Bio Base Europe

UNIVERSITEIT GENT

Biobased products and new prospects for integrated biorefineries

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The biobased economy

Agriculture

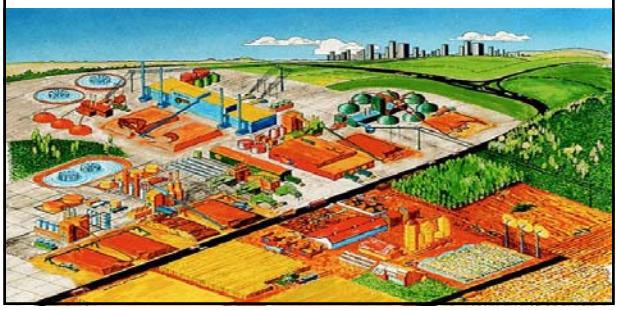
Agricultural commodities
Agricultural waste

Biorefineries

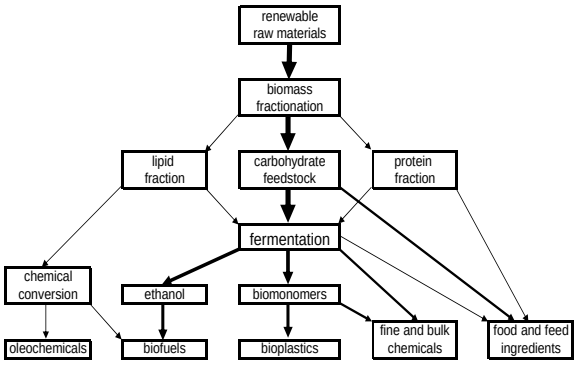
Food and feed
Bio-chemicals
Bio-materials
Bio-energy

Biorefineries

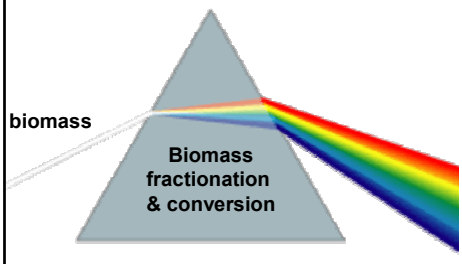
An integrated cluster of bio-industries, using a variety of different technologies to produce chemicals, biofuels, food ingredients and power from biomass raw materials



General concept of a biorefinery



Biorefineries



Food
Feed
Fibers
Bioplastics
Chemicals
Biofuels
Energy…

Products of the biobased economy:

- **Food ingrediënts**
- **Animal feed**
- **Fine chemicals**
- **Bulk chemicals**
- **Biofuels**
- **Bioplastics**
- **Biodetergents**
- **Farmaceutical ingredients**
- **Cosmetic ingredients**
- **…**

In a biorefinery complex, a single raw material such as e.g. corn is converted into:

•Glucose	food industry
•Bio-ethanol	bio-fuel
•Bio-plastic (PLA)	packaging
•Citric acid	food additive
•Starch carboxylate	washing powder
•Antibiotics	pharmaceutical
•Lysine	animal feed additive
•Vitamins	food and feed
•Bio-colorants	food industry
•Enzymes	technical aid
•……..	

PLA bioplastic (Cargill)

corn

enzymes

glucose

fermentation

lactic acid

chemistry

PLA bioplastic

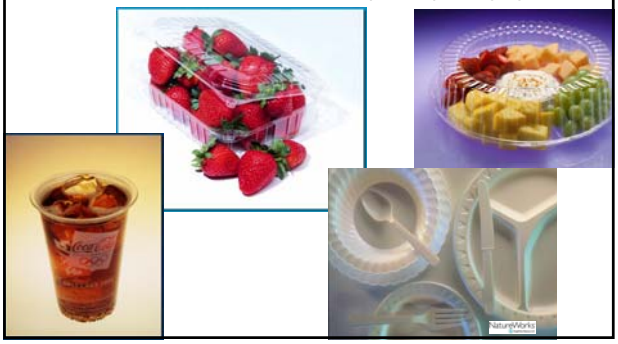
PLA is produced from renewable resources through a combination of industrial biotechnology and conventional (chemical) polymerisation

PLA is a bioplastic comparable to conventional plastics

PLA is biodegradable and decomposes on the compost heap after use

Innovative bioproducts for sustainable production and consumption

NatureWorks™ PLA bioplastic packaging



The milk comes from mother nature

Now, so does the bottle

ingeo

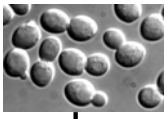
Fibres made from PLA

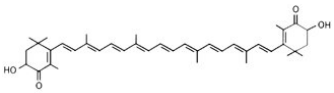
Citric acid (over 1 million ton/year)

Citric acid is used as an organic acid in many foodstuffs and in washing powders as a phosphate replacer

Production with the fungus *Aspergillus niger*

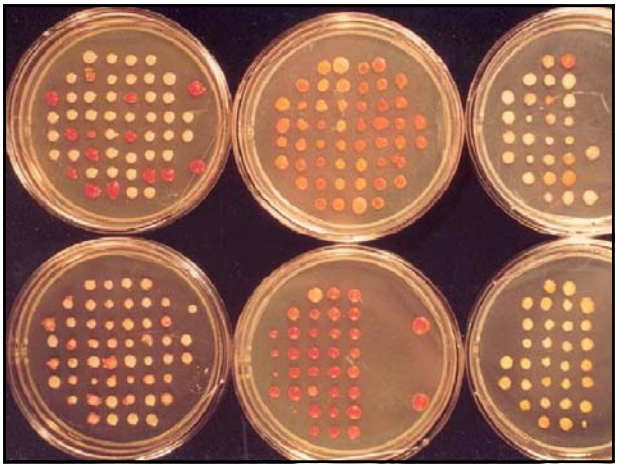
Astaxanthin colorant





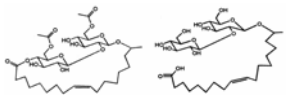
Astaxanthin is a natural β-carotenoid colorant and is produced by the red yeast *Xanthophyllomyces dendrorhous*

Fish feed

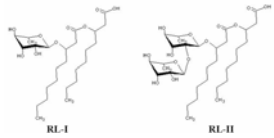


Glycolipids: microbial synthesis of biosurfactants

sophorolipids
(***Candida bombicola***)



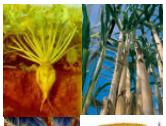
rhamnolipids
(***Pseudomonas aeruginosa)***



Corn Rapeseed

fermentation
to glycolipid biosurfactants

Biofuels: e.g. bio-ethanol



sugar

glucose

Mixture of carbohydrates

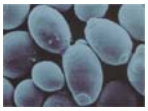
fermentation

distillation

Bio-ethanol
(50 M ton/jaar)

valorisation of byproducts of the bio-ethanol production

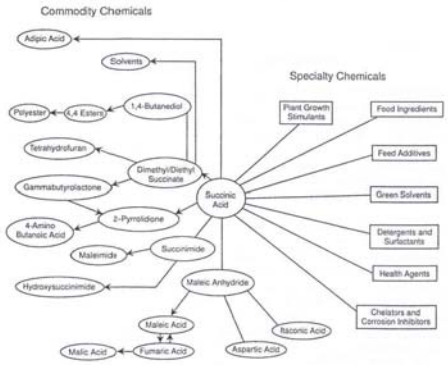
cereals → yeast fermentation → bio-ethanol



CO_2

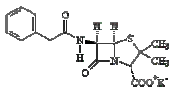
glucose → bacterial fermentation → succinate → bioplastics chemicals

Biotechnological succinate production as a green route to many base chemicals

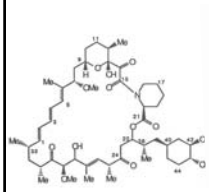


Antibiotics (about 30.000 ton/year)

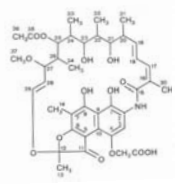
For combatting infectious diseases in humans and animals



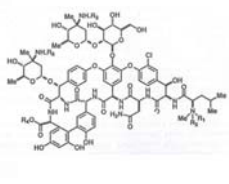
Penicillin G



Rapamycin



Rifamycin B

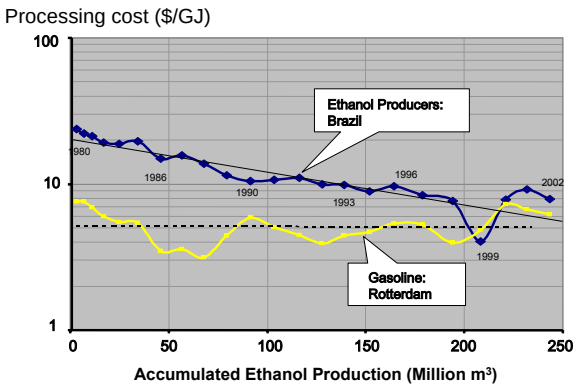


Eromycin

Handicaps in the development of the biobased economy

- **Technological handicap**:
  The used technologies are still at the beginning of their development ⟷ mature petrochemistry
- **Investment handicap:** most biorefineries still need to be built ⟷ existing petrochemical factories
- **Scale handicap:** most biorefineries still have a relatively small scale ⟷ economies of scale of large petroleum refineries

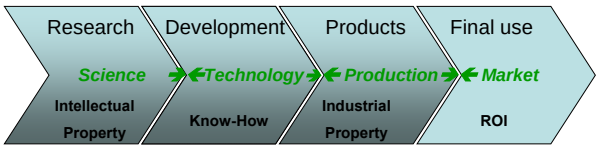
Learning curve of bio-ethanol production



Bio Base Europe

Open innovation and education center for the biobased economy

Problem #1:
Gap in the innovation chain



- Knowledge and expertise are present but…
- Insufficient translation of knowledge into industrial innovation
- Not enough value creation on scientific results

➡ **Need for a multipurpose pilot plant for biobased products and processes:**

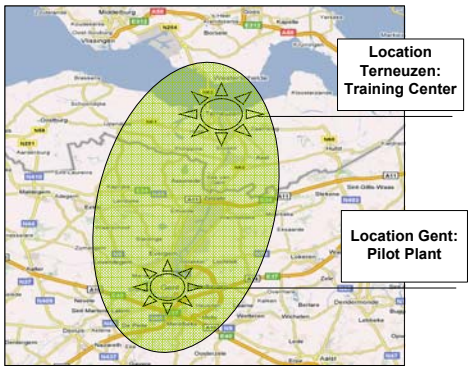
Problem #2:
Lack of process operators for biobased industries

- Declining student interest for technical studies
- Shortage of operators for process industries in general
- Lack of visibility of the biobased economy

➡ **Need for a dedicated training facility for process operators in biobased industries**

Bio Base Europe

Innovation and training for a sustainable biobased economy



Bio Base Europe

Innovation and training for a sustainable biobased economy

Facts & figures

	investment Million €	employees FTE
Pilot Plant	13	32
Training Center	8	12
Total	21	44

The Bio Base Europe Pilot Plant

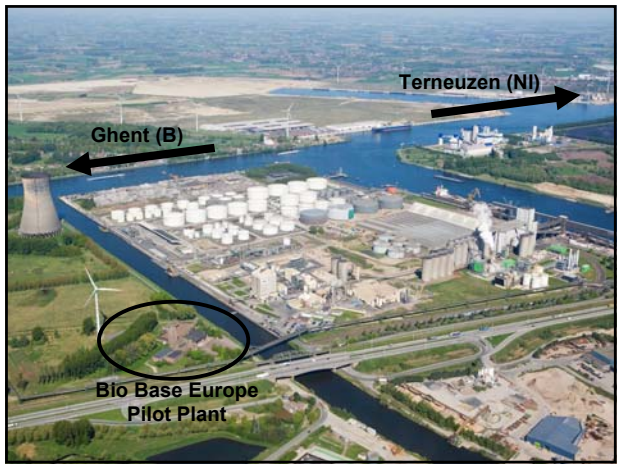
- **Multipurpose** pilot facility with its own specialized personnel
- **One-stop-shop**: the whole value chain from the green resource to the final product can be performed in the same plant
- **Open innovation model**:
  - **Service model**: Pilot projects are performed for customers that maintain the rights to the developed technology
  - **Accessible:** The Bio Base Europe Pilot Plant is open for all companies and research partners from chemical, energy, agro-industrial, food,… sector

The Bio Base Europe Pilot Plant

Activities:

- **Development and optimization** of biobased processes covering a wide range of technologies: biomass fractionation, fermentation, bioconversion, green chemistry, up-stream and down-stream processing
- **Scale-up** of biobased processes up to 10 m³/ton scale
- **Custom manufacturing**: production of ton quantities of new bioproducts for testing the application and market potential

The Bio Base Europe Pilot Plant



Bio Base Europe Pilot Plant

Fermentation and biocatalysis equipment up to 10 m³ scale

Green chemistry equipment up to 10 m³ scale

Up-stream and down-stream processing equipment

- Plant fractionation
- Biomass pretreatment: steam explosion, acid/base hydrolysis
- Fysical separation: filtration, centrifugation,…
- Evaporation
- Crystallisation
- Ion exchange and electrodialysis
- Membrane separation: microfiltration, ultrafiltration,…
- …

Bio Base Europe Training Center

Bio Base Europe Training Center

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Conclusion and perspectives

The world is going through a transition to a biobased economy.

For this development we need new technology and new people

There is a poor transfer of basic technology to production scale and a lack of process operators for biobased processes

Bio Base Europe addresses these problems through a Pilot Plant and a Training Center for the biobased economy

Bio Base Europe is an open innovation and education initiative and is open for business to all players of the biobased economy

Bio Base Europe

Speeding up the development of a sustainable biobased economy

www.bbeu.org