

---

# Development of an integrated bio-refinery for processing chitin-rich food waste into specialty chemicals

---

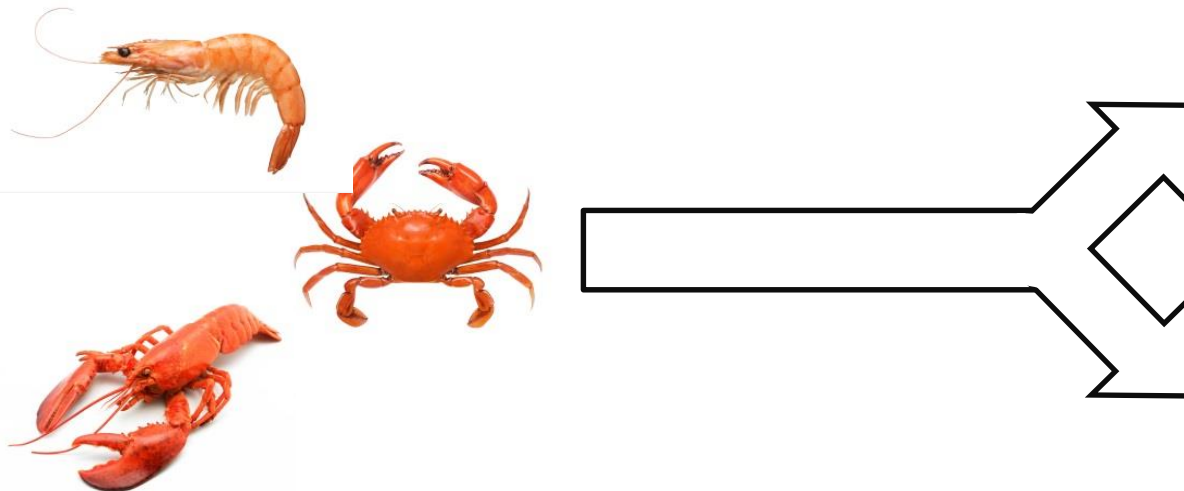


**refining waste, creating value**

**Prof. Volker Sieber**  
Fraunhofer Institute for Interfacial Engineering  
and Biotechnology, Institute branch Straubing  
BioCat – Bio-, Chemo- und Electrocatalysis

# Food waste material

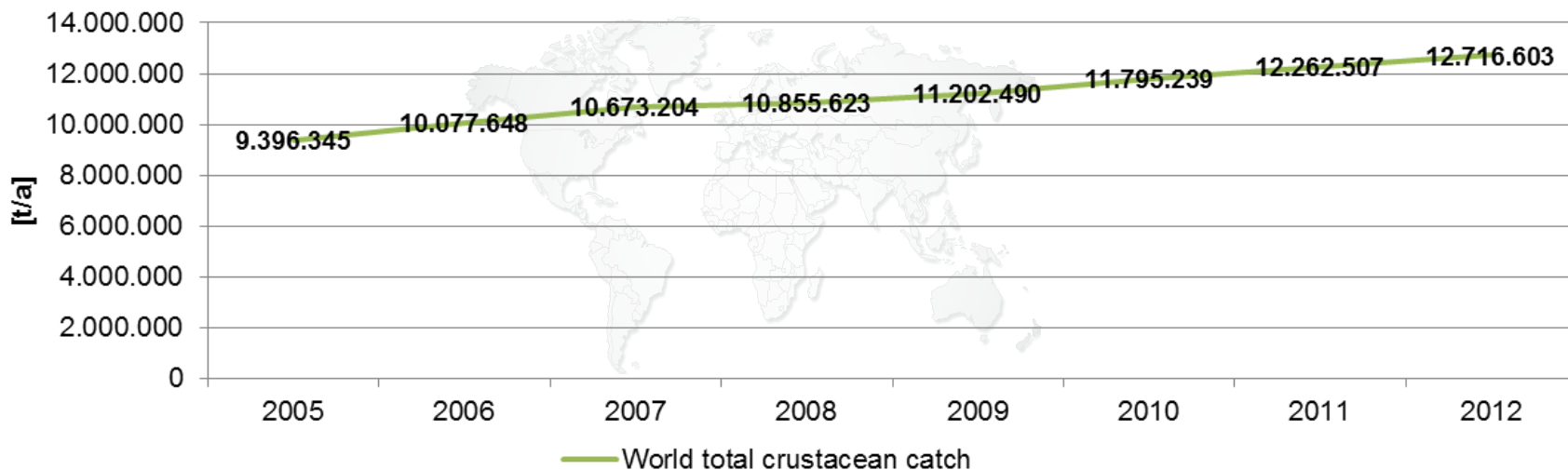
Crustacean shell wastes – a nuisance



# Accumulation of crustacean waste in the World



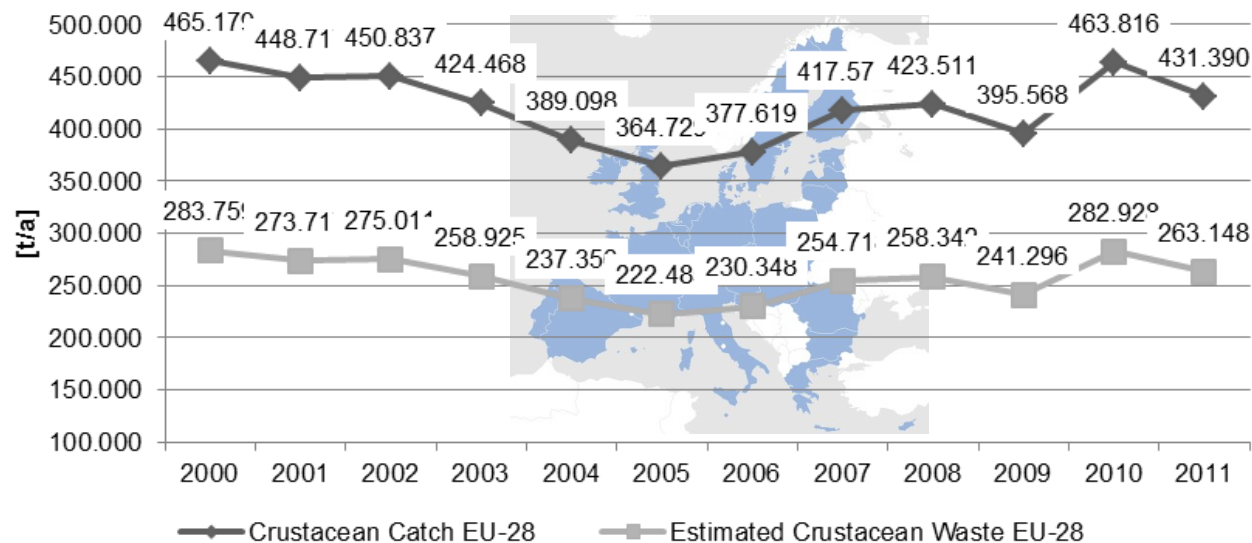
## Global Catch of crabs and shrimp 2005 – 2012



# Accumulation of crustacean waste in Europe



## Crustacean Catch and Waste within EU-28



Mainly: Netherlands, Ireland, Denmark, Norway, Germany, the UK and Iceland

- ca. 60 % of catch is waste
- Landfilling or Sea dumping not allowed in EU
- Cost for Disposal or burning between 60 – 157 €/t in EU



# Circular Economy

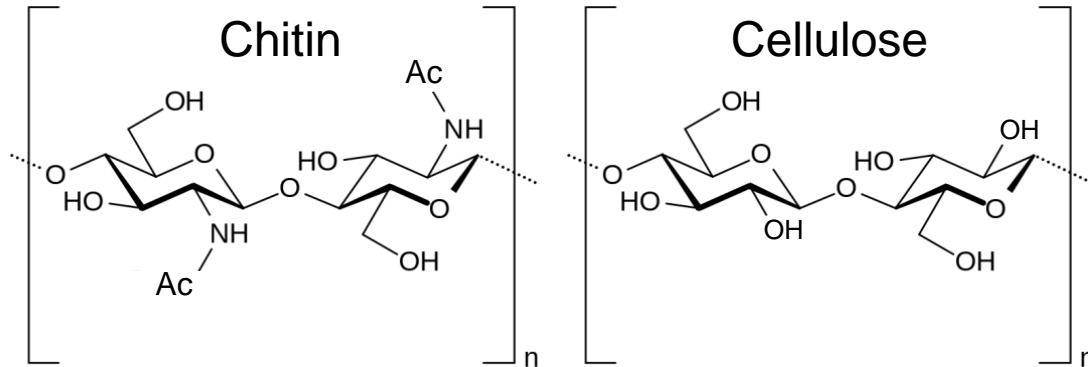
Crustacean shell wastes – not a nuisance but an opportunity

- Major constituents:
  - Chitin, a carbohydrate similar to cellulose



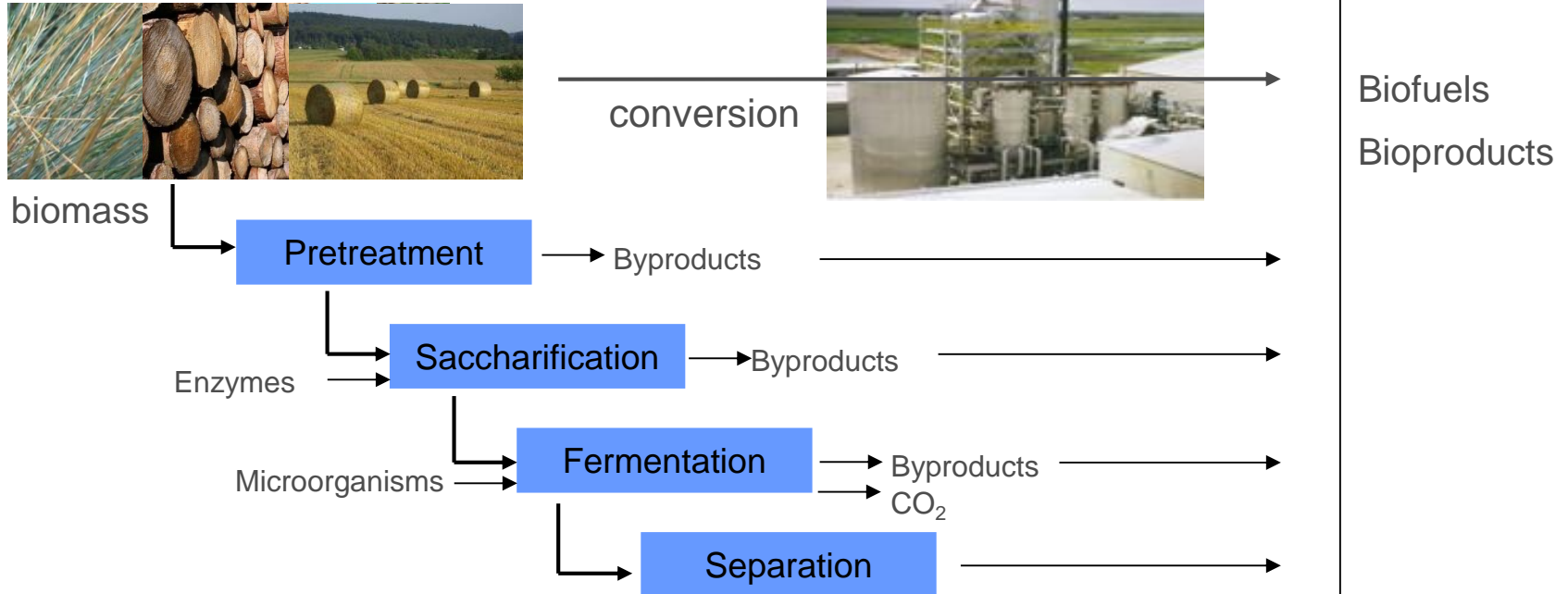
also:

- $\text{CaCO}_3$
- Proteins
- Lipids



# Biorefinery

## Learn from Lignocellulose Biorefinery



# Biorefinery

## Learn from Lignocellulose Biorefinery



Lignocellulose  
Biorefinery



Chitin  
Biorefinery

Pretreatment

Saccharification

Fermentation

Separation

**Similar  
approach**

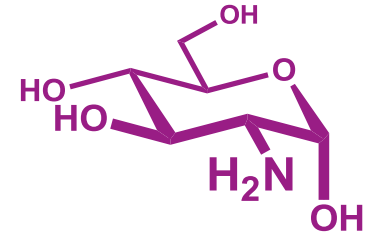
# The ChiBio value chain: A bio-refinery



chitin-rich fishery wastes



raw chitin



glucosamine



key intermediate for value-added polymers



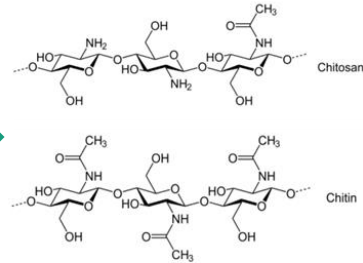
bio-based polymers  
(polyamides)



# Details – getting the glucosamine

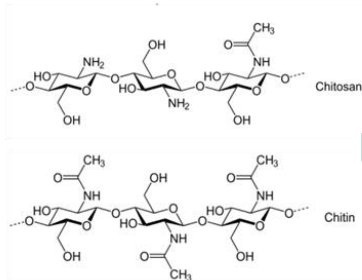


Chitin-rich fishery wastes

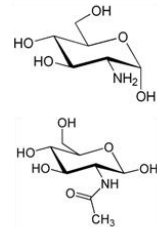


Chitin/Chitosan

- Microbial demineralization and purification of chitin
  - > 90% deproteination and up 99 % demineralization with novel microbial isolates



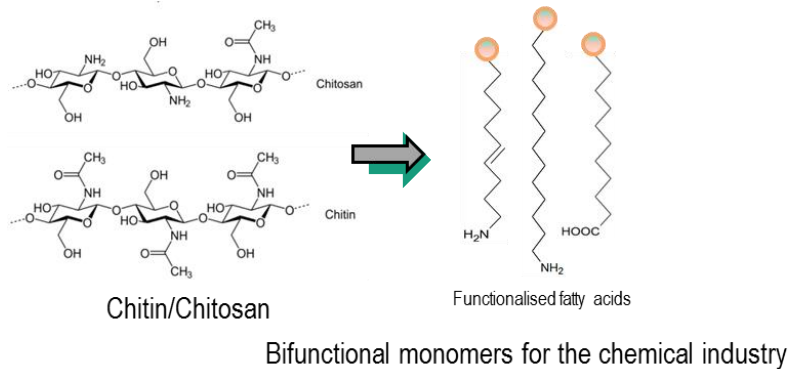
Chitin/Chitosan



Purified Glucosamine/  
N-Acetylglucosamine

- Methods for the enzymatic depolymerisation of chitin to its building block developed
  - Screening for new chitinases and deacetylases, characterisation of enzymes and application of enzyme cocktails and bioprocess development

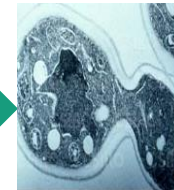
# Details – making the polyamide



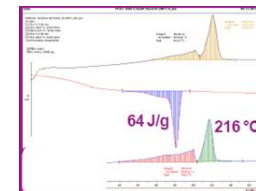
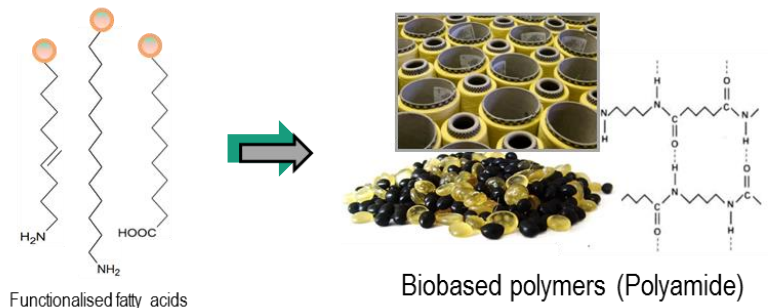
- Transformation of building blocks into chemicals for industry, by enzymatic and microbial transformations

*Hydrolysate*

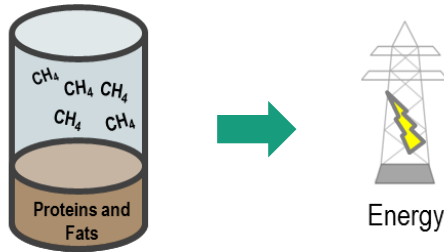
*Olea. Yeast*



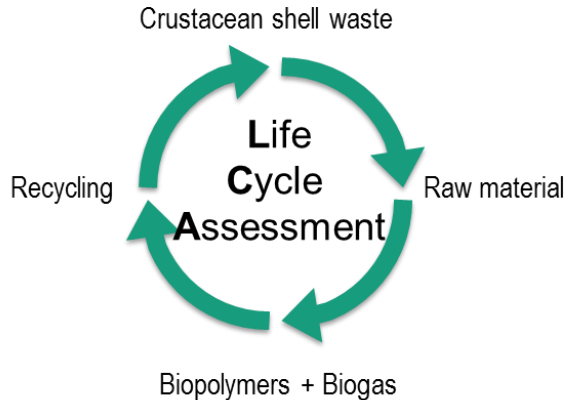
- Production of new biopolymers



# Details – energy re-use and LCA



- Protein and fat residues at the shells were successfully used to produce biogas. Energy can be used for other processes.



- Chitin biorefinery is a viable option. At the current state of development, the process is not economical viable. Further technological development needed.

# There's added value for the EU economy



helps EU fishery industry:

reduced waste costs (>15 Mio. €)

new business for EU fishery industry:

raw material supplier of chitin

replacement of fossil resources

new bio-based products

new technology



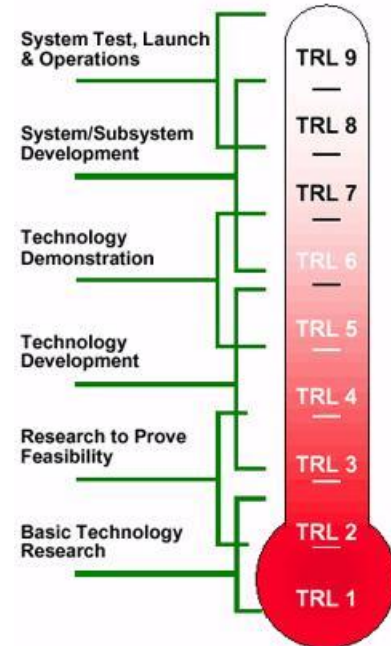
EU in the global lead



# ChiBio in a nutshell



- a new technology platform
- a bio-refinery that turns fishery waste into value-added polymers
- current technology readiness level (TRL) is 3 - 4



# The ChiBio team



Technische Universität München

