

for your information



## **Newsletter**

Ausgabe November/Dezember/Januar/Februar  
2024

Liebe Leserinnen, liebe Leser,

mit diesem Newsletter informieren wir über neue Fachpublikationen, Veranstaltungen und Meldungen zu ausgewählten Dekarbonisierungstechnologien an der Schnittstelle von Land- und Energiewirtschaft. Neue Publikationen und kommende Veranstaltungen werden auf Basis einer Recherche und externen Hinweise zusammengetragen.

Gefördert durch:



Der Newsletter wird im Rahmen des Projekts Landgewinn „Energiesystemanalyse von Dekarbonisierungsstrategien der Landwirtschaft“ veröffentlicht, das vom Bundesministerium für Wirtschaft und Klimaschutz (BMWK) gefördert wird. Ziel des Projekts ist die fachlich übergreifende Bewertung der drei landwirtschaftlichen Dekarbonisierungstechnologien Agri-Photovoltaik, Pyrolyse zur Herstellung von Pflanzkohle sowie klimaneutrale Mobilität in der Landwirtschaft.

aufgrund eines Beschlusses  
des Deutschen Bundestages

Die geteilten Informationen wurden sorgfältig zusammengestellt, dabei übernehmen wir keine Verantwortung für die Inhalte, Richtigkeit und Vollständigkeit der Informationen. Die Suchergebnisse werden entsprechend der Quellen auf Deutsch oder Englisch aufgeführt. Direkte Zitate sind über Anführungszeichen kenntlich gemacht und die Fundstelle angegeben oder auch verlinkt.

Der Newsletter erscheint in einem zwei- bis viermonatigen Turnus. Wir freuen uns, wenn Sie uns für den Landgewinn-Kontext relevante Veröffentlichungen, Veranstaltungen und neue Projekte, die Ihnen über den Weg laufen, zukommen lassen ([hannes.bluhm@ioew.de](mailto:hannes.bluhm@ioew.de)).

Viel Spaß beim Lesen!

Ihr Landgewinn-Team

## Neue Publikationen

### Landgewinn-Veröffentlichung: Datenzusammenstellung zur Herstellung von Pflanzenkohle durch Pyrolyse

Elmar Zozmann, Clara Lenk

Link: [Begleittext zur Datenzusammenstellung](#)

Link: [Datenzusammenstellung zur Herstellung von Pflanzenkohle durch Pyrolyse](#)

Kurzbeschreibung: „Existierende ökonomisch-ökologische Bewertungen zur Herstellung und Anwendung von Pflanzenkohle sind häufig aufgrund ihres Fallstudiencharakters nicht generalisierbar. Um eine aktuelle und verallgemeinerbare Datengrundlage für weitere Analysen zu schaffen, werden in der Datenzusammenstellung drei generische Prozesskonfigurationen für die Herstellung und Anwendung von Pflanzenkohle definiert. Die Prozesskonfigurationen basieren auf empirisch erhobenen Daten, die um weitere Angaben aus der Literatur ergänzt werden. In diesem Begleitdokument werden die erfassten technischen, ökonomischen und ökologischen Parameter beschrieben. Einleitend wird kurz der Pyrolyseprozess, die Vorgehensweise der Recherche und die Ableitung der Prozesskonfigurationen dargestellt.“

### Paper: Biochar reduced the mineralization of native and added soil organic carbon: evidence of negative priming and enhanced microbial carbon use efficiency

Kalu, S., Seppänen, A. et al.

Link: [Biochar reduced the mineralization of native and added soil organic carbon](#)

Kurzbeschreibung: “Biochar has been widely recognized for its potential to increase carbon (C) sequestration and mitigate climate change. This potential is affected by how biochar interacts with native soil organic carbon (SOC) and fresh organic substrates added to soil. However, only a few studies have been conducted to understand this interaction. To fill this knowledge gap, we conducted a <sup>13</sup>C-glucose labelling soil incubation for 6 months using fine-textured agricultural soil (Stagnosol) with two different biochar amounts. Biochar addition reduced the mineralization of SOC and <sup>13</sup>C-glucose and increased soil microbial biomass carbon (MBC) and microbial carbon use efficiency (CUE). The effects were found to be additive i.e., higher biochar application rate resulted in lower mineralization of SOC and <sup>13</sup>C-glucose. Additionally, soil density fractionation after 6 months revealed that most of the added biochar particles were recovered in free particulate organic matter (POM) fraction. Biochar also increased the retention of <sup>13</sup>C in free POM fraction, indicating that added <sup>13</sup>C-glucose was preserved within the biochar particles. The measurement of <sup>13</sup>C from the total amino sugar fraction extracted from the biochar particles suggested that biochar increased the microbial uptake of added <sup>13</sup>C-glucose and after they died, the dead microbial residues (necromass) accumulated inside biochar pores.[...] Overall, the study demonstrates the additional C sequestering potential of biochar by inducing negative priming of native SOC as well as increasing CUE, resulting in the formation and stabilization of microbial necromass.“

## Senior-Thesis: Public Perception's Role in Carbon Removal at Scale: The Importance of Public Opinion on Barriers to Implementation of CDR

Evanson, Ben J.

Link: [Public Perception's Role in Carbon Removal at Scale](#)

Kurzbeschreibung: “The CDR industry will need to overcome six primary barriers: Biophysical Constraints, Research and Modeling, Governance, Funding Mechanisms, Social Acceptability, and Industry Development. Lacking thus far in literature, this thesis explores what role Social Acceptability plays within each of the other established barriers to scaling. This thesis analyses these barriers through the lens of a social license to operate (SLO), building off related industries' successes and failures in achieving such an SLO. We identify four unique communities whose acceptance of the carbon removal industry will be important to its ability to scale at speed and to a high capacity, political communities, markets, general publics, and local communities.”

## Paper: Biochar ageing effects on soil respiration, biochar wettability and gaseous CO<sub>2</sub> adsorption

Gerardo Ojeda, João M. Gil et al.

Link: [Biochar ageing effects on soil respiration, biochar wettability and gaseous CO<sub>2</sub> adsorption](#)

Kurzbeschreibung: “After its application to soil, biochar suffers an ageing process, able to deteriorate its functional properties as soil improver. However, at present, it is not clear how to evaluate biochar ageing. The main aim of this study is to evaluate biochar ageing by determination of temporal changes on (a) soil respiration after biochar addition and (b) the relationship between CO<sub>2</sub> adsorption capacity and wettability of biochar as measurable parameters indicating biochar ageing.”

## Studie: QM für Holzvergaser-BHKW und Pflanzenkohleanlage Teil 1

Thomas Nussbaumer

Link: [QM für Holzvergaser-BHKW und Pflanzenkohleanlagen](#)

Kurzbeschreibung: „Nebst Holzheizwerken wurden in den letzten Jahren auch eine begrenzte Anzahl mit Holzvergasung und Gasnutzung zur Wärme-Kraft-Kopplung in Blockheizkraftwerken (Holzvergaser-BHKW) realisiert. Daneben führte das zunehmende Interesse an Pflanzenkohle auch zur Realisierung einiger Anlagen zur Produktion von Pflanzenkohle. Da auch Holzvergaser-BHKW und Pflanzenkohleanlagen zum Teil Anspruch auf die [...] Fördermöglichkeiten haben und gleichzeitig erst wenig Erfahrungen zu deren Einsatz besteht, wird in der vorliegenden Arbeit ein Vorschlag zum Qualitätsmanagement für diese Anlagenkategorien erarbeitet. Das vorliegende Dokument beschreibt die Grundlagen für das Qualitätsmanagement und dient als Basis für die im Teil 2 dokumentierte Umsetzung eines Qualitätsmanagements für Holzvergaser BHKW und für Pflanzenkohleanlagen”

## Masterarbeit: Pyrolyse von Biomasse zur Unterstützung der Wärmewende im ländlichen Raum

Daniel Gehr

Link: [Pyrolyse von Biomasse zur Unterstützung der Wärmewende](#)

Kurzbeschreibung: „Der Wärmewende und der Abkehr von fossilen Energieträgern kommt gegenwärtig ein zentraler Stellenwert in der politischen Agenda zu. Die Herausforderung liegt insbesondere darin, Unabhängigkeit von Erdöl und Erdgas liefernden Staaten zu erreichen und klimaschädliche Technologien zu substituieren. Chancen und Risiken aus Pflanzenverkohlung mittels Pyrolyseheizkesseln wurden im Hinblick auf deren Beitrag im Rahmen verschiedener Themen betrachtet werden. Hier könnte eine Kombination aus fossilfreier Nahwärmeversorgung, Nutzung nachwachsender regionaler Rohstoffe, Sequestrierung von atmosphärischem Kohlenstoff, Einflüsse auf die Qualität landwirtschaftlicher Böden durch Einbringen von Biokohle sinnvoll sein. Konkret wurde dies modellhaft anhand eines Biomasse-Nahwärmeprojekts einer kleinen Kommune in Oberbayern untersucht. Im Rahmen dieser Arbeit werden Einflüsse dieser Technologie auf Treibhausgasemissionen in der Wärmewende, die Erfüllung von SDG-Indikatoren sowie Möglichkeiten, Pyrolysatoren ökonomisch kompetitiv zu gängigen Biomasseheizkesseln betreiben zu können, untersucht.“

## Review Paper: Life cycle assesment of biochar as a green sorbent for soil remediation

Ahmed I. Osman, Mohamed Farghali et al.

Link: [Life cycle assesment of biochar as a green sorbent for soil remediation](#)

Kurzbeschreibung: “The study explores the essential role of Life Cycle Assessment (LCA) in assessing the environmental sustainability impacts of biochar as a green sorbent in soil remediation. Recent studies from 2021 to 2023 underscore biochar's potential for global warming mitigation and carbon sequestration. The review discusses various concerns related to biochar-to-soil LCA, including its effects on heavy metals and pesticides in soils, the necessity for additional research on application frequency for pollutant sorption, impacts on real/different soil carbon stocks, variability in biochar properties, limited long-term studies, potential health implications, and incomplete assessment of pollutant dynamics, considering different biochar production methods and soil surface albedo. Advocating for LCAs for other green sorbents, such as low-cost clay, chitosan, and green nano-sorbents, is essential. Additionally, the integration of multiple green remediation techniques is proposed to enhance overall efficiency in soil and environmental remediation practices.”

## Review Paper: A Review on International Carbon Credit Certification Methodologies for Biochar as a Soil Amendment

Kyung-Hwa Han, Seok-In Yun et al.

Link: [International Carbon Credit Certification for Biochar as a Soil Amendment](#)

Kurzbeschreibung: “[...]The climate-positive services of biochar are traded as C credits on international C trading platforms through reliable methodologies. Here, we reviewed the international biochar C credit certification methodologies and quality standards to build foundations for biochar C credit trading in Korea. The quality of biochar includes the quantity of Corg sequestered over 100 years, the content of toxic contaminants below their threshold values, and the biochar properties related to soil fertility, as described by European Biochar Certificate (EBC) and International Biochar Initiative (IBI) certification guidelines. [...] The three voluntary C credit trade platforms with their own biochar methodologies are Puro.earth with life cycle assessment, Carbonfuture with C-sink certification, and Verra with UNFCCC Clean development mechanism (CDM) methodology. All three methodologies present standards for permissible biomass for feedstock, energy efficiency and by-product treatment for production, permissible matrices and tracking system for end use, and the third-party verification. On a regional basis in Korea, where biochar feedstock is mainly biogenic waste, GHG emissions during biochar lifetime mainly depend on the production stage. In pyrolysis facilities that meet EBC and Verra’s high-tech standards, GHG emissions during the production stage could be assumed to be very low. However, low-tech facilities with high GHG emissions during biochar production could deteriorate biochar C credits. Therefore, securing biochar C credits could be achieved through the modernization of pyrolysis facilities. Besides, it is essential to establish a process-oriented measurement, reporting, and verification systems, to ensure scientific reliability of biochar C credit certification.”

## Review Paper: Life cycle assessment of greenhouse gas emissions for various feedstocks-based biochars as soil amendment

Fang Xia, Zhuo Zhang et al.

Link: [Life cycle assessment of GHG emissions for various feedstocks-based biochars](#)

Kurzbeschreibung: “The application of biochar as a soil amendment may be an effective way to reduce GHG emissions. Life cycle assessment (LCA) is widely used to assess the impact of biochar as a soil amendment on GHG emissions. The methodology is effective in assessing the impacts of the various stages of the biochar life cycle on GHG emissions. However, because of the diversity of biochar types, it is difficult to summarize the regularity of biochar life cycle impacts on GHG emissions. This paper summarizes the pathways of biochar’s effect on GHG emissions and in-depth analyzes the mechanism of biochar’s influence on GHG emissions from the perspective of biochar properties. Finally, the review comprehensively analyzes the effects of different types of biochar feedstock on GHG emissions at the stages of feedstock pretreatment, preparation, and application of the life cycle.”

## Paper: Biochar Utilization as a Forestry Climate-Smart Tool

Carlos Rodriguez Franco, Deborah S. Page-Dumroese

Link: [Biochar Utilization as a Forestry Climate-Smart Tool](#)

Kurzbeschreibung: “[...] Forests and biochar are two biological methods to retain C in the terrestrial pool for a long time and at a very low cost. However, forest harvesting, the use of woody biomass as a source of renewable C for different applications, and the relationship with decreasing C emissions have created a highly controversial topic among governments, the scientific community, society in general, and social groups. The main objective of this review is to highlight the importance of C, forests, and biochar, including the benefits of C sequestration to decrease the impacts of climate change and promote sustainable forests and healthy soils in the future. The main findings show strong evidence that climate-smart forest management practices are an efficient option for managing C and increasing C stocks. This review suggests that forest management mitigation actions are another efficient C management approach with high potential. The findings show that biochar is a climate-smart tool that contributes to climate change mitigation by increasing soil carbon sequestration and reducing soil GHG emissions, including other associated benefits.”

## Unpublished conference Paper: Exploring Biochar Technology Adoption in a Circular Economy Perspective: A Technology Acceptance Model Approach

M. Perrone, C. Mazzocchi

Link: [Exploring Biochar Technology Adoption in a Circular Economy Perspective](#)

Kurzbeschreibung: “[...] This research introduces an extended framework of the Technology Acceptance Model 2 (TAM-2) to comprehensively investigate the determinants of technology acceptance in the context of biochar technology. It has been conducted among agricultural entrepreneurs and workers in northern Italy to test and find drivers or barriers that influence the choice of such technology adoption. It represents the first academic study addressing technology acceptance of biochar through an Extended TAM-2 Framework, and in general, one of the few investigating such technology acceptance. As in the original TAM, Perceived usefulness (PU) and Perceived ease of use (PEU), are hypothesized to influence the behavioral intention in adopting a specific technology (Davis, 1989). The TAM-2 incorporates additional theoretical constructs spanning social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use) (Venkatesh and Davis, 2000). [...] The first result expected to be found is that an extended TAM-2 represents a suitable model for investigating agricultural technology innovations. Moreover, it is foreseen to encounter a low level of knowledge of biochar technology among respondents, which would align our study with previous research from Latawiec et al. (2017). Such results underline the importance of information dissemination through public policies and incentives. Overall, the outcomes of this study will make meaningful contributions to the understanding of technology acceptance dynamics and provide valuable insights into the formulation of effective strategies fostering the adoption of biochar technology. These insights will be of particular significance to policymakers, agricultural advisors, and technology developers, guiding the implementation of programs tailored to enhance the uptake of sustainable agricultural practices.”

## Paper: Potentials and barriers to land-based mitigation technologies and practices (LMTs) - a review

"Karki, L., Lieu, J., Xylia, M. et al.

Link: [Potentials and barriers to land-based mitigation technologies and practices](#)

Kurzbeschreibung: "Land-based mitigation technologies and practices (LMTs) are critical for achieving the Paris Agreement's aim of avoiding dangerous climate change by limiting the rise in average global surface temperatures. We developed a detailed two-level classification and analysis of the barriers to the adoption and scaling up of LMTs. The review suggests that afforestation/reforestation and forest management are LMTs with wide application and high potential across all continents. BECCS (bioenergy with carbon capture and storage) and biochar have a higher potential in higher-income countries in the short term, due to the availability of technology, funding, and low-cost biomass value chains. Although most LMTs can be cost-effective across multiple world regions, limited knowledge concerning their implementation and insufficient financing appear to be the main barriers to their large-scale deployment. Without considering gender and the rights of marginalised and Indigenous Peoples, the large-scale deployment of LMTs can further aggravate existing inequalities. Therefore, the social and institutional implications of LMTs need to be better understood to improve their public acceptance and reduce negative impacts. An integrated system approach is necessary to strike a balance between ambitious land-based mitigation targets and socioeconomic and environmental goals"

## Thesis: Modeling the Potential for Carbon Removal in Agriculture: Integrating Farmer Perspectives

Andreas Rehn

Link: [Modeling the Potential for Carbon Removal in Agriculture](#)

Kurzbeschreibung: "The overarching aim of this thesis is to provide insights into the dynamic processes governing SOC stocks and to identify viable paths for agricultural systems to contribute to climate change mitigation. By integrating current scientific knowledge of carbon sequestration in agriculture with feasible agricultural applications, this work proposes local realistic strategies for enhancing soil organic carbon and presents a quantitative assessment of their potential for CO<sub>2</sub> removal."



## Report: Report on Permanence of Biochar

H. Bier, H. Lerchenmüller

Link: [Report on Permanence of Biochar](#)

Kurzbeschreibung: “In the quest to understand permanence of biochar, our report sheds light on critical findings from two scientific publications by [Sanei et al. \(2024\)](#) and [Azzi et al. \(2024\)](#). The report [...] offers a comparative analysis of results from the two studies. It reveals a key gap: most incubation experiments use carbonized material that is not representative of biochar produced commercially today. Moreover, these studies often lack detailed characterization of biochar fractions, hindering a comprehensive understanding of their properties. Another key point posited in the paper is that the observed degradation rates shown in incubation experiments are consistent with the size of the labile fractions that are known to be easily degradable. Upon closer examination of the commercially produced state-of-the-art biochar, a noteworthy observation emerges, that it mostly consists of a material that is chemically and structurally equivalent to the geological reference of “inertinite”. A material that is known to be stable over geological timescales even in shallow coal beds exposed to oxygen, weathering, and conditions well-suited for microbial degradation. The inherent stability of inertinite-like biochar fractions implies resistance to degradation within foreseeable periods. This underscores biochar’s potential as a long-term carbon storage solution and has significant implications for climate change mitigation efforts. As the report makes its debut, it invites a broader audience of scientists, policymakers, and stakeholders to review its findings. Through collaborative discourse, we can harness the potential of biochar while ensuring informed decision-making in carbon dioxide removal (CDR) strategies.”

## Paper: Assessing biochar's permanence: An inertinite benchmark

Sanei, H., Rudra, A. et al.

Link: [Assessing biochar's permanence: An inertinite benchmark](#)

Kurzbeschreibung: “The Earth's carbon dioxide removal and storage occur via inorganic and organic pathways: mineralization and maceralization. Biochar, imitating the organic pathway, undergoes controlled pyrolysis to transform biomass feedstock through a carbonization process into the inertinite maceral, which is a permanently stable form of organic carbon. Kinetic modeling in this study confirms inertinite's carbon stability over geological time scale.“

## Paper: Modelling biochar long-term carbon storage in soil with harmonized analysis of decomposition data

Azzi, E.S., Li, H. et al.

Link: [Modelling biochar long-term carbon storage in soil](#)

Kurzbeschreibung: “[...]The detailed analysis performed in this study does not cast doubts on the longevity of biochar carbon storage; rather, it confirms previous knowledge by critically examining the modelling, elucidating the assumptions and limitations, and making the analysis fully reproducible. There is a need for further interdisciplinary work on integration of various theories and approaches to biochar persistence, ultimately leading to the formulation of policy-relevant conclusions.“

## Paper: Environmental life cycle assessment of a stilted and vertical bifacial crop-based agrivoltaic multi land-use system and comparison with a mono land-use of agricultural land

T. Krexner, A. Bauer, A. Gronauer et al.

Link: [Environmental life cycle assessment of agrivoltaic multi land-use system](#)

Kurzbeschreibung: “[...] This study aims to compare two agrivoltaic systems (stilted and vertical bifacial) from cradle-to-gate with the life cycle assessment method using a system expansion approach. Further, an unmodified agricultural production and total substitution of the latter by photovoltaic-modules (photovoltaic-scenario) are assessed. For an objective comparison the same outputs must be produced in every scenario. Hence, in the unmodified agricultural scenario an additional production chain for electricity (Austrian average or green electricity production) was added; while agricultural production was added in the photovoltaic-and stilted agrivoltaic scenario. Results show, that the photovoltaic system has higher (up to 99.32 %) environmental impacts than the agricultural system in all studied impact categories in all scenarios. Compared to the unmodified agricultural scenario with Austrian average electricity both agrivoltaic systems can reduce environmental impacts in 3 of 9 assessed impact categories, but in none compared to the unmodified agricultural scenario with green electricity. [...]”

## Paper: Factors influencing the willingness to use agrivoltaics: A quantitative study among German farmers

J. Wagner, C. Bühner, S. Götz et al

Link: [Factors influencing the willingness to use agrivoltaics](#)

Kurzbeschreibung: “As a combination of agricultural production and solar energy generation, agrivoltaics helps to mitigate land use conflicts. However, this requires the willingness of farmers to adopt the technology, as without them the dissemination of agrivoltaics is not possible. Therefore, the aim of this research was to investigate farmers' willingness to use agrivoltaics. An online survey among German farmers was conducted in February 2023. The dataset consists of 214 farmers. In order to answer the research aim, a factor analysis and a binary logistic regression were undertaken. The results show that 72.4% of the farmers would be willing to use agrivoltaics. The “perceived usefulness” of the technology has the strongest influence, followed by “subjective norm” and “innovativeness” of the farmer. For farmers, the most important function of agrivoltaics is the additional source of income and the future development of the farm. Furthermore, a lack of trust in the technology is not a barrier. The bureaucratic effort and the uncertain regulatory framework are a relevant hurdle, as is the more challenging agricultural processing of the land. Future efforts should focus on addressing these challenges to enable widespread adoption and realize the potential positive impact of agrivoltaics in the agriculture and energy sector.”

## Preprint Paper: "The Contribution of Agrivoltaics to Reaching Climate Neutrality in Austria: Combined simulation of electricity and crop outputs of AgriVoltaic Systems"

Christian Mikovits, Theresa Krexner et al.

Link: [The Contribution of Agrivoltaics to Reaching Climate Neutrality in Austria](#)

Kurzbeschreibung: "A substantial expansion of solar PV is necessary to reach both Austrian renewable energy goals until 2030, as well as the official government goal of climate neutrality in 2040. This will need an expansion of open space solar PV, possibly being in conflict with agricultural production. Here, we assess the techno-economic viability of agrivoltaic (APV) deployment in Austria for attaining these goals, simulating both electricity generation as well as impacts on agricultural production from shading of PV panels. Furthermore, we assess how agricultural production is impacted for past climate, and under future climate change scenarios. The economic analysis of the electrical and agricultural outputs shows that profits from electricity generation are significantly higher than those from agriculture, implying that policy intervention is necessary to boost agrivoltaic schemes. For attaining 50 TWh a<sup>-1</sup> from APV, which is consistent with most climate neutrality scenarios, an amount of 69 000 ha to 127 000 ha would have to be used. The agricultural simulations show higher losses for specific crops like maize, rape, or soybean and generally lower losses for hay crops. We find a small but partly significant adaptation effect of APV for most crops. The required areas and the simulated reduction in the yield imply that the total loss of Austrian crop production will be between 2 % to 3 %."

## Paper: Agrivoltaics and landscape change: First evidence from built cases in the Netherlands

Igor Sirnik, Dirk Oudes, Sven Stremke

Link: [Agrivoltaics and landscape change](#)

Kurzbeschreibung: "[...] while agrivoltaics has begun to proliferate at a global scale, the associated landscape changes have so far received little attention. This knowledge gap is critical, as there is clear evidence that landscape change often contributes to low levels of acceptance of solar power installations. To address this gap, this study examines landscape changes brought by agrivoltaic installations in the Netherlands. Four representative built cases were examined making use of key landscape change indicators extracted from the literature and fieldwork. The study revealed varying degrees of landscape change across the examined cases. Changes in the agricultural landscape pattern and openness emerged as prominent landscape changes. Changes in crop type and in historical linear landscape structures—often associated with the implementation of conventional solar power plants—were not identified. Policy attention to the siting and design of agrivoltaic systems in the landscape is needed to positively influence social acceptance of this relatively novel solution and thereby advance energy transition."

## Paper: Determinants of Consumers' Willingness to Pay for Agrivoltaic Produce: The Mediating Role of Trust

Jasimne Ha, Jason Nguyen, Joshua M. Pearce

Link: [Determinants of Consumers' Willingness to Pay for Agrivoltaic Produce](#)

Kurzbeschreibung: “[...] Are consumers willing to pay a price premium for agrivoltaic produce? Which factors determine the consumers' willingness to pay? We propose a novel theoretical framework to address the unique characteristic of agrivoltaic produce as both a sustainable product and an emerging technology, extending extant research on ethical consumption by considering two contrasting types of risk (climate change risk perception and green perceived risk) and the mediating role of trust on the relationship between both risks and the consumers' willingness to pay. Empirical results based on primary survey data from 1,359 Canadian adults confirm the positive impact of climate risk perception on the consumers' willingness to pay. [...]”

## Paper: Agrivoltaics in France: the multi-level and uncertain regulation of an energy decarbonisation policy

Marie Hrabanski, Sidonie Verdeil, Antoine Ducastel

Link: [Agrivoltaics in France](#)

Kurzbeschreibung: “This article examines the political dynamics of regulating decarbonised energy such as agrivoltaics and questions the intersectoral logics inherent in this energy. It examines the political dynamics of multi-level and multi-sector regulation of decarbonised energy such as agrivoltaics between the local and national levels and between the agricultural and energy sectors. [...] Agrivoltaics also raises the question of the encounter between two historically well-established areas of public policy: energy decarbonisation policies and agrivoltaics. These strongly mobilise agriculture and farmers and call into question the traditional balances, institutions and sectoral divisions between the energy and agriculture sectors and their players.”

## Paper: Landscape user experiences of interspace and overhead agrivoltaics: A comparative analysis of two novel types of solar landscapes in the Netherlands

Kitti Biró-Varga, Igor Sirnik, Sven Stremke

Link: [Landscape user experiences of interspace and overhead agrivoltaics](#)

Kurzbeschreibung: “[...] The implementation of agrivoltaic power plants, [...] potentially impacts landscape quality, consequently raising concerns among local inhabitants and other landscape users. This study examines the effects of two types of agrivoltaic systems on landscape quality and how people perceive these transformed landscapes. Eleven landscape quality factors are assessed in a survey with residents from Culemborg and Wadenoijen, the Netherlands, to compare their landscape experience before and after the construction of agrivoltaic systems. [...]”

### Paper: Potential of sugar beet (*Beta vulgaris*) and wheat (*Triticum aestivum*) production in vertical bifacial, tracked, or elevated agrivoltaic systems in Belgium

Thomas Reher, Cas Lavaert et al.

Link: [Potential of sugar beet and wheat production in agrivoltaic systems in Belgium](#)

Kurzbeschreibung: “Two arable agrivoltaic pilot sites with vertical, horizontal, and tracking setups were constructed in Belgium between 2019 and 2022. Field trials for sugar beet and wheat production were conducted for two consecutive seasons. [...]”

Highlights:

- Interspaced and elevated arable AV systems can enhance the LER.
- Soil compaction resulting from AV installation should be avoided.
- Wheat performance under elevated AV is sub-optimal in Belgium.
- Sugar beet production is compatible with interspaced AV systems in Belgium.
- Innovative designs are needed to make agrivoltaics economically viable.”

### Paper: Sparking stakeholder support: Creating personas for renewable energy innovation adoption based on qualitative data analysis

Gabriele Torma, Jessica Aschemann-Witzel

Link: [Creating personas for renewable energy innovation adoption](#)

Kurzbeschreibung: “The success of innovations hinges on the relevant stakeholders' perceptions. While the success of some innovations—for example, those related to consumer products—often depends on only one stakeholder, the buyer, the success of other innovations, such as renewable energy sources, depends on multiple stakeholders. The traditional trend of focusing on only one stakeholder, the buyer, bears the risk of failing innovation adoption simply because it ignores other relevant stakeholders. We show the potential value of personas for the adoption and acceptance by multiple stakeholders of innovations related to renewable energy. [...] Our study includes a case example of persona development based on 27 semi-structured interviews with different stakeholders of our case of agrivoltaics. [...]”

### Veröffentlichung: Trends, Insights, and Future Prospects for Production in Controlled Environment Agriculture and Agrivoltaics Systems

Erik Dohlman, Karen Maguire, Wilma V. Davis et al.

Link: [Trends, Insights, and Future Prospects for Production in Agrivoltaics Systems](#)

Kurzbeschreibung: Ökonomische Trends und Motivationen im Agrovoltaic Sektor der USA

## Paper: Just energy imaginaries? Examining realities of solar development on Pennsylvania's farmland

K. Spangler, E. Smithwick et al.

Link: [Examining realities of solar development on Pennsylvania's farmland](#)

Kurzbeschreibung: “[...] Through a theoretical grounding in energy justice and land imaginaries, we interviewed farmers and solar stakeholders across PA to better understand why farmers are leasing their land for solar and how these leasing processes balance farmer, stakeholder, and community costs and benefits. We find that farmers enter solar leases for multiple reasons, of which economic gain is a central but insufficient factor. Farmers negotiated lease terms to ensure end-of-life decommissioning, hinged on the hope that the land will be farmable again after solar panels are removed. Yet, as solar was described as a “thirty-year cover crop,” negotiating terms for agrivoltaics was not observed, obscuring the potential for agricultural production to continue during the solar lease. Further, solar developers have utilized option contracts and non-disclosure agreements, reducing the ability of landowners to collectively negotiate for more favorable terms. We situate these findings in both the fraught legacies of energy production in PA, as well as in three main tenets of energy justice, highlighting the caution and hope associated with solar rollouts contributing to just and sustainable energy transitions.”

## Paper: Design and Performance Evaluation of a Photovoltaic Greenhouse as an Energy Hub with Battery Storage and an Electric Vehicle Charger

M. A. Torres, D. Muñoz et al.

Link: [Evaluation of a Photovoltaic Greenhouse as an Energy Hub](#)

Kurzbeschreibung: “This work presents a photovoltaic greenhouse’s design and performance evaluation as an energy hub in modern agriculture that integrates battery energy storage, an electric vehicle charging station, and non-controlled loads. The greenhouse roof comprises 48 semi-transparent photovoltaic panels with nominal transparency of 20% and 110 W capacity. The control of the photovoltaic greenhouse as an energy hub was approached as an optimization problem with the aim of minimizing the energy purchased from the grid. The simulation results indicate that the system is capable of balancing power transactions within the microgrid, thus enabling electromobility and, at the same time, achieving an average energy saving of up to 41%. Furthermore, it was found that the case of slow charging of the electric vehicle at night was less demanding on the battery system than fast charging during the day in terms of abrupt power transitions and average state of charge of the battery system, 61% vs. 53%, respectively. Empirical results also demonstrated the negative impact of soiling generated by agricultural activity on the performance of solar panels. For a period analyzed of three years, an average annual production loss of 6.8% was calculated.”

## Paper: Techno-economic and life cycle assessment of agrivoltaic system (AVS) designs

Shirkey Ravilla et al.

Link: [Techno-economic and life cycle assessment of agrivoltaic system \(AVS\) designs](#)

Kurzbeschreibung: “Land use competition between agricultural activities and ground-mounted solar photovoltaic (PV) deployment has increased worldwide attention to hybrid agriculture, and PV systems known as agrivoltaic systems (AVS) in efforts to increase the efficiency of energy and food production and minimize the land use competition. However, little is known about AVS's economic feasibility and environmental tradeoffs. Here we aim to evaluate the techno-economic and environmental impacts of four AVS configurations (full density, half density, mono-axial tracking, and bi-axial tracking) and compare their performance against PV-only systems. We used the life cycle revenue generated from a hectare of land area (\$/ha) as a functional unit of our analysis.”

## Veröffentlichung: Ökonomische und agronomische Auswirkungen von Agri-Photovoltaik auf die landwirtschaftliche Ackernutzung am Beispiel der Region Stuttgart

Christian Sponagel, Arndt Feuerbacher, Daniela Bendel et al.

Link: [Auswirkungen von Agri-Photovoltaik auf die landwirtschaftliche Ackernutzung](#)

Kurzbeschreibung: „[...] Bisherige Forschungsaktivitäten haben sich vor allem mit der Technologie an sich sowie potenziellen Ertragsveränderungen einzelner Kulturarten beschäftigt. Darauf aufbauend leistet diese Studie eine räumlich-explicite Analyse des Potenzials von Agri-PV am Beispiel von Ackerland in der Region Stuttgart, einer der bedeutendsten Ballungsräume in Deutschland. Der Fokus liegt auf den resultierenden agronomischen Auswirkungen in der Region sowie die damit verbundenen ökonomischen Effekte auf Seiten der Landwirtschaft, abseits der Rentabilität der Stromerzeugung. Die Analyse erfolgt mit einem integrierten Landnutzungsmodell, das die ackerbauliche Nutzung auf Schlagebene anhand von Deckungsbeiträgen optimiert. Rechtliche Rahmenbedingungen wie der Regionalplan als Nebenbedingungen werden berücksichtigt und vorhandene Studien zu den Ertragsauswirkungen unter Agri-PV genutzt. Die Ergebnisse zeigen, dass grundsätzlich Synergieeffekte zwischen Landwirtschaft und erneuerbaren Energien möglich sind. [...] Eine hohe ökonomische Vorzüglichkeit ergibt sich für Betriebe bzw. Räume mit einem hohen Anteil an Sonderkulturen wie Erdbeeren. Dementgegen scheinen Regionen mit hohen Anteilen von Hackfrüchten in der Fruchtfolge eher weniger vorzüglich für die Errichtung von Agri-PV. Die landwirtschaftliche Flächennutzungsstruktur ist somit relevant für die ganzheitliche Bewertung der Flächennutzungseffizienz von Agri-PV-Anlagen. Unsere Ergebnisse helfen politischen Entscheidungsträgern, die Effekte von Agri-PV auf die Landnutzung noch besser einschätzen zu können und sind für die Identifikation prioritärer Umsetzungsräume, u. a. bei Regional- oder Flächennutzungsplänen nützlich.”



## Paper: Agrivoltaics mitigate drought effects in winter wheat

Lisa Pataczek, Axel Weselek, Andrea Bauerle et al.

Link: [Agrivoltaics mitigate drought effects in winter wheat](#)

Kurzbeschreibung: “[...] The aim of this study was to assess [the effects of wateravailability on plant performance] via carbon isotopic composition in grains, as well as grain yield of winter wheat in an AV system in southwest Germany. Crops were cultivated over four seasons from 2016–2020 in the AV system and on an unshaded adjacent reference (REF) site. Across all seasons, average grain yield did not significantly differ between AV and REF [...], with higher interannual yield stability in the AV system. However,  $\delta^{13}\text{C}$  as well as carbon-13 isotope discrimination differed significantly across the seasons by 1‰ [...] between the AV system and the REF site. These drought mitigation effects as indicated by the results of this study will become crucial for the resilience of agricultural production in the near future when drought events will become significantly more frequent and severe.”

## Veröffentlichung: Produktion und Einsatz von synthetischem Diesel in der Landwirtschaft – Simulation für einen Milchviehbetrieb

Clemens Fuchs , Drees Meyer, Axel Poehls

Link: [Produktion und Einsatz von synthetischem Diesel in der Landwirtschaft](#)

Kurzbeschreibung: „Eine klimafreundliche und CO<sub>2</sub>-neutrale Energieversorgung von landwirtschaftlichen Betrieben ist Gegenstand der Untersuchung. Sie umfasst die Betrachtung der Innenwirtschaft (Gebäude und Tierhaltung) ebenso wie die Erzeugung von synthetischen Kraftstoffen für die Außenwirtschaft (Bewirtschaftung der Felder). Gefordert wird dies nicht zuletzt von den Abnehmern der landwirtschaftlichen Erzeugnisse wie, z.B. der Molkereigenossenschaft Arla Foods, deren Ziel die Erzeugung von Kuhmilch mit Netto-Null-CO<sub>2</sub>-Emissionen bis zum Jahr 2050 ist. Das betrachtete betriebliche Energiesystem umfasst die erneuerbare Stromerzeugung (PV und Windrad), die Deckung des Stromverbrauches im Kuhstall (80.000 kWh), die Batteriespeicherung für Zeiten ohne Stromerzeugung, die Produktion synthetischer Kraftstoffe (35.000 l Diesel) und eine Einspeisung des Stromüberschusses ins öffentliche Stromnetz. Tages- und jahreszeitabhängige Schwankungen werden beim Strom in 15-Minuten Zeitintervallen und beim Kraftstoff pro Kalenderwoche jeweils für ein Jahr berücksichtigt. Im Ergebnis wird gezeigt, dass die eigene Stromproduktion derzeit bereits rentabel ist, die eigene Produktion von synthetischem Kraftstoff jedoch noch vergleichsweise hohe Kosten verursacht und damit noch nicht rentabel ist. Weitere technische Fortschritte, steigende Preise für fossile Kraftstoffe und Skaleneffekte, z.B. größere genossenschaftlich betriebene Anlagen könnten der neuen Technologie zum Durchbruch zu verhelfen.“



## Kapitel in „Klimawandel in Deutschland“: Klimawirkungen und Anpassung in der Landwirtschaft

H. Lotze-Campen, T. Conradt et al.

Link: [Klimawirkungen und Anpassung in der Landwirtschaft](#)

Kurzbeschreibung: „Die Änderungen wichtiger Klimakenngrößen wie Temperatur und Niederschlag sowie der Konzentration von Spurengasen in der Atmosphäre beeinflussen unmittelbar physiologische Prozesse in Kulturpflanzen und damit die Ernte und die Landwirtschaft insgesamt. Zudem wirken sich Klimaänderungen indirekt auf die Pflanzenproduktion aus, indem sie strukturelle und funktionelle Eigenschaften von Agrarökosystemen verändern. Zu erwarten sind sowohl negative als auch positive Konsequenzen für die deutsche Landwirtschaft. Betrachtet werden neben direkten Auswirkungen auch mögliche Folgen für Schadorganismen und Nutztiere sowie die zu erwartende Entwicklung der Agrarproduktion. Entscheidend dafür, wie diese Effekte ausfallen, sind zum einen die Art und Intensität der Klimaveränderungen selbst, zum anderen die Empfindlichkeit der jeweils betrachteten Produktionssysteme und die Implementierung von Anpassungsmaßnahmen, mit deren Hilfe sich die Folgen des Klimawandels nutzen, vermeiden oder mildern lassen.“

## Beitrag im Tagungsband: Entwicklung eines Traktors mit Brennstoffzellen-Antrieb

Jürgen Karner, Christian Mayer et al.

Link: [Entwicklung eines Traktors mit Brennstoffzellen-Antrieb](#)

Kurzbeschreibung: „Um die Emissionen beim Betrieb landwirtschaftlicher Traktoren zu reduzieren, werden alternative Antriebssysteme wie Diesel-Hybrid Systeme, Gasantriebe (flüssig und gasförmig), synthetische Kraftstoffe oder Wasserstoff in Betracht gezogen. Im von der TU Wien geleiteten Projekt “FCTRAC – fuel cell tractor fuelled with biogenic hydrogen” wurde ein ganzheitlicher Ansatz zwischen dem Fahrzeug und seiner Einsatzumgebung verfolgt. Es wurde ein Brennstoffzellenbetriebener Elektrotraktor mit elektrifizierten Nebenaggregaten entwickelt, der auf einem bestehenden Dieselbetriebenen Standardtraktor mit Verbrennungsmotor und Stufenlosgetriebe basiert. Der Aufbau umfasst einen Elektroantrieb, eine Brennstoffzelle, ein Wasserstoffspeichersystem sowie ein wiederaufladbares elektrisches Energiespeichersystem als Energiepuffer zum Ausgleich transienter Lastanforderungen. Hierfür kommt eine Hochvoltbatterie auf Basis der Lithium-Ionen Zellentechnologie zum Einsatz. Der hochreine Wasserstoff wird im sog. BioH2Modul aus Produktgas, welches durch Gaserzeugung aus holzartiger Biomasse entsteht, hergestellt. Dieser Beitrag konzentriert sich auf das Fahrzeug, insbesondere auf die Systemarchitektur und den Fahrzeugaufbau“

## Ausgabe 17 von ATZheavyduty: Titelthema „Chancen und Grenzen der Elektrifizierung“

Link: [ATZheavyduty Ausgabe 17-1](#)

Die ATZheavyduty ist das Fachmagazin für Entwicklungsingenieure und Forschende im Bereich Nutzfahrzeugtechnik auf und abseits der Straße. Bau- und Landmaschinen sind ebenso Teil der Berichterstattung wie schwere Straßennutzfahr- sowie Flurförderzeuge und die breite Palette der Branchenzulieferer.

Vorwort von Mathias Keiber um Titelthema: „[...] Zwar hält sich die Politik in Berlin und Brüssel momentan noch relativ bedeckt. Doch eine öffentliche Diskussion dürfte nur eine Frage der Zeit sein. Derweil sind Hersteller und Zulieferer längst in puncto Energiewende aktiv. Das müssen sie auch, denn die Entwicklungs- und Modellzyklen sind deutlich länger als etwa im Pkw-Sektor. Allerdings ist es alles andere als ausgemacht, dass sich elektrische Antriebe bei mobilen Bau- und Landmaschinen durchsetzen: „Heavy duty is the name, heavy duty is the game“, würde man im englischsprachigen Raum wohl sagen - „Schwerlastarbeit heißt es, Schwerlastarbeit ist es.“ Ob diese Art von Arbeit ausschließlich mittels elektrischer Antriebe verrichtet werden kann? [...]”

## Kommende Veranstaltungen

### 05.06.2024: Landgewinn Pflanzenkohle-Abschluss-symposium

Berlin

Am 5. Juni findet unser Abschluss-symposium zum Thema Pflanzenkohle in Berlin statt – das Landgewinnteam freut sich, wenn Sie teilnehmen können!

Link für [Kalendereintrag](#)

## Sonstige Neuigkeiten

### Global Biochar Market Report on behalf of the International Biochar Initiative (IBI) and the US Biochar Initiative (USBI)

Launched on 26.03.2024, this report highlights the growth in the biochar industry, along with priorities, challenges, and insights, gathered during a 2023 survey.

Link zum Report: <https://biochar-international.org/2023-global-biochar-market-report/>

### Pressemitteilung: Montagesystem aus nachwachsenden Rohstoffen für Agri-Photovoltaik-Anlagen

„Wir werden die tragenden Bauteile in unseren Agri-Photovoltaik-Anlagen durch nachwachsende Rohstoffe ersetzen und somit organische Strukturen anstatt Stahl beim Bau verwenden.“

Link zum [Artikel](#)

## Ankündigung: Removing carbon dioxide from the atmosphere

Juliane El Zohbi and Diana Rechid

Link: [Removing carbon dioxide from the atmosphere](#)

Kurzbeschreibung: “The [...] Climate Service Center Germany (GERICS) explores what actors of the agricultural sector think of removing carbon dioxide and what support they need from science. GERICS’ case study focusses on the agricultural sector. The study aims to answer questions such as: how do farmers and agricultural stakeholders experience climate change? Do farmers and agricultural stakeholders know or apply CO2 removal methods, and which barriers have they perceived? [...] GERICS has conducted 29 interviews, including farmers, farmers’ associations, start-ups producing biochar, and governance bodies such as administrations and state ministries. So far, we found that farmers who are already actively changing their management strategies towards carbon sequestration are well informed. None of the farmers are motivated by the idea of removing additional CO2 from the atmosphere but rather are interested in sustainable and resilient agricultural systems. Their needs lie in continuous funding and reliable regulations. Farmers’ associations that are rather new to the topic of CO2 removal are eager to learn more about the topic and methods to provide a better knowledge basis for their members.

What does the future hold for CO2 removal The results – expected by mid-2024 – will provide an inventory of knowledge gaps and information needs. This can provide a starting point for the joint development of information prototypes in relation to climate change.”

## Podcastfolge: Agrardiesel oder Batterie? Dr. Joachim Sobotzik & Roger Stirnimann

Geladen – The German Battery Podcast

Link: [Agrardiesel oder Batterie? Dr. Joachim Sobotzik & Roger Stirnimann](#)

Kurzbeschreibung: „[...] Für den Geladen-Podcast ist die derzeitige politische Debatte ein willkommenener Anlass, um mal genauer über die Rolle der Antriebsart, den Diesel zu sprechen. Während nämlich zahlreiche Verkehrs- und Mobilitätssektoren immer mehr elektrifiziert werden, stößt die Batterietechnik mancherorts auch an klare Grenzen: Zum Beispiel in der Schifffahrt, in der Luft- und Raumfahrt sowie bei Baumaschinen. Diese Podcast-Episode soll Aufschluss darüber geben, inwieweit die Landwirtschaft zu eben diesen "Problemsektoren" gehört, in denen die Batterietechnik (auch perspektivisch) nie eine Lösung bieten wird. Roger Stirnimann (BFH) und Dr. Joachim Sobotzik (#JohnDeere) diskutieren, inwieweit große landwirtschaftliche Maschinen überhaupt elektrifiziert werden können. Die technische Machbarkeit scheint dabei oftmals konträr zur eingeschätzten Wirtschaftlichkeit und vor allem jahrzehntelang entwickelten Abläufen auf Bauernhöfen (Fütterung, Aussaat, Ernte, Pflügen, etc.). [...] Beide Podcastgäste sehen [...] flüssige, alternative #Kraftstoffe (u.a. E-Fuels) als eine naheliegende Lösung, die allerdings noch in ferner Zukunft liegt. Da alternative synthetische Kraftstoffe, HVO und Biokraftstoffe aber teurer sind als der derzeitige Agrardiesel, befindet sich die Landwirtschaft in einem echten Dilemma: #CO2-neutrale Kraftstoffe sind noch nicht verfügbar und bei Marktreife höchstwahrscheinlich sehr teuer. Wenn der Agrardiesel nun wieder voll besteuert wird, dann werden zwangsläufig auch die Lebensmittelprodukte im Preis steigen.“

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