

*Joint Event*

3<sup>rd</sup> International Conference & Expo on

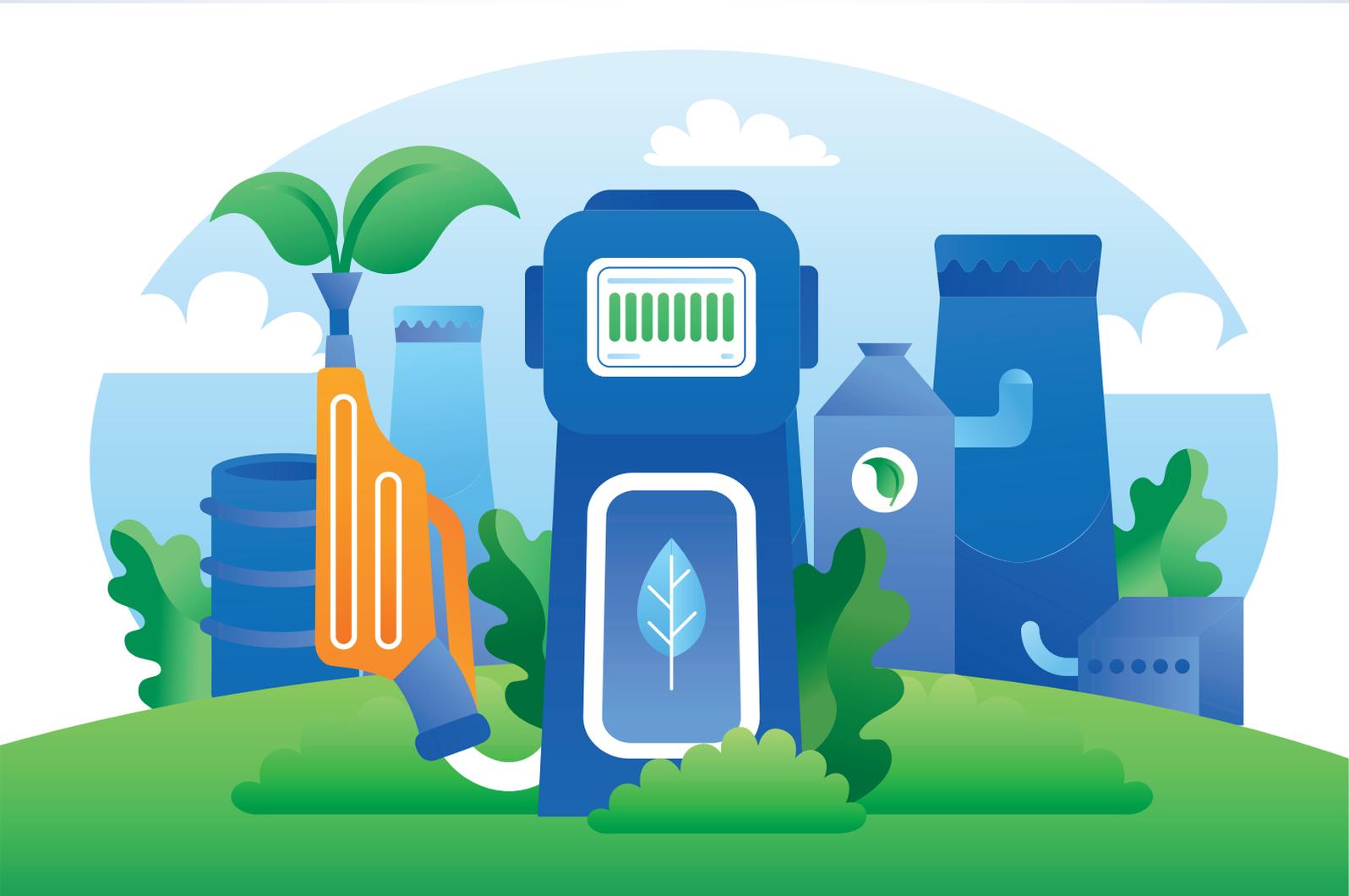
# Biofuels and Bioenergy

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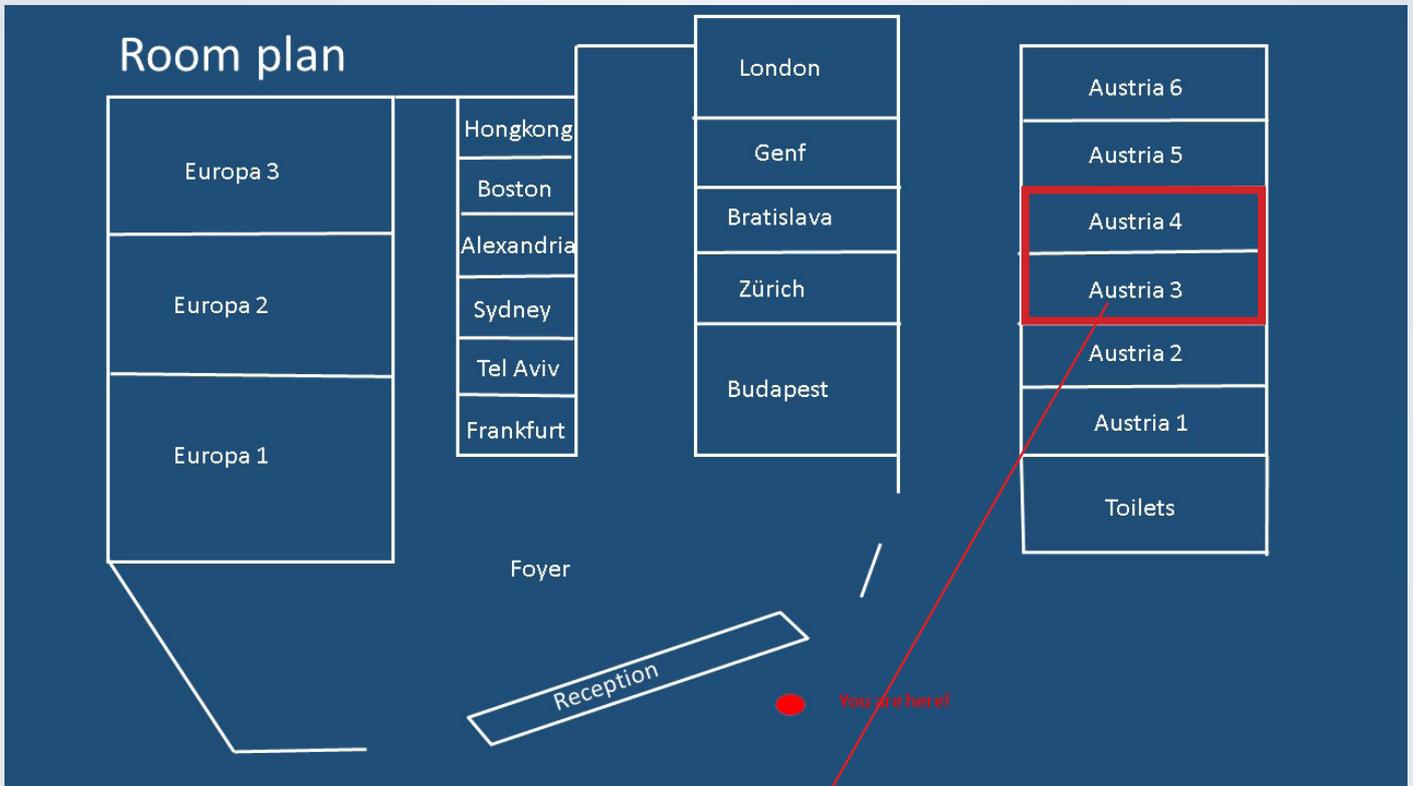
International Conference on

# Biomass

September 25-26, 2025 | Vienna, Austria



# Floor Map



*Conference Hall - Austria 3+4*

# Wifi Details

*Username: nh*  
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# Speaker Representations



# Media Partners



# **Conference Programme**

# Day 1

25<sup>th</sup> September

## Session Chairs

**Caroline Braun**, Anew Climate LLC, Germany  
**Muddasser Inayat**, Aalto University, Finland

# Conference Programme

## Day 1: 25, September, 2025

Meeting Hall: Austria 3+4

**08:00 - 08:45** Registrations

**08:45 - 09:00** Introduction

### Keynote Presentations

**09:00 - 09:40** **Caroline Braun, Anew Climate LLC, Germany**

**Title:** BioCCS and the Carbon Markets: Positioning Biogenic Waste as A Strategic Asset in the EU Carbon Removal Economy

**09:40 - 10:20** **Timo Huotari, Prometec Tools Oy, Finland**

**Title:** From Variability to Reliability – Automating Biomass Sampling, Sample Handling, and Moisture Measurement before Unloading

### Oral Presentations

**Session Chair** **Caroline Braun, Anew Climate LLC, Germany**

**Session Chair** **Muddasser Inayat, Aalto University, Finland**

**Sessions:** Bio-Economy | Biofuels | Biodiesel | Biomass | Biorefineries | Sustainable Energy | Environmental and Climate impacts | Biomethane Production | Municipal and industrial waste | Biomass Power & Thermal

**10:20 - 10:50** **Marta Yabar, Bio Base Europe Pilot Plant, Belgium**

**Title:** Recovery and Purification of Microbially produced SAF Precursors: Screening of Sustainable Downstream Processing Techniques for Triacylglycerols

**Networking & Refreshments 10: 50 - 11:10 @ Foyer**

**11:10 - 11:40** **Dexter Lay Huang Teik, Nanyang Technological University, Singapore**

**Title:** Effect of Additives on UCOME Biodiesel (B100) Properties during Storage: A Comparative Analysis between UCOME Biodiesel of a Single Batch and Mixed Batch

**11:40 - 12:10** **Jonas Ståhls, Valmet Technologies Oy, Finland**

**Title:** Turning Flue Gas Streams from Biomass Combustion into Valuable Resources by Condensing Heat Recovery Solutions

<b>12:10 - 12:40</b>	<b>Damir Zibrat, Technikgruppe, Austria</b>
<b>Title:</b> Combustion Optimization on Forward Moving Reciprocating Grates	
<b>Group photo 12:40- 12:50</b>	
<b>Lunch (12:50-14:00) @ Hotel Restaurant</b>	
<b>14:00 - 14:30</b>	<b>Jingkang Shi, Zhejiang University, China</b>
<b>Title:</b> Co-Conversion of Lignin and Bioethanol for Polygeneration of Fuels and Chemicals in a One-Pot Process: Experimental Study and 4E (Energy-Exergy-Economy-Environment) Assessment	
<b>14:30 - 15:00</b>	<b>Raghad Alamro, AEC SAMI, Saudi Arabia</b>
<b>Title:</b> From Sunlight to Scalability: AI-Driven Business Models for Green Hydrogen in Desert Regions	
<b>15:00 - 15:30</b>	<b>Bruna Soares Fernandes, São Paulo State University, Brazil</b>
<b>Title:</b> Biomethane Production from Sugarcane Byproducts	
<b>15:30 - 16:00</b>	<b>Gautham Srinivas Ganesh, Indian Institute of Science, India</b>
<b>Title:</b> Assessment of Potentials for Import Substitution and Local Income Generation with Biomethanol Blending in Petrol: A Case Study from India	
<b>Networking &amp; Refreshments 16:00 - 16:30 @ Foyer</b>	
<b>16:30 -17:00</b>	<b>Sebastian Ospina, Blue Synergy SL, Spain</b>
<b>Title:</b> Assessing the Low-Carbon Production of Bio-Based Resins and Solvents <i>via</i> Thermochemical Biomass Conversion	
<b>Day 1 Concludes followed by Certificate Distribution</b>	

# Day 2

26<sup>th</sup> September

## Session Chairs

**Masaaki Takahashi**, Yokkaichi University, Japan

**Muddasser Inayat**, Aalto University, Finland

Day 2: 26 , September, 2025

## Meeting Hall: Austria 3+4

### Keynote Presentations

10:00-10:40

**Yingmin Ye Frank, CHEM1 Consulting & Service Co., Limited, Hong Kong**

**Title:** Investment Opportunities and Technological Innovations in China's Biofuel Industry: Growth, Challenges, and Strategic Insights

10:40-11:20

**Kyung-Hwan Han, Michigan State University, USA**

**Title:** EliteTree™: An Advanced Biomass Tree Crop Technology that Features Accelerated Growth and Greater Biomass Density

**Networking & Refreshments @11:20-11:40 @ Foyer**

### Oral Presentations

Session Chair

**Masaaki Takahashi, Yokkaichi University, Japan**

Session Chair

**Muddasser Inayat, Aalto University, Finland**

**Sessions:** Syngas | Sustainable Biomass Production | Thermochemical Biomass Conversion | Bio-based products | Municipal and industrial waste | Bioethanol | Aviation Fuels | Biofuels

11:40 - 12:10

**Giovanni Ferrarese, Aix-Marseille University, France**

**Title:** Influence of Ash Forming Elements Content and Lignocellulosic Structure on the Evolution and Transport of S and Cl from the Gasification to the Combustion Zone in A Fast Internally Circulating Fluidised Bed Reactor

### Poster Presentations ( 12:10 - 13:00 )

Poster Judge

**Kyung-Hwan Han, Michigan State University, USA**

PP001

**Ana Raquel Gonçalves, Instituto Superior Técnico, Portugal**

**Title:** Biomass Detection and Fuel Mapping for Wildfire Mitigation and Bio-oil Production

PP002

**Stavroula Zervopoulou, TU WIEN, Austria and  
Muddasser Inayat, Aalto University, Finland**

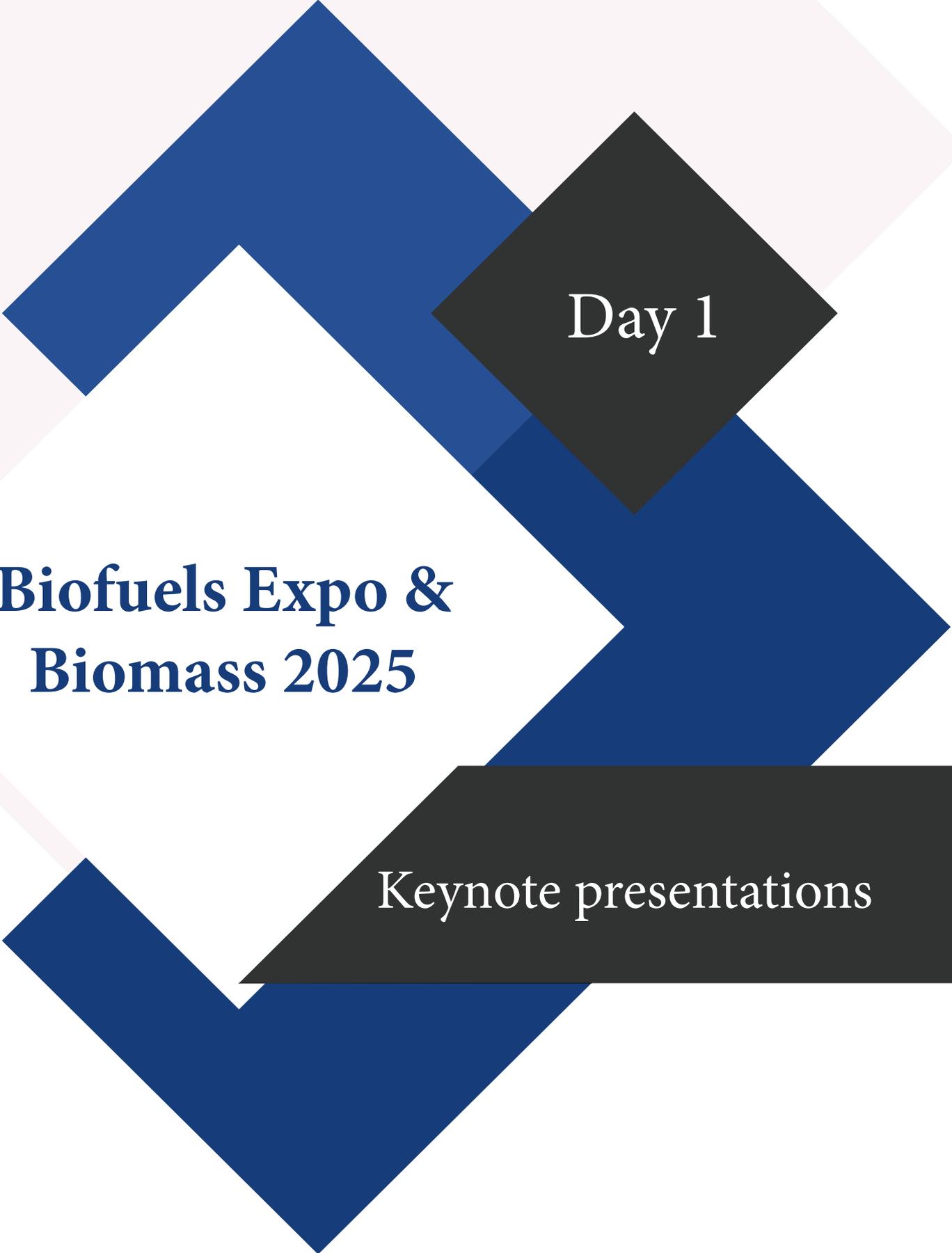
**Title:** Estimating Sustainable Aviation Fuel Production Potential in the EU-27 by 2050 using Second-Generation Waste-Based Feedstocks *via* Solar-Assisted Fast Pyrolysis

PP003

**Alessia De Cataldo, Polytechnic of Bari, Italy**

**Title:** Development of Ethanol-Based Gel Fuels: Investigating the Effects of Calcium Chloride on Gelation and Performance

<b>PP004</b>	<b>Bruna Soares Fernandes, São Paulo State University, Brazil</b>
<b>Title:</b> Biostruvite Production from a Byproduct of Organic Solid Waste Biorefinery	
<b>PP005</b>	<b>Masaaki Takahashi, Yokkaichi University, Japan</b>
<b>Title:</b> The Detoxify Method of the Discharged Biomass Ash for Recycling	
<b>PP006</b>	<b>Bruna Soares Fernandes, São Paulo State University, Brazil</b>
<b>Title:</b> Bio-struvite Production from Corn Steep Liquor: Potential for Nutrient Recovery and Agricultural Sustainability	
<b>PP007</b>	<b>Joanna Poluszyńska, Institute of Ceramics and Building Materials, Poland</b>
<b>Title:</b> Biomass Fractions in Alternative Fuels and Biofuels using Radioisotope <sup>14</sup> C Methodology	
<b>Lunch (13:00-14:00) @ Hotel Restaurant</b>	
<b>Oral Presentations</b>	
<b>14:00 - 14:30</b>	<b>Peter Opoku Badu, Université de Lorraine, France</b>
<b>Title:</b> Hydrogen-Rich Syngas Production from Biomass Oxy-Steam Gasification: Influence of Gasification Conditions and Bed Materials	
<b>14:30 - 15:00</b>	<b>Antonio Castellano Albors, University of Aberdeen, United Kingdom</b>
<b>Title:</b> Identifying Explanatory Variables for Willow Biomass Growth: Application of Random Forest to a Global Dataset	
<b>Day-2 Concludes followed by Certificates Distribution and Vote of Thanks</b>	



Day 1

**Biofuels Expo &  
Biomass 2025**

Keynote presentations

## **BIOCCS AND THE CARBON MARKETS: POSITIONING BIOGENIC WASTE AS A STRATEGIC ASSET IN THE EU CARBON REMOVAL ECONOMY**



**Caroline Braun**

*Anew Climate LLC, Germany*

### **Abstract:**

As the European Union accelerates its path toward net-zero emissions, Bioenergy with Carbon Capture and Storage (BioCCS) is emerging as a critical solution for delivering permanent, high-integrity carbon dioxide removals. With the adoption of the EU Carbon Removals Certification Framework (CRCF) and growing momentum to integrate permanent removals into the EU Emissions Trading System, the policy landscape is evolving to support the scale-up of technologies like BioCCS.

This presentation will explore how Anew Climate is working with industries that generate biogenic CO<sub>2</sub> emissions—such as agriculture, forestry, and food processing—to develop investable BioCCS projects that align with EU quality standards and emerging carbon market mechanisms. These sectors, often overlooked in climate mitigation strategies, hold significant potential to become key contributors to the EU's carbon removal targets by transforming waste streams into durable climate assets.

We will examine the technical and economic conditions necessary to unlock this opportunity, including feedstock availability, capture integration, and long-term CO<sub>2</sub> storage. The presentation will also address how demand signals from both compliance and voluntary carbon markets are creating new incentives for industrial emitters and biomass producers to participate in the carbon removal economy.

By bridging EU policy, project development, and market readiness, BioCCS offers a compelling opportunity to scale negative emissions in a way that is both environmentally robust and economically viable. Anew's experience in early-stage project development across Europe provides practical insights into how these systems can be deployed at scale, contributing meaningfully to national and EU-wide climate goals.

### **Biography**

Caroline Braun functions as Director of Sales and New Business at Anew Climate, advancing Bio-LNG as a renewable fuel and paving the way for more carbon reduction and removal projects on both a national as well as international level. As an expert in the field, Braun is a popular speaker at industry conferences in Germany, Europe, and North America. Prior to her position at Anew, she drove the implementation of innovative solutions around green gases in her role as team lead for Business Development and Carbon Removal in the bioenergy sector. Before that, she worked at PGNiG Supply and Trading, where she started in business development and later transitioned into a natural gas trader position. In these roles, she gained invaluable insights that solidified her understanding of the market. With a strong passion for the energy sector, she started working at 50hertz, one of Germany's transmission system operators, during her studies. Braun holds a master's degree in Industrial and Network Economics from the Technical University in Berlin.

## FROM VARIABILITY TO RELIABILITY – AUTOMATING BIOMASS SAMPLING, SAMPLE HANDLING, AND MOISTURE MEASUREMENT BEFORE UNLOADING



**Timo Huotari**

*Prometec Tools Oy, Finland*

### Abstract:

One of the biggest challenges in biomass trade and energy production is inconsistent fuel quality data. Manual sampling is time-consuming, labour-intensive, and prone to human error. Poor sampling representativeness can lead to disputes, unfair payments, operational inefficiencies, and increased CO<sub>2</sub> emissions from suboptimal combustion. In many cases, even when laboratory procedures are precise, the root cause of inaccurate results lies in how the sample was taken, handled, and prepared.

Prometec's Q-Robot addresses these challenges by fully automating the process—from representative sampling directly from trucks or rail wagons, to controlled sample handling and integrated real-time moisture measurement. By following international standards (EN 18135, EN 14780), the system ensures consistency, traceability, and reliability in every sample.

Our clients have reported measurable benefits, including:

- Improved fairness in supplier–buyer transactions through verifiable, standardized sampling
- Process optimization enabled because of online data
- Reduced disputes and faster deliveries thanks to immediate moisture data
- Lower operational costs by minimising manual labour and laboratory dependency
- Optimised combustion efficiency and reduced CO<sub>2</sub> emissions with better fuel quality control

Industrial case studies demonstrate that automation not only increases accuracy and transparency but also accelerates decision-making and strengthens long-term supplier relationships. This presentation will show how fully automated sampling and measurement can transform biomass quality control, creating value across the supply chain while supporting the global transition to cleaner energy.

### Biography

Timo Huotari is an experienced international business leader with a strong track record in the energy and industrial sectors. Over the past decade, he has successfully introduced new technologies to international markets, developed global marketing and sales strategies, and built lasting partnerships across the globe. His expertise lies in bridging sales and marketing with business development, ensuring that innovation is closely aligned with market needs and long-term growth. In the energy sector, Timo has worked extensively with industrial-scale solutions where biomass and renewable technologies play a central role in the transition toward sustainability. Drawing on his international experience and deep understanding of market-driven innovation, he emphasizes the critical importance of biomass quality control in securing efficient and sustainable energy generation.

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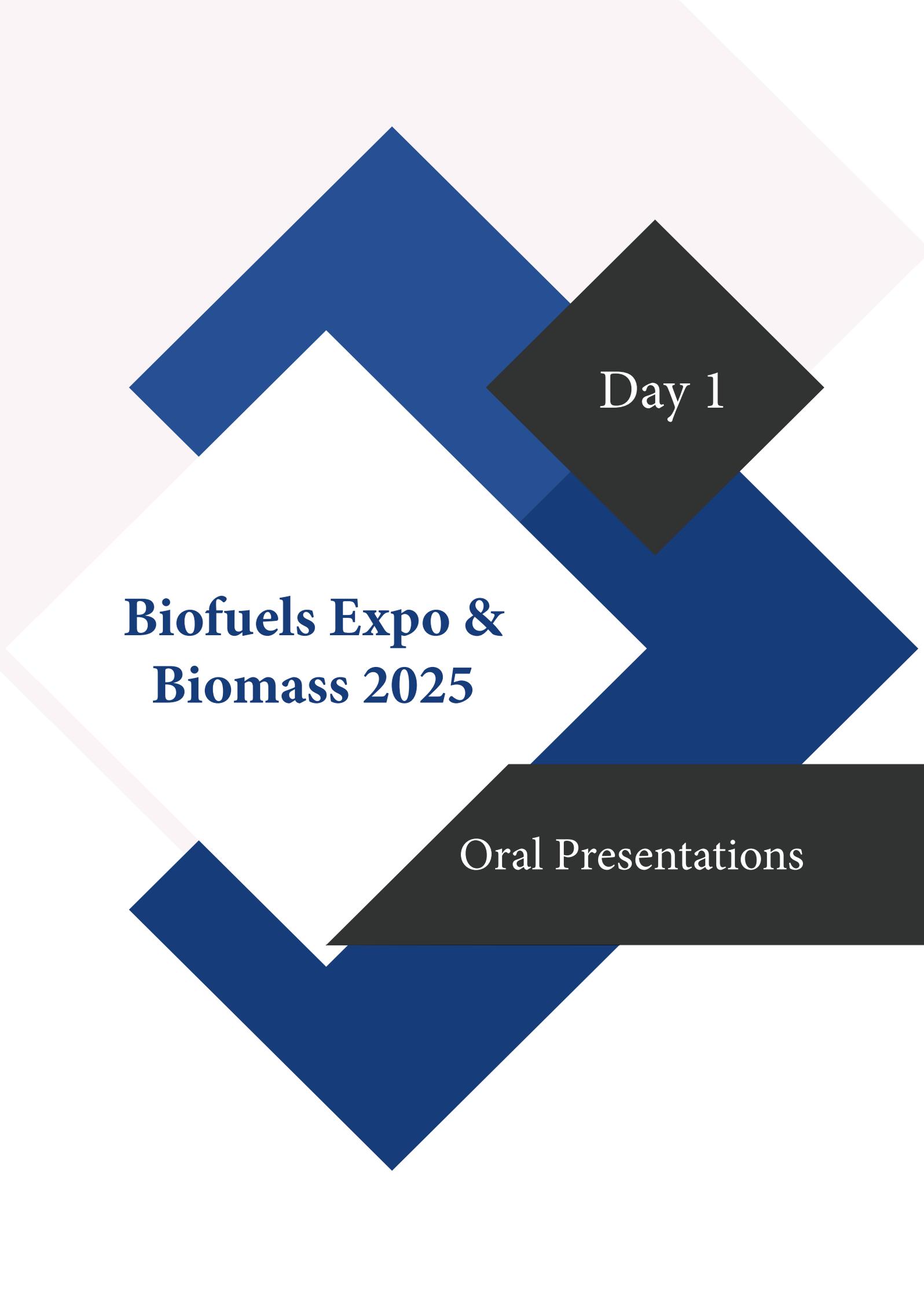
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At Biomass 2025 in Vienna, Timo will highlight why proper quality monitoring is essential for ensuring consistent performance, improving efficiency, and strengthening the role of biomass as a reliable and sustainable energy source in the global energy transition.

The background features a large, light pink diamond shape. Overlaid on this are several dark blue geometric shapes, including a large chevron pointing up and another pointing down. A black diamond is positioned in the upper right, and a black horizontal bar is at the bottom right. The text is placed within these shapes.

Day 1

**Biofuels Expo &  
Biomass 2025**

Oral Presentations

## RECOVERY AND PURIFICATION OF MICROBIALLY PRODUCED SAF PRECURSORS: SCREENING OF SUSTAINABLE DOWNSTREAM PROCESSING TECHNIQUES FOR TRIACYLGLYCEROLS

**Marta Yabar, Elodie Vlaeminck, Koen Quataert, Evelien Uitterhaegen, Karel De Winter and Wim Soetaert**

*Bio Base Europe Pilot Plant, Belgium*

### **Abstract:**

The aviation sector faces increasing challenges by the depletion of fossil fuel reserves and the urgent need to reduce CO<sub>2</sub> emissions. Sustainable aviation fuels (SAF) obtained from renewable feedstocks have emerged as a promising alternative to conventional jet fuels. Using oleaginous microorganisms, biological resources can be converted into microbial oil, which is accumulated intracellularly and can be used as SAF precursors. However, a major bottleneck in the economic and energy feasibility of this process lies in the efficient purification of the microbial oil.

This study focusses on screening various technologies for the recovery of microbial oil produced by the oleaginous yeast *Yarrowia lipolytica*. This downstream processing involves two main steps: cell disruption and oil extraction. To improve the cell disruption efficiency, various mechanical and chemical cell disruption techniques were tested once cells are disrupted, the hydrophobic microbial oil released can be extracted with a solvent. However, the traditional solvent-extraction method using chloroform: methanol solvent is not environmentally friendly. Therefore, a solvent screening was conducted, exploring greener solvent alternatives. These findings provide a foundation for scalable and eco-friendly downstream processing, advancing the industrial viability of microbial SAF production.

### **Biography**

Marta Yabar is a doctoral candidate with an international background in bioprocess engineering, specializing in downstream processing. Originally from Pamplona, Spain, she studied Biotechnology in Tarragona before moving to Austria to pursue a Master's degree in Bioprocess Engineering at IMC FH Krems. Her career started in Vienna, Austria, where she was employed at Boehringer Ingelheim in downstream process development, and later as downstream processing manufacturing specialist in Lonza (Visp, Switzerland). Currently, she is pursuing a PhD at Bio Base Europe Pilot Plant (Gent, Belgium) within the YAF (Yeast-based solutions for Sustainable Aviation Fuels) project, a Marie

Skłodowska-Curie Actions (MSCA) Doctoral Network. Her research is focused on optimizing Sustainable Aviation Fuels (SAF) precursors extraction and purification in order to develop a sustainable and cost-effective downstream process for the production of aviation biofuel.

## EFFECT OF ADDITIVES ON UCOME BIODIESEL B100 PROPERTIES DURING STORAGE: A COMPARATIVE ANALYSIS BETWEEN UCOME BIODIESEL OF A SINGLE BATCH AND MIXED BATCH

**Dexter Lay, Huang Teik and Liu Ming**

*Nanyang Technological University, Singapore*

### **Abstract:**

The increasing adoption of biodiesel as a sustainable alternative to fossil fuels necessitates a deeper understanding of its storage stability and compatibility with maritime engines. The B100 project focuses on the comprehensive evaluation of 100% biodiesel (B100), specifically Used Cooking Oil Methyl Ester (UCOME), to assess its long-term viability for maritime applications.

This study investigates the physicochemical changes that occur in B100 during storage, emphasizing the effects of oxidation, degradation, and additive interactions. Key parameters such as oxidation stability, acid value, and viscosity were tracked over extended storage periods to evaluate fuel degradation trends. The study also assessed the effectiveness of antioxidants and other stabilizing additives in mitigating these degradative processes.

In addition to fuel stability, the compatibility of stored B100 with maritime engine components was examined to identify potential operational risks. Engine performance tests were conducted to evaluate combustion characteristics, emissions profile, and overall efficiency when using stored B100.

Findings from the B100 project provide critical insights into optimizing biodiesel formulation and storage practices to improve reliability in maritime contexts. The research highlights the importance of targeted additive strategies and robust storage protocols in preserving fuel quality and ensuring operational performance. By addressing key challenges in biodiesel stability and engine compatibility, this work supports the broader goal of maritime decarbonization and regulatory compliance.

Ultimately, the B100 project lays the groundwork for expanded biodiesel adoption in the shipping industry, contributing to cleaner energy transitions and the development of more sustainable marine fuel solutions.

**Objective of the Study:** The objective of the study is to evaluate the storage stability and maritime engine compatibility of 100% biodiesel (B100), specifically Used Cooking Oil Methyl Ester (UCOME), to ensure its long-term viability as a sustainable marine fuel.

More specifically, the study aims to:

1. Investigate the physicochemical changes in B100 during extended storage, focusing on oxidation, degradation, and interactions with additives.
2. Assess the effectiveness of antioxidants and stabilizing additives in mitigating fuel degradation.
3. Analyze engine performance, emissions, and combustion characteristics using stored B100.

These objectives ultimately support efforts in enhancing biodiesel reliability, ensuring compliance with maritime regulations, and promoting the transition toward cleaner, sustainable fuels in the shipping industry.

**Materials and Methods:** The study utilized 100% biodiesel (B100) derived from Used Cooking Oil Methyl Ester (UCOME), stored under ambient condition ( $25 \pm 2$  °C) for up to 4.5 months. 11 Key fuel properties-including but not limited to - oxidation stability (EN 14112), acid value (EN 14104), and kinematic viscosity (EN ISO 3104)-were monitored periodically to assess degradation. The effectiveness of antioxidants and stabilizing additives was evaluated by comparing treated and untreated samples. Additionally, material compatibility tests with engine components and performance assessments using a marine engine were conducted to analyze operational impacts of stored B100.

**Inclusion Criteria:** The inclusion criteria for this study focused on selecting B100 samples produced exclusively from Used Cooking Oil Methyl Ester (UCOME), representative of fuels commonly considered for maritime use. Only B100 that met initial fuel quality standards as specified in EN 14214 was included to ensure consistency in baseline properties. Samples from both single-batch and mixed-batch sources were considered to reflect practical supply chain conditions. Additionally, additives used in the study were commercially available and compatible with marine fuel applications.

**Exclusion Criteria:** The exclusion criteria for this study included biodiesel blends containing petroleum diesel (e.g., B5, B20), as the focus was solely on 100% biodiesel (B100). Samples derived from non-UCOME feedstocks, such as palm oil methyl ester (POME) or soybean-based biodiesel, were also excluded to maintain feedstock consistency.

**Results and Discussion:** Stored B100 samples exhibited gradual degradation over time, with

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significant increments in both water content and acid value, over 4.5 months. Antioxidant-treated samples showed improved stability, demonstrating the effectiveness of additives in slowing oxidative degradation. Engine tests indicated that while stored B100 maintained acceptable performance, prolonged storage slightly affected combustion efficiency and emissions, highlighting the importance of proper storage and additive use.

**Conclusion:** The study demonstrates that while B100 biodiesel from UCOME is a viable alternative for maritime applications, its storage stability is influenced by oxidation and thermal degradation. The use of antioxidants significantly enhances fuel longevity, and most engine materials showed acceptable compatibility. Although aged B100 remains usable, slight performance and emission trade-offs were observed. Overall, proper additive use and storage management are essential to support the reliable adoption of B100 in the maritime sector.

## Biography

Dexter Lay is a Research Fellow at the Maritime Energy and Sustainable Development Centre of Excellence (MESD) at Nanyang Technological University (NTU), Singapore. His research focuses on sustainable marine fuels, particularly the storage stability and engine compatibility of 100% biodiesel (B100) derived from waste feedstocks such as Used Cooking Oil Methyl Ester (UCOME). With a PhD in Interdisciplinary Programmes (Chemical Engineering & Environmental Engineering) and a background in membrane filtration technologies, Lay has transitioned his expertise toward maritime decarbonization, exploring fuel quality management, additive optimization, and emissions reduction strategies. He currently leads the biofuel and biodiesel projects at MESD, collaborating with industry partners to support the adoption of cleaner fuels in the shipping sector. His work includes experimental studies on fuel degradation, material compatibility, and engine performance evaluation under real-world conditions. Lay has published in high-impact journals such as the Journal of Membrane Science and is actively involved in promoting sustainable practices through research, education, and outreach.

## **TURNING FLUE GAS STREAMS FROM BIOMASS COMBUSTION INTO VALUABLE RESOURCES BY CONDENSING HEAT RECOVERY SOLUTIONS**

**Jonas Ståhls**

*Valmet Technologies Oy, Finland*

### **Abstract:**

Valmet's advanced flue gas cleaning and condensing solutions for Bio to Energy (BtE) plants offer numerous benefits, including effective emission control to meet environmental regulations, improved efficiency, and reduced operating costs. These solutions enable efficient heat recovery and the conversion of recovered water from flue gas streams into valuable resources. Additionally, flue gas cooling and conditioning are simultaneously achieved to support carbon capture solutions.

Innovative technologies like wet scrubbers, combustion air humidifiers, and heat pumps significantly enhance cleaning and heat recovery efficiency. The payback time for these installations can be less than two years, making them highly cost-effective. Flue gas temperatures can be lowered far below 40 degrees Celsius, a typical requirement for carbon capture plants to boost efficiency. The condensate generated can be cleaned and reused for district heating networks and boiler make-up water, contributing to overall efficiency and cost reduction.

The presentation will include practical implementations and real-life case examples, demonstrating achievements such as increasing heat recovery efficiency up to 30% by condensing and simultaneously lowering stack temperature close to 10 degrees Celsius, resulting in overall plant efficiencies exceeding 120%. Cleaning flue gas condensate to a pristine level suitable for use as boiler make-up water reduces the need for tap water and associated costs. Valmet's approach emphasizes the potential of flue gas as a source of heat and water for power plants, improving operating costs in flue gas cleaning.

Overall, Valmet's combined emission control and heat recovery technologies offer a viable path toward enhanced plant efficiency and environmental sustainability.

### **Biography**

Jonas Ståhls is the Manager of Concept Sales in the Environmental Solutions, part of Energy and Circularity Business Unit at Valmet Technologies, specializing in flue gas cleaning and condensing. Based in the Tampere, Finland office, Jonas brings over a decade of experience in the flue gas cleaning industry, having held various roles such as product engineer and product sales manager. Currently, Jonas leads a concept sales team in developing, selling, and delivering flue gas cleaning and heat recovery projects on a global scale.

## COMBUSTION OPTIMIZATION ON FORWARD MOVING RECIPROCATING GRATES

**Damir Zibrat**

*Technikgruppe, Austria*

### **Abstract:**

Combustion process on forward moving reciprocating grates for incinerators in biomass to energy or waste to energy plants is very complex. Optimisation of combustion process can have considerable impacts on reliability, availability and profitability of plants.

Control of combustion process is based on 3 main controlled actions:

1. Add fuel
2. Add combustion air (oxygen)
3. Mix the fuel with combustion air

Those actions are provided with 20 – 30 actuators. Those actuators provide billions of possible combinations for fine adjustment. Status of combustion process is changing every few seconds. Every few seconds is necessary fine adjust actuators. Define appropriate combination (one of billions) is very complex task. Quality of combustion process can simply be estimated/measured by observation of:

- stability of steam production
- stability of electricity stabilisation
- stability of air combustion air flow
- stability of flue gas temperature
- quantity of steam production
- quantity of electricity production
- quantity of fly ash

Modern measurement system in plants can provide about 100 measurement results which have informations about current combustion status. Those measurement results can be base for calculation of appropriate combination for fineadjustment of actuators. Because of large number of possible fast changing combinations usual industry controllers with 1 signal

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input – 1 signal output in general can not afford this task. For such applications implementation of controllers which can simultaneously read AND process 100 measurements is necessary. Short term benefits like stabilisation of steam production, stabilisation of electricity production, enhancement of steam production, enhancement of electricity production can be observed about 1 hour after starting of appropriate combustion optimisation. Analyse of those parameters can quickly estimate financial and technical benefits.

**Objective of the Study:** To explain theory, working principles and practical results of unique methods for combustion optimisation on forward moving reciprocating grates.

**Materials and Methods:** The study included analyse of practical results on combustion optimisation on forward moving reciprocating grates.

**Conclusion:** Combustion optimisation on forward moving reciprocating grates can provide technical and commercial benefits in Biomass to Energy plants and Waste to Energy plants. Because every combustion line is unique system it is necessary before decision of implementation in deep analyse combustion process and estimate possible results.

### **Biography**

Damir Zibrat is M.Sc.E.E. and work in Austrian Engineering company TECHNIKGRUPPE. Damir has working experience in electronic development (analog technology), field of industrial measurements, implementation of industrial automation systems, technical/commercial consulting. During last 30 years he had presentations on more seminars, conferences, and events in Europe and USA. He wrote more technical papers regarding analyse of working principles and implementation of measurement instrument and automation systems. Last 8 years his work is aimed on practical implementation of combustion optimization on forward moving reciprocating grates. Damir has experience in international strategical technical selling, organization of technical presentations and organization of international networks. Over last 30 years Damir organized international networks for technical promotions, and practical implementations for more products in field of automation and measurement. In his work in field of combustion optimization he has support of technical experts and experienced application engineers. Damir and his colleagues have interest on exchange of experiences with scientists, researches and engineers.

## CO-CONVERSION OF LIGNIN AND BIOETHANOL FOR POLYGENERATION OF FUELS AND CHEMICALS IN A ONE-POT PROCESS: EXPERIMENTAL STUDY AND 4E (ENERGY-EXERGY-ECONOMY-ENVIRONMENT) ASSESSMENT

Jingkang Shi, Zhongyang Luo, YuSheng Xu, Qian Qian, Qi Wei and Longfei Li  
*Zhejiang University, China*

### Abstract:

Biomass, with its carbon-neutral nature, plays a key role in the global transition to a zero-carbon energy system and stands out among renewable energy sources for producing sustainable, high-density fuels and chemicals; however, the recalcitrant structure of lignin reduces the overall efficiency and economic viability of biomass refineries, as it is challenging to convert into high-value end products.

Our previous studies demonstrated that ethanol is an effective solvent for lignin depolymerization. Beyond promoting mass and heat transfer, ethanol molecules actively interact with catalyst surfaces under harsh conditions. However, this reactivity can hinder the hydrodeoxygenation of lignin depolymerized products, leading to excessive solvent consumption.

In this study, we developed a novel one-pot conversion method that harnesses the dual role of ethanol to simultaneously produce cyclic hydrocarbons and oxygenated chemicals, including oxygenated aromatics, n-butanol, ethyl acetate, acetaldehyde, and ethyl ether. Ethanol and n-hexadecane were employed as co-solvents for lignin depolymerization and hydrodeoxygenation, using various catalysts such as Ni/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub>, Pt/C, Nb<sub>5</sub>Mo<sub>5</sub>O<sub>x</sub>, and their combinations. Pyrolytic lignin and kraft lignin were investigated as feedstocks. By optimizing the ethanol-to-lignin ratio, reaction conditions, and catalysts, we successfully tuned the product distribution. Additionally, lignin structure significantly influenced product yield and composition. Under the optimized conditions, 47 wt% aromatics (based on lignin) were produced, along with 26 wt% n-butanol, 8 wt% ethyl acetate, 9 wt% acetaldehyde, and 13 wt% ethyl ether.

Based on experimental results, we proposed a process scheme for lignin conversion using renewable bioethanol. The process was simulated in Aspen Plus V12 to evaluate energy and exergy performance. Technical-economic analysis and life cycle assessment were conducted using simulation data. This approach enables the adjustment of operating conditions based on market dynamics to optimize the ratio of oxygenated chemicals to fuels, thereby balancing the economic and environmental benefits of lignin from different sources.

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## Biography

Jingkang Shi, born on December 10, 1999, is currently a PhD student at the College of Energy Engineering, State Key Laboratory of Clean Energy Utilization, Zhejiang University. His research interests focus on the thermochemical conversion of lignocellulosic biomass and the assessment of biorefineries.

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## FROM SUNLIGHT TO SCALABILITY: AI-DRIVEN BUSINESS MODELS FOR GREEN HYDROGEN IN DESERT REGIONS

**Raghad Ali Alamro**

*AEC SAMI, Saudi Arabia*

### **Abstract:**

Saudi Arabia, the epicenter of the global oil industry, is one of the countries with the highest solar irradiation in the world. It has shown growing interest in investing in renewable energy, especially solar power in recent years. Nevertheless, storing and using solar energy for long term remains a challenge, especially in desert climates. One of the solutions to this challenge is the production of green hydrogen.

However, there are many obstacles and problems facing not only solar panels but also hydrogen production systems in these climate conditions. High temperatures, dust, and humidity are some of them.

The purpose of this study is to use AI-based models designed to improve energy production in desert regions. they will focus on how AI can help reduce costs, improve efficiency, and support smarter investment decisions. This also includes how AI tools can predict solar generation, optimize electrolyzer performance, and suggest the best locations for hydrogen projects. The presentation will also review real-world pilot projects and will discuss how similar models could be adapted for use Saudi Arabia.

### **Biography**

Raghad Ali Alamro is a science graduate from UQU. She has a deep interest in sustainable energy and environmental responsibility, with a focus on developing clean energy systems to address pollution and resource waste. She currently works as a Sales Operations Specialist at AEC a company involved in sustainable energy projects, where she contributes to operational support for commercial energy activities. This role gives her valuable insight into the intersection of the financial benefits and environmental impacts of sustainable energy development. Raghad presented her research on solar energy challenges in desert areas at the EuroSun 2020 International Conference. She also had the opportunity to acquire knowledge through professionals during an internship in Advanced Energy Systems at the University of Tokyo. Additionally, she won first place in the “Hydrogen Revolution” competition organized by the Saudi Chemical Society. Her goal is to combine her technical background and business experience to support clean energy innovation, especially in desert regions like Saudi Arabia.

## BIOMETHANE PRODUCTION FROM SUGARCANE BYPRODUCTS

**Bruna Soares Fernandes, Rebeca do Nascimento Nunes, Henrique Honorato de Souza, Sarita Candida Rabelo, Marcos Antônio de Moraes Júnior, Aline Carvalho da Costa and Emmanuel Damilano Dutra**

*São Paulo State University, Brazil*

### **Abstract:**

Biomethane is considered a fuel of the future and can replace natural gas of fossil origin. However, in order to be used, it requires purification processes, since it comes from biogas. The biogas, obtained from sugarcane by product as vinasse, is a gas rich in H<sub>2</sub>S and CO<sub>2</sub>, making its purification process expensive. In this sense, this research evaluated the production of biomethane from the biohydrogen and carbon dioxide obtained from the dark fermentation of vinasse (V) and hemicellulosic hydrolysate (HH), both sugarcane byproducts, using enriched cultures of methanogenic hydrogenotrophic archaea. The results of the research showed that it was possible to obtain hydrogen from a mixture of 75% vinasse and 25% hydrolysate and 100% vinasse. The conditions with higher concentrations of HH led to nutritionally poor systems and consequently with lower hydrogen production. The maximum hydrogen production was 436.45 ± 3.98 NmL/g.SV. The biomethanation process led to a gas with a biomethane content of 53% methane, free of H<sub>2</sub>S and a microbial culture rich in methanogenic hydrogenotrophic archaea. The process showed relevant results for the biomethane market and the authors believed that with more experiments the microbial culture would become more specific and with methane levels close to the resolution for use as biomethane.

**Objective of the Study:** The research aims to evaluate the biomethane production from sugarcane byproducts.

**Materials and Methods:** First, hydrogen production tests were performed via dark fermentation using vinasse and hemicellulosic hydrolysate, sugarcane byproducts, as substrate, and the biohydrogen and carbon dioxide were characterized to be used in the production of biomethane. The proportion of 80% H<sub>2</sub> and 20% CO<sub>2</sub> was used in the biomethanation experiment in contact with a mixed anaerobic microbial culture and through successive passages, the enrichment of CH<sub>4</sub> in the gaseous medium and the microbial community were evaluated.

**Inclusion Criteria:** Experiments with high hydrogen production.

**Exclusion Criteria:** Experiments with low hydrogen production.

**Results and Discussion:** The results of the research showed that it was possible to obtain hy-

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drogen from a mixture of 75% vinasse and 25% hydrolysate and 100% vinasse. The conditions with higher concentrations of HH led to nutritionally poor systems and consequently with lower hydrogen production. The maximum hydrogen production was  $436.45 \pm 3.98$  NmL/g. SV. The biomethanation process led to a gas with a biomethane content of 53% methane, free of H<sub>2</sub>S and a microbial culture rich in methanogenic hydrogenotrophic archaea.

**Conclusion:** The process showed relevant results for the biomethane market and the authors believed that with more experiments the microbial culture would become more specific and with methane levels close to the resolution for use as biomethane.

### Biography

Bruna Soares Fernandes é Chemical Engineering, a master's degree and a PhD in Hydraulic and Sanitation Engineering from the University of São Paulo, and has MBA in Project Management. She worked on the development of new technologies for the sanitation and environmental areas at Dedini, a company licensed at the time from Paques BV. She was a research coordinator in biotechnology for the Ergostech/Sapporo/Petrobras project. She completed a postdoctoral project at the Faculty of Chemical Engineering at Unicamp, at the National Laboratory of Science and Technology of Bioethanol, and completed a research internship at the University of Minho. She was Director of Innovation at UFPE and Adjunct Professor in the Department of Civil Engineering at the Federal University of Pernambuco. She is currently an Assistant Professor at UNESP and in the Postgraduate Programs in Microbiology at Ibilce - UNESP and Biotechnology at UFPE. Visiting Professor at the University of Manitoba, Manitoba - Canada (2022-2023). Responsible for the international event Soapbox Science in Assis. She is the coordinator of the Laboratory of Biotechnological and Environmental Processes and responsible for the Research Center for Biotechnological and Environmental Processes and the Multiuser Laboratory of Biotechnological Analysis at UNESP in Assis.

## ASSESSMENT OF POTENTIALS FOR IMPORT SUBSTITUTION AND LOCAL INCOME GENERATION WITH BIOMETHANOL BLENDING IN PETROL: A CASE STUDY FROM INDIA

**Gautham Srinivas Ganesh, Balachandra Patil and S Dasappa**

*Indian Institute of Science, India*

### **Abstract:**

The increase in GHG emissions over the past few decades has prompted the transition towards low-carbon pathways. Biofuels could provide a sustainable alternative towards the decarbonization of the transport systems worldwide. Biofuel blending could also potentially reduce fossil fuel dependency and energy imports. Additionally, the development of an advanced biofuel value chain based on agricultural residues could create a local bioeconomy, benefitting various stakeholders, including farmers and farm workers, biomass trading entrepreneurs, machinery operators, truck drivers, and employees involved in biomass pre-processing and biofuel plant operations. This case study from India explores the potential for oil import reduction, taxpayer impact for financial assistance, and employment and income generation throughout the value-chain, leading to the blending of biomethanol in petrol. Replacing 20% of the required petrol with biomethanol (M20) in Karnataka State, India, could lead to savings of up to INR 4.47 billion (\$52.65 million) in direct petrol and crude oil imports. With a high estimated cost of producing methanol from agricultural residues [INR 63.49/kg (\$0.75/kg)], providing financial assistance could increase its adoption. An incentive of 50% on the biomass feedstock at the biomethanol plant gate would reduce the methanol cost by about 24% and lead to a net financial impact of INR 1.8 billion (\$21.15 million) on taxpayers. The establishment of a local economy based on biomethanol would benefit about 4 million stakeholders across the state, with an aggregate income potential of INR 45.47 billion (\$535 million). Hence, despite the net impact on the taxpayers, the reduced import bills and enhanced positive impacts on rural and semi-urban economies could lead to high acceptance of advanced biofuels in the future.

**Objective of the Study:** To analyze the impact of advanced biofuels from agricultural residues on the fossil fuel import dependencies, net financial impacts on taxpayers, and employment and income potentials.

### **Materials and Methods:**

- The employment generation and income potentials are estimated for each stage in the bio-

methanol value chain based on the prevalent conditions for 20 districts in Karnataka. The number of unskilled farm workers and skilled operators required for the clearance of the available biomass (straws, cobs, and fronds) depends on the availability of mechanized collection, which is obtained from government reports. The number of drivers required for biomass transportation is estimated through the vehicles required, based on the average carrying capacity and speed of the vehicles. The number of employees for pre-processing and biofuel plant operations is estimated based on correspondence with local plants and through expert opinions.

- The feedstock cost is estimated as a function of the collection, transportation, storage, and pre-processing costs. The gross impact of financial assistance is estimated on the feedstock costs at the biomethanol plant gate.
- The amount of petrol saved for the M20 blending scenario is estimated through the annual petrol consumption in Karnataka, which is obtained from government reports. The net impact on taxpayers is estimated as the difference in import savings and financial incentives.

**Exclusions:** This study has assessed the direct impact of the biomethanol value chain on the local economy. Indirect job creation and income potential are excluded from this work.

**Results and Discussion:** Replacing petrol with M20 in Karnataka could lead to annual savings of 67,000 tonnes in petrol import equivalent, leading to INR 4.47 billion (\$52.65 million) of saved foreign exchange. These savings could be used towards financial incentives for biomethanol plants, reducing production costs and thereby improving their economic viability. The average cost of feedstock is estimated to be INR 7.71/kg (\$0.09/kg), leading to a methanol production cost of INR 63.49/kg (\$0.75/kg). Financial assistance for the feedstock to the tune of 50% reduces the methanol costs by about 24%, resulting in a gross impact of INR 6.27 billion (\$73.8 million) on the taxpayers. The net impact, considering the savings on imports, reduces to INR 1.8 billion (\$21.15 million). The government spending on financial assistance could potentially enhance the incomes of about 3.77 million farmers and create about 321,000 direct jobs in biomass collection, transportation, biomass trading, and plant operations. The biomethanol value chain could generate an aggregate income of about INR 45.47 billion (\$535 million).

**Conclusion:** The available net surplus agricultural residues could potentially be used for biomethanol production. Our findings indicate that the blending of biomethanol in petrol could lead to substantial import savings. However, due to its high costs, financial assistance must be provided to improve adoption. Despite the net negative burden on the taxpayers, the develop-

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ment of an advanced biofuel economy could lead to significant economic benefits for stakeholders situated in rural and semi-urban areas. Enhancement in the local economy could lead to high social acceptance of biofuel projects and ensure their continuity in the long run.

### **Biography**

Gautham Srinivas Ganesh is a research scholar at the Centre for Sustainable Technologies, Indian Institute of Science, Bengaluru. His research focuses on the sustainability assessment of the advanced biofuel value chains for transition in the Indian transport system. He has been a recipient of the prestigious Prime Minister's Research Fellowship (PMRF) since 2021. In the past few years, he has taken up various voluntary teaching activities for university students in India, having taught subjects like sustainability and biomass energy systems. Gautham completed his master's degree in Energy Engineering from the Technical University of Berlin in 2015 and his bachelor's degree from the National Institute of Technology, Bhopal, India, in 2011. He has worked as a project manager for solar power projects in India for three years prior to his current stint as a doctoral student. He is a polyglot and speaks five languages fluently, including Tamil, Hindi, Kannada, English, and German.

## ASSESSING THE LOW-CARBON PRODUCTION OF BIO-BASED RESINS AND SOLVENTS VIA THERMOCHEMICAL BIOMASS CONVERSION

**Sebastian Ospina, JC Morales, P Cano and G Caverro**

*Blue Synergy SL, Spain*

### **Abstract:**

**Objective of the Study:** This study presents a preliminary Life Cycle Assessment (LCA) of an integrated biorefinery that utilizes thermochemical fractionation of lignocellulosic biomass—primarily wood residues—to produce bio-based chemicals and materials. Target products include bioresins, medium-density fiberboard (MDF), and furan-derived solvents such as 2-methyltetrahydrofuran (MeTHF) and tetrahydrofurfuryl alcohol (THFA). The aim is to evaluate environmental performance and identify key areas for improvement across these production lines.

**Materials and Methods:** The LCA was conducted in accordance with ISO 14040/44 standards using SimaPro 9.6, Ecoinvent 3.10 as the background database, and the Environmental Footprint 3.1 method. System boundaries were defined as cradle-to-gate for products and cradle-to-grave for emissions and waste. Functional units were set at 1 kg of MeTHF or THFA and 1 m<sup>3</sup> of MDF among others. Primary data were derived from pilot-scale process modeling, covering inputs such as biomass, energy, and chemicals, while secondary data addressed upstream processes.

**Results and Discussion:** Thermochemical fractionation proved effective in converting wood residues into valuable intermediates with comparatively low climate impact. The Global Warming Potential (GWP) associated with MeTHF and THFA production was significantly lower than that of their petrochemical equivalents, primarily due to the renewable origin of carbon in the biomass and internal recovery of process energy. The integration of anaerobic digestion for biogas generation and efficient thermal loops further contributed to emissions reduction. MDF production also showed favorable GWP results when using bioresins derived from pyrolytic fractions.

**Conclusion:** The LCA indicates that biorefineries based on thermochemical fractionation of wood biomass can achieve considerable reductions in GWP compared to conventional fossil-based systems. The substitution of petrochemicals with renewable intermediates and the use of energy integration strategies highlight the environmental promise of this approach for sustainable materials and solvent production.

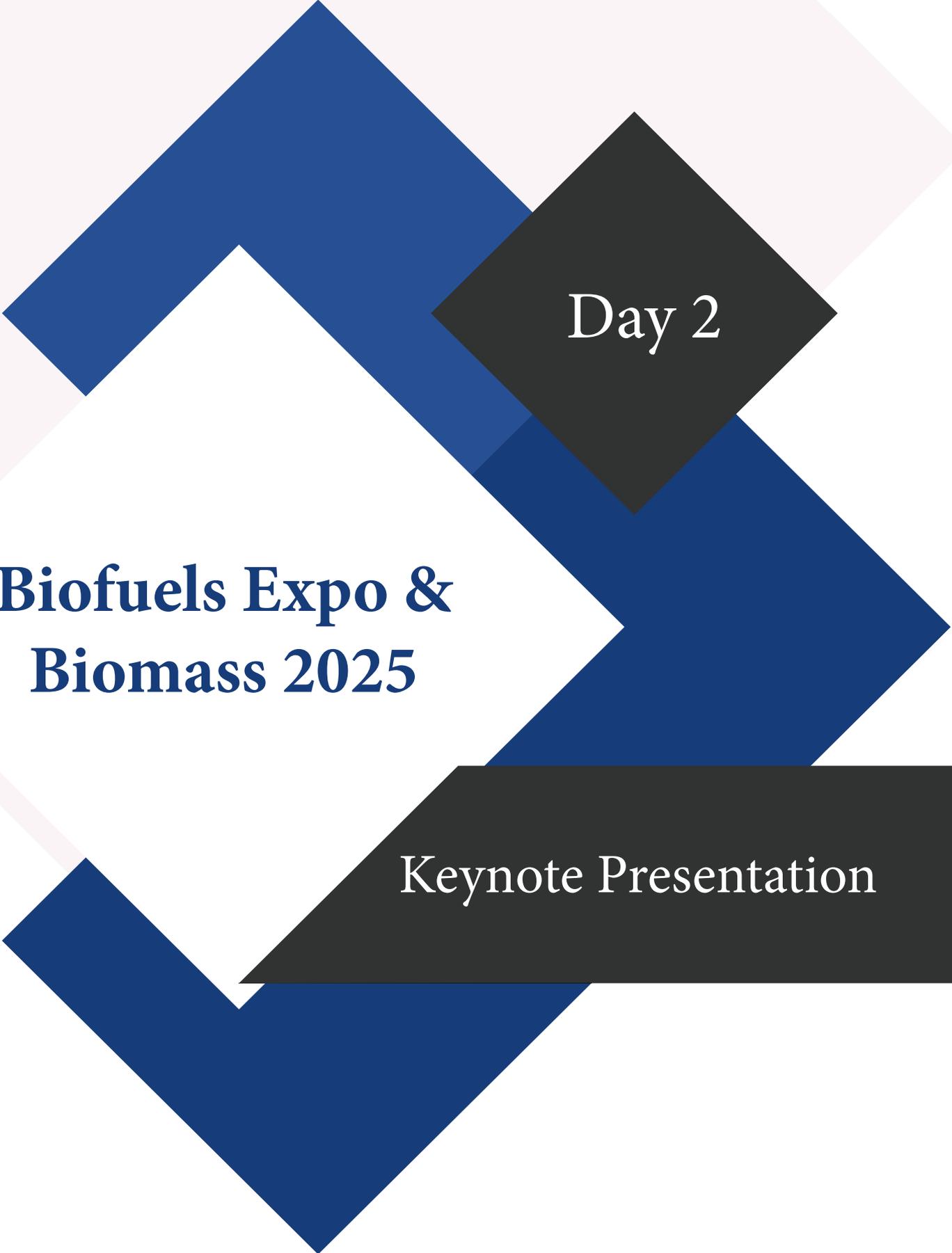
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## Biography

Sebastian Ospina Corral is a chemical engineer and PhD candidate in Food Technology, Quality, and Safety at the Universidad de Zaragoza, where he conducted his doctoral research under a prestigious Marie Skłodowska-Curie H2020 fellowship. His work focused on enhancing the sustainability of meat supply chains through non-thermal preservation technologies. Based in Madrid, he currently holds a senior position at Blue Synergy SL, a sustainability consultancy, where he leads several work packages in European Horizon Research and Innovation Action (RIA) projects. Sebastian's expertise spans life cycle assessment (LCA), life cycle costing (LCC), social LCA, technoeconomic assessment (TEA), process modeling and simulation, and the application of machine learning for sustainability evaluations. His focus areas include biorefineries, nanoelectronics, agribusiness, and food supply chains. He also leads the company's grant writing efforts and contributes as a data analyst, supporting the development of innovative and environmentally conscious technologies. With a strong foundation in biotechnology and ecodesign, Sebastian is dedicated to bridging science and industry to foster circular, resilient, and data-driven value chains across Europe.



Day 2

**Biofuels Expo &  
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Keynote Presentation

## INVESTMENT OPPORTUNITIES AND TECHNOLOGICAL INNOVATIONS IN CHINA'S BIOFUEL INDUSTRY: GROWTH, CHALLENGES, AND STRATEGIC INSIGHTS



**Yingmin Ye Frank**

*CHEM1 Consulting & Service Co., Limited, Hong Kong*

### Abstract:

This study explores China's growing biofuels industry, highlighting technological innovations, market dynamics, and investment opportunities. It provides strategic insights for stakeholders aiming to capitalize on China's renewable energy transition while addressing industry challenges.

**Objective of the Study:** This study explores the growth trajectory of China's biofuel sector, focusing on the latest technological advancements, market dynamics, and key investment opportunities within the biofuel industry.

**Materials and Methods:** The study integrates market analysis, policy assessments, and case studies to assess China's biofuels landscape. Special focus is placed on biofuels technologies, such as biodiesel, bioethanol, and biogas, with an emphasis on feedstock innovations and production scalability.

**Inclusion Criteria:** The study includes biofuel technologies and investment opportunities related to sustainable feedstocks, such as used cooking oil, acidified oils, and waste oils, that support China's renewable energy and carbon reduction goals.

**Exclusion Criteria:** Projects outside the scope of biofuel production, such as those focusing solely on fossil fuels, are excluded.

**Results and Discussion:** Key findings highlight the rapid growth of China's biofuels market, driven by strong policy support and technological breakthroughs. Bioethanol and biodiesel production technologies are evolving, with significant investments in feedstock sourcing and production optimization. Investment opportunities in R&D, infrastructure, and market expansion are discussed, along with risks related to policy uncertainty and feedstock supply chain disruptions.

**Conclusion:** China's biofuel sector holds substantial investment potential, particularly in production technologies, feedstock sourcing, and market expansion. Stakeholders can benefit from strategic investments aligned with China's green energy policies to unlock opportunities in the growing biofuels market, contributing to sustainable development goals.

### Biography:

Yingmin Ye is the Founder and Managing Director of CHEM1 Consulting & Service (Hongkong) Co.,LTD, with over 20 years of experience in the energy and chemical industries in China. He specializes in industry research, strategic planning, and investment analysis, offering professional consulting and research services to both domestic and international companies. He has frequently collaborated with government bodies in the

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petrochemical sector, contributing to the development of economic indicators and forecasting systems for the chemical industry. His expertise in these areas has positioned him as a trusted advisor in the sector. A respected and sought-after speaker, Yingmin Ye has been invited multiple times to address prestigious international energy and chemical forums, sharing his insights on industry trends and innovations. Before founding CHEM1, he worked as a professional analyst in the Market Analysis Department of SinoChem Group. He holds degrees in Materials Chemistry and International Commerce from Sun Yat-sen University.

## **ELITETREE™ AN ADVANCED BIOMASS TREE CROP TECHNOLOGY THAT FEATURES ACCELERATED GROWTH AND GREATER BIOMASS DENSITY**



**Kyung-Hwan Han**

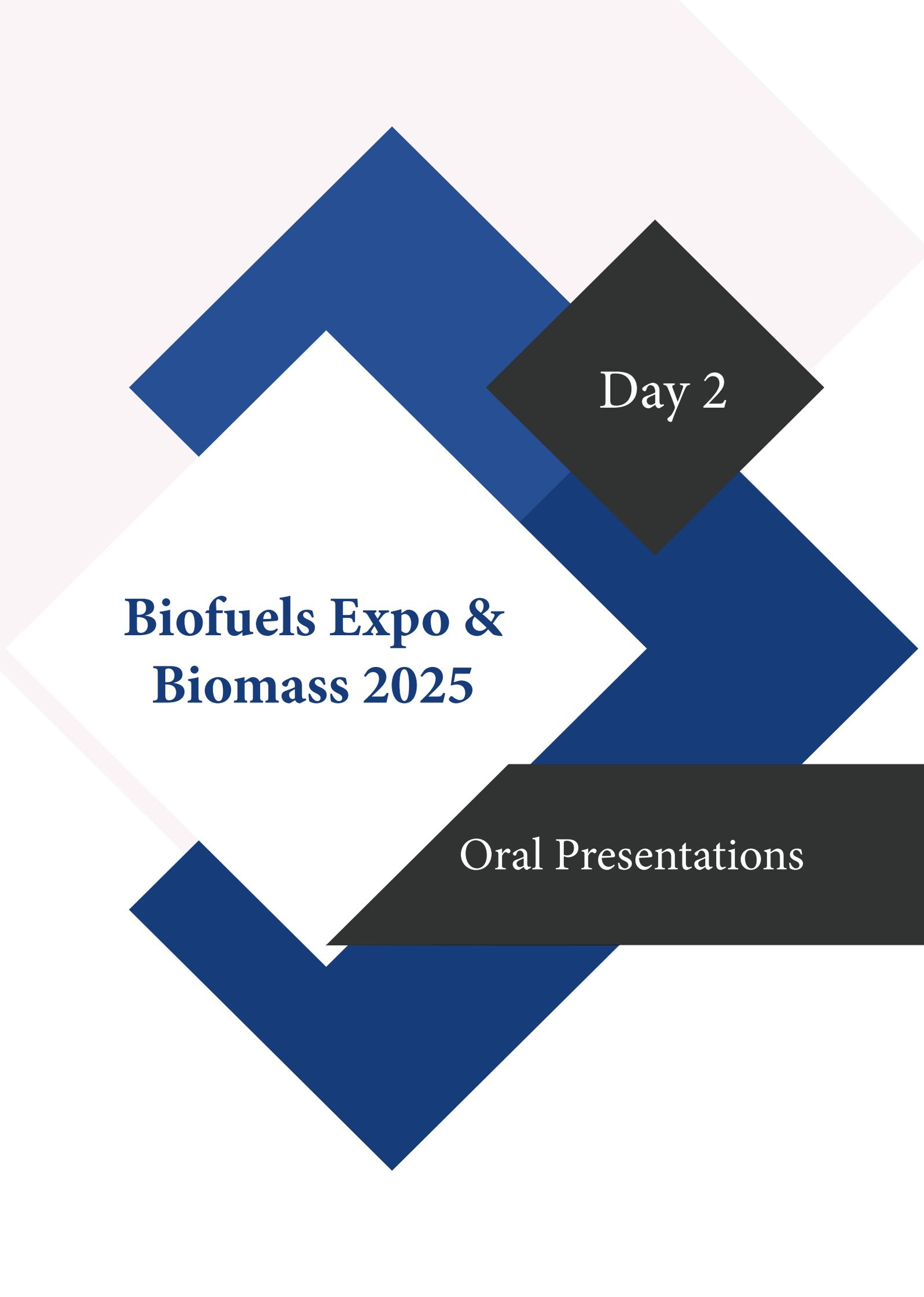
*Michigan State University, USA*

### **Abstract:**

A rapid increase in the use of woody biomass for bioproducts is expected as new global climate change policies encourage a transition away from fossil fuels. We developed an innovative and proprietary technology, called EliteTree™, to speed the introduction of genetically designed biomass tree crops that can significantly improve the profitability of all stages of plant biomass-based industries. Sustainable production of biomass feedstocks requires overcoming economic, environmental, and societal obstacles. Deploying EliteTree™ crops in Short Rotation Coppice (SRC) plantations has the potential to produce a consistent supply of woody biomass feedstock that will overcome existing economic, environmental, and social barriers. If commercialized, otherwise unproductive retired agriculture land can become the source of the woody feedstocks required to contribute to renewable energy and non-fossil product goals of the future while strengthening rural economies around the country and world. Using EliteTree™ poplars, we are trying to demonstrate the superior 'in-field' performance of our proprietary biomass crop, leading to increased profitability of plant biomass-based industries including bioenergy (both liquid and solid fuels), fiber, feedstock for industrial chemicals (e.g., lignin-derived products), and pulp and paper manufacturing.

### **Biography:**

Kyung-Hwan Han is a plant molecular biologist in the Department of Horticulture at Michigan State University. Dr. Han's research interests focus on the molecular biology of plants, specifically: (1) secondary growth and secondary wall biosynthesis, (2) feedstock development for bioenergy and biomaterials, (3) drought tolerance in plants.

The background features a large, light pink diamond shape. Overlaid on this are several dark blue geometric shapes, including a large inverted triangle at the top, a smaller triangle at the bottom, and a large triangle on the right side. A black diamond is positioned in the upper right, and a black horizontal bar is at the bottom right.

Day 2

**Biofuels Expo &  
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Oral Presentations

## INFLUENCE OF ASH FORMING ELEMENTS CONTENT AND LIGNOCELLULOSIC STRUCTURE ON THE EVOLUTION AND TRANSPORT OF S AND CL FROM THE GASIFICATION TO THE COMBUSTION ZONE IN A FAST INTERNALLY CIRCULATING FLUIDISED BED REACTOR

**Ferrarese Giovanni, Jean-Henry Ferrasse, Lina Maria Romero Millan, Perrine Chaurand, Bernard Angeletti, Andrea Campos, Maxime Hervy, Olivier Boutin and Yilmaz Kara**

*Aix Marseille University, France*

### **Abstract:**

Biomethane production through pyro-gasification technologies (as FICFB reactor) using waste materials could meet 2% of global biogas demand by 2040, offering a low-carbon energy solution. However, such produced syngas contains harmful pollutants like Cl and S, which can damage downstream processes.

**Objective:** Controlling S and Cl devolatilization in gasification zone, by storing them in nascent char, reduce syngas contamination minimizing risks of poisoning, corrosion and slagging in downstream pipelines. This enhances waste treatment efficiency, safety and sustainability of biomethane production.

**Materials and Methods:** Gasification operating conditions: T~830°C, SB:0.6, Capacity: 600 kWth.

Mixed feedstocks (M-n°) of forestry chips (FC), straw pellet (SP), pine bark (PB) tested:

0. 100%FC

1. 80%FC+20%SP

2. 80%FC+10%SP+10%PB

Feed, gasification (quick coke, QC) and combustion section (fines, F) ashes has been analysed by proximate, ultimate, elemental analysis, granulometry, XRD, densitometry, sequential extraction, SEM-EDS and  $\mu$ -XRF.

**Results and Discussion:** QC increases size and fixed carbon content in M-2. Density behaved oppositely between QC and F, increasing in M-1 for QC and decreasing in F. Volatile matter increased significantly in F of M-2. K, Ca, Na, Zn, S and Cl concentration decreased in both QC

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and F in M-1, increasing instead in M-2. KCl and  $\text{Na}_8(\text{Al}_6\text{Si}_6\text{O}_{24})(\text{SO}_4)_6\text{Cl}_2$  in QC of M-1 has been identified while KCl and  $\text{Ca}_2\text{Al}_2(\text{SO}_4)_4 \cdot 22\text{H}_2\text{O}$  in M-2 F. S content in M-1 QC increased in organic fraction and mineral one (Including earth metal salts and alumina silicates). In M-1 F, S is instead revealed as alkaline metal salts and hydrated aluminates.

**Conclusion:** S and Cl retention in gasification nascent char is not completely explained by the estimated factor (based on elemental composition of M-n<sup>o</sup>), demonstrating importance of hemicellulos and lignin fractions in creating a more mechanically and thermally resistant feed, able to increase S and Cl residence time, interaction and caging in solid phase of gasification.

**Biography:**

Giovanni Ferrarese is a PhD student at the M2P2 Amu lab of the Aix-Marseille University (AmU) and at the BBW lab of ENGIE's R&D centre (CRIGEN). His research focuses on the study and statistical characterization of ashes from steam pyro-gasification of biomass and solid waste in fluidized beds, to understand the evolution and retention of sulfur and chlorine in nascent char. During this project he is actively supported by the CEREGE lab (Europole Arbois) and CP2M lab (AmU). This researcher holds a master's degree in Engineering Chemistry and Sustainable Processes from Politecnico di Torino (2023). His academic path includes international experiences such as the master's thesis (presented at an international conference in 2025) developed at M2P2 in collaboration with REONOVA Group, and the Unite Project program at Técnico de Lisboa in 2021. Before his PhD, he worked as a teaching assistant and consultant, collaborating with the Chemistry Department at PoliTO.

## HYDROGEN-RICH SYNGAS PRODUCTION FROM BIOMASS OXY-STEAM GASIFICATION: INFLUENCE OF GASIFICATION CONDITIONS AND BED MATERIALS.

**Peter Opoku Badu, M Debal, M Navid, P Girods and Y Rogauime**

*Universtité de Lorraine, France*

### **Abstract:**

This study focuses on the production of hydrogen-rich syngas from woody biomass via oxygen-steam gasification in a 20 KW electrically-heated bubbling fluidized bed reactor. Specifically, the objectives were to identify optimum gasification parameters, assess and compare the influence of three bed materials: natural olivine, iron-enriched olivine, and silica sand on hydrogen production, syngas quality, and tar reduction. Initial tests with natural olivine identified optimal operating conditions of low equivalence ratio (0.19), moderate steam-biomass ratio (0.7), and high bed temperature ( $> 740^{\circ}\text{C}$ ), which were subsequently applied to other bed materials for comparative assessment. Key exclusion criteria included not using catalytic additives beyond iron enrichment in olivine. The hydrogen-rich syngas composition was continuously monitored with dual online micro-gas chromatography. Tar content was quantified following the standard tar protocol. Contaminants and the water fraction in the dry gas were measured using a laser-cem analyzer and an Infra-Red Fourier Transform spectrometer, complemented by Karl Fischer titration for validation. Gasification performance metrics for the entire process for each bed material were analyzed. Results show that natural olivine produced the highest hydrogen performance, with 44 vol%  $\text{H}_2$ , 55  $\text{gH}_2/\text{kg}$  dry biomass, and syngas lower heating value (LHV) of 10.5 MJ/kg. Outperforming iron-enriched olivine, which showed marginally lower hydrogen outputs (40.62 vol%, 52  $\text{gH}_2/\text{kg}$ ) and an LHV of 8.7 MJ/kg. Silica sand, serving as the inert reference, yielded 37 vol%  $\text{H}_2$ , 40  $\text{gH}_2/\text{kg}$  dry biomass, and 9.6 MJ/kg LHV. On the contrary, iron-enriched olivine offered slightly better tar reduction capabilities (57%), slightly outperforming natural olivine (53 %) relative to inert silica sand as a reference. Our results provide preliminary insights into bed material selection for optimal hydrogen production and syngas quality while minimizing downstream processing requirements in biomass gasification using fluidized bed systems.

### **Biography**

Peter Opoku Badu is a PhD candidate in Process Engineering at Université de Lorraine (Epinal, France), where he's investigating hydrogen-rich syngas production via biomass gasification in a dense fluidized-bed. He earned an MSc in Biomass & Waste Process Engineering from IMT Mines Albi (2021) and a BSc in Materials Science & Engineering from the University of Ghana (2017), specializing in polymer, environmental engineering, and waste valorization. His professional experience includes internships at LRGP (Nancy) studying flash pyrolysis and ISO-standard dust-

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explosion limits, and at Rapsodee Laboratory (Albi) characterizing clay mechanics for industrial partners. As an undergraduate teaching assistant at the University of Ghana, he developed renewable-energy course materials and led a project converting polythene waste into high-performance composites. Peter's key projects span Aspen Plus CHP design (2020), brewer's spent-grain valorization, and theoretical gasifier/boiler design (2019). As a first author in the Biomass and Bioenergy journal, he's published on biomass gasification in a semi-industrial gasifier, focusing on the syngas characterisation and energy balance. Peter is also a first co-author in Process Safety and Environmental Protection (2023) and the Italian Association of Chemical Engineering (2022), where he's published on biomass powder explosions and pyrolysis, respectively. Fluent in English with working French, he holds the BIWEM merit scholarship (2020–21) and volunteered with STEM outreach (PEN, Ghana). His multidisciplinary expertise in thermo-chemical conversions, kinetic modeling, and process simulation equips him to contribute cutting-edge insights at your conference.

## IDENTIFYING EXPLANATORY VARIABLES FOR WILLOW BIOMASS GROWTH: APPLICATION OF RANDOM FOREST TO A GLOBAL DATASET

**Antonio Castellano Albors, A Shepherd, I Shield, W Macalpine, K Lindegaard, I Tubby and A Hastings**

*University of Aberdeen, United Kingdom*

### **Abstract:**

Extensive research and breeding programmes have been carried out in order to understand and improve biomass production of short rotation coppice (SRC) willow. Despite these efforts, differences in management methods and genotype by environment interaction (GxE) challenge the global prediction of yield. Machine learning models such as random forest have shown great performance when many variables were analysed and are less restrictive than other statistical models in their assumptions. Random forest was applied to a global dataset of SRC willow, collected from literature review and personal communications with key players in willow research in the UK. Missing values (NA) were included when data was not reported and correlation between some variables was found through data exploration.

**Objective of the study:** To find what environmental factors and management methods are associated with a higher productivity of SRC willow at a global scale.

**Materials and Methods:** R package '*randomForest*' was used to study the variance in yield explained by the model along with the importance of each variable. A comparison between models with and without missing values was performed. Backwards variable selection by discarding the 20 % of the variables with lowest score in the importance metric of the model was followed until the variable including the genotypes was removed. This was done for the two models (with/without NA).

**Results and Discussion:** The random forest model with missing values included explained 64.65 % of the variance observed in yield with nine variables, while the model with missing values discarded explained 59.73 % of the variance with ten variables. Terrain aspect, mean temperature and mean precipitation for the growing season, clay percentage, harvest cycle number, planting density, genetic diversity and plant available water are shared by the two models as the most important variables associated with biomass production of willow.

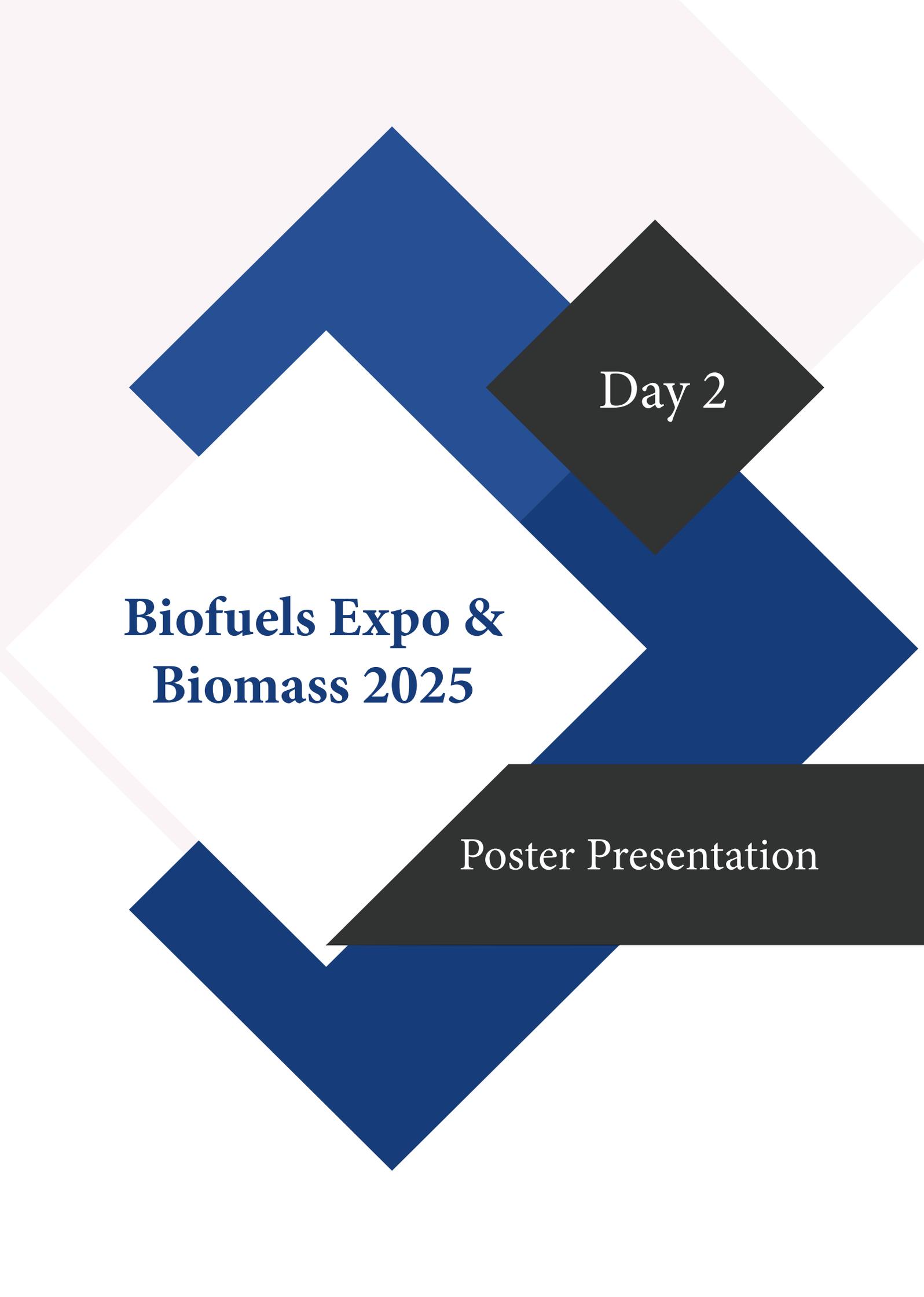
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## Biography

Antonio Castellano Albors is a current PhD student at the University of Aberdeen with a focus on short rotation coppice (SRC) willow for multiple end uses. He is developing the process-based model SalixFor for willow, based on the MiscanFor model previously developed by Prof. Astley Hastings at the University of Aberdeen. His PhD falls under the Demonstrator project Perennial Biomass Crops for Greenhouse Gas Removal (PBC4GGR), where he has been taking allometric and light interception measurements for parameterizing and calibrating SalixFor. Antonio has collaborated with Envirocrops in the UK by collecting final yield data from willow trees at twelve commercial plantations in England. He has also supported students at the University as a demonstrator in lab and computer practicals. He completed his MSc in Environmental Management with Commendation at the University of Aberdeen in 2019, where he collaborated with Stirling Council and the Scottish Environmental Protection Agency (SEPA) on the project 'Towards a more sustainable territory: Development of consumption-based metrics that help Stirling Council to manage their footprint more efficiently'. Antonio graduated with a BSc (Hons) in Environmental Science at the National Distance Education University (UNED) in Spain. His final project was entitled 'The Water Framework Directive and the Jucar Hydrological Plan: Lights and Shadows'. Previously, he worked as an environmental consultant in the soil remediation sector for over a year and a half, where he took soil samples for analysis, conducted investigations, supervised drilling jobs, and created environmental reports, among other tasks. He also worked in a laboratory testing the physical and mechanical properties of materials used in the offshore industry, such as pipelines, and earlier as a sampling technician in the offshore industry, collecting water and fuel samples from vessels and industrial premises.

The background features a large, light pink diamond shape. Overlaid on this are several dark blue geometric shapes, including a large downward-pointing chevron and a smaller upward-pointing chevron. A black diamond is positioned in the upper right, and a black horizontal bar is at the bottom right. The text is placed within these shapes.

Day 2

**Biofuels Expo &  
Biomass 2025**

Poster Presentation

## BIOMASS DETECTION AND FUEL MAPPING FOR WILDFIRE MITIGATION AND BIO-OIL PRODUCTION

**Ana R P Gonçalves, Dos Santos, Rui Galhano, Goyanes, Gabriel, Miranda and Vasco**

*Instituto Superior Técnico, Portugal*

### **Abstract:**

Forest fires pose a significant threat worldwide, highlighting the urgent need for proactive forest management and cleaning practices to mitigate risks and protect ecosystems. A synergistic integration of the biomass conversion process and remote sensing methodologies could solve this problem. The biomass in the field will be detected, and high-resolution Fuel Maps will be generated, enabling accurate monitoring of fuel amount and moisture content. This will facilitate the forecasting of forest wildfire risks. The collected biomass will be converted into bio-oil through thermochemical liquefaction, which can be further processed into lower molecular weight lignin and sugar derivatives. The bio-oil or the non-valuable fraction can also be applied as energy carriers. Finally, the results of the liquefaction experiments will be integrated with the Fuel Maps to predict the energetic value of the liquefied biomass. This interdisciplinary approach aims to improve biomass management and utilization while contributing to predicting and mitigating wildfire risks.

**Objective of the Study:** An integrated approach combining biomass conversion and remote sensing aims to enhance forest fire prevention by enabling accurate fuel monitoring, bio-oil production, and improved biomass management.

### **Biography**

Ana Raquel Gonçalves obtained her Master's degree in Chemistry Technology in 2019 and her Bachelor's degree in Chemistry Technology in 2017 from the Faculdade de Ciências da Universidade de Lisboa. In November 2021, she was awarded a PhD scholarship from CERENA's Strategic Project funded by FCT to develop the workplan "Mapping, identification, and valorization of biomass - Development of fuel maps for forest management and valorization." In 2022, Ana Raquel Gonçalves received recognition for co-authoring, as the first author, a highly cited paper in the International Journal of Molecular Sciences, titled "Ionic Liquids—A Review of Their Toxicity to Living Organisms." Published in the Collection Feature Papers in Molecular Toxicology, it was acknowledged as one of the most highly cited articles in 2021, reflecting its impact in the field. This recognition underscores her commitment to advancing research in molecular toxicology and highlights her contributions to the scientific community in the area of ionic liquids. Her current research focuses on the sustainable valorization of biomass through thermochemical liquefaction and waste treatment. By converting organic residues into valuable bio-based products, Ana Raquel Gonçalves' work supports the circular economy and promotes green and sustainable chemistry through efficient, low-waste solutions for energy and material recovery.

## ESTIMATING SUSTAINABLE AVIATION FUEL PRODUCTION POTENTIAL IN THE EU-27 BY 2050 USING SECOND-GENERATION WASTE-BASED FEEDSTOCKS VIA SOLAR-ASSISTED FAST PYROLYSIS

Stavroula Zervopoulou<sup>1</sup>, Muddasser Inayat<sup>2</sup>, Stavros Papadokonstantakis<sup>1</sup> and Mika Järvinen<sup>2</sup>

<sup>1</sup>Vienna University of Technology, Austria

<sup>2</sup>Aalto University, Finland

### Abstract:

The EUROCONTROL 2022 report, presents long-term projections for flights and CO<sub>2</sub> emissions under three different scenarios: low, base, and high. In the base scenario, the European aviation sector is anticipated to experience significant growth, with flight numbers rising 44% above with respect to 2019 levels. It is expected to reach approximately 16 million flights annually by 2050. This increase in air traffic will drive a substantial rise in fossil fuel consumption, resulting in millions of gigatons of CO<sub>2</sub> emissions from the aviation industry. Among available mitigation strategies, sustainable aviation fuels (SAF) present the most promising solution for reducing aviation-related emissions. Notably, biomass-based fuels stand out as the only renewable energy source capable of actively capturing CO<sub>2</sub> during their lifecycle.

This study estimates the production capacity of SAF for each EU member state and the EU-27 as a whole while assessing the extent to which conventional Jet A-1 fuel could be replaced. The analysis aims to underscore the role of SAF in achieving the ReFuelEU Aviation targets by 2050. In this study, four different feedstocks from agriculture and forestry were used for SAF estimation, which is derived from an innovative solar-assisted thermal fast pyrolysis process, which converts waste biomass feedstocks into bio-oil. Bio-oil further needs intermediate upgrading processes to refine it before it can be used as aviation fuel. To enhance its stability and energy content, the pyrolysis oil undergoes slurry hydrotreatment and hydrodeoxygenation (HDO), upgrading it into renewable crude, which is subsequently refined into SAF and other valuable co-products.

By evaluating SAF production potential across the EU-27, this study provides key insights into the feasibility of replacing fossil-based Jet A-1 fuel with sustainable alternatives. The findings support the broader goal of carbon-neutral aviation, reducing dependency on fossil fuels, and advancing the EU's commitment to a sustainable energy transition in the aviation sector.

**Objective of the Study:** The study aims to assess SAF production capacity in the EU-27 member states and its potential to replace fossil-based Jet A-1 fuel, supporting the ReFuelEU Aviation targets by 2050. It evaluates the feasibility of bio-waste-based SAF from a solar-assisted pyrolysis

process to reduce aviation CO<sub>2</sub> emissions and advance carbon-neutral aviation.

**Materials and Methods:** The study included the SAF estimation from four waste biomass feedstocks to estimate SAF production capacity in the EU-27 member states for 2030 and 2050. For the feedstock, different estimation methods were applied.

#### **Inclusion Criteria:**

- Geographical Scope: EU-27 member states included in the SAF production potential assessment.
- Feedstock Type: Waste biomass feedstocks that are suitable for the solar-assisted thermal fast pyrolysis process.
- Timeframe: SAF production potential estimated for 2030 and 2050.
- Data Availability: Countries with reliable data on feedstock availability, and Jet A-1 fuel supply.

**Results and Discussion:** The estimated replacement of Jet A-1 fuel by SAF production shows significant variation across EU-27 member states. Some countries demonstrate high replacement potential (Denmark, Czechia and Slovakia), while others show more modest contributions (Greece and Portugal). Overall, the data highlights a growing capacity for sustainable aviation fuel production, but also underscores the uneven distribution of resources and the need for targeted strategies to maximize contributions across all member states.

**Conclusion:** This study estimates SAF production potential across the EU-27, offering key insights into the feasibility of replacing conventional Jet A-1 fuel with renewable alternatives. The findings support efforts to achieve carbon-neutral aviation, decrease dependence on fossil fuels, and promote the EU's transition to sustainable energy in the aviation sector.

#### **Biographies**

Stavroula Zervopoulou is a Research Project Assistant in the Process Systems Engineering for Sustainable Resources Research Group of the Institute of Chemical, Environmental, and Bioscience Engineering of the Faculty of Technical Chemistry at Vienna University of Technology in Austria. She is currently involved in the Circular Fuels project funded by the EU Horizon program while conducting her Doctoral Research. She holds a 5-year Integrated Master's in Mineral Resources Engineering from the Technical University of Crete. She has completed three postgraduate degrees: Administration and Management of Industrial Systems (University of Piraeus & NTUA), Business Administration – Banking and Finance (Open University of Cyprus), and Petroleum Engineering (Imperial College London). Additionally, she earned a second degree in Energy Economics from the Open University of Cyprus. She has worked as a Research Assistant at the University of Piraeus (Thales Programme) and has authored/co-authored five scholarly papers. With six years of experience in both the private and public sectors, she has expertise as a Mineral Resources and Petroleum Engineer.

Muddasser Inayat is currently working as a postdoctoral researcher in the Energy Conversion and System group at the Department of Energy and Mechanical Engineering at Aalto University Finland. He earned his MS and PhD degrees from Universiti Teknologi PETRONAS Malaysia. His research interests include thermochemical conversion processes, biofuels, hydrogen production, and gas cleaning for upstream applications. Currently, he is involved in the Circular Fuels project funded by the EU Horizon program. He has published more than 40 research articles in leading energy journals and actively serves as a reviewer for several prestigious Elsevier journals.

## DEVELOPMENT OF ETHANOL-BASED GEL FUELS: INVESTIGATING THE EFFECTS OF CALCIUM CHLORIDE ON GELATION AND PERFORMANCE

**Alessia De Cataldo, Luigi Gentile and Roberto Cerbino**

*Politecnico di Bari, Italy*

### **Abstract:**

Ethanol is a substance classified as Generally Recognized as Safe (GRAS) and a natural by-product of plant fermentation, making it widely used in cosmetics, household products, food additives, antiseptics, and disinfectants. Beyond these applications, ethanol is also employed as a fuel, either pure or blended with gasoline, to reduce crude oil consumption and mitigate environmental pollution.

In recent decades, the scientific community has focused on improving the storage, transportation, and combustion processes of fuels, which has led to increased interest in gel fuels. Gel fuels combine the advantages of both solid and liquid fuels: they are resistant to leakage and easy to store and transport like solid fuels, while also enabling controllable thrust and multiple starts of engines, like liquids. These gels can be easily obtained by adding a gelling agent to liquid fuels, thereby altering their rheological properties.

This study explores the rheological and thermal properties, combustion performance, and microscale structure of ethyl cellulose (EC) in ethanol, with a particular focus on how calcium chloride ( $\text{CaCl}_2$ ) influences their structure and stability. Our results demonstrate that EC forms strong threedimensional gel networks in ethanol when  $\text{CaCl}_2$  is present, significantly enhancing the gelation process. Thermogravimetric analysis indicates that EC in ethanol exhibits good thermal stability, with a single decomposition stage. Furthermore,  $\text{CaCl}_2$  modifies the rheological behavior and improves the thermal properties of the EC/ethanol system, resulting in enhanced ignition performance due to the formation of  $\text{CaCl}_2$ -methanolates.

### **Biography**

Alessia De Cataldo is a third-year Ph.D. student in Aerospace Science and Engineering at Polytechnic of Bari in southern Italy. She is enrolled in an inter – university Ph.D. program between Polytechnic of Bari and University of Bari Aldo Moro. She conducts her research at the Chemistry Department of University of Bari under the supervision of Prof. Luigi Gentile. Her research focuses on the formulation and characterization of viscoelastic gels made from sustainable materials such as cellulose, its derivatives, and/or biocompatible polymers. These gels are designed to create highly efficient systems for trapping sustainable fuels. In 2023, De Cataldo published her first paper on this topic, titled “Methyl Cellulose as a NonBonding Gelling Agent for Calcium Chloride Methanol Fuel Gels.” She is now preparing to submit her second paper on the gelation of ethanol. The final goal of her Ph.D. project is to explore the feasibility of gelling biodiesel. Before beginning her doctoral research, Dr. De Cataldo worked on heterogeneous catalysis and the removal of pollutants from wastewater through physical-chemical adsorption using waste materials such as bentonite, a common clay.

## BIO-STRUVITE PRODUCTION FROM CORN STEEP LIQUOR: POTENTIAL FOR NUTRIENT RECOVERY AND AGRICULTURAL SUSTAINABILITY

**Bruna Soares Fernandes, Maria Luiza da Paes Xavier, Mislane Iva da Cruz, Vanessa Andrade da Silva, Iracema Carla Calixto da Silva, Romulo Simoes Cezar Menezes and Emmanuel Damilano Dutra**

*São Paulo State University, Brazil*

### **Abstract:**

Struvite ( $MgNH_4PO_4 \cdot 6H_2O$ ) is a crystalline mineral formed by the precipitation of magnesium, ammonium, and phosphate in aqueous environments. Its potential as a slow-release fertilizer has gained attention, as it provides nitrogen, phosphorus, and magnesium gradually, reducing nutrient leaching and increasing crop nutrient use efficiency. Given the growing concern over the depletion of natural phosphorus reserves and the low efficiency of conventional fertilizers, recovering this nutrient from waste sources has become a strategic alternative. Although widely used, physicochemical methods for struvite production require high costs related to pH control, chemical reagents, and energy. In this context, biological processes have been proposed as a more sustainable alternative. Microorganisms such as *Bacillus* spp. can mediate struvite precipitation through enzymatic ion release or modification of the microenvironment, with lower energy consumption and greater selectivity. Brazil, one of the world's largest corn producers, has an agro-industrial chain that generates nutrient-rich residues such as corn steep liquor. The use of this by-product as a substrate for bio-struvite production fosters nutrient recycling and contributes to the sustainability of the production chain. This study aims to theoretically assess the biological production of struvite from corn steep liquor using biomineralizing microbial strains, to obtain a potential biofertilizer that can contribute to more sustainable agricultural applications.

**Objective of the Study:** The research aims to assess the biological production of struvite from corn steep liquor (CSL), using biomineralizing microorganisms, with the goal of obtaining a sustainable biofertilizer for agricultural applications.

**Materials and Methods:** First, strains of *Bacillus* spp. were selected based on their potential to precipitate struvite, as described by Leng and Soares (2021). These microorganisms will be cultured in a medium enriched with corn steep liquor (CSL) under controlled conditions. The precipitation of struvite will be monitored by measuring changes in pH and ion concentrations, with the formation of crystals observed through scanning electron microscopy (SEM)

and X-ray diffraction (XRD).

Additionally, the efficiency of nutrient recovery will be evaluated by quantifying the phosphorus, magnesium, and ammonium content in the final precipitate.

**Inclusion Criteria:** Experiments with bio-struvite production.

**Exclusion Criteria:** Experiments without bio-struvite production.

**Results and Discussion:** Corn steep liquor (CSL) appears to possess the necessary nutrients to support microbial growth and facilitate the biological precipitation of struvite. CSL is known to be rich in organic matter, phosphorus (P), nitrogen (N), and magnesium (Mg), all of which are essential for the formation of struvite, a process that has been extensively studied in various organic substrates. These nutrients make CSL a promising substrate for microbial activity, particularly for microorganisms such as *Bacillus* spp., which are known to play a key role in mediating struvite precipitation through enzymatic ion release and microenvironment modifications. The recovery of phosphorus, nitrogen, and magnesium from CSL aligns with global sustainability goals by reducing dependency on synthetic fertilizers and providing a more environmentally friendly alternative.

**Conclusion:** while direct experimental evidence is still needed, the review suggests that corn steep liquor (CSL) holds significant potential as a substrate for the biological precipitation of struvite.

## Biography

Bruna Soares Fernandes é Chemical Engineering, a master's degree and a PhD in Hydraulic and Sanitation Engineering from the University of São Paulo, and has MBA in Project Management. She worked on the development of new technologies for the sanitation and environmental areas at Dedini, a company licensed at the time from Paques BV. She was a research coordinator in biotechnology for the Ergostech/Sapporo/Petrobras project. She completed a postdoctoral project at the Faculty of Chemical Engineering at Unicamp, at the National Laboratory of Science and Technology of Bioethanol, and completed a research internship at the University of Minho. She was Director of Innovation at UFPE and Adjunct Professor in the Department of Civil Engineering at the Federal University of Pernambuco. She is currently an Assistant Professor at UNESP and in the Postgraduate Programs in Microbiology at Ibilce - UNESP and Biotechnology at UFPE. Visiting Professor at the University of Manitoba, Manitoba - Canada (2022-2023). Responsible for the international event Soapbox Science in Assis. She is the coordinator of the Laboratory of Biotechnological and Environmental Processes and responsible for the Research Center for Biotechnological and Environmental Processes and the Multiuser Laboratory of Biotechnological Analysis at UNESP in Assis.

## THE DETOXIFY METHOD OF THE DISCHARGED BIOMASS ASH FOR RECYCLING

**Masaaki Takahashi, Yukimasa Takemoto, Tadaharu Kado, Naoki Seko, Atsushi Suzuki, Yasuyuki Saito, Ayaka Ooshima and Nanako Ueno**

*Yokkaichi University, Japan*

### **Abstract:**

Amounts of the ash from biomass is increasing through biomass energy recovery. Incinerated ash is rich in potassium, and has uniform or stable properties, and is expected to be used as civil engineering material or fertilizer. However, it sometime contain harmful substances such as hexavalent chromium or fluorine, and in Japan, most of the ash is disposed of in landfills, which is cost-intensive. In order to remove such harmful substances, insolubilization method using iron sulfate and calcium phosphate instead of cement solidification or organic chelating agents. Addition method of the chemical agent and the management system was investigated to make the chemical treatments more effective. As a result, the elution of hexavalent chromium and fluorine in the ash was suppressed to below the environmental standards.

**Object of the Study:** To promote the effective use of ash, suppress the leaching of harmful substances such as chromium and fluorine from ash.

**Materials and Method:** As the material, incineration ash from a biomass power plant is used. As the treatments agents, iron sulfate (II) and calcium hydrogen phosphate added with sulfuric acid were used.

The treatment method, 20 kg of raw ash was mixed with the treatment agents in an appropriate ratio using a 60 L electric mixer. The simple analysis method was used for treatment process management.

**Inclusion Criteria:** Amount of the chemical agents to be added to ash, liquid and solid volume ratio, mixing time.

**Exclusion Criteria:** Harmful substance elution data, environmental standards

**Results and Discussion:** The chromium elution concentration was decreased 0.13 mg/L to less than 0.02 mg/L by adding the treatment agent. Fluorine was also reduced from 0.8 mg/L to less than 0.1 mg/L, and confirmed the effectiveness of the treatment. As for other harmful

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substances, most were at low concentrations below the environmental standards and could not be verified

**Conclusion:** This research made it possible to insolubilize hexavalent chromium and fluorine, which are often found in biomass incineration ash. This method is expected to make harmful substances insoluble without using organic chelating agents. We would like to continue to examine the possibility of applying this method to various types of incineration ash.

### **Biography**

Masaaki Takahashi, during his time as an employee of the Mie Prefecture Environmental Research Institute, he was mainly involved in air and water pollution issues, contributing to environmental improvement. During this process, he began research into the recycling of incineration ash. After becoming a professor at Yokkaichi University, he researched various extraction methods using sulfuric acid or sodium hydroxide as a method of recovering phosphorus from sewage sludge incineration ash, and developed a basic method for efficient phosphorus recovery. After retiring from the university, he worked as a researcher in the development of environmental technology, and contributed to the development of simple analysis methods and purification technologies for various types of wastewater. He also focused on the insolubilization of hazardous substances such as hexavalent chromium and fluorine in biomass incineration ash, and pioneered the development of insolubilizing agents, method of adding chemicals, and chemical control methods for the insolubilization process of hazardous substances.

## BIOSTRUVITE PRODUCTION FROM A BYPRODUCT OF ORGANIC SOLID WASTE BIOREFINERY

**Bruna Soares Fernandes, Maria Luiza da Paes Xavier, Mislane Iva da Cruz, Vanessa Andrade da Silva, Iracema Carla Calixto da Silva, Romulo Simoes Cezar Menezes and Emmanuel Damilano Dutra**

*São Paulo State University, Brazil*

### **Abstract:**

Struvite is a hexahydrated magnesium ammonium phosphate, a mineral, that can be obtained from wastewater rich in nutrients, especially phosphorus. Experts point out that there will be a shortage of phosphorus in the coming years, given the difficulty in replenishing phosphorus reserves through its biogeochemical cycle. In this sense, seeking alternatives for its recovery is essential. One of the ways to recover phosphorus is through the production of struvite. Currently, its production is primarily through physical-chemical processes that require high pHs, above 8.5, and its production is in the tertiary treatment, while biological processes occur at pHs from 5.5 to 8.0 and in the secondary treatment system, minimizing capital and operational costs of wastewater treatment processes. In this sense, this study, within the context of solid waste biorefinery, evaluated the production of struvite from hydrolyzed organic solid waste. As a first step, biomineralized microorganisms were isolated from struvite stones of canine renal calculi. As a next step, the isolated microorganisms were cultivated in adapted medium Park et al. (2011) and in hydrolysate of organic solid waste. The results demonstrated the feasibility of producing struvite biologically through the tested wastewater.

**Objective of the Study:** The research aims to evaluate the biostruvite production from a by-product of organic solid waste biorefinery.

**Materials and Methods:** First, microorganisms were isolated with adapted medium and agar in a Petri dish from canine kidney stones, then the microorganisms were placed to grow in adapted medium and hydrolyzed solid organic waste, observing the formation of struvite by SEM and XRD and the consumption of organic matter by chromatography.

**Inclusion Criteria:** Experiments with biostruvite production.

**Exclusion Criteria:** Experiments without biostruvite production.

**Results and Discussion:** As a first step, biomineralized microorganisms were isolated from struvite stones of canine renal calculi. As a next step, the isolated microorganisms were cultivated in adapted medium and in hydrolysate of organic solid waste. Struvite crystals were observed

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by SEM and XRD, with orthorhombic formation, as expected.

**Conclusion:** The results demonstrated the feasibility of producing struvite biologically through the tested wastewater.

### **Biography**

Bruna Soares Fernandes é Chemical Engineering, a master's degree and a PhD in Hydraulic and Sanitation Engineering from the University of São Paulo, and has MBA in Project Management. She worked on the development of new technologies for the sanitation and environmental areas at Dedini, a company licensed at the time from Paques BV. She was a research coordinator in biotechnology for the Ergostech/Sapporo/Petrobras project. She completed a postdoctoral project at the Faculty of Chemical Engineering at Unicamp, at the National Laboratory of Science and Technology of Bioethanol, and completed a research internship at the University of Minho. She was Director of Innovation at UFPE and Adjunct Professor in the Department of Civil Engineering at the Federal University of Pernambuco. She is currently an Assistant Professor at UNESP and in the Postgraduate Programs in Microbiology at Ibilce - UNESP and Biotechnology at UFPE. Visiting Professor at the University of Manitoba, Manitoba - Canada (2022-2023). Responsible for the international event Soapbox Science in Assis. She is the coordinator of the Laboratory of Biotechnological and Environmental Processes and responsible for the Research Center for Biotechnological and Environmental Processes and the Multiuser Laboratory of Biotechnological Analysis at UNESP in Assis.

## BIOMASS FRACTIONS IN ALTERNATIVE FUELS AND BIOFUELS USING RADIOISOTOPE <sup>14</sup>C METHODOLOGY

**Joanna Poluszyńska and Marcin Biernacki**

*Institute of Ceramics and Building Materials, Poland*

### Abstract:

In order to achieve climate neutrality, it has become necessary to seek methods, technologies and processes that minimize the negative impact of humans on the environment and to adapt to legislative requirements. One way to reduce CO<sub>2</sub> emissions into the environment is to use biomass in energy processes, including the production of fuels used in transport.

The consequence of increasing the amount of biomass-containing fuels burned was the need to use reliable and proven methods for determining the biogenic fraction content in fuels. In the case of solid alternative fuels, when the composition of the mixture is unknown, the only reliable method is to determine the biomass content based on the <sup>14</sup>C method. In the same way, for liquid biofuels and bioplastics, only radiocarbon techniques can be used to test the bio-based carbon content.

The preparation of the sample for LSC analysis is a very important issue due to the significant number of factors that interfere with the analysis. Samples can be prepared by complete combustion to CO<sub>2</sub> and absorption of the resulting CO<sub>2</sub> in a NaOH solution or a 3-methoxy-1-propylamine (3MPA) solution and scintillator. The function of the scintillator is to detect beta radiation and convert the energy into light radiation, which is then captured by a photomultiplier. Another form of preparation is the synthesis of the sample into benzene. One method is to carbonize the sample. The carbonized samples are subjected to a direct reaction with lithium. Charred or uncharred samples can also be subjected to oxidation and then reacted with CO<sub>2</sub> and lithium. Samples prepared for benzene are usually measured in 7 ml vials. The method of converting carbon from samples to benzene may be more accurate and may allow for lower <sup>14</sup>C contents to be obtained.

**Objective of the Study:** The aim of the study was to investigate the impact of the sample preparation method used on the effectiveness of determining the biomass fraction content in solid and liquid fuels tested using the

**Materials and Methods:** The material for tests included samples of solid alternative fuels from waste used in the cement industry and samples of liquid fuels with biocomponents.

The research was conducted using the <sup>14</sup>C radioisotope method and liquid scintillation tech-

nique (LSC). The samples for testing were prepared using two methods: combustion to CO<sub>2</sub> and absorption in a liquid scintillator, and synthesis to benzene.

**Results and Discussion:** The test results included analyses of alternative solid fuel samples and liquid fuel samples. For the testing of 14 background samples and 5 actual solid fuel samples, the obtained recovery process efficiency results indicate that the highest recovery rate was recorded for the preparation of samples using the benzene synthesis method. The average efficiency of the process was 85.5%. In comparison, for the method of sample combustion and CO<sub>2</sub> absorption on a scintillator, the average efficiency in the Oxidizer device was 62.9%.

For liquid fuel samples, the efficiency of the direct analysis method, where a scintillator was added to the liquid fuel sample, was compared with the method of synthesizing samples into benzene. Here, significantly higher efficiencies were also obtained for the benzene sample synthesis method, which was 84.9%. For the direct analysis method, the efficiency result obtained was 39.2%.

**Conclusion:** Comparative studies conducted for various methods of preparing solid and liquid samples in order to prepare them for analysis by liquid scintillation in the field of biomass carbon content testing, showed that the best method of sample preparation, which gives the highest efficiency/recovery of the method, is the preparation method that uses the process of converting solid and liquid biofuel samples into benzene.

Benzene is characterised by excellent light transmission, high chemical conversion efficiency of carbon samples to benzene, and a high percentage of carbon content in the molecule (92%). Therefore, the method is more accurate and allows for the measurement of lower <sup>14</sup>C contents.

## Biography

Joanna Poluszyńska has been a researcher at the Łukasiewicz Research Network – Institute of Ceramics and Building Materials (Poland) for 27 years. She currently works as the Head of the Research Department and Director of the Environmental Engineering Centre. She is the co-author of two patents in the field of waste raw material utilization in industry and agriculture, and over 50 R&D works, research projects and 47 scientific publications of national and international scope. In her professional work, she has focused on the development of analytical methods, including in the field of organic and inorganic chemistry (BTEX, PAHs and petroleum hydrocarbons, PCDD/PCDF, PCBs, pesticides, heavy metal ions and others). In recent years, her work has focused on research aimed at developing waste management technologies, raw material recovery, reducing emissions, circular economy, and developing research methods in the field of biodegradation and the application of radiocarbon methods in environmental analyses, including research on alternative fuels, liquid biofuels, waste, biopolymers, plastics and packaging materials. Joanna Poluszyńska mentors academic staff, including master's and doctoral students. She is also a reviewer for Polish and international journals and an expert in the evaluation of projects financed from Polish national funds.