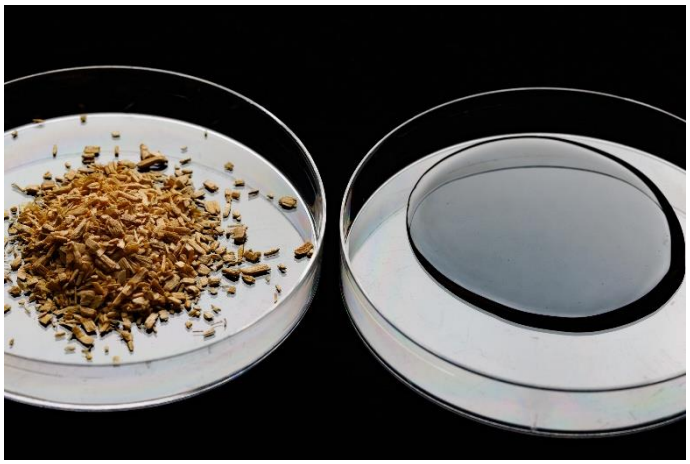
IEA Bioenergy
Technology Collaboration Programme
Task 34

Newsletter
Direct Thermochemical Liquefaction



PyNe 58

Dec. 2025

As we approach the end of another productive year, I am pleased to present this new issue of the PyNe Newsletter. Once again, it reflects the breadth, depth, and scientific quality of the work carried out within our community, spanning fundamental research, technology development, and applied system perspectives along the entire thermochemical conversion chain.

The opening article focuses on advances in intermediate pyrolysis liquid production and valorisation pathways, demonstrating how thermochemical processing of biogenic biomass-based systems, we deliberately residues can unlock new options for carbon-based products. In particular, the work illustrates how intermediate pyrolysis liquids liquids and their recirculation can enhance biochar yields and influence material properties, opening promising routes for carbon utilization beyond energy applications.

The second article addresses a topic that goes slightly beyond the traditional focus of biomass pyrolysis by discussing plastic pyrolysis. While PyNe is firmly rooted in

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decided to include this contribution. The reason is twofold: first, plastic pyrolysis shares fundamental thermochemical principles with biomass pyrolysis, and advances in reactor design, vapor handling, product upgrading, and system integration are highly relevant across both fields. Second, from a systems perspective, future circular economies will need to address biogenic and non-biogenic carbon streams in parallel. Understanding plastic pyrolysis therefore helps to sharpen the boundaries, strengths, and sustainability advantages of biomass-based routes, while also identifying potential synergies.

The third article shifts the focus from conversion science to the broader system perspective and introduces the InnoFuels initiative. InnoFuels is designed as an open and integrative platform to support the rapid ramp-up of renewable fuels across transport sectors by bundling existing knowledge, adding targeted analyses, and identifying gaps where further research or follow-up activities are needed. A key strength is the consortium's breadth, bringing together research institutions, industry (automotive, aviation, maritime), energy suppliers, and public authorities to align scientific, technological, industrial, and policy perspectives.

Beyond the individual articles, this issue also provides an opportunity to briefly look back at a very active year for the Task. In 2024, we had the pleasure of meeting in Canada, where our Task Meeting brought together experts from across the network for intensive discussions and valuable exchanges. The outcomes and impressions from this meeting are documented in the previous PyNe.

Another major milestone this year was the publication of the report "Direct use of Direct Thermochemical Liquefaction liquids as fuels". This report provides a comprehensive overview of fuel properties of DTL liquids derived from fast pyrolysis and hydrothermal liquefaction, with a clear focus on their direct application potential and compatibility with existing fuel standards.

In addition, two joint reports were released this year, underlining the strong collaboration across Tasks. Together with Task 42 a technical, economic and environmental asessment was published for a case study of a fast pyrolysis biorefinery (3-Platform: Bio-oil, electricity, steam), providing an overview of ist role in circular energy systems. Furthermore, in collaboration with Task 44, the updated report "Technologies for Flexible Bioenergy" highlights how bioenergy technologies – including pyrolysis and liquefaction pathways – can contribute to both short-term system flexibility and long-term energy storage and sector coupling. These joint efforts clearly demonstrate the added value of cross-Task perspectives when addressing complex energy system challenges.

More generally, I would like to encourage all readers to explore the full range of Task 34 reports.

What makes all of this particularly rewarding is the community behind it. The Task continues to be shaped by a remarkable group of dedicated scientists and experts, whose openness, scientific rigor, and willingness to collaborate make the work not only productive, but genuinely enjoyable.
The quality of the discussions, the constructive exchange of ideas, and the shared motivation to move sustainable thermochemical technologies forward are what truly define our network.

With this spirit in mind, I would like to close by thanking all contributors, reviewers, and readers for their engagement throughout the year. I wish you and your families a peaceful Christmas season and a healthy, successful start into the New Year. I very much look forward to continuing our collaboration in the year ahead.

Yours sincerely,
Alexandra Böhm, Task Manager

Advances in Intermediate Pyrolysis Liquid Production and Valorisation Pathways

Manuel Schwabl, Elisabeth Wopienka, Konstantin Moser, Michael Fahrngruber, Irene Sedlmayer, Best, Bioenergy and Sustainable Technologies, Wieselburg, Austria

Co-funded by the European Union

The intermediate pyrolysis process has gained significant attention in recent years, particularly with the development of circular (bio)-economies. These economies aim to efficiently utilize resources, minimize waste, and maximize the utilization of by-products. Pyrolysis plays a crucial role in this context as it enables the transformation of biogenic residues into valuable products, especially carbon-based materials that can replace fossil fuels, store CO_2, and open new applications for carbon products, such as biochar/biocarbon and bio-oils. However, the complexity and the mixture of compounds found in the bio-oils from intermediate pyrolysis pose a challenge to their application.

In this context, the "pyro2GAS" project aimed to investigate microbiological and thermochemical pathways to convert liquid pyrolysis products towards renewable gases and biochar/biocarbon products. This article focuses on the thermochemical pathways of bio-oil recirculation, which has been identified as a promising approach to enhance biochar yield and influence its properties.

Methodology

The study was conducted using a continuously operating laboratory reactor (GCLpyro2k) at the Green Carbon Lab of BEST in Wieselburg, Austria. The methodology involved the following steps:

Initial Pyrolysis and Mass Balance Investigation: Organic feedstocks, including poplar and spruce wood chips, were pyrolyzed at various temperatures ranging from 340 °C to 1000 °C. The mass balances of the pyrolysis products (biochar, pyrolysis oil, and gases) were investigated at these temperatures.

Fig. 1: Pyrolysis reactor with condensation unit (left) and associated condensation modules (right).

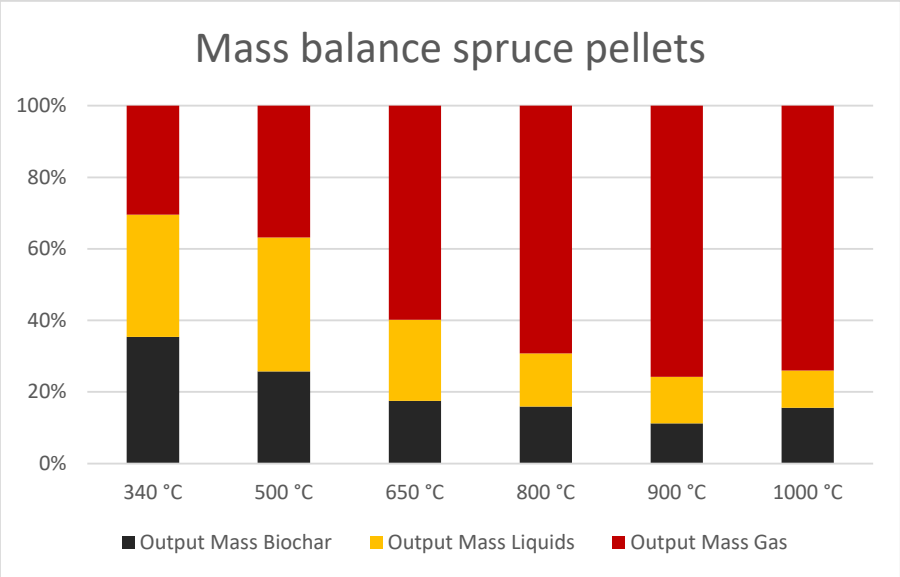

Fig. 2: Mass balance of spruce pellet conversion showing biochar, liquid, and gas yields at different process temperatures.

The GCLpyro2k consists of a rotary kiln and a condenser system (depicted in the accompanying figure). The condenser system was operated at constant condensation temperatures in each column: column 1 at 110 °C, column 2 at 25 °C and column 3 at 20 °C.

Bio-oil Recirculation: Bio-oil recirculation was simulated by applying it to different carrier materials (initial poplar pellets and biochar produced at 500 °C). The mixture was then subjected to pyrolysis again at 500 °C in an oxygen-free atmosphere. Comparative tests using lava rock as an inert carrier material were conducted to investigate the influence of the starting material on the conversion of the bio-oils used.

Results and Discussion

The results of the study indicate that recirculating bio-oil into the pyrolysis process can significantly increase the yield and production volume of biochar. Key findings include:

Mass Balance and Temperature Effects:

The initial investigation of mass balances at different temperatures provided insights into the distribution of pyrolysis products. The diagram of mass balance for pyrolysis x

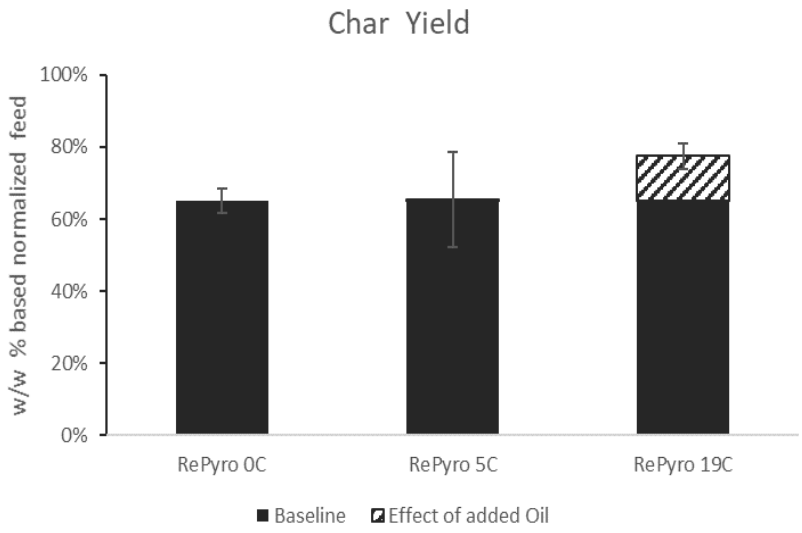

Fig. 3: Char yield for RePyro experiments showing baseline and oil addition effects.

Biochar Yield Increase: Thermogravimetric analysis (TGA) data indicates that approximately 20-25 % by weight of the oil is converted into char. When bio-oil is added to biochar produced at 500 °C, the mass balance results an increase in biochar yield due to recirculation. Notably, a 19 % bio-oil addition resulted in a significantly higher biochar yield than expected from TGA experiments, suggesting secondary charring effects on the biochar surface. However, with only a 5 % bio-oil addition, the effect was not observable due to the low accuracy of the mass balance.

Conclusions

The recirculation of bio-oil into the pyrolysis process significantly increases the yield and production volume of biochar. The proportion of biochar yield is influenced by the volume of bio-oil recirculated and the stage at which it is reintroduced into the process. Applying bio-oil directly to the initial feedstock versus to the already produced biochar results in markedly different products. Consequently, re- pyrolyzing bio-oils represents a valuable application for these liquids. However, several open questions remain. Theoretical considerations suggest that carbonizing fossil oils on the surface of chars increases their density and reduces inner surface area.

Therefore, bio-oil pyrolysis on biochars is expected to significantly influence porosity and inner surface area. This aspect has not yet been investigated. If this hypothesis holds true, the recirculation of bio-oils could provide an interesting strategy for tailoring biochar properties, potentially making it suitable for applications in metallurgy and construction where low inner surface area is desirable. Further research is needed to explore these possibilities and to optimize the process for specific applications.

The research leading to these results was funded by the European Union as part of the pyro2GAS project. Further information about the IBW/ERDF & JTF program can be found on www.efre.gv.at .

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Experimental and Atomistic-Molecular Modeling Contributions to Selective Carbonization and Biochar Engineering

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One of the most significant challenges in enhancing carbon yield during biochar production is the removal of oxygen during pyrolysis. Ideally, this oxygen should be removed as H_2O rather than CO, CO_2, or small volatile compounds, as this will maximize carbon retention. To achieve this, promoting dehydration reactions is key [1,2]. These reactions drive selective carbonization, which can increase biochar yields by over 50%, a critical factor for making biochar production sustainable and economically viable.

Recent studies have shown that acid pretreatments of biomass act as catalysts for these dehydration reactions, effectively reducing oxygen content before pyrolysis [3,4]. In parallel, pressure has emerged as another influential factor; it helps retain tarry vapors on the reacting biomass surface, facilitating secondary reactions that further boost carbon yield [5,6].

To validate the effects of these parameters, we designed a series of experiments using hybrid poplar wood treated with various acids, both inorganic (sulfuric and phosphoric) and organic (acetic and formic), across a range of concentrations and pressure conditions [3]. The results were promising, with up to 78% carbon conversion efficiency achieved, along with the formation of phosphorus- and sulfur-doped biochars when using inorganic acids (see Fig. 1). These results emphasize the importance of considering the carbon yield and examining the resulting biochar's structural and functional characteristics.

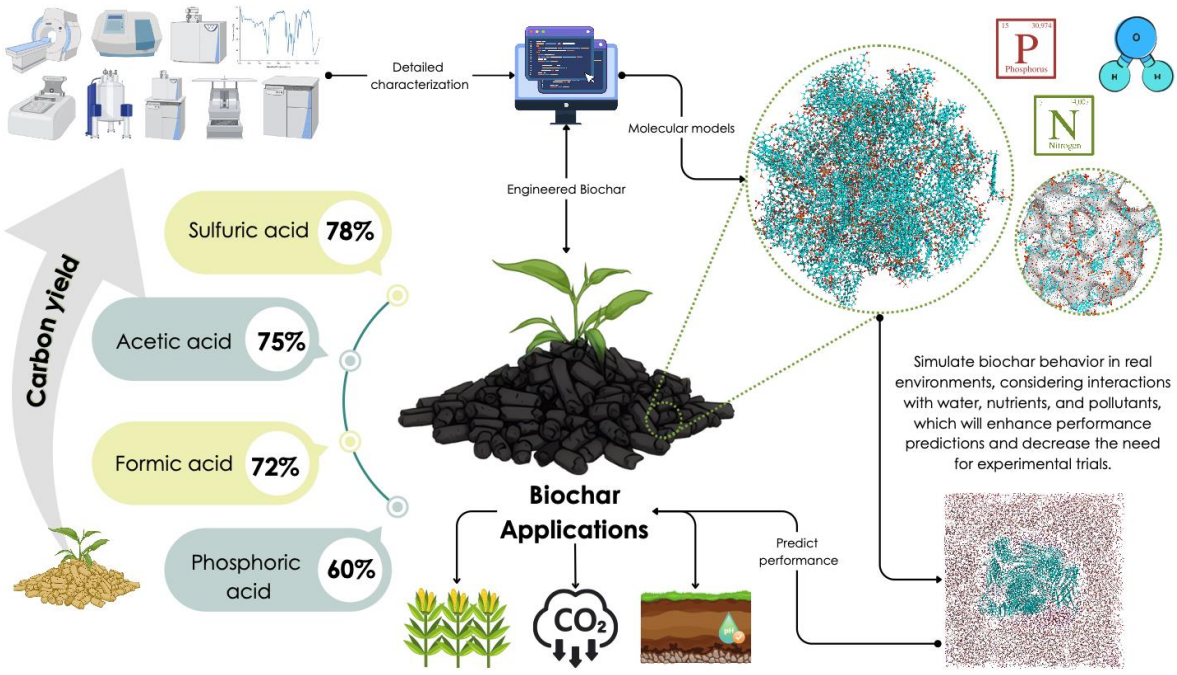

Fig. 1: Methodology for engineering biochar using experimental and atomic-molecular modeling data.

While carbon yield is a crucial metric, it is not the sole determinant of biochar's performance. In real-world applications, the effectiveness of biochar depends heavily on its intrinsic properties, including porosity, surface functionality, and elemental composition [7,8]. The biomass source and the pyrolysis conditions influence these properties. They, in turn, dictate how biochar interacts with water, nutrients, and pollutants, making it crucial to understand and optimize them for specific uses [9].

To investigate these properties in greater detail, we conducted a complete characterization of the materials using advanced analytical techniques (see Figure 1). While current technologies allow us to visualize the micro- and nanostructures of biochar, a comprehensive understanding also necessitates insights into its atomic-scale molecular arrangements. To address this, we previously developed an automated protocol for constructing molecular building blocks directly from characterization data [10]. This methodology was rigorously validated by comparing its predictions to multiple experimental observables, including 13C Nuclear Magnetic Resonance (NMR), aromatic cluster size distributions, elemental composition, X-ray diffraction (XRD), helium density, surface area, and porosity, and achieved over 90% agreement with measured values [3,10].

The characterization results serve as the foundation for constructing atomistic models that capture how variables such as acid treatments, pressure, and temperature shape the chemical composition, porosity, and carbon skeleton structure of biochar (see Figure 2). Beyond structural insights, they clarify the link between molecular architecture and functional performance, enabling us to predict how biochar will behave under various real-world conditions.

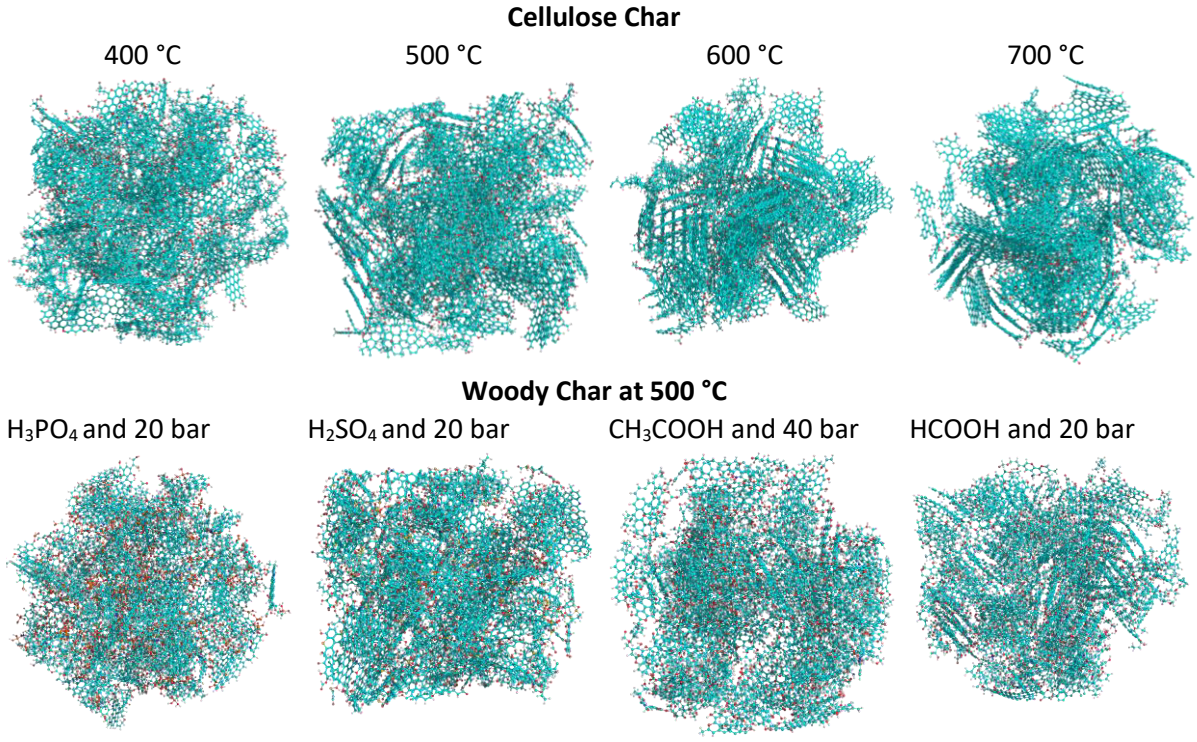

Fig. 2: First open-source methodology for constructing large-scale atomistic models of biochar. Examples of biochar models available depending on production conditions.

These predictive capabilities accelerate the design process by reducing the need for trial-and-error experimentation. Collectively, the models provide a robust foundation for engineering biochars tailored to specific environmental or industrial applications.

Beyond their predictive capabilities, molecular models also address questions that cannot be answered solely through experimentation. These models support the theoretical validation of experimental findings and enable the design of new biochars with tailored functionalities. For example, they can help address key scientific questions such as: What underlies the recalcitrance of biochar? How does biochar's structure decompose in the soil? What are the degradation pathways of its carbon structure, and which functional groups or environmental factors enhance its long-term stability and carbon storage potential?

Beyond their predictive capabilities, molecular models also address questions that cannot be answered solely through experimentation. These models support the theoretical validation of experimental findings and enable the design of new biochars with tailored functionalities. For example, they can help address key scientific questions such as: What underlies the recalcitrance of biochar? How does biochar's structure decompose in the soil? What are the degradation pathways of its carbon structure, and which functional groups or environmental factors enhance its long-term stability and carbon storage potential?

Another application of these models is in assessing the impact of contaminants present in biomass, such as PAHs, VOCs, PFAS, and PTES, which often become concentrated in biochar after pyrolysis due to their thermal stability. By simulating how these species adsorb to, and desorb from, specific pore structures and surface functional groups, molecular modeling can guide the choice of feedstock pretreatments and pyrolysis conditions that minimize contaminant loading. In addition, insights into the binding mechanisms of these pollutants enable the design of "clean" biochars with tailored surface chemistries for targeted applications (e.g., soil amendment, water treatment), ensuring both regulatory compliance and optimal environmental performance.

While these atomistic models have successfully captured many chemical and physical features of biochar, we aim to evaluate whether these representations account for mechanical properties such as elasticity, rheology, and viscoelasticity, which are essential for other applications, such as concrete or polymer composites. Crucially, we emphasize that the complexity of a model should be guided by the scientific question: a model should focus on capturing the specific properties most relevant to the hypothesis being tested.

Recognizing the value of shared tools and collective innovation, we openly share our models as open-source tools that can be freely accessed, adapted, and applied by the broader community. We welcome collaborations to co-develop a framework that integrates experimental studies with modeling approaches, helping to understand better and engineer biochar materials.

Whether you're interested in using our models to predict performance, adapting them for new materials, or developing entirely new approaches, we are eager to collaborate and support this growing field.
GitHub repository:
https://github.com/BiocharModeling/BiocharAtomisticModels

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About Innofuels: Full Commitment to Renewable Fuels

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The InnoFuels project aims to develop comprehensive and actionable strategies to support the rapid ramp-up of renewable fuels across multiple transport sectors. These strategies are subsequently made available to a broad range of stakeholders, thereby supporting informed decision-making and coordinated action along the value chain. To achieve this objective, the InnoFuels platform systematically bundles existing knowledge, supplements it with additional analyses, and identifies areas where further research activities are required. Where gaps are identified, new research projects or follow-up activities are initiated. In this way, InnoFuels positions itself as an open and integrative platform that contributes to making the ramp-up of renewable fuels tangible, transparent and ultimately feasible.

The project consortium comprises a wide and diverse group of stakeholders. Project participants include research institutions, industrial manufacturers from the automotive, aviation and maritime sectors, energy suppliers, as well as representatives of federal and state-level authorities. This broad composition ensures that scientific, technological, industrial and policy perspectives are jointly considered and aligned.
The InnoFuels platform is structured into seven thematic areas, referred to as Innovation Focus Points (ISPs). Each Innovation Focus Point addresses a specific thematic field relevant to the development and deployment of renewable fuels. The ISPs are coordinated by expert teams drawn from the participating partners in science, industry and policy. This structure enables focused technical work within each thematic area while at the same time ensuring close interaction and exchange between the different focus points.

The activities carried out within the InnoFuels platform are wide-ranging. They include the organisation of regular workshops and other events, which are open not only to project partners but also to external stakeholders and interested parties. These formats provide opportunities for technical input, structured

Innovation focus	Responsible partners	Associated partners
Office of the project	Institute for Piston Machines (KIT)	
Production	Institute for Catalysis Research and Technology (KIT)	Mineralölraffinerie Oberrhein (MiRO)
Supply Chain	Center for Solar Energy and Hydrogen Research Baden-Württemberg (ZSW)	Infraserv Höchst e-mobil BW
Aviation application	German Aerospace Center (DLR) CENA Competence Center Hessen	Condor
Shipping application	University of Rostock	Rolls-Royce Solutions GmbH
Road & rail application	Institute for Piston Engines (KIT)	Volkswagen AG Porsche AG
Sustainability	German Biomass Research Center (DBFZ)	Ptx-Hub
Market & Regulation	RheinMain University of Applied Sciences	Frontier Economics

Table 1: Overview of the Innovation Focus Points (ISPs) within the project consortium

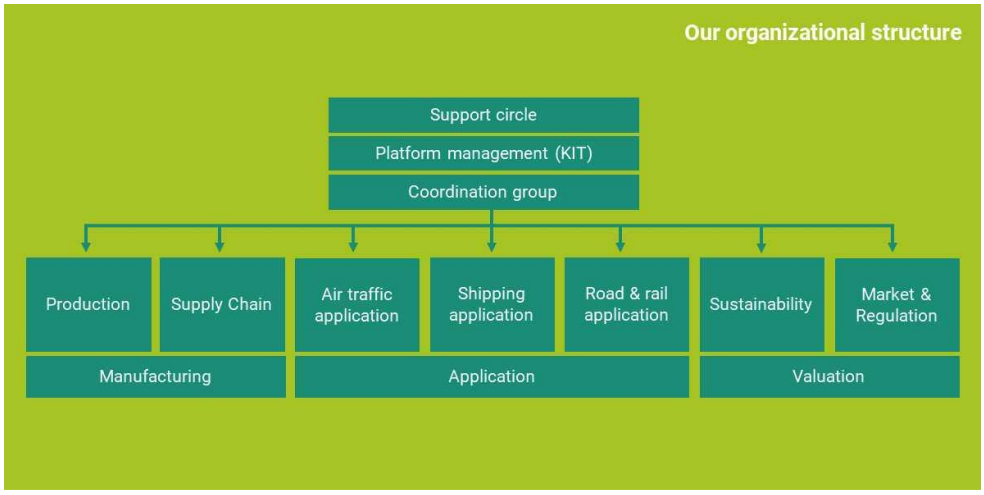

Fig. 1: Organizational Structure of Innofuels

exchange and active networking. Further activities include the preparation of meta-analyses, the development of roadmaps and the creation of technical mapping tools that

systematically capture and visualise national and international development activities. In addition, existing research approaches are examined and evaluated with regard to their technical maturity, scalability and feasibility. Where appropriate, InnoFuels initiates targeted research activities and ensures close coordination and exchange with other federally funded projects focusing on the development of Power-to-Liquid (PtL) and advanced biofuels plants, as well as on the industrial-scale production of synthetic fuels.

The InnoFuels project was launched in February 2023 and has a total duration of three and a half years, running until the end of August 2026. It is funded with a total budget of €5.24 million by the German Federal Ministry for Digital and Transport under the Renewable Fuels funding framework. The funding scheme for the development of renewable fuels is coordinated by NOW GmbH and implemented by the project management organisations VDI/VDE Innovation + Technology GmbH and Fachagentur Nachwachsende Rohstoffe e. V.. While InnoFuels provides an overarching framework for strategic alignment, information exchange and networking among relevant stakeholders, concrete research and development activities are carried out within complementary projects. These projects pursue the same overarching objective of accelerating the deployment of renewable fuels and contribute specific technical and scientific results to the broader InnoFuels context.

Two such projects are coordinated at the Karlsruhe Institute of Technology:
– Refineries for Future (www.ref4fu.de)
– reFuels (www.refuels.de)

Further partner projects and initiatives with related objectives are explicitly invited to engage with the InnoFuels platform and contribute to the growing network.

Olaf Toedter
Innofuels Project Coordination
Karlsruhe Institute of Technology,
Germany

Pyroliq III September 2025 in Cetraro/ Italy

Axel Funke,
Karlsruhe Institute of Technology, Germany

This year's ECI Pyroliq III strengthened its position as one of the important conferences in the field of pyrolysis and HTL. It took place September 14th-19th in beautiful Grand Hotel San Michele in Calabria/ Italy. The awe-inspiring beauty of the location really added to a vivid and intense exchange among the participants, across the fields and competences. With its focus on the production of liquids, it represents an important aspect next to ECI's Biochar conference series.

Pyroliq III was dedicated to both biomass and plastic liquefaction and both topics were well represented. It was striking to see how these two communities integrated during the week and how similarities to overcome seemingly different challenges started to emerge. One notable example is certainly the analysis of the complex product matrix.

The available new powerful technologies are getting increasingly applied for liquefaction oils, which marks an important breakthrough in getting to know the unknowns and enable more detailed modelling. The interplay between these two is certainly something that should be followed more closely in near future

Sascha Kersten opened the conference with a critical keynote on biomass liquefaction and a very precise evaluation of achievements and shortcomings. It was followed by Marion Carrier with an excellent overview of global kinetic modelling of pyrolysis reactions with intriguing insights into new approaches. A somewhat different angle was provided by Paul Stuart, who presented a closer look at business models for fast pyrolysis and how they are affected by integrating the valorization of the byproduced char fraction.

Frederick Ronsse reported in his keynote from his vast experience in pyrolysis of lignin and associated challenges, but also promising aspects of this valorization route. As one of the representatives from industry, Tooran Khazraie provided an overview of and insights into the pyrolysis technology of Valmet and its development. Another remarkable talk was Patrick Billers keynote about the progress in integrating wet oxidation in the HTL process to tackle the challenge of aqueous phase disposal. He will also be hosting Pyroliq IV together with Manuel Garcia-Perez – an event I already look forward to and recommend to mark in your calendars as soon as the dates are out!

Conference venue (left), Conference chairs (from left to right) Paola Giudicianni, Pilar Ruiz Ramiro, Axel Funke, Manuel García-Perez and Franco Berrutti (right)

"News from the PhD Community" – Giving Young Researchers a Voice in Task 34

Alexandra Böhm,
Karlsruhe Institute of Technology, Germany

At the core of every scientific breakthrough, there is a question. And more often than not, that question comes from someone who's just starting out – curious, determined, maybe a little uncertain, but full of drive. With our new section **"News from the PhD Community"**, we want to open a space for exactly those people: PhD students who are shaping the future of DTL research.

IEA Bioenergy Task 34 is proud to introduce this platform to bring visibility to the next generation of scientists and engineers working in the field of thermochemical biomass conversion. We want to hear their stories. Not just their results.

What is "News from the PhD Community"?
It is a recurring section in our newsletter, dedicated to showcasing the work and experience of PhD candidates connected to our international network. Each edition will highlight one young researcher, their academic and professional path, and the research questions they are tackling – whether it's the intricacies of fast pyrolysis, the scaling of HTL reactors, or the potential of novel feedstocks.
But more than that, we are interested in the *person* behind the project:

- What led them to this field?
- What keeps them motivated through setbacks?
- What part of their research excites them the most – or surprised them the most?
- And what do they wish more people in the bioenergy community understood?

Introducing our next contributor:
Swanand Bhatwadekar
We are pleased to introduce Swanand Bhatwadekar, a postdoctoral researcher at AAU Energy, Aalborg University.
His research focuses on hydrothermal liquefaction (HTL) and the role of biofuels in decarbonising hard-to-abate sectors such as aviation and maritime transport. During his PhD, Swanand worked on continuous HTL systems, with particular attention to aqueous phase valorisation and reactor operation.

He is currently involved in the Horizon Europe project COCPIT, which aims to convert algal feedstocks into sustainable aviation and marine fuels. Swanand brings a strong combination of process understanding and practical engineering to his work, with a clear focus on advancing HTL toward real-world deployment.

We hope you enjoy this contribution, and we look forward to hearing from more PhD candidates in our network in the coming editions.
If you are a PhD student working in this field, or supervising someone who is – we'd love to hear from you.

What we are looking for:
We invite contributions that are:

- 1–2 pages long
- Written in a personal but informative style
- Including a personal photo (e.g. in the lab, during fieldwork, at a conference)
- Focusing on current research in the field of DTL or related), challenges, milestones, and insights

Alexandra Böhm, Karlsruhe Institute of Technology (KIT)

From PhD to Postdoc: Advancing HTL and Biofuels for a Sustainable Future

Swanand Bhatwadekar,
AAU Energy

My journey into the world of biofuels began with a simple question: How can we decarbonize sectors that cannot easily be electrified? Aviation and marine transport are prime examples of these hard-to-abate sectors, and I strongly believe that biofuels will be crucial to achieve global climate targets by 2050. This conviction has guided my academic and professional path, from my PhD to my current postdoctoral research.

During my PhD, I could experience the complexity of hydrothermal liquefaction (HTL), particularly focusing on the aqueous phase that emerges after processing. This byproduct stream is often viewed as a challenge, but it can turn into a resource, with significant potential for valorization, when treated with the right technologies. I investigated both commercial and exploratory pathways, working with mechanical vapor recompression distillation and electrochemical oxidation to improve the sustainability and value recovery of the process. Alongside this, I took a major role in the design, commissioning and operation of a continuous lab-scale HTL unit. Developing this system from concept to stable operation was a turning point for me. The unit revealed the real behavior of continuous reactors, especially the recurring issue of fouling, which became a central part of my research.

Of course, progress in this field never follows a smooth line. There were days when experiments failed without obvious explanation, when systems behaved unpredictably or when improvements seemed just out of reach. What carried me through those moments was the support around me, especially from my colleagues at Aalborg University. Whether through technical discussions, new ideas, shared troubleshooting or simply reminding me to take a step back and breathe, they helped turn frustration into understanding. Their encouragement and collaboration were fundamental for my growth as a researcher.

Fig. 1: From the early days of assembling the HTL unit during the pandemic to the moment it stood as a fully completed plant, this journey reflects both persistence and shared effort. None of it would have been possible without the support of my colleagues along the way

What continues to inspire me most is the versatility of HTL. The ability to convert diverse wet feedstocks into biocrude suitable for upgrading still feels remarkable, and it creates possibilities that few other technologies can match. The research on this topic is always stimulating and gives always new insights: from how small changes in feed composition alter performance to how small adjustments in operating conditions can dramatically improve stability of operations. Day by day practice in HTL, on a device that can mimic on a small scale the behavior of an industrial one, gives a very enhanced and deep understanding of the process, able to

As a postdoctoral researcher, my focus has expanded from fundamental understanding to real deployment pathways. I am currently contributing to the Horizon Europe project COCPIT, which aims to convert algal feedstocks into sustainable aviation and marine fuels. Here, I can expand my research on HTL, biocrude upgrading and aqueous phase valorization, also thanks to the partnership with several valuable research institutions across Europe. In parallel, I am developing new proposals that aim to push HTL toward higher technology readiness levels and eventual commercialization, including work supported by Danish innovation initiatives such as MissionGreenFuels. The emphasis is on enabling reliable production and upgrading of HTL biocrude for bunker fuels and other demanding applications.

The message I hope can resonate with the broader bioenergy community is that biofuels are neither temporary nor secondary solutions. They are a fundamental part of a net-zero future, particularly for sectors where electrification or hydrogen alone will not be sufficient. By advancing technologies such as HTL through rigorous science, robust engineering, and strong collaboration, we can deliver sustainable fuels that support global mobility while significantly reducing carbon emissions.

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What happened 10 years ago?

It is interesting to see how the field of direct thermochemical liquefaction developed over the years. We are thus presenting one example highlight from the PyNe newsletter twenty years ago in this regular feature...:

Opening of the EMPYRO fast pyrolysis plant

Bert van de Beld of BTG Biomass Technology Group BV and Ruud Meulenbroek of BTG Bioliquids BV in the Netherlands discuss the new EMPRYO plant and EMPYRO symposium

Bert van de Beld (above) and Ruud Meulenbroek (below)

In previous newsletters the EMPYRO demonstration project has been introduced (see PyNe Newsletters 35 & 27). The objective is to demonstrate fast pyrolysis technology at a biomass capacity of 5t/hr (~25MWth) and to simultaneously produce process steam, electricity and pyrolysis oil. The pyrolysis oil will be transported to FrieslandCampina and used on their site to replace natural gas as fuel for a steam boiler.

A national symposium was organised to take place commencing May 21 2015, parallel to the IEA Bioenergy Task 34 meeting. The symposium included 75 participants from 15 different countries and included the official opening of the EMPYRO plant. In the morning session of the first day Kyriakos Maniatis – Principal Administrator in the Directorate General for Energy of the European Commission – informed the audience of the latest developments around the Renewable Energy Directive and the Fuel Quality Directive, and also addressed new developments related to the 2030 Roadmap and the Energy Union. Doug Elliott introduced IEA Bioenergy Task 34 and the role of the Task in supporting the further development of fast pyrolysis technology and products. A number of presentations followed on the development and implementation of the EMPYRO project, and subsequently at midday delegates were able to visit the EMPYRO plant for its opening ceremony and a tour. The opening ceremony was conducted by Eddy van Hijum, governor of the Province of Overijssel, who pushed the button to start the filling of a tank truck with freshly produced fast pyrolysis oil. Some 80 participants attended the first day of the symposium and presentations were given on national policies, realisation of the plant and the use of pyrolysis oil. FrieslandCampina provided an insight into the reasoning behind their choice to use pyrolysis oil to further develop their green operations.

In the afternoon session the focus of the presentations shifted to the main product of the process, fast pyrolysis liquid/pyrolysis oil (or "bio -oil"). Martijn Vis (BTG) discussed the sustainability and certification of fast pyrolysis oil, and Pia Saari (Fortum) provided an update on ongoing European standardisation work. Next, three (potentially) near-term applications of pyrolysis oil were presented. Marco Beune (Stork) delivered a presentation on the design, construction and implementation of the new steam boiler for FrieslandCampina, which has seen the boiler system modified so that it is suitable to co-fire pyrolysis oil with natural gas and will be where the majority of the EMPYRO oil will be utilised. Lars-Uno Axelsson – chief engineer at Opra Turbines -

(Continued on page 25)

Figure 1: A two day symposium was organised around the opening of the EMPYRO plant.

You can access the full article by using the following link:

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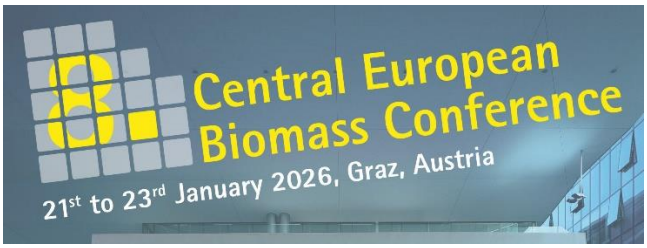
Upcoming Events

19. + 20. January 2026
23rd International Conference on renewable Mobility “Fuels of the Future”, Berlin, Germany
https://www.fuels-of-the-future.com/en



21. - 23. January 2026
8th Central European Biomass Conference CEBC 2026, Graz Austria
https://biofuels-energy.magnusconferences.com/

25. - 26. February 2026
Lignofuels 2026, Helsinki, Finland
https://www.cebc.at/8_mitteleuropaeische_biomassekonferenz_cebc_2026?_lang=englisch

18. – 20. March 2026
ABLC 2026
https://ablcevents.com/ablc/

19. – 22. March 2026
EUBCE 2026
https://www.eubce.com

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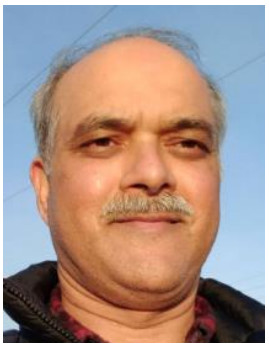

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Task 34: Direct Thermochemical Liquefaction