

# RLS Energy Network

## Regional Panel I: Current research in Biofuels

### *Research on Biofuels in Upper Austria*



#### **Sebastian Goers**

Scientific coordinator of Upper Austria  
Researcher at the Energy Institute, Department of Energy Economics

Western Cape, 12<sup>th</sup> March 2014



# Upper Austrian Energy Research

## **Johannes Kepler University of Linz (JKU Linz)**



### *Institute for Chemical Technology of Organic Materials*

 Focus: new materials from renewable resources/waste materials

### *Center for Surface and Nanoanalytics*

 Focus: energy storage via hydrogen storage in metal hydrides

### *Institute for Organic Solar Cells*

 Focus: organic semiconductors and photoactive nanostructures

### *Institute for Industrial Mathematics*

 Focus: Condition Monitoring for Wind Energy Converters

## **University of Applied Sciences Upper Austria**



 Focus: solar thermic systems, solar cooling, biofuel generation, photovoltaic systems, wind energy, battery technology , energy efficient transport

## **Energy Institute at the JKU Linz**



# Energy Institute: Completed projects....

Project title	BioFuels 2021 Innovative Biofuels from the biorefinery of the future		
Funding	German Federal Ministry of Education and Research (BMBF)		
Applicant	Süd-Chemie AG		
Project partner	<ul style="list-style-type: none"> <li>• <b>Energieinstitut an der Johannes Kepler Universität Linz</b></li> <li>• KWS Saat AG</li> <li>• Technische Universität München</li> <li>• Universität Ulm</li> <li>• Universität Rostock</li> <li>• Justus-Liebig-Universität Gießen</li> <li>• Forschungsinstituts biopos e.V. Potsdam</li> </ul>		
Project duration	start: 03/2009	end: 12/2011	duration: 36 months
<b>Project budget Energy Institute</b>	<b>198.620 EUR</b>		

## Project description

The German Federal Ministry of Education and Research (BMBF) funded the joint project "BioFuels 2021 - Innovative Biofuels from the biorefinery of the future" with € 2.9 million which was successfully completed on 31 May 2012: The research project managed by Süd-Chemie AG **investigated innovative approaches in processing the lignocellulosic fraction of plants efficiently for the production of biofuels**, such as Cellulosic ethanol. The findings obtained in close collaboration with KWS Saat AG, two chairs of the Technical University of Munich, with Ulm University, the University of Rostock, Justus-Liebig-University Giessen, the Research Institute Biopos eV Potsdam and the Energy Institute Linz come into economic applications within the Clariant AG (formerly Süd-Chemie AG).

# Energy Institute :Ongoing projects....



<b>Project title</b>	<b>REG-STORE - Development of procedures for storage of renewable electricity under CO<sub>2</sub> capture by electro-biotechnology</b>		
Funding	Regio 13		
Applicant	Profactor GmbH		
Project partner	<ul style="list-style-type: none"> <li>• <b>Energieinstitut an der Johannes Kepler Universität Linz</b></li> <li>• FH Oberösterreich F&amp;E GmbH</li> <li>• Linzer Institut für organische Solarzellen an der Johannes Kepler Universität Linz</li> </ul>		
Project duration	start: 11/2011	end: 04/2014	duration: 36 months
<b>Project budget Energy Institute</b>	<b>53.783 EUR</b>		

## Project description

**The aim of this project is to develop a novel combination of electrochemical and biotechnological processes for the storage of renewable energy under bonding of climate-relevant CO<sub>2</sub>.** For this, the new and innovative concept of MECs (Microbial Electrolysis Cells) is fundamentally further developed as a way to enable efficient energy storage in the form of liquid or gaseous fuels. The project builds on the ability of certain microorganisms to reduce CO<sub>2</sub> directly to commodity chemicals and fuels such as ethanol, butanol, acetic acid or methane. Carbon dioxide is in this case used as a carbon source of the synthesis.

# Energy Institute :Ongoing projects..



Projekttitel	OptFuel - Optimization of energy production from biomass with the involvement of excess electricity		
Funding	Research Studios Austria		
Applicant	Energieinstitut an der Johannes Kepler Universität Linz		
Project partner	<ul style="list-style-type: none"><li>• PROFACTOR GmbH</li><li>• Montanuniversität Leoben, Institut für Verfahrenstechnik des industriellen Umweltschutzes</li><li>• Technische Universität Wien, Institut für Verfahrenstechnik, Umwelttechnik und Technische Biowissenschaften</li></ul>		
Project duration	start: 02/2013	end: 01/2016	duration: 36 months
Project budget Energieinstitut	224.000 EUR		
<p><u>In the project OPTFUEL different energy sources with the involvement of surplus power are obtained in an optimized overall process from biomass.</u> For this purpose different process steps are combined, each for its own marketable with stand-alone products. The core components include H2 fermentation and a chemical or biological methanation, electrolysis for additional hydrogen production, biogas plant and membrane gas cleaning for the production of methane. Targeted fuels are hydrogen, methane but also liquid products such as ethanol , butanol or organic acids from biomass residues. The optimized overall process will be displayed at the end of the project duration in a continuously operated pilot plant.</p>			

# Energy Institute :Ongoing projects....



Projekttitel	Development of an integrated biorefinery for processing chitin rich biowaste to specialty and fine chemicals (ChiBio)		
Program	European Commission FP7		
Project leader	Fraunhofer-Gesellschaft		
Project partner	<ul style="list-style-type: none"> <li>• <b>Energieinstitut an der Johannes Kepler Universität Linz</b></li> <li>• Technische Universität München</li> <li>• Letterkenny Institute of Technology</li> <li>• The Norwegian University of Life Sciences</li> <li>• Institut National des Sciences et Technologies de la Mer</li> <li>• Apronex s.r.o</li> <li>• Errigal Fish Company Ltd</li> <li>• Evonik Degussa GmbH</li> <li>• Clariant (vormals Südchemie AG)</li> <li>• PT Biotech Surindo</li> </ul>		
Bestehende(r) Finanzierungspartner	European Commission FP7		
Duration	Begin: 11/2011	End: 10/2014	36 months

➔ <http://www.chibiofp7.fraunhofer.de/>





## EU-Project *ChiBio*: Development of an integrated biorefinery for processing chitin rich biowaste to specialty chemicals.



Coordinators: L. Wiemann & V. Sieber, Project Group BioCat, Fraunhofer IGB (Straubing/Germany) [lars.wiemann@igb.fraunhofer.de](mailto:lars.wiemann@igb.fraunhofer.de)

Local partner contact: **The Energy Institute at the Johannes Kepler University Linz GmbH**, [lindorfer@energieinstitut-linz.at](mailto:lindorfer@energieinstitut-linz.at)

### Starting material: Chitin rich biowaste



The fishing industry in the EU and elsewhere produces an increasing amount of negative value crustacean shell waste (> 6 MTPA), whose current disposal in landfills results in significant costs and risks to human health as well as to the environment. While in Asia small amounts of shrimp waste are processed to chitosan, the high  $\text{CaCO}_3$  content of EU crab shell waste has prevented cost effective conversion to value adding products. *ChiBio* will develop an integrated biorefinery to transform the chemical constituents of EU, African and Asian crustacean shell waste into novel “drop-in” chemical intermediates to produce high value, high performance bio-based polymers at high atom efficiencies.

### The *ChiBio* biorefinery

### How will *ChiBio* accomplish these goals?

*ChiBio* develops innovative processes comprising pretreatment steps to facilitate depolymerisation and conversion of sugars into chemical building blocks utilizing both enzymatic and whole-cell biocatalysis routes. The biocatalyst development requires application of genomics techniques in combination with green-chemical and process-engineering know-how. Sustainable purification technologies will enable integration of monomers into current industrial polymerisation processes. Biowaste streams will be valorised for the production of energy to optimise process efficiency and greenhouse gas footprint. The environmental impact of the process chain will be evaluated by a cradle-to-product life cycle analysis. Process scale-up will be linked with modelling and optimisation studies to demonstrate economic viability.

### Consortial partners

The consortium of 5 academic, 4 SME and 2 large industrial partners has the technical and management expertise to rapidly transfer laboratory scale results into novel industrial product lines at an accelerated pace within the given 3 years (11/2011-10/2014). The consortium members are from 5 different EU and 2 associated ICP states, which allows for strategic technology transfer from high- to low-tech driven countries, fostering the development of sustainable economies in the EU and beyond.



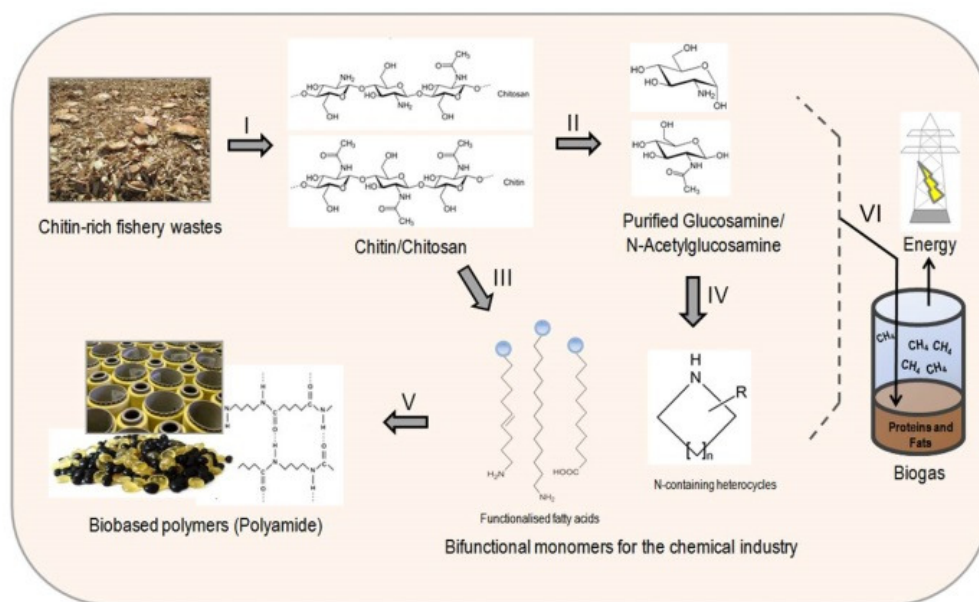


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- I) Pretreatment & stabilisation
- II) Depolymerisation (chemo- and biocatalytic) to sugar polymers
- III) Microbial conversion of chitin hydrolysates to lipid congeners
- IV) Multi-Enzymatic conversion of sugar monomers to N-containing bi-functional monomers
- V) Polymerisation & Demonstration
- VI) Anaerobic digestion of protein & lipid residues to biogas/energy





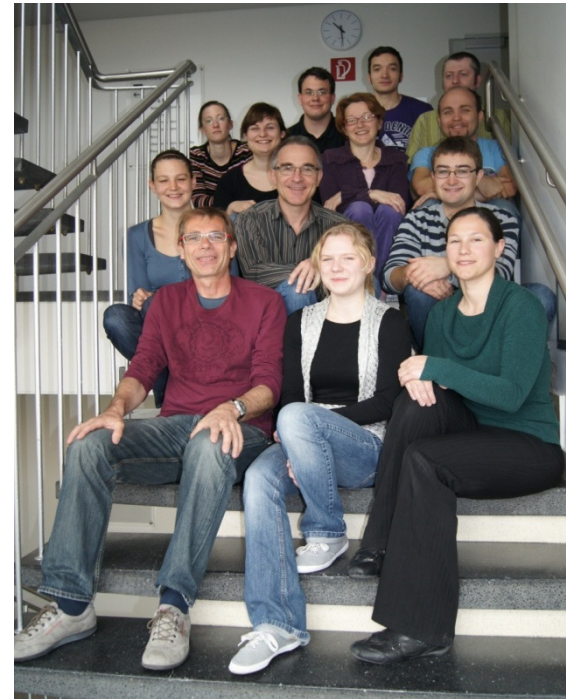
## **Research group „Bioethanolics“Wels**

**Head: Prof. Dr.Alexander Jäger**  
**Vice Dean**

# University of Applied Sciences, Campus Wels



**Foundation 1994**  
**~1,500 students**  
**No.1 in R&D of all Austrian**  
**Universities of Applied**  
**Sciences**



**Research Group Bioethanolics**  
**2 Profs. 6 Researchers**  
**10 Graduate / Undergraduate**  
**Students**



# Wels: three main topics - Bioethanol, Biogas & Biodiesel production from lignocelluloses



Wheat straw



Rye straw



Corn straw



Oat straw



Miscanthus



Corn cobs



Sun flower

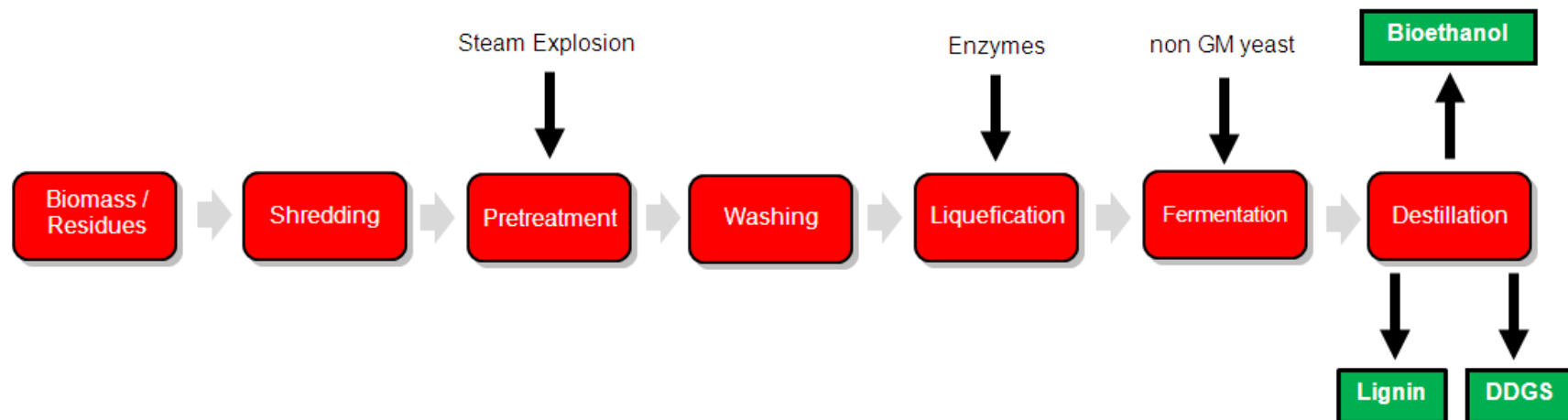


# Lignocellulosic Bioethanol



**Head Prof. Dr. Alexander Jäger**

**Generation of the scientific basis for planning of demonstration plant of 2<sup>nd</sup> generation bioethanol based on straw. Pretreatment with steam explosion**



Partners sought for scientific collaboration and industrialisation and exchange of researchers

# Biogas



**Head: Paul Kuttner Bsc.**

**Research on small scale biogas plants, focus on psychrophilic fermentation, low cost plants, & computerized plant optimization**



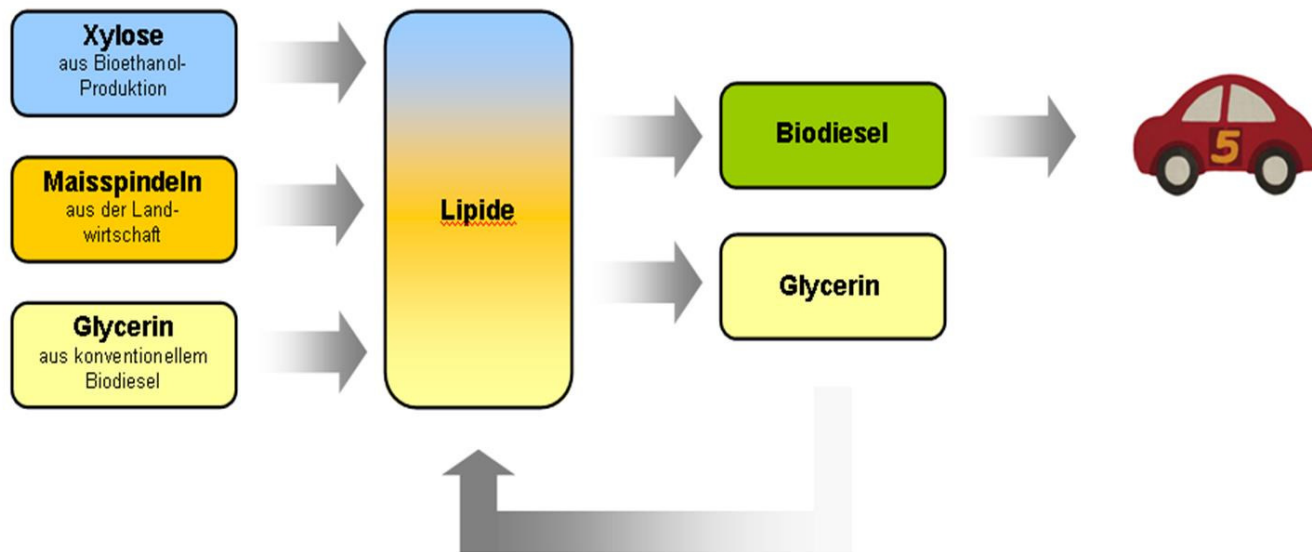
Partners sought for scientific collaboration and industrialisation and exchange of researchers



# Next Generation Biodiesel

**Head: Dr. Heike Kahr**

**Basic research on generation of lipids by means of lipophilic yeast**



Partners sought for scientific collaboration and exchange of researchers

# Summary and outlook



Bioethanol process ready for scale up. Partners

Biogas process offers large optimization potential.

Next Generation Biodiesel production is still basic research

Scientific and commercial partners sought

Exchange of researchers desired

Contact: **A.jaeger@fh-wels.at**



# Thank you for your Attention!

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