

**STATE OF NEW MEXICO
ENVIRONMENTAL IMPROVEMENT BOARD**

**IN THE MATTER OF PROPOSED
ADOPTION of 20.2.92 NMAC
*Clean Transportation Fuel Program***

No. EIB 25-23(R)

**GROWTH ENERGY'S NOTICE OF
INTENT TO PRESENT TECHNICAL EVIDENCE**

Growth Energy, by and through its counsel of record, Hinkle Shanor LLP (Thomas M. Hnasko), pursuant to 20.1.1.302 NMAC and the Pre-Hearing Order of July 15, 2025, hereby submits this Notice of Intent to Present Technical Evidence at the public hearing regarding the captioned proceeding.

1. Name of Person for Whom the Witness will Testify.

Growth Energy.

2. Identification of Technical Witness(es).

Tristan R. Brown, J.D., Ph.D.

3. Qualifications, Education and Work Background.

Dr. Brown's qualifications, education and work experience are set forth in his curriculum vitae, attached as Exhibit A to his direct testimony, and are further described in Part I of his direct testimony.

4. Text of Recommended Rule Modification.

Growth Energy recommends that the EIB replace Table 9 in NMED's proposed Rule with Table 1 set forth in Dr. Brown's direct testimony at page 7.

5. Statement of Reasons.

NMED's proposed regulation assigns carbon intensity values to indirect land use change (ILUC) that are calculated using a decade-old model adopted by the California Air Resources Board (CARB). Over the last ten years, advancements in research and scientific modeling have rendered CARB's model obsolete. More up-to-date models have become the standard in federal climate policy, including through incorporation in various climate incentives in the Inflation Reduction Act passed under President Biden. By adopting the CARB figures, NMED is proposing values that contradict the latest federal policy and science developed by the United States National Laboratories. Dr. Brown will offer technical testimony regarding the evolution in ILUC research and modeling since 2014 and will explain the advantages of using the U.S. Department of Energy's Research and Development GREET Model (R&D GREET) and its GTAP-BIO + CCLUB method for quantifying ILUC. Dr. Brown will recommend that the Board replace Table 9 in NMED's proposed regulation with a Table that reflects the ILUC values calculated by the R&D GREET model, which better capture observed data regarding ILUC, align New Mexico with more recently developed state and federal biofuels programs, and position New Mexico for greater success in the implementation of the CFTP.

6. Identification of Exhibits.

The following Exhibits have been reproduced in Dr. Brown's direct testimony as Figure 1, Table 1, and Figure 2 at pages 6, 7, and 8.

1. Figure 1: Comparison of U.S. corn acres harvested and corn yields since 2000, as set forth in U.S. Department of Agriculture. 2025. "Corn and Other Feed Grains – Feed Grains Sector at a Glance," USDA Economic Research Service, April 17. Available on the Web at: <https://www.ers.usda.gov/topics/crops/corn-and-other-feed-grains/feed-grains-sector-at-a-glance> (accessed September 1, 2025).

2. Table 1: Comparison of New Mexico's estimated ILUC values for crop-based biofuels with most recent estimated values, as set forth in Kwon, H., X. Liu, S. Kar, H. Cai, and

M. Wang. 2025. “Expansion of Carbon Calculator for Land Use and Land Management Change from Biofuels Production (CCLUB) to Address Induced Land Use Changes and Other Indirect Effects of Clean Fuel Production for R&D GREET 2024,” Argonne National Laboratory, ANL/ESIA-24/22, January. Available on the Web at: <https://publications.anl.gov/anlpubs/2025/05/193639.pdf> (accessed August 31, 2025).

3. Figure 2: Comparison of corn ethanol ILUC values from selected studies, adapted from Lee, U., H. Kwon, M. Wu, and M. Wang. 2021. “Retrospective analysis of the U.S. corn ethanol industry for 2005-2019: implications for greenhouse gas emission reductions,” *Biofuels, Bioproducts and Biorefining* 15: 1318-1331. Available on the Web at: <https://scijournals.onlinelibrary.wiley.com/doi/abs/10.1002/bbb.2225> (accessed September 1, 2025), and updated to include Kwon, H., X. Liu, S. Kar, H. Cai, and M. Wang. 2025. “Expansion of Carbon Calculator for Land Use and Land Management Change from Biofuels Production (CCLUB) to Address Induced Land Use Changes and Other Indirect Effects of Clean Fuel Production for R&D GREET 2024,” Argonne National Laboratory, ANL/ESIA-24/22, January. Available on the Web at: <https://publications.anl.gov/anlpubs/2025/05/193639.pdf> (accessed August 31, 2025).

Dr. Brown’s direct testimony also cites and relies upon the following Exhibits, all of which are available through the hyperlinks provided in Section VI of Dr. Brown’s direct testimony.

4. Searchinger, T., R. Heimlich, R. Houghton, F. Dong, A. Elobeid, et al. 2008. “Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land-Use Change,” *Science* 319(5867): 1238-1240. Available on the Web at: <https://www.science.org/doi/abs/10.1126/science.1151861> (accessed September 1, 2025).

5. Dumortier, J., D. Hayes, M. Carriquiry, F. Dong, X. Du, A. Elobeid, J. Fabiosa, and S. Tokgoz. 2011. “Sensitivity of Carbon Emissions Estimates from Indirect Land-Use Change,” *Applied Economic Perspectives and Policy* 33(3): 428-448. Available on the Web at: <https://onlinelibrary.wiley.com/doi/abs/10.1093/aep/prr015> (accessed September 1, 2025).

6. Malins, C., R. Plevin, and R. Edwards. 2020. “How robust are reductions in modeled estimates from GTAP-BIO of the indirect land use change induced by conventional biofuels?” *Journal of Cleaner Production* 258: 120716. Available on the Web at: <https://www.sciencedirect.com/science/article/pii/S0959652620307630> (accessed September 1, 2025).

7. California Air Resources Board. 2014. “Detailed analysis for indirect land use change,” LCFS Land Use Change Analysis, December. Available on the Web at: <https://ww2.arb.ca.gov/resources/documents/lcfs-land-use-change-assessment> (accessed August 30, 2025).

8. New Mexico Environment Department. 2024. “Discussion Draft Rule Regarding the Clean Transportation Fuel Program: Title 20, Chapter 2, Part 92,” December 19. Available on the Web at: <https://cloud.env.nm.gov/resources/translator.php/NDg1MWY2MmRhZTY1YjUwODRkNDJlNTJlM18xNzg1NzA~.pdf> (accessed August 31, 2025).
9. Prabhu, A. 2015. “Staff Report: Calculating Carbon Intensity Values from Indirect Land Use Change of Crop-Based Biofuels,” California Air Resources Board, March. Available on the Web at: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/peerreview/050515staffreport_iluc.pdf (accessed August 31, 2025).
10. Washington Department of Ecology. 2025. “Fuel pathways and carbon intensity,” Clean Fuel Standard. Available on the Web at: <https://ecology.wa.gov/air-climate/reducing-greenhouse-gas-emissions/clean-fuel-standard/fuel-pathways-and-carbon-intensity> (accessed August 31, 2025).
11. Oregon Department of Environmental Quality. 2025. “Fuel Pathways – Carbon Intensity Values,” Oregon Clean Fuels Program. Available on the Web at: <https://www.oregon.gov/deq/ghgp/cfp/pages/clean-fuel-pathways.aspx> (accessed August 31, 2025).
12. U.S. Department of Energy. 2025. “U.S. Department of Energy Releases 45ZCF-GREET,” Bioenergy Technologies Office, January 15. Available on the Web at: <https://www.energy.gov/eere/bioenergy/articles/us-department-energy-releases-45zcf-greet> (accessed August 31, 2025).
13. Argonne National Laboratory. “ICAO-GREET Model,” Energy Systems and Infrastructure Assessment. Available on the Web at: https://greet.anl.gov/greet_icao (accessed August 31, 2025).
14. Wind, C.-A. 2021. “Oregon Clean Fuels Program Overview,” Oregon Department of Environmental Quality, Office of Greenhouse Gas Programs, September 30 – October 1. Available on the Web at: <https://cnee.colostate.edu/wp-content/uploads/2022/01/Cory-Ann-Wind-Oregon-LCFS-Workshop.pdf> (accessed August 31, 2025).
15. Unnasch, S. 2022. “Indirect Land Use Conversion for Washington Clean Fuels Standard,” Life Cycle Associates, April 4. Available on the Web at: <https://ecology.wa.gov/getattachment/be3e311f-34de-4001-a055-b6dd07d25ead/iLUC20220404.pdf> (accessed August 31, 2025).
16. Kwon, H., X. Liu, J. Dunn, S. Mueller, M. Wander, et al. 2021. “Carbon Calculator for Land Use and Land Management Change from Biofuels Production (CCLUB),” Argonne National Laboratory, ANL/ESD/12-5 Rev. 7, October. Available on the Web at: <https://publications.anl.gov/anlpubs/2021/10/171711.pdf> (accessed August 31, 2025).

17. Kwon, H., X. Liu, S. Kar, H. Cai, and M. Wang. 2025. "Expansion of Carbon Calculator for Land Use and Land Management Change from Biofuels Production (CCLUB) to Address Induced Land Use Changes and Other Indirect Effects of Clean Fuel Production for R&D GREET 2024," Argonne National Laboratory, ANL/ESIA-24/22, January. Available on the Web at: <https://publications.anl.gov/anlpubs/2025/05/193639.pdf> (accessed August 31, 2025).
18. Taheripour, F., S. Mueller, I. Emery, O. Karami, E. Sajedinia, et al. 2024. "Biofuels Induced Land Use Change Emissions: The Role of Implemented Land Use Emission Factors," *Sustainability* 16: 2729. Available on the Web at: <https://www.mdpi.com/2071-1050/16/7/2729> (accessed September 1, 2025).
19. Chen, L., R. Rejesus, S. Aglasan, S. Hagen, and W. Salas. 2022. "The impact of no-till on agricultural land values in the United States Midwest," *American Journal of Agricultural Economics* 105(3): 760-783. Available on the Web at: <https://onlinelibrary.wiley.com/doi/abs/10.1111/ajae.12338> (accessed September 1, 2025).
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22. U.S. Department of Agriculture. 2025. "Corn and Other Feed Grains – Feed Grains Sector at a Glance," USDA Economic Research Service, April 17. Available on the Web at: <https://www.ers.usda.gov/topics/crops/corn-and-other-feed-grains/feed-grains-sector-at-a-glance> (accessed September 1, 2025).
23. Copenhagen, K. and S. Mueller. 2024. "Considering Historical Land Use When Estimating Soil Carbon Stock Changes of Transitional Croplands," *Sustainability* 16: 734. Available on the Web at: <https://www.mdpi.com/2071-1050/16/2/734> (accessed September 1, 2025).
24. Xu, H., H. Sieverding, H. Kwon, D. Clay, C. Stewart, et al. 2019. "A global meta-analysis of soil organic carbon response to corn stover removal," *Global Change Biology Bioenergy* 11(10): 1215-1233. Available on the Web at: <https://onlinelibrary.wiley.com/doi/abs/10.1111/gcbb.12631> (accessed September 1, 2025).
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7. Direct Testimony.

Dr. Brown's direct testimony is attached to this Notice of Intent.

Respectfully submitted,

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I hereby certify that on the 2nd day of September, 2025, the foregoing was served via electronic mail to all counsel and parties listed below:

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DIRECT TECHNICAL TESTIMONY OF TRISTAN R. BROWN, J.D., Ph.D.

Introduction

My name is Tristan R. Brown, J.D., Ph.D. I am an energy economist and lawyer specializing in the assessment of the climate and financial impacts of low-carbon fuels under life cycle assessment (LCA) and techno-economic analysis frameworks.

I have been retained by Growth Energy, the world's largest ethanol trade organization, to advise on New Mexico's Clean Transportation Fuel Standard. My engagement by Growth Energy is strictly in my individual capacity as an independent consultant, and my comments are not made on behalf of any other institution with which I am affiliated.

My testimony supports Growth Energy's proposal that the New Mexico Environmental Improvement Board ("EIB") adopt revised emissions factors for indirect land use change (ILUC) that align with the most recent version of Argonne National Laboratory's Research and Development GREET Model (R&D GREET).

Executive Summary

Part I provides an overview of my expert qualifications and work experience on the subject of low-carbon fuels life cycle assessment (LCA).

Part II provides a brief narrative description of how early modeling on the indirect land-use change (ILUC) of crop-based biofuels was conducted by the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (CARB). It specifically focuses on modeling that was conducted up through the release of CARB's 2014 ILUC estimates since these are the values on which New Mexico's proposed ILUC values are based. Part II discusses the primary components of the GTAP-BIO + AEZ-EF model that CARB used to calculate its 2014 estimates and how this was combined with a variation of the Argonne National Laboratory Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) model to calculate life cycle carbon intensity (CI) scores for crop-based biofuels based on the land use change modeling capabilities that were available to CARB at the time.

Part III details the iterative process of ILUC modeling critiques and improvements that occurred in the ILUC modeling community between 2015 and 2025 and how this led to the development of the Carbon Calculator for Land Use Change from Biofuels Production (CCLUB) land use change emissions factor model as a replacement for the now-obsolete AEZ-EF model that was used by CARB in 2014. The section also discusses how the GTAP-BIO + CCLUB modeling framework has been employed to produce land use change estimates for crop-based biofuels in jurisdictions other than California. Finally, Part III provides details on the continuous federally-funded improvements that have been made to

GTAP-BIO + CCLUB in recent years in direct response to critical feedback that has been published in the refereed literature.

Part IV compares New Mexico's proposed ILUC values for crop-based biofuels with estimates from the most recent version of GTAP-BIO + CCLUB. It also compares New Mexico's proposed ILUC values for corn ethanol with estimates that have been made since 2008. Part IV shows that New Mexico's proposed ILUC values for both crop-based biofuels and corn ethanol specifically are much higher than those found in modeling estimates from the last decade.

Part V presents a recommendation that New Mexico align itself with the U.S. government by utilizing the latest version of the GTAP-BIO + CCLUB modeling framework to calculate ILUC estimates under the Clean Transportation Fuel Program. It explains how such an alignment would (1) minimize distortions between the Program and similar programs in other programs that utilize (or can be expected to utilize) the most recent modeling to produce ILUC estimates, and (2) reduce compliance costs under the Program by enabling crop-based biofuels to receive full credit for the emissions reductions that are calculated by modern LCA models based on up-to-date modeling methodologies and data sources.

Part VI lists all references cited in this testimony along with hyperlinks.

I. Qualifications

My full background and qualifications are set forth in my resume, which is attached to this direct testimony as Exhibit A.

I am currently a (Full) Professor of Energy Resource Economics and Director of the Bioeconomy Development Institute at the SUNY College of Environmental Science & Forestry (SUNY-ESF), where I was named Exemplary Researcher in 2024. I hold a J.D. from the University of Missouri, a Ph.D. in Biorenewable Resources & Technology from Iowa State University, and I am a member of the Missouri Bar.

I have 16 years of direct experience analyzing low-carbon fuels policies and their greenhouse gas (GHG) accounting systems, including ILUC assessment methodologies. From 2009-2010 I was employed as a research associate in Iowa State University's (ISU) Center for Agricultural and Rural Development (CARD), where I conducted research using the Global Trade Analysis Project (GTAP) global equilibrium model. From 2010-11 I was employed as a research associate in ISU's Department of Economics, where I conducted research on the U.S. Renewable Fuel Standard (RFS) and California's Low Carbon Fuel Standard (LCFS). From 2012-2014 I was employed as a research associate in ISU's Bioeconomy Institute, where I conducted research on systems analyses of low-carbon fuels, including life cycle

assessment (LCA). Since 2014 I have been employed in my current faculty position at the ranks of Assistant Professor (2014-2019) and Associate Professor (2019-2025).

In my 16 years of researching low carbon fuels policies, I have provided testimony, comments, and information to numerous government agencies, boards, and commissions. I have provided written testimony to the Virginia State Corporation Commission and written comments to the California Air Resources Board, the New York Climate Action Council, the Vermont Public Utility Commission, and the U.S. Environmental Protection Agency. From 2015-2017 I served as an expert witness on behalf of the State of Mississippi. From 2020-21 I served on the Energy-Intensive and Trade-Exposed Industries advisory panel of the New York State Climate Action Council.

I have specific and longstanding experience regarding systems analyses, including LCA, of low-carbon fuels. I have published 44 papers on low-carbon fuels in the refereed literature in addition to several books, book chapters, and non-refereed papers. I have also been credited with 86 presentations on the subject at conferences, workshops, and other professional gatherings as either lead or co-author. I have taught eight different courses on renewable energy topics and served as major or co-major professor for 16 graduate students, including six Ph.D. students. Finally, I have been principal or co-principal investigator on 24 different research grants covering low carbon fuel topics, including LCA of low carbon fuel pathways.

II. How ILUC Modeling Was Conducted Under the U.S. Renewable Fuel Standard (RFS) and California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS)

Prior to 2007, the modeling of GHG emissions from low-carbon fuels such as corn ethanol was primarily conducted on the basis of direct supply chain emissions on a life cycle basis. These emissions would be summed across the full chain and then compared to those of the corresponding fossil fuel (e.g., gasoline in the case of corn ethanol). A smaller emissions total for the low-carbon fuel would lead to a finding that its use resulted in a net reduction to GHG emissions relative to the business-as-usual case involving the corresponding fossil fuel's use.

Beginning in 2008 it became common for GHG emissions from land-use change induced by the consumption of low-carbon fuels to be included in LCAs of low-carbon fuels. An initial analysis by Searchinger et al.¹ estimated that the lifecycle GHG emissions for corn ethanol were higher than for gasoline after accounting for ILUC emissions of 104 gCO₂e/MJ. The analysis was based on the logic that higher demand for low-carbon fuels from crop feedstocks leads to higher global prices, resulting in the conversion of non-cropland (forests, pasture, and grazing land) to cropland, especially in developing countries. The Searchinger et al. finding corresponded with a requirement in the authorizing legislation for the U.S. RFS and California LCFS that ILUC emissions be included in the calculation of lifecycle GHG

emissions of participating biofuels (RFS) and low-carbon fuels (LCFS). The original Searchinger et al. estimate was highly sensitive to its use of an unrealistic set of default assumptions, however,² leading to large downward revisions to estimated ILUC emissions from U.S. corn ethanol as ILUC modeling improved in rigor and complexity between 2009 and 2014,³ at which point CARB adopted an ILUC emissions value for that fuel of 19.8 gCO₂e/MJ.⁴ This is the ILUC emissions value that is being proposed for use in New Mexico.⁵

CARB's 2014 estimate was the result of an analysis conducted with the general equilibrium model GTAP-BIO in conjunction with the land emissions factor model AEZ-EF. Put simply, GTAP-BIO was employed to identify the area of non-cropland in different "agro-ecological zones" (AEZ) that would be converted to cropland in response to low-carbon fuel supply chain shocks at volumes generally corresponding to U.S. policy requirements. AEZ-EF, which was based on the then-current (circa 2006) IPCC GHG inventory methods and default values, was then used to determine the emissions released by the conversion of each type of land in each AEZ. Taken together, GTAP-BIO and the AEZ-EF calculated ILUC emissions factors for corn ethanol (among other low-carbon fuels). In early 2015 CARB described AEZ-EF as the "current state-of-the-art for emissions factors for various types of land conversions across the globe" and the combination of GTAP-BIO and AEZ-EF as "the best tools currently available to estimate ILUC emissions from biofuels."⁶

CARB's lifecycle carbon intensity (CI) calculations in 2014 were therefore based on an ad hoc combination of models that had been developed for different modeling objectives by different modeling teams. The Argonne National Laboratory's (ANL) Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) model, as modified by CARB (CA-GREET), was used to calculate emissions across the low-carbon fuel supply chain. GTAP-BIO and AEZ-EF were used to calculate ILUC emissions for each crop-based low-carbon fuel pathway based on their specific feedstock. These were then combined to produce a lifecycle CI score for each corresponding low-carbon fuel pathway participating in California's LCFS.

III. ILUC Modeling Has Significantly Improved Since the California Air Resources Board's Latest Estimates Were Released in 2014

The subsequent decade has seen steady improvements made to both the GTAP-BIO model and the overall CI score calculation methodology through funding from the U.S. government. The GREET model continues to be the primary means of calculating lifecycle GHG emissions across the low-carbon fuel supply chain, and it has been further adopted in support of the Washington Clean Fuel Standard (WA-GREET),⁷ the Oregon Clean Fuels Program (OR-GREET),⁸ the U.S. Department of Treasury (45ZCF-GREET),⁹ and the International Civil Aviation Organization (ICAO-GREET).¹⁰

Given the widespread adoption of GREET to analyze a suite of low-carbon fuels pathways that includes several that utilize crop-based feedstocks, Argonne National Laboratory has taken the additional step of developing a GREET-integrated land use emissions factor model called the Carbon Calculator for Land Use Change from Biofuels Production (CCLUB). CCLUB, as detailed below, replaces the obsolete AEZ-EF model with a much more detailed model that incorporates the subsequent decades' worth of new research on land use change and land use emissions. CCLUB has started to replace AEZ-EF in newer LCA-based programs such as Oregon's Clean Fuels Program,¹¹ which estimates ILUC emissions for U.S. corn ethanol of 7.6 gCO₂e/MJ.¹² Like the AEZ-EF model that preceded it, CCLUB is compatible with the GTAP-BIO model (GTAP-BIO + CCLUB), which has also undergone major evidence-based modifications from the version that CARB used to calculate its corn ethanol ILUC value of 19.8 gCO₂e/MJ in 2014.

Development of both GTAP-BIO and CCLUB has benefited over the last several years from multiple rounds of theoretical critiques followed by evidence-based updates, resulting in major improvements to their modeling rigor and accuracy compared to the combined version of GTAP-BIO and AEZ-EF that was employed by CARB in 2014. GTAP-BIO and CCLUB have also benefited from database and other source material updates that were not available to CARB back in 2014. Taken together, these improvements fall into two broad categories: (1) data upgrades and (2) modeling improvements.

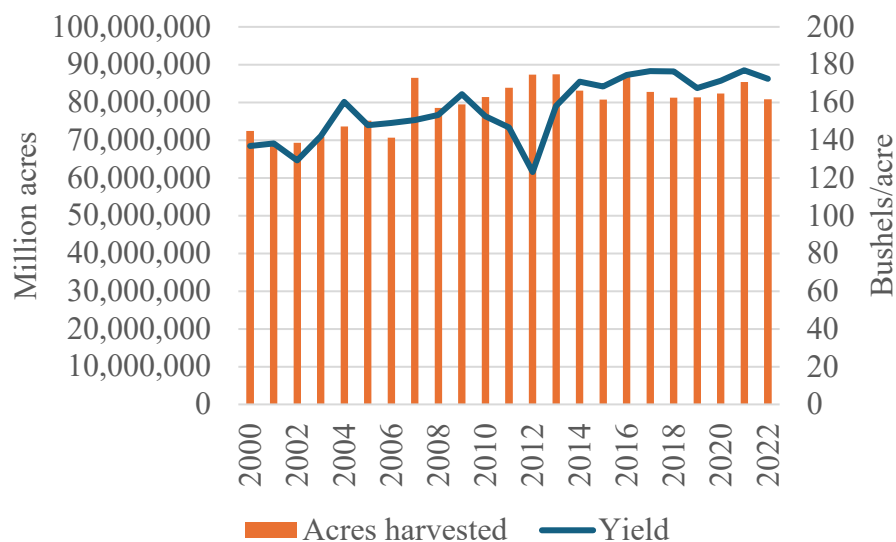
GTAP-BIO + CCLUB has superior modeling complexity than was available to GTAP-BIO + AEZ-EF due to its use of different land use change and land use emissions factor databases for domestic and international regions. CCLUB makes use of an updated version of AEZ-EF that incorporates the latest IPCC 2019 emission inventory guidelines (GTAP-BIO + AEZ-EF made use of IPCC 2006 guidelines), but this time as one input for calculating land use change emissions factors rather than as the sole input. In addition to the updated AEZ-EF, CCLUB also is able to utilize either Winrock or Woods Hole datasets for the calculation of international carbon emissions factors, reducing output sensitivity to the model's assumed factors.¹³ Domestic land use change estimates in CCLUB originally used the parameterized CENTURY model but, since 2023, CCLUB has further utilized the DayCent model (a daily time-step version of CENTURY) for this purpose.¹⁴

These modeling improvements enable GTAP-BIO + CCLUB to incorporate datasets that were unavailable when GTAP-BIO + AEZ-EF was utilized by CARB in 2014, providing the former with improved analytical rigor relative to the latter. Its use of IPCC 2019 emission inventory guidelines is a substantial upgrade to the AEZ-EF model,¹⁵ for example, while the use of CENTURY (and now also DayCent) incorporates regularly updated research on county-level soil carbon emissions factors from Colorado State University in a manner that is compatible with the U.S. Environmental Protection Agency's national GHG inventory guidelines for domestic lands.¹⁴ Specifically, the use of CENTURY and DayCent enable GTAP-BIO + CCLUB to calculate soil carbon emissions factors as a function of

climatological, physical, and input factors at a time when low- and no-till agricultural practices have become so widespread as to be reflected in agricultural land values.¹⁶

Perhaps most importantly, GTAP-BIO + CCLUB incorporates observational data on the soil content of domestic lands in order to “ground truth” a rough assumption made by GTAP-BIO + AEZ-EF regarding a parameter that past ILUC estimates have been especially sensitive to. An important finding of GTAP-BIO + AEZ-EF was that land use change primarily occurred on “cropland-pasture”, a domestic land type in which cropland and pasture transition from the one to the other over time (e.g., cropland rotating to pasture and then back to cropland).¹⁷ In 2014 the definition of this land type was not well understood, and AEZ-EF accounted for this uncertainty by assuming that the emission factor for cropland-pasture converted to cropland was 50% that of the emission factor from converting pasture to cropland for the first time.¹⁸

GTAP-BIO + CCLUB also uses inputs that reflect observational data on domestic land use that is different from what was assumed a decade ago. In 2014 the U.S. had experienced steady growth in corn acreages as measured by acres harvested (see Figure 1). This led to expectations of increased domestic land use change in order to meet rising corn ethanol demand that was reflected in the ILUC modeling at the time. Corn acres harvested peaked in 2016 before trending lower, however, as corn yields increased. More recent ILUC modeling reflects this important change in corn harvest trends.



*Figure 1. Comparison of U.S. corn acres harvested and corn yields since 2000.*¹⁹

A critique of earlier versions of CCLUB was that the model assumed the existence of a negative emission factor (i.e., net carbon sequestration) on average from the conversion of cropland-pasture to cropland, which was a major difference from the AEZ-EF model’s net carbon loss assumption.³ The CCLUB model’s incorporation of bespoke emission factor

datasets for domestic land use change that were not accessible in 2014's GTAP-BIO + AEZ-EF models proved to be an important upgrade in this regard, however. Recent real-world data published in the refereed scientific literature has supported the CCLUB model's assumption by finding that negative emission factors exist on average at surveyed domestic cropland-pasture parcels when converted to cropland, for example.²⁰ Regenerative agricultural practices in corn production such as no-till,²¹ cover-cropping,²² can lead to negative emission factors. Observational data on the international peatland, which contains especially high carbon stocks, also suggests that CCLUB's land use change emission factors are more accurate than those of 2014's GTAP-BIO + AEZ-EF.²³

IV. New Mexico's proposed ILUC values are much higher than commonly used ILUC values that are based on recent modeling.

New Mexico's proposed ILUC values are, with the exception of canola-based biofuels, much higher than the most recent values that have been calculated by GTAP-BIO + CCLUB for the same biofuels (see Table 1). This is a consequence of New Mexico's proposed use of the values that were estimated by CARB in 2014. CARB's 2014 values were outliers even at that time (see Figure 2), and the improvements to ILUC modeling and model databases described above have caused ILUC estimate values to fall substantially further over the subsequent decade.

Table 1. Comparison of New Mexico's estimated ILUC values for crop-based biofuels with most recent estimated values.

Low-carbon fuel pathway	ILUC (gCO₂e/MJ)	
	<i>New Mexico proposal</i>	<i>GTAP-BIO+CCLUB (2024)¹⁴</i>
Corn ethanol	19.8	6.10
Sugarcane ethanol	11.8	13.10
Sorghum ethanol	19.4	7.52
Soy biodiesel	29.1	10.32
Soy renewable diesel	29.1	11.69
Canola biodiesel	14.5	15.15
Canola renewable diesel	14.5	16.68

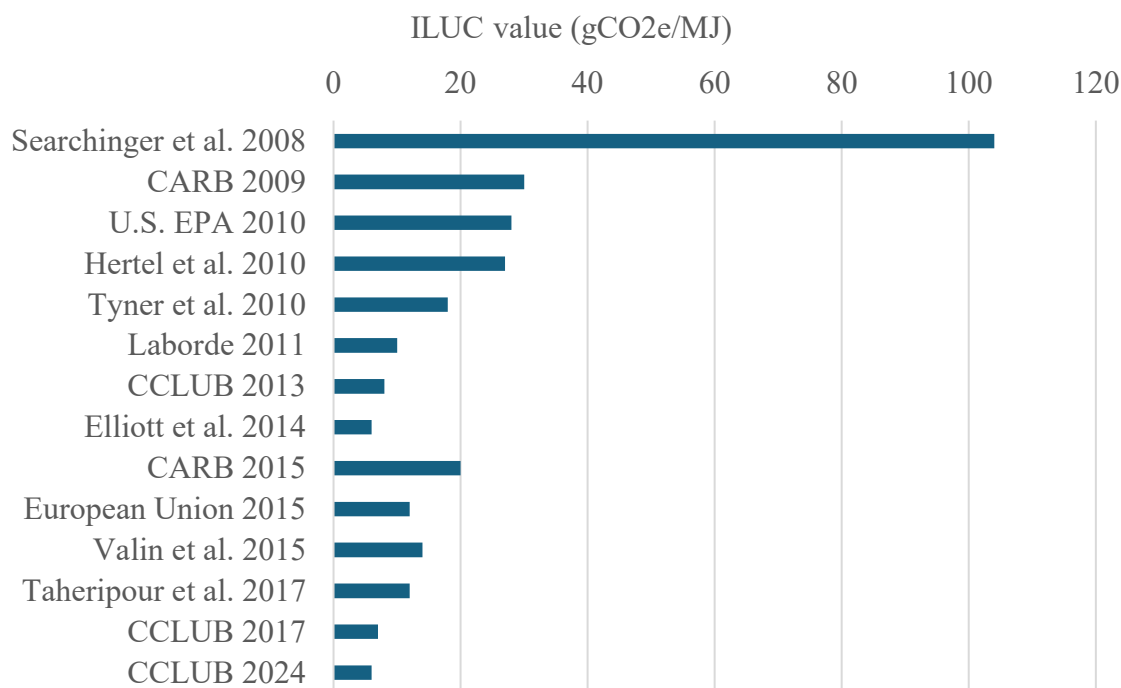


Figure 2. Comparison of corn ethanol ILUC values from selected studies. Adapted from Lee et al.²⁴ and updated to include Kwon et al.¹⁴

New Mexico’s proposed ILUC value for corn ethanol is higher than any of the values that GTAP-BIO + CCLUB is capable of calculating regardless of the database that is employed. A 2023 model comparison exercise (MCE) was conducted by the U.S. Environmental Protection Agency (EPA) using GTAP-BIO + CCLUB, as well as other ILUC models.²⁵ The exercise ran the 2017 version of GTAP-BIO + CCLUB through an extensive sensitivity analysis in order to determine how sensitive its ILUC estimates were to user assumptions. The MCE found that the estimates using CENTURY for domestic land use change emission factors ranged from 6.5 to 9.7 gCO₂e/MJ, with a midpoint value of 7.4 gCO₂e/MJ. Even applying international land use change emission factors to domestic lands, which is an extremely conservative assumption due to large differences in soil carbon content between the two, produced a high ILUC estimate of only 16.2 gCO₂e/MJ.

V. New Mexico Should Utilize ILUC Values as Calculated by GTAP-BIO + CCLUB in Order to Maintain Alignment with the U.S. Government Through Use of the Latest Data and Modeling Capabilities

ILUC emission value estimates have trended steadily lower since CARB calculated values for the LCFS in 2014 due to the development of more rigorous ILUC models that utilize updated databases supported by empirical data. The period from 2015 to 2025 saw major

improvements to ILUC modeling that were driven by U.S. government investment into the GTAP-BIO + CCLUB modeling framework. This framework now serves as the basis for multiple low-carbon fuel policies at the state and federal levels. Most notably, on January 10, 2025, the Biden Administration issued Treasury Notices [2025-10](#) and [2025-11](#), which implement the clean fuel production tax credit (26 U.S.C. § 45Z) and adopt the [45ZCF-GREET model](#) for purposes of calculating the lifecycle emissions of biofuels eligible for the tax credit. Like Argonne National Laboratories' R&D GREET Model, the 45ZCF-GREET Model uses the GTAP-BIO + CCLUB modeling framework to measure ILUC. New Mexico should align with the United States Treasury Department, Department of Energy and the State of Oregon which have all adopted GTAP-BIO + CCLUB to calculate updated ILUC values instead of adopting the obsolete values from CARB's 2014 use of GTAP-BIO + AEZ-EF.

Alignment would have two major advantages. First, alignment would minimize future distortions between New Mexico and other jurisdictions, particularly given that future policies (both existing and new) can be expected to utilize the latest modeling techniques and datasets. Second, alignment would minimize costs of the Clean Transportation Fuel Program while increasing the competitiveness of New Mexico's low-carbon fuel feedstock producers (e.g., sorghum farmers) by ensuring that participating low-carbon fuels with ILUC emissions receive the appropriate number of credits. The proposed use of the GTAP-BIO + AEZ-EF's 2014 ILUC values, by contrast, would unnecessarily reduce the credits received by low-carbon fuels with ILUC emissions, increasing the credit price necessary to achieve the required GHG emissions reduction threshold under the Clean Fuel Transportation Program.

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Professional Preparation

Member of the Missouri Bar	2009 – Present
Iowa State University, Ph. D., Biorenewable Resources & Technology	2014
University of Missouri, J.D.	2008
University of Iowa, Political Science, B.A.	2005

Professional Employment

Director of the Bioeconomy Development Institute, SUNY College of Environmental Science & Forestry, 2021 – Present

Professor of Energy Resource Economics, Dept. of Sustainable Resources Management, SUNY College of Environmental Science & Forestry, 2025 – Present

Associate Professor of Energy Resource Economics, Dept. of Sustainable Resources Management, SUNY College of Environmental Science & Forestry, 2019-2025

Assistant Professor of Energy Resource Economics, Dept. of Forest and Natural Resources Management, SUNY College of Environmental Science & Forestry, 2014–2019

SyracuseCoE Faculty Fellow, Syracuse Center of Excellence, Syracuse University, 2017–2018

Graduate Lecturer, Department of Political Science, Iowa State University, 2013–2014

Research Associate, Bioeconomy Institute, Iowa State University, 2011–2014

Research Associate, Department of Economics, Iowa State University, 2009–2011

Honors and Awards

2024 2024 Exemplary Researcher Award, SUNY ESF.

2014 Teaching Excellence Award, Iowa State University.

2012 Biofuels Digest 2012 Book of the Year Award, for Why are We Producing Biofuels?

2009 Winner, Farm Foundation 30-Year Policy Competition, Climate Change category, for “The Embedded Carbon Valuation System: A Policy Concept to Address Climate Change.”

Advisory Appointments

Energy Vision Board of Directors (2021-Present)

NYSERDA Anaerobic Digestion Project Steering Group (2021-2023)

NYS Climate Action Council, Agriculture and Forestry Advisory Panel, Bioeconomy Subgroup (2021-2022)

NYS Climate Action Council, Energy-Intensive and Trade-Exposed Industries Advisory Panel (2020-2022)

Synergistic Activities

- Led and coordinated research teams across four disciplines and with collaborators from outside institutions for two USDA grants totaling \$1,906,622.
- PI for externally-funded projects on the policy and economics of renewable energy and biobased products with combined budgets of \$2,287,409.
- Developed and taught five different classes on renewable energy policy and economics, and taught another three existing courses on renewable energy pathways.

EXHIBIT

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- Author or co-author on 32 refereed articles, three book chapters, and two textbooks on techno-economic analysis, life cycle assessment, and policy analysis of renewable energy pathways with collaborators from the fields of Agronomy, Economics, Engineering, Law, and Management.
- Advised government officials in policymaking and law enforcement at the international, federal and state levels on U.S. climate policy, and developed state policies in support of statutory decarbonization targets.

Grants Funded

- 2024 Co-PI: “Advancing Commercialization through the Monitoring, Measurement, and Verification of Large, Established Willow Biomass Crops,” U.S. DOE (\$8,012,587).
- 2023 PI: “Development of Stochastic Techno-economic Feedstock Risk Model,” EcoStrat (\$58,000).
Co-PI: “Upstate 2.0,” National Science Foundation (\$1,000,000, \$220,000 ESF share).
Co-PI: “Tool for Assessing Carbon Storing Materials – TACSMA,” NYSERDA (\$686,483).
Co-PI: “Sustainable Manufacturing via Upconversion of Waste to Stored Energy Systems. USDA NSRC (\$270,110).
- 2022 PI: “A review of the scientific literature on particulate matter emissions from wood-burning appliances,” Empire State Forest Products Association (\$37,022).
PI: “Carbon-Negative Renewable Distillate Fuels: Conversion of Willow Feedstocks into Liquid Fuels and Biochar,” USDA AFRI (\$999,900).
Co-PI: “New York Connects,” USDA Climate-Smart Commodities Partnership (\$60,000,000, \$11,000,000 ESF share).
Co-PI: “Indicators of the U.S. bioeconomy,” USDA Office of the Chief Economist (\$70,498 ESF share).
Co-PI: Sustainable sugar production from shrub willow and forest residues for bioproducts, biochemicals, and biofuels. CUSE Grant (\$44,000).
- 2021 PI: “A Review of the Scientific Literature on Greenhouse Gas and Co-Pollutant Emissions from Waste-Derived Bioenergy Resources,” New York League of Conservation Voters (\$34,858).
PI: “Quantifying the Comparative Value of Carbon Abatement Pathways Over Different Investment Timing Scenarios,” National Biodiesel Board (\$119,381).
PI: “Quantifying the Comparative Value of Carbon Abatement Pathways in Residential Space Heating Over Different Investment Timing Scenarios,” National Grid (\$89,213).
- 2020 Co-PI: “Developing New York’s Wood-Based Economy,” New York Ag & Markets (\$1,000,000).
Co-PI: “Mid-Atlantic Sustainable Biomass for Value-Added Products Consortium (MASBio),” USDA NIFA AFRI Competitive Grants Program (\$629,000 SUNY ESF share).
- 2019 PI: “Quantifying the Comparative Value of Carbon Abatement Pathways Over Different Investment Timing Scenarios,” National Biodiesel Board (\$58,585).
Co-PI: “Mass Timber Construction,” SUNY Discovery Challenge (\$600,000)
Co-PI: “Pathways to a Net-Zero Carbon Future: Landscape Design for Sustainable Energy and Climate Change Mitigation,” SUNY Discovery Challenge (\$600,000)
- 2017 PI: “Evaluating the Ability of Land to Replicate Indian Point’s Electricity Supply Profile,” Syracuse Center of Excellence (\$15,000).
- 2016 PI: “Development Of Stochastic Techno-Economic And Life Cycle Models For Quantifying The Economic And Environmental Costs Of Cellulosic Bioenergy,” USDA BRDI (\$906,722).
- 2015 PI: “Development of Stochastic Techno-economic Model for Short-Rotation Woody Crop Production,” NEWBio (\$10,000).
- 2011 PI: “Energy Education Grant,” Iowa Office of Energy Independence (\$13,750).
Co-PI: “Techno-economic Analysis Initiative,” Bioeconomy Institute (\$150,000).
- 2010 PI: “The Embedded Carbon Valuation System as an Alternative to Cap-and-Trade,” Biobased Industry Center (\$40,000).

Refereed Publications (* denotes invited paper)

- 2025 Asamoah, S., **T.R. Brown**, S. Mousavi, R. Malmsheimer, T. Volk. "Technoeconomic Evaluation of Landowner Participation in Willow Biomass Production for a Biorefinery." *Biomass and Bioenergy* 200: 108060.
- Mousavi, S., **T.R. Brown**, R. Malmsheimer, D. Kumar, J. Frank. "End-of-Life Climate Impacts of Polyhydroxyalkanoates in the United States: The Role of Feedstock Variability and Temporal Dynamics - A Systematic Review." *Polymer Degradation and Stability* 240: 111500.
- Mousavi, S., **T.R. Brown**, R.W. Malmsheimer. "Sustainable bioplastics products for building applications: recent trends and future opportunities – A systematic review." *Biofuels, Bioproducts, and Biorefining* <https://doi.org/10.1002/bbb.70005>.
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- 2014 **Brown, T.R.**, M.M. Wright. “Techno-economic impacts of shale gas on cellulosic biofuel pathways.” *Fuel*, 117B: 989-995 (2014).
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- 2013 ***Brown, T.R.**, R.C. Brown. “Techno-economics of advanced biofuels pathways.” *RSC Advances*, 3(17):5758-5764 (2013).
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- Zhang, Y., **T.R. Brown**, G. Hu, R.C. Brown. “Comparative techno-economic analysis of biohydrogen production via bio-oil gasification and bio-oil reforming.” *Biomass and Bioenergy*, 51:99-108 (2013).
- 2012 **Brown, T.R.**, R. Thilakaratne, R.C. Brown, and G. Hu. “Techno-economic analysis of biomass to transportation fuels and electricity via fast pyrolysis and hydroprocessing.” *Fuel*, 106:463-469 (2012).
- Brown, T.R.**, Y. Zhang, G. Hu, R.C. Brown. “Techno-economic analysis of biobased chemicals production via Integrated Catalytic Processing.” *Biofuels, Bioproducts, and Biorefining*, 6:73-87 (2012).
- Brown, T.R.**, G. Hu. “Technoeconomic sensitivity of biobased hydrocarbon production via fast pyrolysis to government incentive programs.” *Journal of Energy Engineering*, 138:54-62 (2012).

- Zhang, Y., **T.R. Brown**, G. Hu, R.C. Brown. “Techno-economic analysis of monosaccharide production via fast pyrolysis of lignocellulose.” *Bioresource Technology*, 127:358-365 (2012).
- 2011 **Brown, T.R.**, M. Wright, R.C. Brown. “Estimating profitability of two biochar production scenarios: Slow pyrolysis vs. fast pyrolysis.” *Biofuels, Bioproducts, and Biorefining* 5:65-68 (2011).
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Industry Publications

- 2021 Carr, M., **T.R. Brown**, C. Murphy. “Biotech solutions for climate report: Examining biotechnology's contributions to addressing the climate crisis.” *Industrial Biotechnology* 17(3): 151-165 (2021).
- 2020 **Brown, T.R.** “Biomass-based diesel: A market and performance analysis.” Fuels Institute, March 2020.

Working Papers and Essays

- 2022 Ha, H. and **T.R. Brown**. “A review of the scientific literature on greenhouse gas and co-pollutant emissions from waste- and coproduct-derived biomass-based diesel and renewable natural gas.” Bioeconomy Development Institute, January 2022. Available on the Web at: https://static1.squarespace.com/static/53a09c47e4b050b5ad5bf4f5/t/61f9865afb2b77058f2f4515/1643742811198/BBD_RNGwhitepaper.pdf.
- 2019 Malmsheimer, R.W., T.A. Volk, H. Ha, J. Frank, **T.R. Brown**. “Why the IPCC believes that Bioenergy Carbon Capture and Storage (BECCS) is Critical to Limiting Global Warming to 1.5°C.” *World Biomass*.
- 2017 **Brown, T.R.** “A perspective on proposed changes to the revised Renewable Fuel Standard’s blending obligation.” Available on the Web at: https://www.researchgate.net/publication/315812529_A_Perspective_on_Proposed_Changes_to_the_Revised_Renewable_Fuel_Standard%27s_Blending_Obligation.
- 2010 **Brown, T.R.**, A. Elobeid, D. Hayes, J. Dumortier. “Market impact of domestic offset programs.” Working Paper 10-WP 502, Center for Agricultural and Rural Development, Iowa State University, January 2010.
- 2009 **Brown, T.R.**, D. Hayes, R.C. Brown. “The Embedded Carbon Valuation System: A Policy Concept to Address Climate Change.” Farm Foundation 30-Year Challenge Policy Competition, June 2010.

Books and Book Chapters

- 2024 **Brown, T.R.** and J. Frank. “Policy and Biochar.” In: Lehmann, Johannes and S. Joseph, editors. Biochar for Environmental Management. Routledge; 2024.
- 2019 Wright, M.M. and **T.R. Brown**. “Costs of Thermochemical Conversion of Biomass to Power and Liquid Fuels.” In: Brown, R.C., editor. Thermochemical Processing of Biomass. Wiley; 2019.
- 2017 **Brown, T.R.** “Economic Comparison of Various Pathways to Pyrolysis-Based Fuels.” In: Brown, R.C. and K. Wang, editors. Fast Pyrolysis of Biomass: Advances in Science and Technology. Royal Society of Chemistry; 2017.
- 2014 **Brown, T.R.**, M.M. Wright, Y. Roman-Leshkov, R.C. Brown. “Techno-economic assessment of biorefineries.” In: Waldron, K.W., editor. Advances in Biorefineries: Biomass and waste supply chain exploitation. Woodhead Publishing; 2014.
- 2013 Brown, R.C., **T.R. Brown**. Biorenewable Resources, 2nd ed., 2013.
- 2012 Brown, R.C., **T.R. Brown**. Why are We Producing Biofuels? Ames: Brownia; 2012.

Technical Presentations

- 2025 Hossain, M.S., C.G. Yoo, S. Adhikari, O. Therasme, T.A. Volk, T.R. Brown, and D. Kumar. “Techno-economic analysis of bioplastic and bio-oil co-production from forest residue biomass using hybrid conversion process.” ASABE Annual International Meeting 2025, Toronto, Canada, July 13 – 16, 2025.
Mousavi, S., **T.R. Brown**, R.W. Malmsheimer. “Decarbonization through Bioplastic Wall Systems: Life Cycle and Energy Analysis in Residential Buildings in New York State.” 23rd Annual New York State Green Building Conference, Syracuse, NY, March 27, 2025.
- 2024 **Brown, T.R.** “The climate- and environmentally-beneficial valorization of woody biomass in New York State.” Key Technologies of the Bioeconomy 2024, Ubatuba, Brazil, October 4, 2024.
- 2023 **Brown, T.R.**, T. Volk, R.W. Malmsheimer, D. Kumar, and O. Therasme. “Renewable carbon-negative distillate fuels: Conversion of willow feedstocks into liquid fuels and biochar.” U.S. Department of Agriculture 2023 Principal Investigator Meeting, Kansas City, MO, July 14, 2023.
Dill, A., **T.R. Brown**, H. Ha, R.W. Malmsheimer. “Integration of Biomass Feedstock and Conversion Models.” ISSST 2023, Ft. Collins, CO, June 13, 2023.
- 2022 H. Ha, **T.R. Brown**, R.J. Quinn, T.A. Volk, R.W. Malmsheimer, M.-O. Fortier, J.R. Frank, S. Bick. “A stochastic techno-economic analysis of forest biomass feedstock supply chains: clean and dirty chips for bioenergy applications.” 2022 North American Biochar and Bioenergy Conference, Morgantown, WV. August 9, 2022.
Brown, T.R., T. Volk, R. Malmsheimer, D. Kumar, O. Therasme, R.C. Brown, R. Smith, T. Daugaard, and M. Haverly. “Carbon-negative renewable distillate fuel in New York State.” tcbiomass2021, Denver, CO. April 21, 2022.
Dill, A., **T.R. Brown**, R. Malmsheimer, H. Ha, J. Frank, P. Kileti, B. Barkwill, and M. Mauro. “Determining the comparative value of carbon abatement pathways in residential space heating.” AIChE Spring Meeting, San Antonio, TX. April 13, 2022.

- H. Ha, **T.R. Brown**, J. Frank, and A. Dill. Carbon intensities and criteria air pollutant emissions of waste- and coproduct-derived bioenergy resources resulting from on-road transportation applications. AIChE Spring Meeting, San Antonio, TX. April 12, 2022.
- H. Ha, **T.R. Brown**, R. J. Quinn, T. A. Volk, R. W. Malmshiemer, M. O. Fortier, J. R. Frank, S. Bick. "A Stochastic Techno-Economic Analysis of Forest Biomass Feedstock Supply Chains: Clean and Dirty Chips for Bioenergy Applications." 3rd International Conference on Environment and Forest Conservation (ICEFC), Kastamonu, Turkey. February 21, 2022.
- 2021 Frank, J., **T.R. Brown**, H. Ha, M. Haverly, D. Slade, and R.W. Malmshiemer. "Quantifying the Cumulative Greenhouse Gas Emissions and Financial Viability of Heavy-Duty Transportation and Residential Heating Pathways for the Northeastern United States." Energy Policy Conference. October 15, 2021.
- 2020 Frank, J., **T.R. Brown**, M. Haverly, D. Slade, and R.W. Malmshiemer. "Quantifying the Comparative Value of Carbon Abatement Scenarios over Different Investment Timing Scenarios." Next Generation Scientists for Biodiesel, Virtual Science Live Event. September 10, 2020.
- Ha, H., Y. Kim, **T.R. Brown**, M.-O. Fortier, T.A. Volk, R.W. Malmshiemer, J. Frank, and O. Therasme. "Integrated Life Cycle Assessment and Techno-Economic Analysis of a Forest Biomass Feedstock Supply in the Northeast United States." AIChE Virtual Spring Meeting. August 21, 2020.
- Brown, T.R.** "Biofuels and Transportation Decarbonization Under the CLCPA." New York Society of American Foresters Annual Meeting, Syracuse, NY. January 24, 2020.
- Frank, J., **T.R. Brown**, M. Haverly, D. Slade, and R.W. Malmshiemer. "Quantifying the comparative value of carbon abatement scenarios over different investment timing scenarios." National Biodiesel Conference and Expo, Tampa, FL. January 22, 2020.
- 2019 Frank, J., **T.R. Brown**, R. Bhonagiri, R. Quinn, K. McGiver, M.-O. Fortier, R. Malmshiemer, T. Volk, and T. Dapp. "Assessing Indian Point's electricity generation through renewable energy pathways: A technical and economic analysis." Energy Policy Research Conference, Boise, ID. September 30, 2019.
- 2018 Frank, J., **T.R. Brown**, R. Bhonagiri, R.J. Quinn, K. McGiver, M.-O. Fortier, R.W. Malmshiemer, T.A. Volk. "Assessing Indian Point's energy generation through renewable electricity pathways: A technical and economic analysis." AIChE Annual Meeting, Pittsburgh, PA. November 1, 2018.
- Ha, H., **T.R. Brown**, Quinn, Ryan J., T.A. Volk, R.W. Malmshiemer, M.O. Fortier and J.R. Frank, "Techno-economic analysis of supplying forest biomass feedstock for biopower applications." AIChE Annual Meeting, Pittsburgh, PA. October 25, 2018.
- Quinn, R.J., H. Ha, R. Bhonagiri, T.A. Volk, **T.R. Brown**, D. Kiernan, R. Malmshiemer, and M.-O. Fortier. "Life cycle assessment of forest biomass pathways in the Northeast U.S." AIChE Annual Meeting, Pittsburgh, PA. October 27, 2018.
- Sullivan, B.M., M.-O. Fortier, **T.R. Brown**, R. Malmshiemer. "Geographic life cycle assessment of electricity from tidal turbines in the United States." SETAC Europe 24th LCA Case Study Symposium, Vienna, Austria. September 25, 2018.

- Frank, J., **T.R. Brown**, R. Malmsheimer. “A techno-economic evaluation of the financial trade-off between the production of biochar, biofuel, and methanol via pyrolysis under uncertainty.” USBI Biochar Conference, Wilmington, DE. August 22, 2018.
- Brown, T.R.**, J. Frank, H. Ha, R. Quinn, J. Heavey, M.-O. Fortier, T. Volk, R. Malmsheimer. “Stochastic analysis of lignocellulosic feedstock systems for bioenergy applications.” AIChE Spring Meeting, Orlando, FL. April 25, 2018.
- 2017 Frank, J., **T.R. Brown**, T. Volk, R. Malmsheimer, J. Heavey. “A Stochastic Techno-Economic Model for Quantifying the Economic Cost of Cellulosic Bioenergy Pathways in the Northeast U.S.” AIChE Annual Meeting, Minneapolis, MN. November 2, 2017.
- 2015 **Brown, T.R.** “A Critical Analysis of Thermochemical Cellulosic Biorefinery Capital Cost Estimates.” Tcbiomass2015, Chicago, IL. November 5, 2015.
- Zhao, X., **T.R. Brown**, W. Tyner. “Stochastic techno-economic evaluation of cellulosic biofuel pathways.” 33rd USAEE/IAEE North American Conference, Pittsburgh, PA. October 26, 2015.
- 2014 **Brown, T.R.** “A Framework for Defining the Economic Feasibility of Cellulosic Biofuel Pathways.” 4th Annual Energy Policy Research Conference, San Francisco, CA. September 4-5, 2014.
- 2013 **Brown, T.R.** and M.M. Wright. “Techno-economic impacts of shale gas on cellulosic biofuel pathways.” AIChE 2013 Meeting, San Francisco, CA. November 4-7, 2013.
- 2012 Brown, R.C. and **T.R. Brown**. “Commercial Prospects for Advanced Biofuels.” Coastal Bend Energy Forum of the ACS South Texas Chapter, Chicago, IL. October 26-28, 2012.
- 2010 **Brown, T.R.**, M. Wright, R.C. Brown. “Estimating the Profitability of Two Biochar Production Scenarios.” 2010 U.S. Biochar Initiative Conference, Ames, IA. June 26-30, 2010.

Invited Talks

- 2025 **Brown, T.R.** “Overcoming Barriers to Carbon Accounting for Bio-Based Chemicals.” Molecule Forum EU, Brussels, Belgium. June 13, 2025.
- Brown, T.R.** “New York State’s Climate-Focused Biochar Policies: Opportunities, Obstacles, and Lessons for other Jurisdictions.” Biochar IV, Santa Marta, Colombia. May 21, 2025 (keynote).
- Brown, T.R.** “Overcoming Barriers to Carbon Accounting for Bio-based Products.” Molecule Forum North America, Washington, D.C. May 13, 2025.
- Brown, T.R.** “State-level Legislative Leadership on Clean Fuel Programs.” RNG Summit 2025, Houston, TX. April 24, 2025.
- Brown, T.R.** “Cutting Through the Noise: Obtaining Foundational Data for Advocacy & Education.” RNG Summit 2025, Houston, TX. April 23, 2025.
- Brown, T.R.** “The New York State Bioeconomy: Opportunities and Hurdles Under the New York State CLCPA.” SUNY ESF Exemplary Researcher Seminar, Syracuse, NY. March 27, 2025.
- 2024 **Brown, T.R.** “Global Water Industry: Supplies and Infrastructure.” GLG Virtual Climate Change Event, London, UK. June 12, 2024.
- Brown, T.R.** “Plastic Waste Crisis: Environmental Impact and Industry Challenges.” GLG Virtual Climate Change Event, London, UK. February 13, 2024.

- 2023 **Brown, T.R.** “New York Cap-and-Invest: Lessons Learned Elsewhere.” New York Association of Public Power Fall Conference, Cooperstown, NY, October 3, 2023.
- Brown, T.R.** “Low-Carbon Fuels and the New York State CLCPA.” NECA Fuels Conference, Boston, MA, September 18, 2023.
- Brown, T.R.** “Affordability and Equity.” City & State NY Electrification Summit, Albany, NY, May 31, 2023.
- Brown, T.R.** “The Role of Forestry during New York’s Energy Transition.” New York Society of American Foresters Annual Meeting 2023, Syracuse, NY, January 26, 2023.
- 2022 **Brown, T.R.** “Seed Industry and Sustainability Demands: Opportunities and Challenges.” CSS & Seed Expo 2022, Chicago, IL, December 7, 2022 (keynote).
- Brown, T.R.** “Plastics Pollution and the Oceans.” GLG Virtual Climate Change Event, London, UK. November 16, 2022.
- Brown, T.R.** “The Future of Energy on Long Island.” Long Island Energy Conference, Molloy University, Rockville Centre, NY, October 26, 2022.
- Brown, T.R.** “The Financial Sector and Droughts.” GLG Virtual Climate Change Event, London, UK, October 25, 2022.
- Brown, T.R.** “The Financial Sector and Climate Change.” GLG Virtual Climate Change Event, London, UK. October 19, 2022.
- Brown, T.R.** “An Update on the Climate-Focused Bioeconomy in New York State.” All-Island Bioeconomy Summit, Tullamore, Ireland. October 12, 2022.
- Brown, T.R.** “Insurance and the Climate-Focused Bioeconomy.” InnSure Climate Forum, Boston, MA. October 6, 2022.
- Brown, T.R.** “Achieving State Climate Change Goals with Bio-Energy” (panel). Pathways to a Clean Future Forum, Albany, NY. September 15, 2022.
- Brown, T.R.** “The Insurance Sector and the Climate Protection Gap.” Joh. Berenberg, Gossler & Co. KG Virtual Climate Change Event, Hamburg, Germany. July 7, 2022.
- Brown, T.R.** “The Climate-Focused Bioeconomy in New York State.” NewLab Bioeconomy Initiative Workshop, Brooklyn, NY. June 29, 2022.
- Brown, T.R.** “The Climate-Focused Bioeconomy in New York State.” 2022 Climate-Focused Bioeconomy Workshop, Syracuse, NY. May 12, 2022.
- Brown, T.R.** “The Role of New York Agriculture Under the CLCPA.” 2021 New York State Agricultural Society Annual Meeting and Forum. Syracuse, NY, January 6, 2022.
- 2021 **Brown, T.R.** and H. Ha. “Methane at the Interface of Science and Policy: A New York State Perspective.” 3rd Renewable Natural Gas Summit. Virtual, December 14, 2021.
- Brown, T.R.** “The Next Generation of State Clean Energy Initiatives.” Council of State Governments National Conference. Santa Fe, NM, December 3, 2021.
- Frank, J., **T.R. Brown**, H. Ha, D. Slade, M. Haverly, and R. Malmsheimer. “Quantifying the Cumulative Greenhouse Gas Emissions and Financial Viability of Heavy-Duty Transportation Pathways for the Northeastern United States.” Biodiesel Technical Workshop. Kansas City, MO, November 12, 2021.

- Brown, T.R.** “Why Hydrogen Must be a Part of New York’s Decarbonization Strategy.” New York Business Council 2021 Annual Environment Conference, Saratoga Springs, NY. November 10, 2021.
- Brown, T.R.** “Biofuels and Transportation Decarbonization under the CLCPA.” Empire State Forest Products Association Regional Meeting, Rensselaer, NY. September 27, 2021.
- Brown, T.R.,** J. Frank, O. Therasme, T. Volk, H. Ha, M.-O. Fortier, R. Malmshiemer. “Negative carbon abatement costs from shrub willow production in the Northeastern U.S.: An integrated stochastic analysis.” Iowa State University, Bioeconomy Institute, Ames, IA. May 3, 2021.
- Brown, T.R.** “Overview of Advanced Biobased Processing.” New York Climate Leadership and Community Protection Act Bioeconomy Subgroup, Albany, NY. March 1, 2021.
- 2020 **Brown, T.R.** “Thermochemical Processing and the New York Climate Leadership and Community Protection Act.” 2020 Thermochemical Conversion & Biochar Workshop, Rochester, NY. October 29, 2020.
- Brown, T.R.** “Why are we producing sustainable energy?” Union College Earth Day Lecture, Schenectady, NY. April 22, 2020.
- Brown, T.R.** “Global Biofuel Growth and Developments.” UBS Global Investment Research Conference, London, UK. April 1, 2020.
- 2019 Malmshiemer, R.W., C. Beier, **T.R. Brown**, P. Crovella, J. Heavey, and T. Volk. “SUNY ESF’s Forest-Based Climate Change Research.” Mackenzie Hughes LLP Attorney Retreat, Oneida, NY. September 26, 2019.
- Brown, T.R.** “Biochar and Sustainability in NYS: A Brief Overview.” Helping NYS Address Its Climate Goals through Thermochemical Conversion Workshop, Cornell University. July 16, 2019.
- Brown, T.R.** “Biomass-based diesel in the U.S. and world markets: An overview.” Fuels2019, Dallas, TX. May 21, 2019.
- Brown, T.R.,** Frank, J., Ha, HakSoo, Quinn, R., McGiver, K., et al. “Assessing Indian Point’s Energy Generation Through Renewable Electricity Pathways: A Technical and Economic Analysis.” University of Idaho Natural Resources and Society Seminar, Moscow, ID. March 26, 2019.
- 2018 **Brown, T.R.,** H. Ha, R. Quinn, T. Volk, R. Malmshiemer, et al. “Integrated TEA/LCA of Lignocellulosic Feedstock Systems for Bioenergy Applications.” MABEX 2018, Philadelphia, PA. September 12, 2018.
- Brown, T.R.** “An Interdisciplinary Approach to Analyzing International Energy Development Feasibility Under Uncertainty.” Pennsylvania State University, School of International Affairs, State College, PA. January 22, 2018.
- 2017 **Brown, T.R.** “America’s Missing Cellulosic Gallons.” Pennsylvania State University, MABEX 2017, State College, PA. September 13, 2017.
- 2016 **Brown, T.R.** “Biochar, Dedicated Energy Crops, and Sustainable Energy Policy.” Cornell University, 2016 Biochar Conference, Ithaca, NY. April 15, 2016.
- 2015 **Brown, T.R.** “Soil Carbon and Sustainable Energy Policy.” Cornell University, Atkinson Center for a Sustainable Future Seminar, Ithaca, NY. September 25, 2015.

- Brown, T.R.** “Motivations for Energy Policy.” Alfred State Renewable Energy Seminar, Alfred, NY. March 26, 2015.
- 2014 **Brown, T.R.** “A Landmark Test of ILUC.” ExCo 74 Workshop: Land-use and Mitigating ILUC, IEA Bioenergy, Brussels, Belgium. October 23, 2014.
- 2013 **Brown, T.R.** “Middle East Energy: Crisis or Plenty?” Osher Lifelong Learning Institute at ISU Lecture, Ames, IA. October 7, 2013.
- Brown, T.R.** “Biofuels and Globalization.” 2013 Technology, Globalization, and Culture Lecture, Ames, IA. September 17, 2013.
- Brown, T.R.** “RIN Policy and Regulatory Headline Risk in 2013.” Iowa Biodiesel Board 2013 Annual Meeting, Ankeny, IA. September 13, 2013.
- Brown, T.R.** “RIN Policy and Regulatory Headline Risk in 2013.” 2013 EcoEngineers RIN Academy, Des Moines, IA. August 26, 2013.
- Brown, T.R.** “The Challenges to Biodiesel.” 2013 Renewable Energy Group Leadership Meeting, Ames, IA. August 1, 2013.
- Brown, T.R.** “The Economics of Hybrid Processing.” 2nd Annual Hybrid Processing Symposium, Ames, IA. May 16, 2013.
- Brown, T.R.** “Are Biofuels a Crime against Humanity?” 2013 Agricultural Forum: Science, Education & Research, Ames Chamber of Commerce, Ames, IA. April 18, 2013.
- Brown, T.R.** “Fast Pyrolysis and the RFS2: The Effects of Uncertainty.” Iowa NSF EPSCoR Energy Policy Workshop Series, Ames, IA. February 7, 2013.
- 2012 **Brown, T.R.** “Biofuels and Globalization.” 2012 Technology, Globalization, and Culture Lecture, Ames, IA. October 17, 2012.
- Brown, T.R., R.C. Brown.** “Why Are We Producing Biofuels?” Osher Lifelong Learning Institute at ISU Lecture, Ames, IA. April 24, 2012.
- 2011 **Brown, T.R.** “Biofuels and Globalization.” 2011 Technology, Globalization, and Culture Lecture, Ames, IA. November 28, 2011.
- 2010 **Brown, T.R., M. Wright, R.C. Brown.** “The Embedded Carbon Valuation System: Impacts on Bio-energy Systems.” Alternative Policies on Climate Change and their Implications for U.S. Agricultural Economy Conference, Fargo, ND. May 24, 2010.

Teaching Experience

SRE 419/619 Energy Policy Assessment Methodologies, SUNY-ESF (Spring 2017 – Spring 2020)
 SRE 337/537 Energy Resource Assessment, SUNY-ESF (Spring 2017 – Spring 2019)
 SRE 335/535 Renewable Energy, SUNY-ESF (co-taught Spring 2016)
 FOR 208 Intro to Sustainable Energy Resources, SUNY-ESF (Fall 2015)
 SRE 416 Sustainable Energy Policy, SUNY-ESF (Spring 2015 - present)
 BRT 516X International Biorenewables Law & Policy, Iowa State University (Spring 2014)
 BRT 501 Fundamentals of Biorenewable Resources (Spring 2013)
 BRT 515 Biorenewables Law & Policy, Iowa State University (Spring 2012 - Fall 2013)

Graduate Students

Andry Razanokoto (M.S., 2017)
 Jenny Frank (M.S., 2018)

Wayne Wang (M.P.S., 2018)
 Mark Finley (M.P.S., 2019)
 Ryan Quinn (M.S., 2019)
 Kirsten McGiver (M.P.S., 2020)
 Phoebe O’Conner (M.P.S., 2020)
 HakSoo Ha (Ph.D., 2021)
 Patrick Wickersham (M.P.S., 2021)
 Jenny Frank (Ph.D., 2021)
 Michael Goodman (M.P.S., 2022)
 Leila Nayar (M.P.S., 2022)
 Alexandra Dill (Ph.D., 2025)
 Niloufar Mousavi (Ph.D., expected 2026)
 Samuel Asamoah (Ph.D., expected 2027)
 Chen, Xiaowei (Ph.D., expected 2027)

Peer Reviewer

<i>Biomass & Bioenergy</i>	2018 – present
<i>Energy Policy</i>	2017 – present
<i>Green Chemistry</i>	2016 – present
<i>GCB Bioenergy</i>	2015 – present
<i>Bioresource Technology</i>	2013 – present
<i>BioFPR</i>	2013 – present
<i>BioResources</i>	2013 – present
<i>Fuel</i>	2012 – present
<i>Journal of Waste Management</i>	2012 – present

Academic Committee Work

SUNY-ESF General Education Assessment Committee (2024-Present)
 SRM Departmental Review Committee (2022-Present)
 SRM Graduate Education Committee (2018-Present)
 Sustainable Energy Management Faculty Search Committee (2019-2020)
 Sustainable Energy Management Faculty Search Committee (2018-2019)
 Sustainable Energy Management Faculty Search Committee, Chair (2017–2018)
 Construction Management Faculty Search Committee (2017-2018)
 SUNY-ESF Campus Sustainability Committee (2016–Present)
 Sustainable Energy Management Ad Hoc Committee (2015–2017)
 Sustainable Energy Management Faculty Search Committee (2015–2016)