration with commercial agriculture?. *Biomass and Bioenergy*, 123, pp.175-185.](#)

Woolf D, Lehmann J, Stephen Ogle S, Kishimoto-Mo AW, McConkey B and Baldock J 2021 A greenhouse gas inventory model for biochar additions to soil. *Environmental Science and Technology* 55, 14795–14805.

Ye L, Camps-Arbestain M, Shen Q, Lehmann J, Singh B and Sabir M 2020 Biochar effects on crop yields with and without fertilizer: a meta-analysis of field studies using separate controls. *Soil Use and Management* 36, 2-18.

Zhao N, Lehmann J and You F 2020 Poultry waste valorization via pyrolysis technologies: economic and environmental life cycle optimization for sustainable bioenergy systems. *ACS Sustainable Chemistry & Engineering* 8, 4633-4646.

Current and potential role of CDR credits markets on biochar production and utilization

[Mistry, K., Carroll, B., Baker, T., Barido, P., Dewar, A. and Sims, A. 2023. Climate Needs and Market Demand Drive Future for Durable CDR. BCG.](#)

Amonette, J.E., J.G. Archuleta, M.R. Fuchs, K.M. Hills, G.G. Yorgey, G. Flora, J. Hunt, H.-S. Han, B.T. Jobson, T.R. Miles, D.S. Page-Dumroese, S. Thompson, K.M. Trippe, K. Wilson, R. Baltar, K. Carloni, C. Christoforou, D.P. Collins, J. Dooley, D. Drinkard, M. Garcia-Pérez, G. Glass, K. Hoffman-Krull, M. Kauffman, D.A. Laird, W. Lei, J. Miedema, J. O'Donnell, A. Kiser, B. Pecha, C. Rodriguez-Franco, G.E. Scheve, C. Sprenger, B. Springsteen, and E. Wheeler. 2021. *Biomass to Biochar: Maximizing the Carbon Value*. Report by Center for Sustaining Agriculture and Natural Resources, Washington State University.

<https://csanr.wsu.edu/biomass2biochar/>

Knowledge gaps and future research needs

[Amonette, J., Blanco-Canqui, H., Hassebrook, C., Laird, D., Lal, R., Lehmann, J., and Page-Dumroese, D. 2021. Integrated Biochar Research: A Roadmap. Journal of Soil and Water Conservation 76 \(1\) 24A-29A; DOI: <https://doi.org/10.2489/jswc.2021.1115A>](#)

Singh, B, JE Amonette, M Camps-Arbestain, and RS Kookana. (2023, in press). “A biochar classification system and associated test methods.” Chapter 9 in: Lehmann, J. and Joseph, S. (eds) *Biochar for Environmental Management: Science, Technology and Implementation/Application*, 3rd edition, Routledge.

Public policy needs to accelerate expansion of biochar production and utilization capacities

Scaling Biochar Forum <https://www.scalingbiochar.com/>

Recommendations to Scale Up Sustainable Biochar Research and Commercialization for Agriculture and Conservation. American Farmland Trust.
<https://farmlandinfo.org/publications/biochar-recommendations/>

Additional resources

Biochar in the Woods. How to improve forest soil health and resilience. <https://www.youtube.com/watch?v=hZ7LVMDa4EU>

National Biochar Week. <https://www.youtube.com/playlist?list=PL1S3D7L3NZpWRiHAJGQFhd0iYiFl6uPHt>

Springer Biochar Journal

<https://www.springer.com/journal/42773>

The Biochar Journal

<https://www.biochar-journal.org/en/home>

Journal of Analytical and Applied Pyrolysis

<https://www.sciencedirect.com/journal/journal-of-analytical-and-applied-pyrolysis/special-issue/10M90TQT6CX>

Woody biochar potential for abandoned mine land restoration in the U.S.: a review

<https://link.springer.com/article/10.1007/s42773-020-00074-y>