



# Biobased Economy in R(&D)eality

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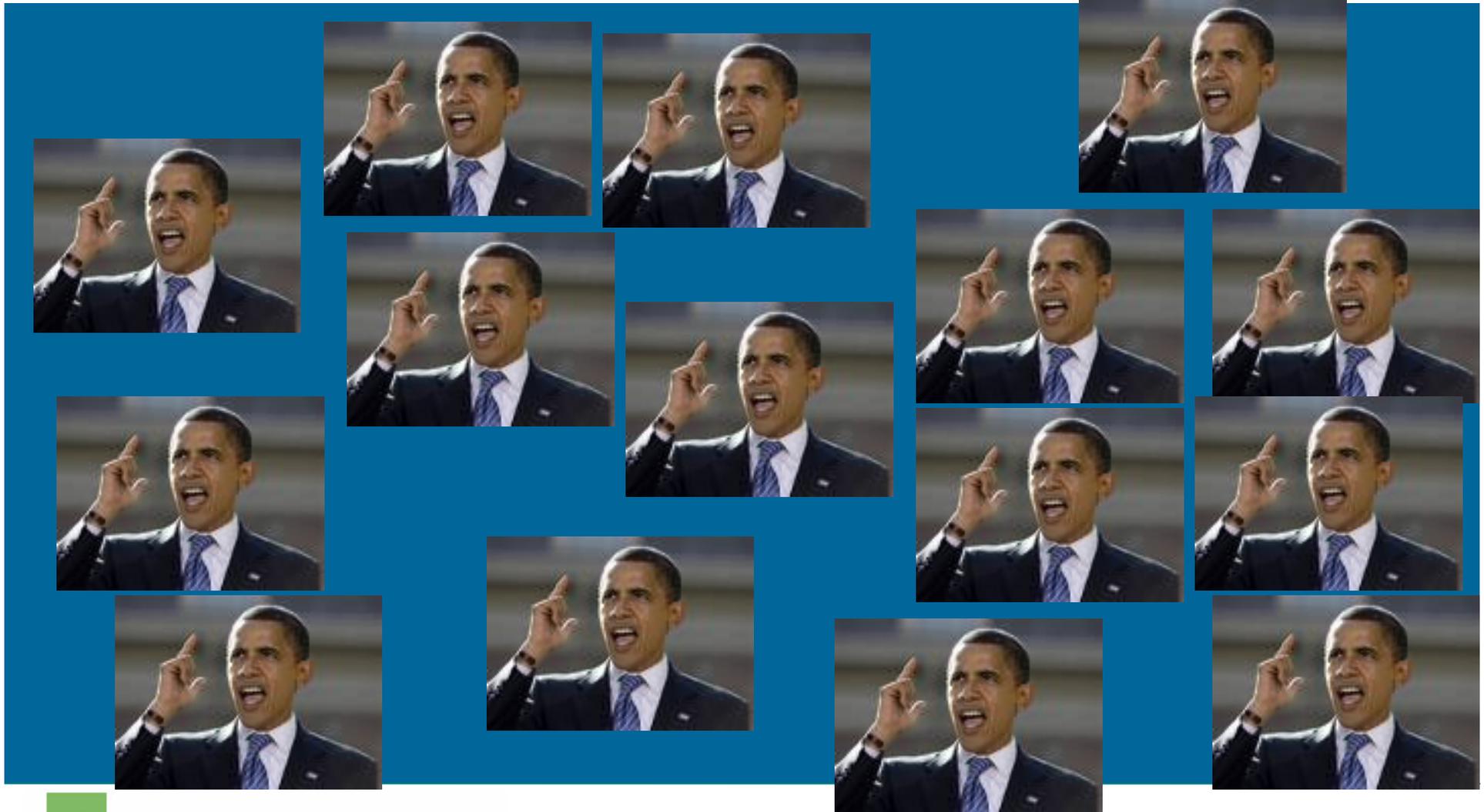
Rotterdam, 20 januari 2009



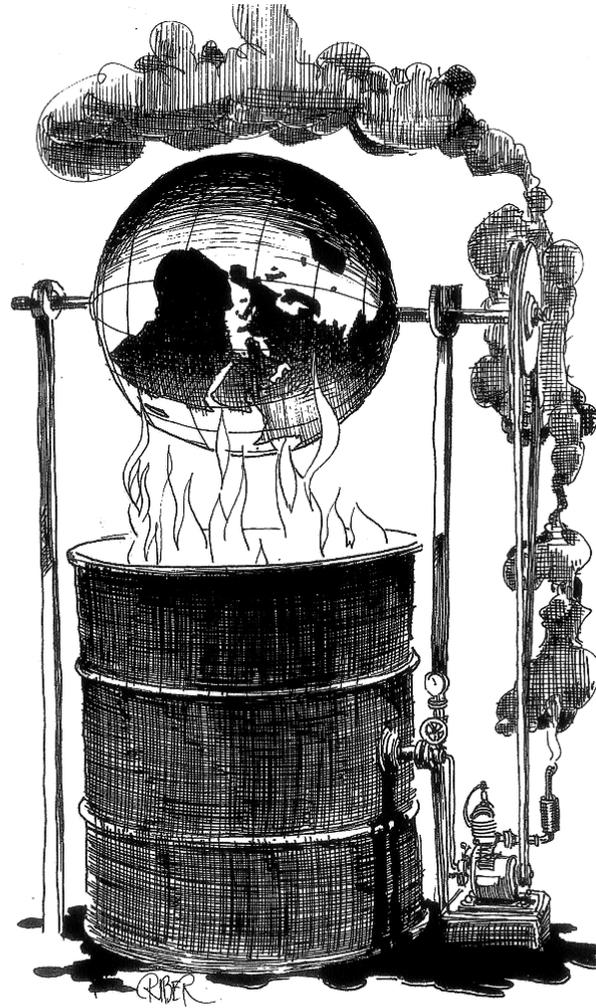
WAGENINGEN UR

*For quality of life*

20 januari 2009



# Good idea?

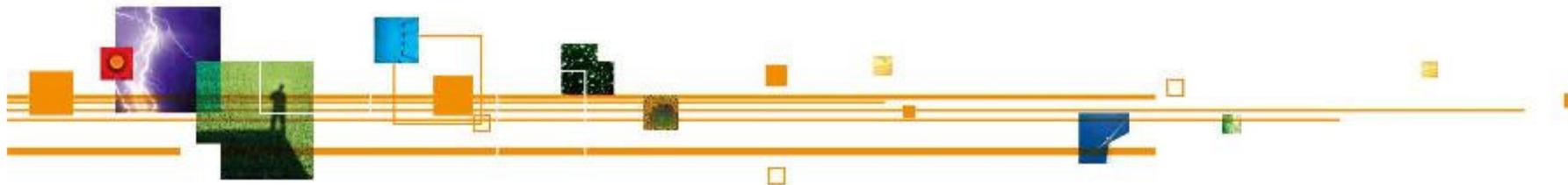


## The dramatic rise of China & India presents one of the gravest threats and greatest opportunities facing the world today

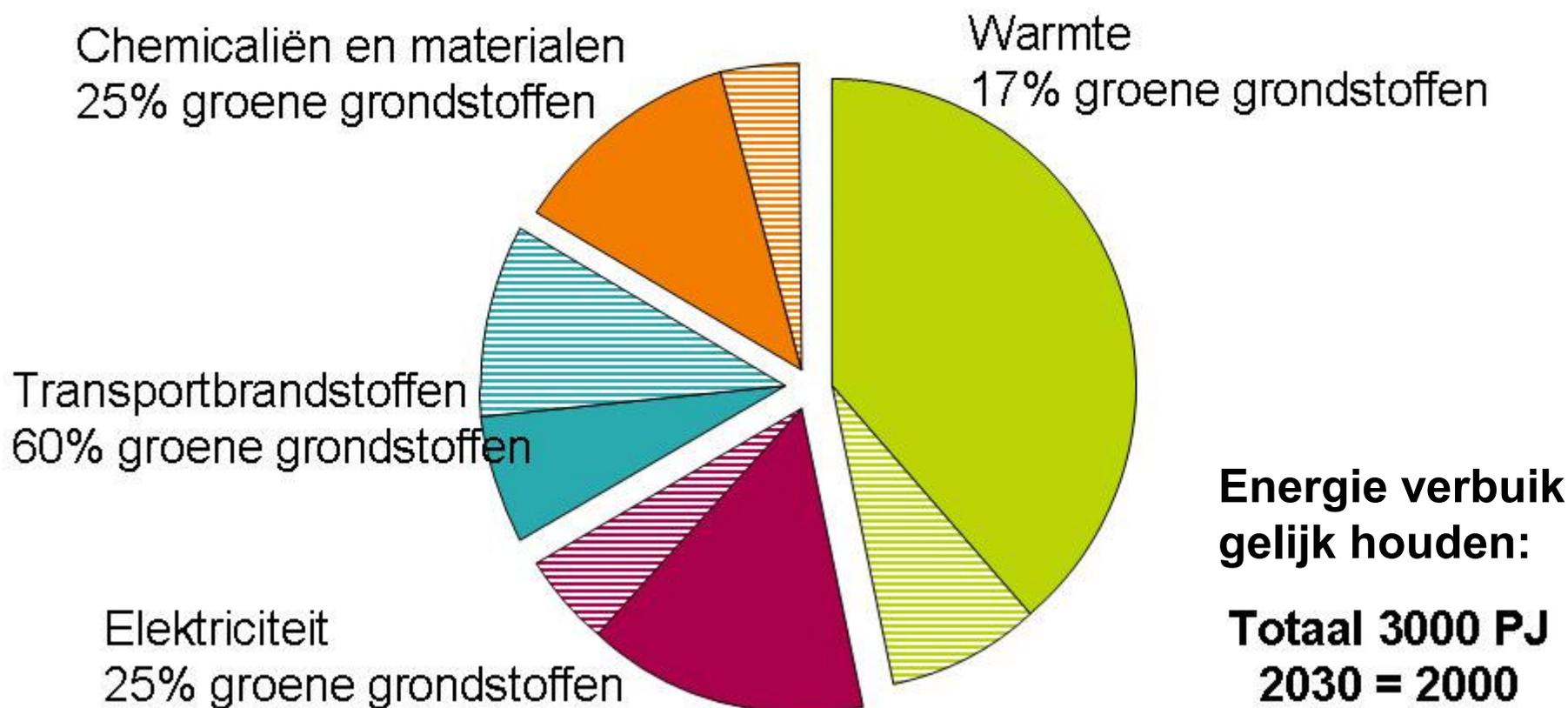
- If **China and India were to consume** resources and produce pollution **at the current US per-capita** level, it **would require two planet Earths** just to sustain their two economies.
- The **resource-intensive model** for economic growth **can't work** in the 21st century.
- There is a **urgent need** for a new path of industrialisation based on **new production and consumption technology with low consumption of resources and low environmental pollution**, and the optimal allocation of human resources.

# Looking for renewable resources

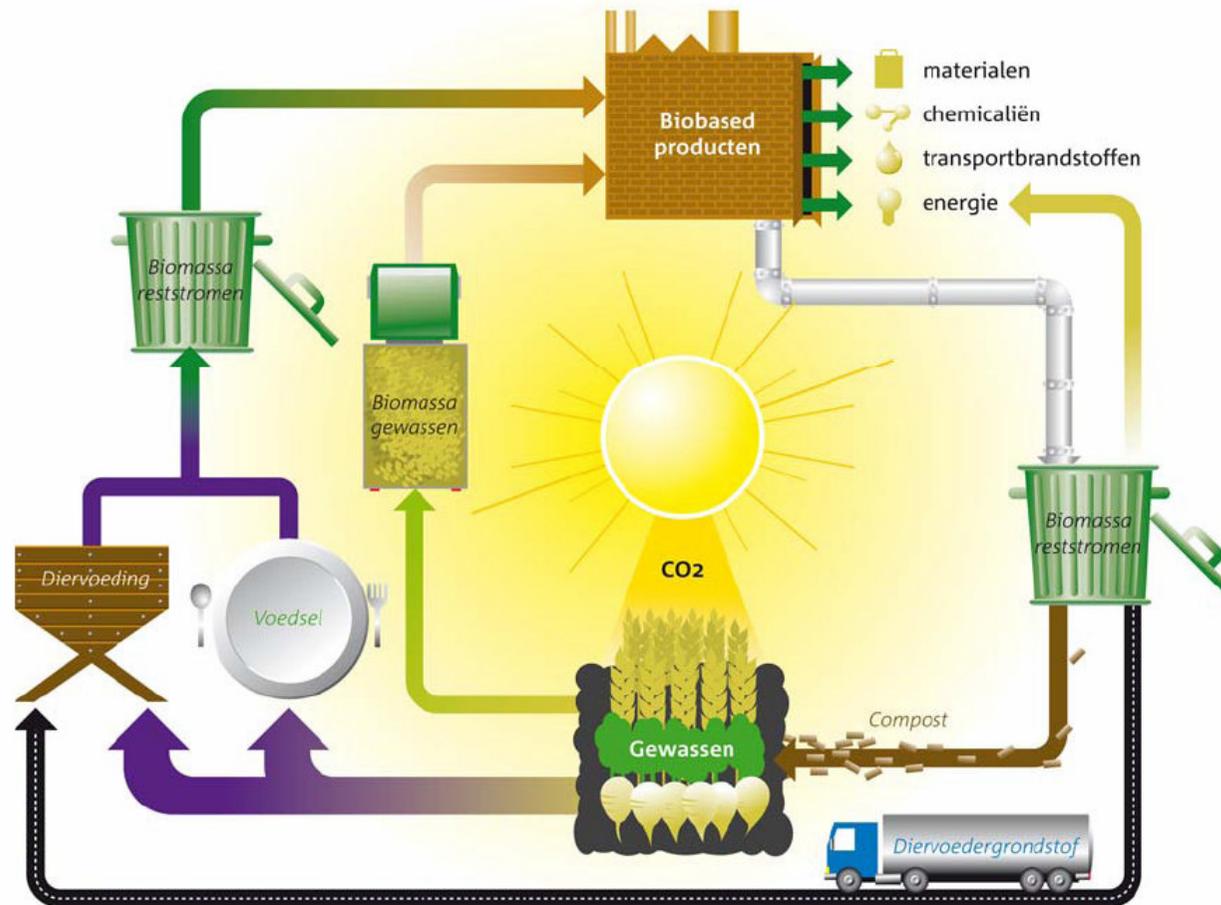




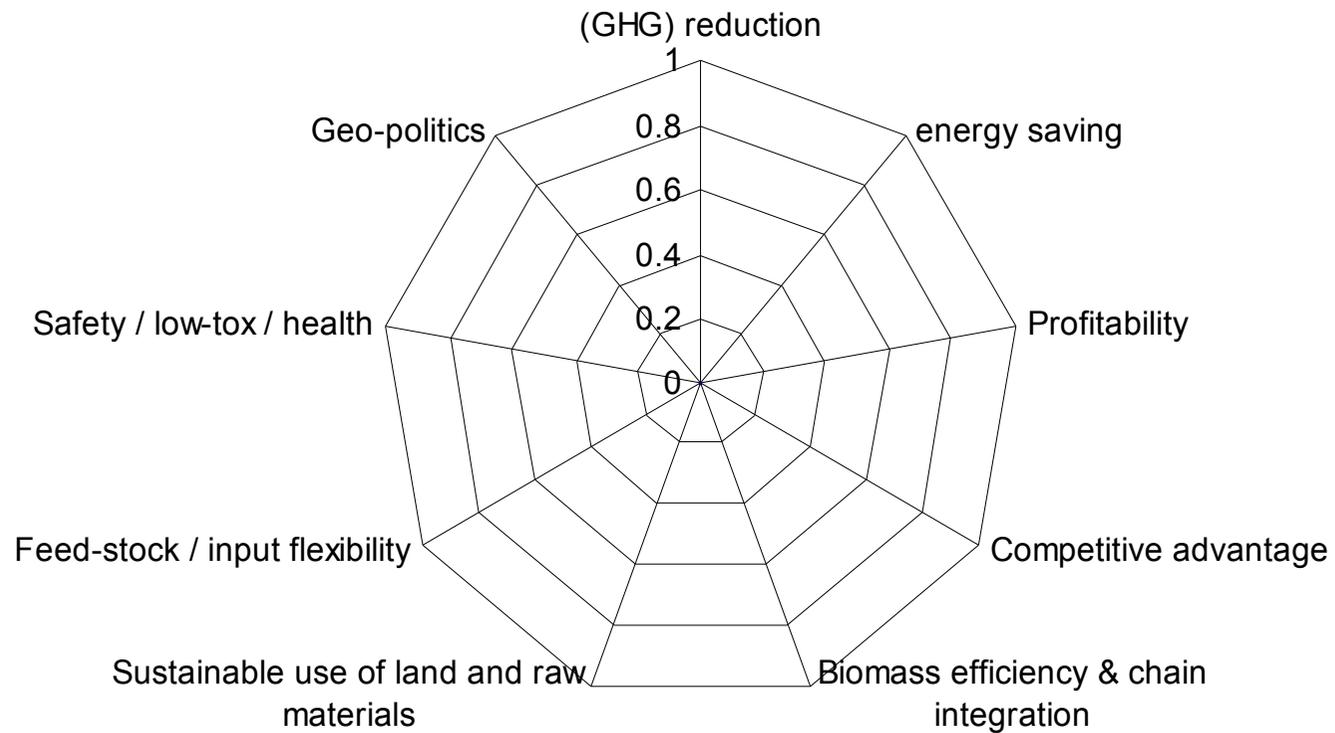
## Visie 2030 in cijfers : 30% Fossiel vervangen door Bio



# Dutch Government vision Biobased Economy: “Closing the loop”. 6 March 2008 Dutch Parliament.



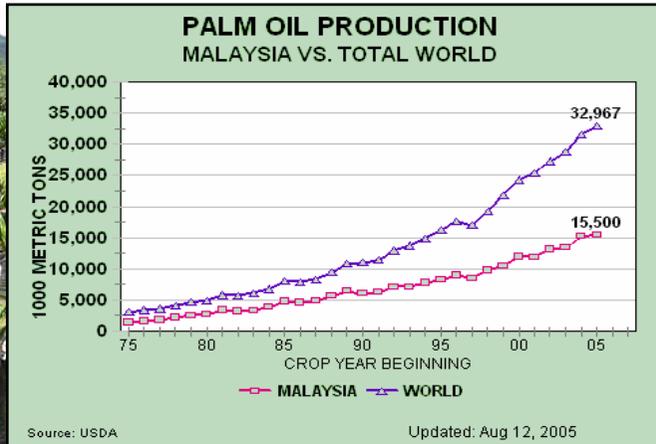
# Biobased Economy: Drivers



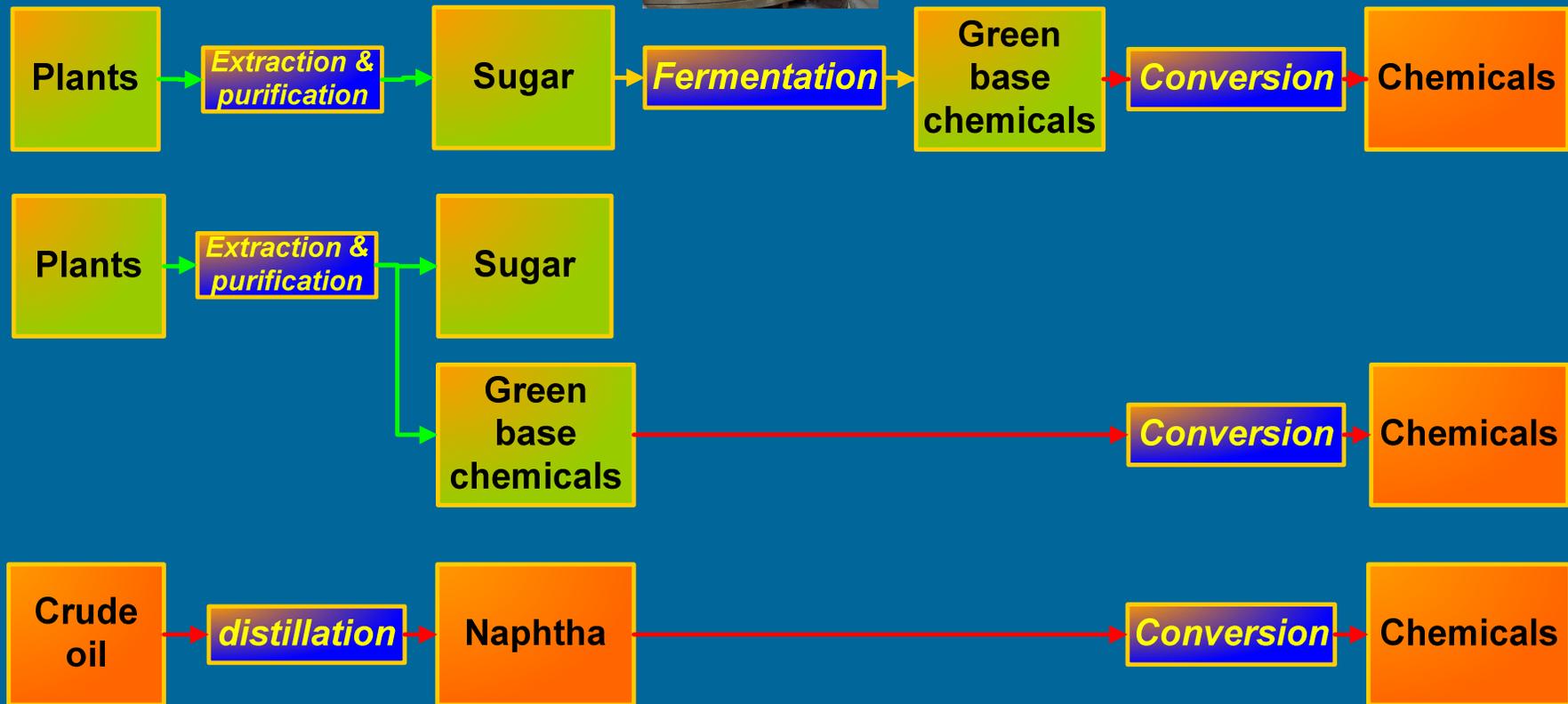
# Argumenten over Biobased Economy vanuit andere vertrekpunten: vaak langs elkaar heen.

Global	Part: Kyoto protocol				Energy Consumption = 2X vs Y2000
EU	5,75% bio-fuel X% renewable	20% renewable 10% bio-fuel -20% CO <sub>2</sub> vs '90			
National		Schoon & Zuinig: -30% CO <sub>2</sub> vs '90 -2% Energy/y	30% fossil => Biomass Energy = 2000		
Regional					
Local					
	Now 2010	2020	2030	2040	2050

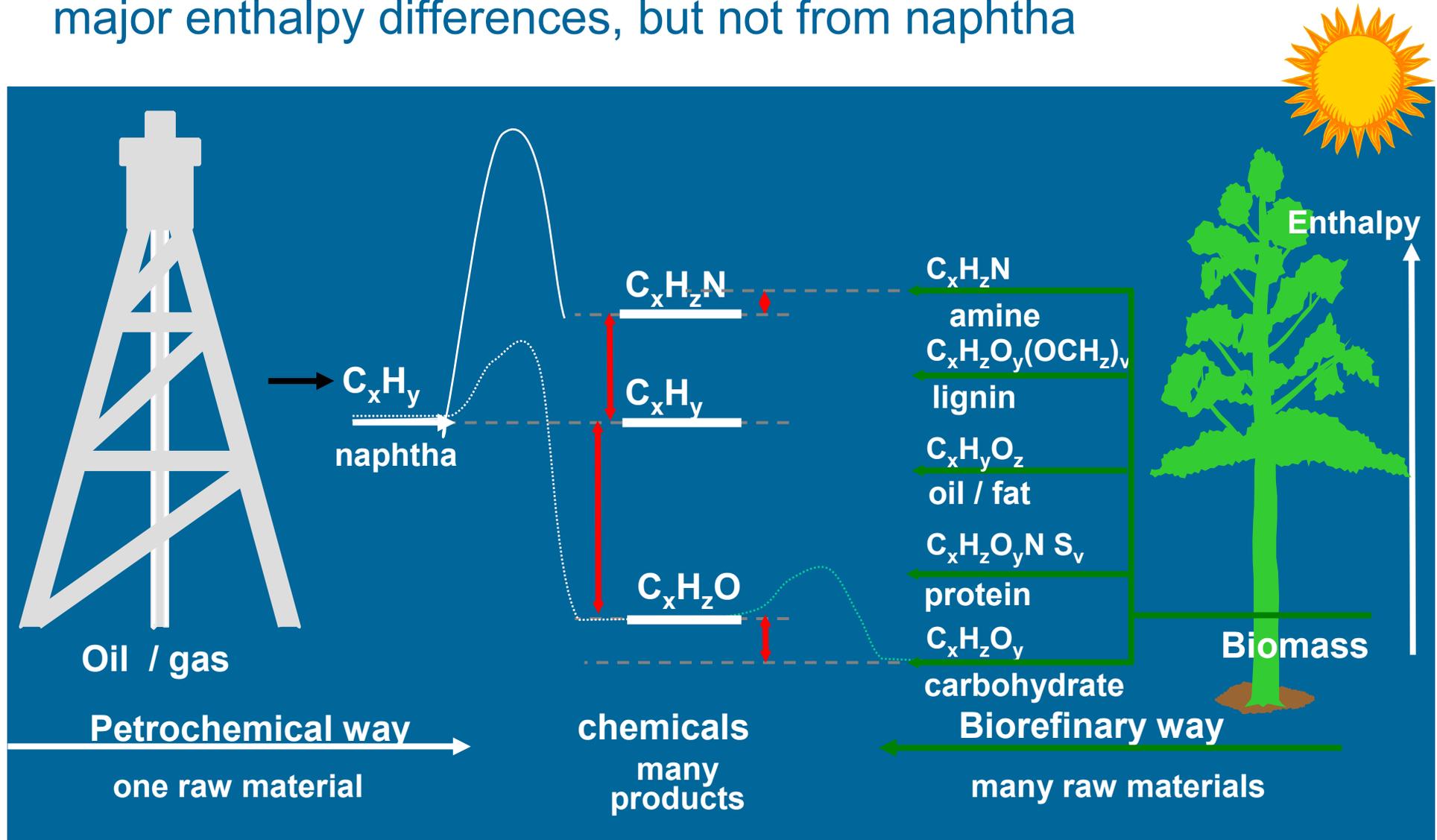
# Energy: Competing claims!



Fuel and Food (Feed) and Nature



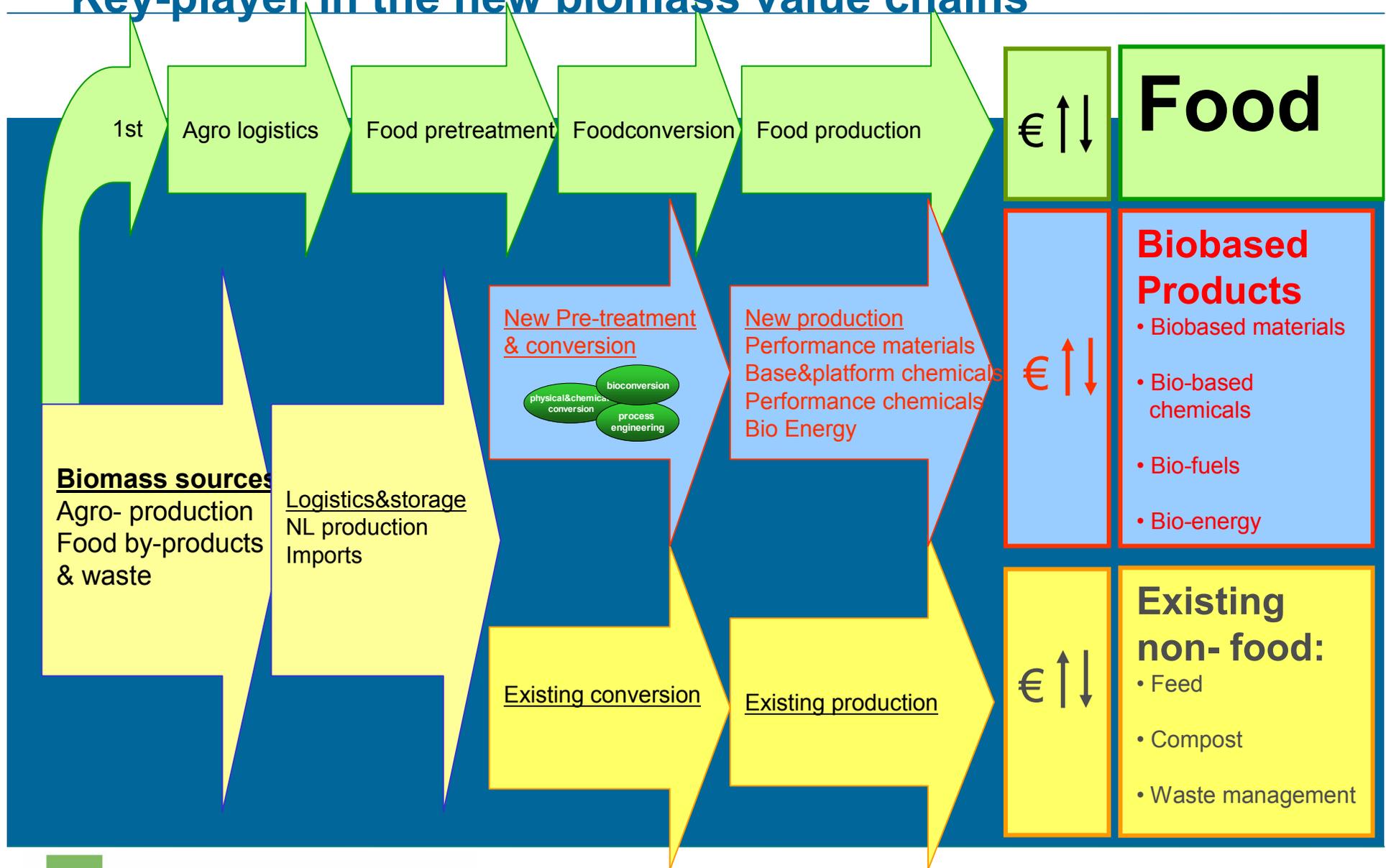
Functionalised chemicals can be made from Biomass without major enthalpy differences, but not from naphtha



# DuPont / Tate & Lyle BioProducts: 1,3 Propanediol factory, Loudon, USA



# Wageningen UR: Key-player in the new biomass value chains



# Wageningen UR (University & Research centre)

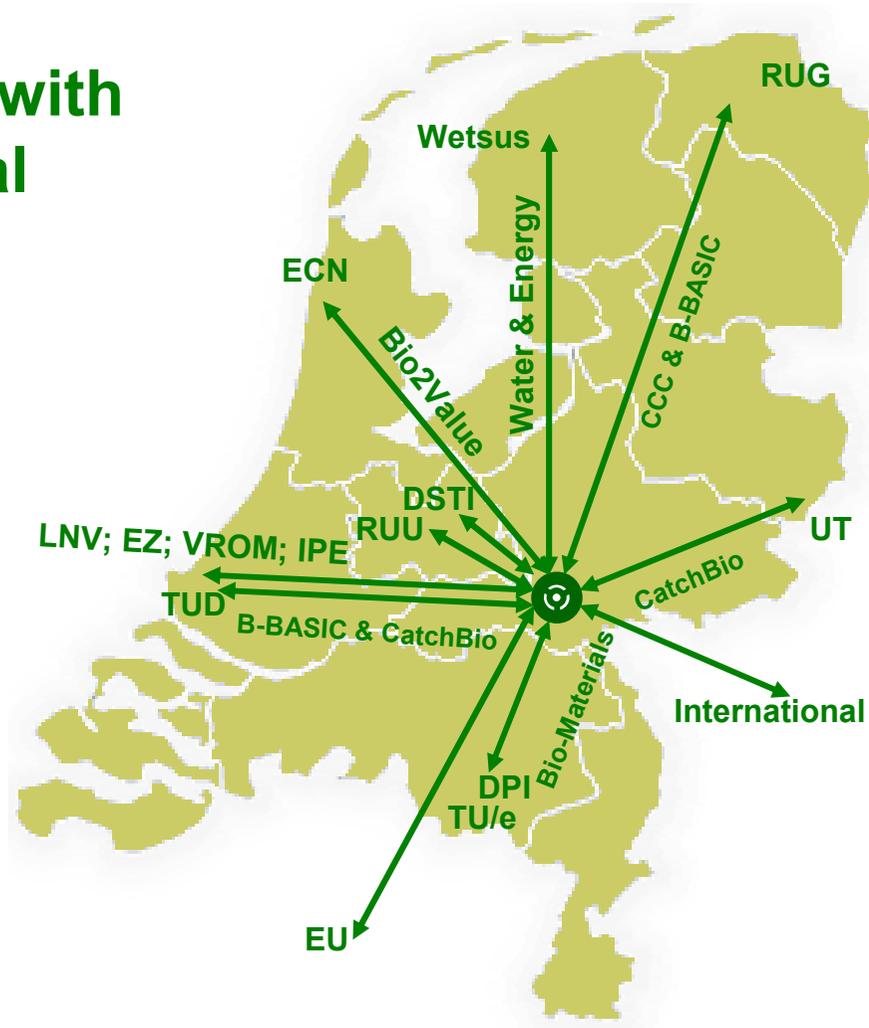
- Three pillars:
  - Wageningen University
  - Van Hall Larenstein Univ. of Appl. Sci
  - DLO - Applied Research Institutes
- Annual budget about 650 m euros
- About 6500 employees
- 9000 BSc/MSc; 1200 PhD (>100 countr.)

*...to explore the potential of nature  
to improve the quality of life...*



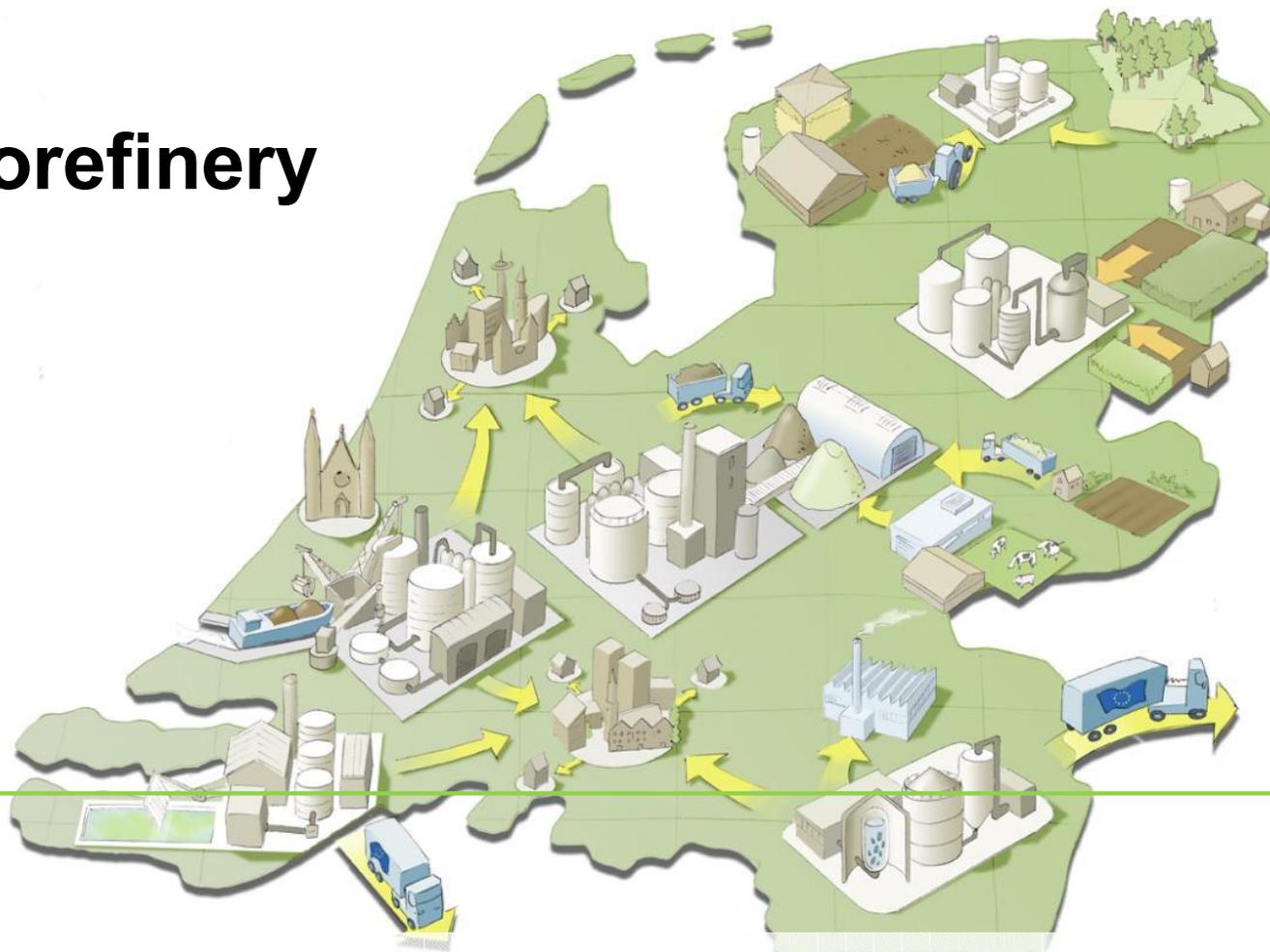
# Wageningen UR Biobased Economy: the centre of cooperation and development

## Cooperation with (inter)national industry



# Dutch Biorefinery Initiative

## *Biorefinery workshop*



landbouw, natuur en  
voedselkwaliteit

Utrecht, October 14<sup>th</sup> 2008

## PROGRAM

# Biorefinery is the sustainable processing of biomass into a spectrum of marketable products and energy

### PRODUCE BIOMASS

Sustainable available  
(parts) of crops/plants



Algae



Primary residuals  
(road grass, wood  
trimmings,



Secondary residuals  
(beet pulp, beer brush)



Tertiary residuals  
(animal fat, dung,  
GFT)



### CONVERT BIOMASS

Biochemical conversion



(Thermo)chemical conversion



### PRODUCE BIO-BASED PRODUCTS



Specialty  
chemicals



Food & feed



(Base)chemicals  
& materials



Fuels



Power



Heat

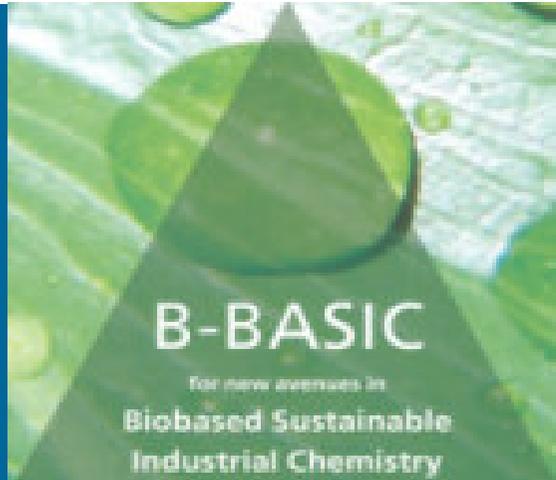
Waste



Waste

Very broad area → Focus needed → Base on SWOT for Netherlands

# Examples of BbP R&D-projects, all moving towards market implementation



## Investment:

€ 52 million

6 years R&D

## B-Basic key-success factors:

- High biocatalytic selectivity
- High biocatalytic activity
- Low bioprocess investments

## Consortium partners

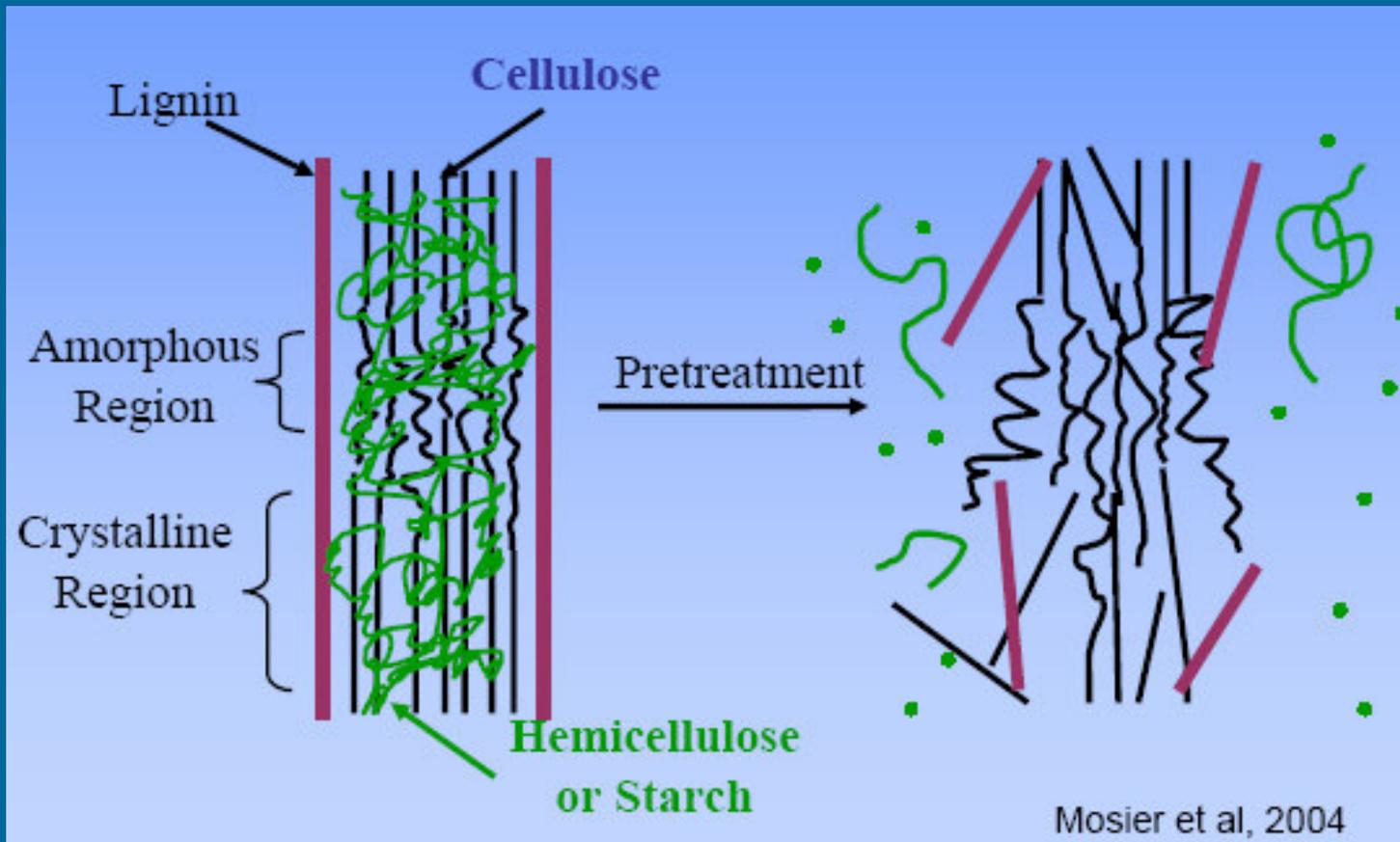


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# Nog een paar voorbeelden

# Effect of Pretreatment of Corn Stover

## Representation of Physical Changes



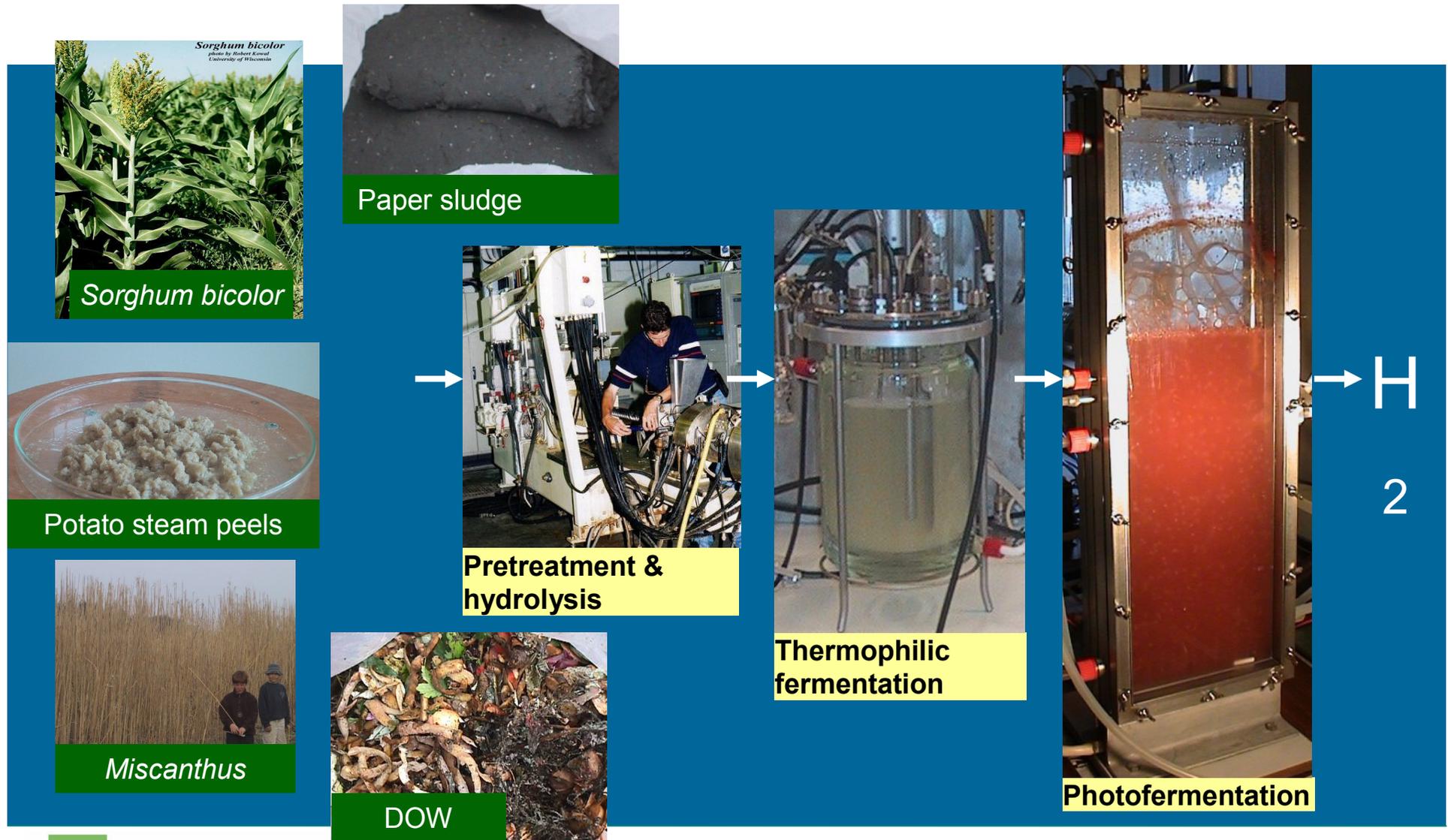
Source: Michael R. Ladisch, Nathan Mosier, Gary Welch, Bruce Dien, Andy Aden, Phil Shane, Purdue University

# Upscaling-30L pretreatment of straw + cellulase



*Reactor during enzymatic hydrolysis at  $t = 0$  and  $t=24$  h after adding enzymes*

# Hyvolution: Bioprocess for hydrogen from biomass

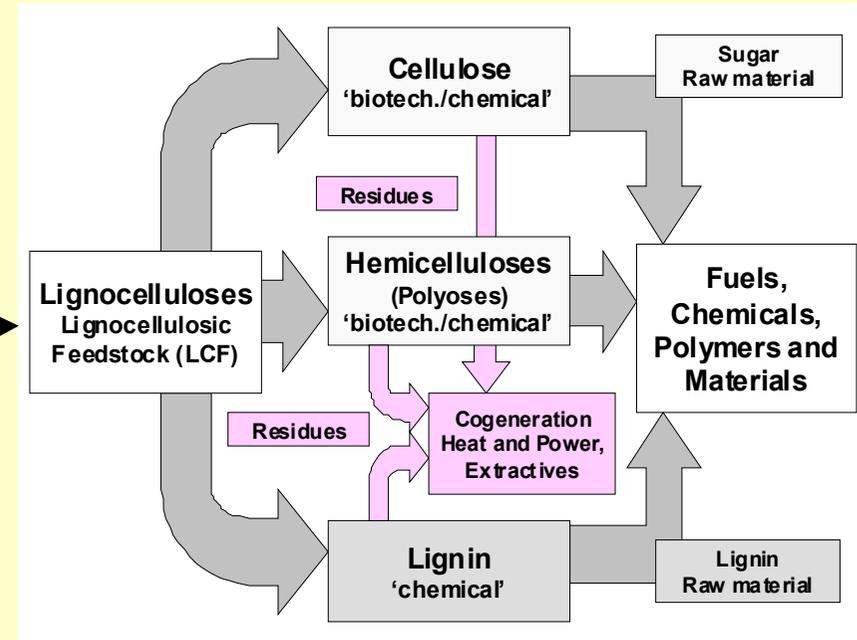
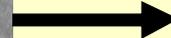


# BioSynergy

[www.biosynergy.eu](http://www.biosynergy.eu)

EC Contract no.: 038994 – (SES6)

January 2007 – December 2010



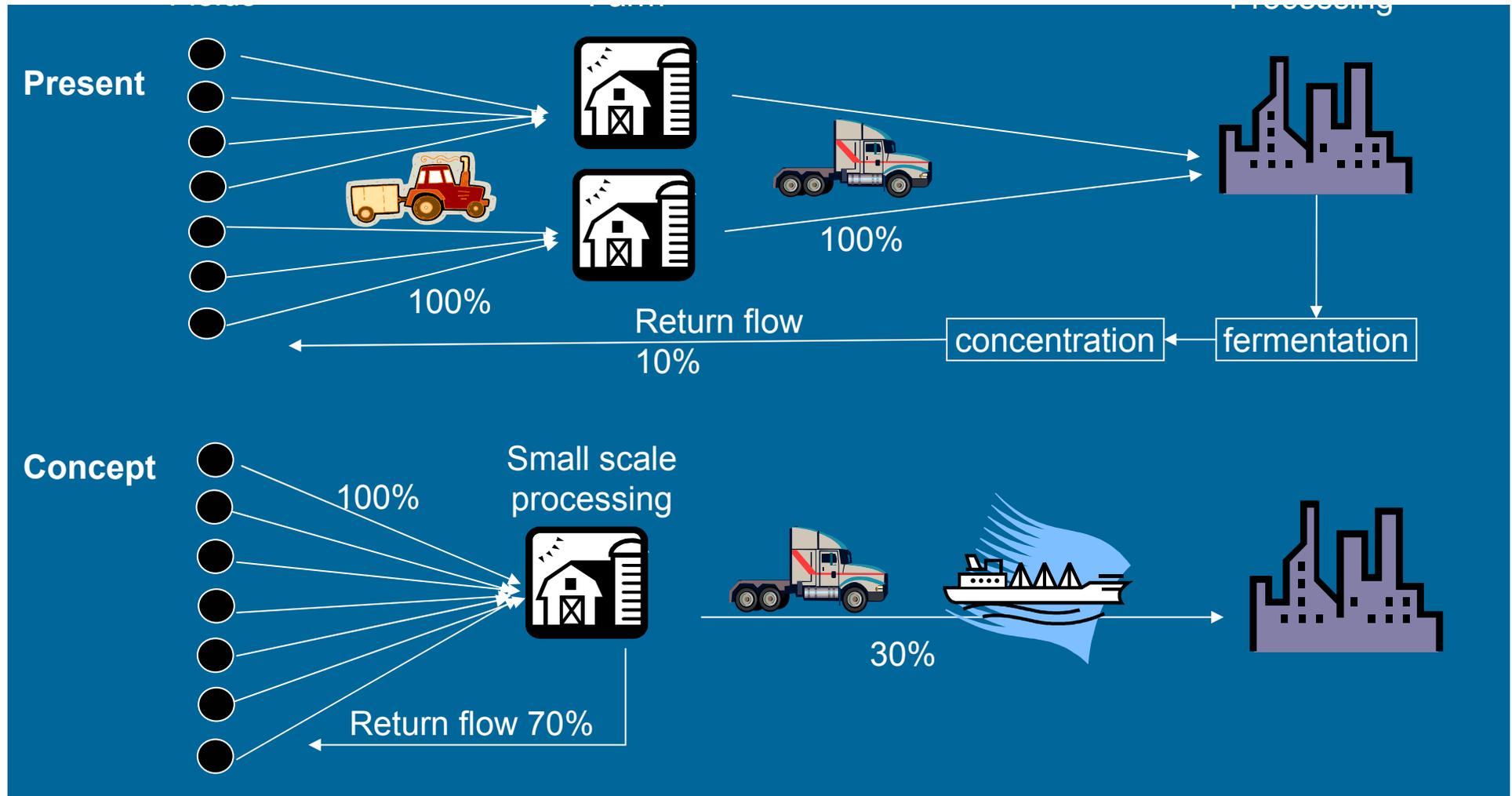
Conventional and lignocellulosic bioethanol production facility



**B**iomass for the market competitive and environmentally friendly **S**YNthesis of bio-products – chemicals and/or materials – together with the production of secondary en**E**RGY carriers – transportation fuels, power and/or CHP – through the biorefinery approach.



# Forward integration reduces transport cost and seasonality and will give more income to the farmer



# Mobile Cassava starch refinery in Africa



Source: Duteso



# Biobutanol



*Proefopzet voor fermentatie  
en extractie van butanol  
uit fermentatievloeistoffen*

# Uitgangspunten Biobutanol

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- Doelstelling: innovatief en duurzaam bioraffinageproces gekoppeld aan productie van butanol
- Butanol: vervanger benzine/diesel; platformchemical
- Relatief natte en verspreid aangeboden biomassa-stromen (zijn vaak moeilijk te benutten)
- Projectleiding: A&F; partner: ECN
- Matching van EOS-Lange termijn onderzoek
- 2005-2009

# Productie van butanol (5 FTE)

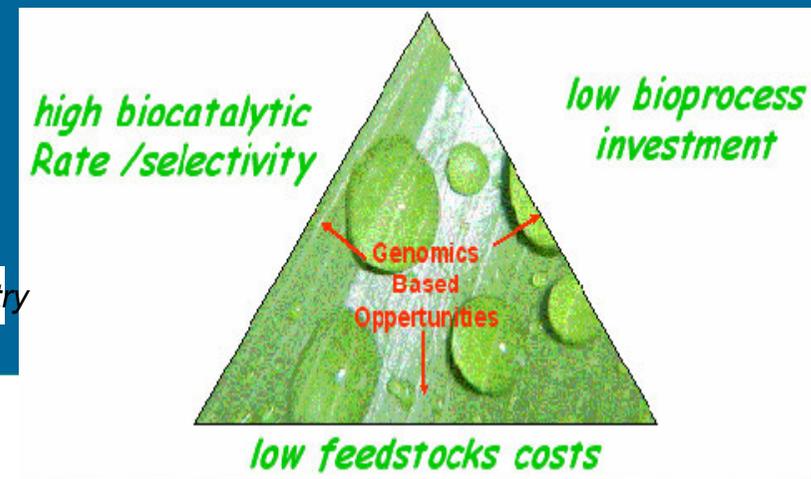
- 3 BBasic projecten, 1 EOS project
- Butanol: met/i.p.v. diesel
- Partners:
  - Shell, Paques/TNO/ECN/Wageningen UR: Biobased Products, Microbiologie (AIO), Proceskunde (AIO)
- Inhoud
  - Butanol is toxisch voor m.o. en remt daarmee productie
    - \* In-situ product removal
    - \* Minder toxisch butanol derivaat
  - Bijproductvorming
    - \* Afsluiten metabole routes naar bijproducten
  - Microbiele biomassavorming
    - \* Recycling



# B-Basic Recycling, uitgangspunten

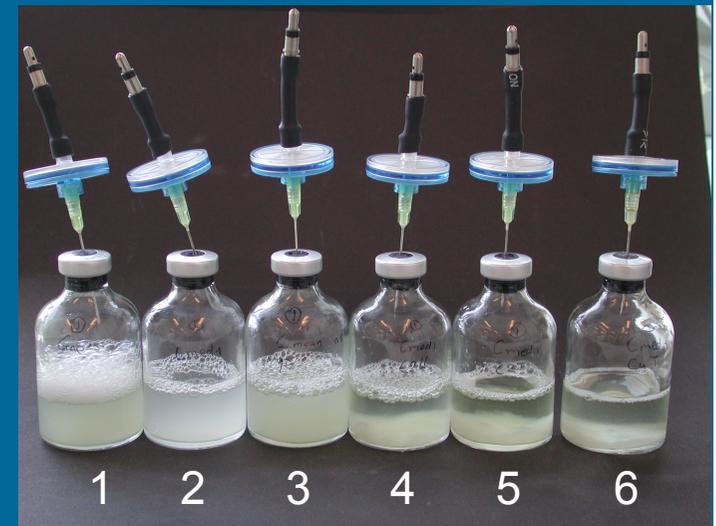
- Doelstelling: verhogen duurzaamheid en verlagen kosten van industriële fermentatieprocessen
- Projectleiding: A&F; partner: Paques bv
- Matching van B-Basic Programma
- 2004-2009

*Bio-based Sustainable Industrial Chemistry*

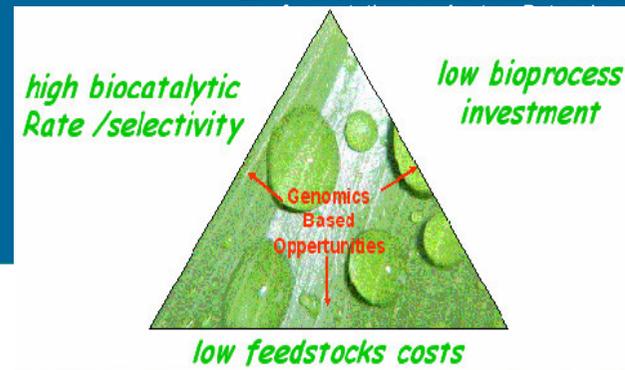


# B-Basic Recycling

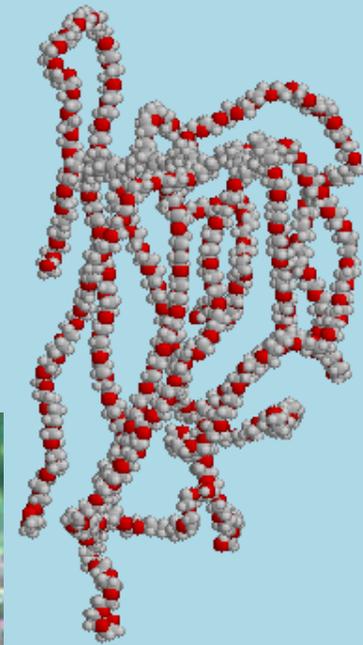
- Hergebruik van organische reststromen
  - Ontsluiting Microbiele biomassa
  - Hergebruik in fermentatie
    - \* Vervanging gist extract
    - \* Sluiting van nutriëntenkringloop
    - \* Focus op ABE fermentatie
  - Bioafbreekbaarheid van restfracties
  - Procesontwerp, modellering



Extracten van microbiele biomassa worden getest door middel van acetone-butanol-ethanol (ABE)



- KP6 – integrated project
- Aim:
  - Build an R&D platform in sustainable production of functional biopolymers and biosurfactants made from renewable resources
- Partners:
  - 6 Universities
  - 5 Research Institutes
  - 13 Companies



# Agrovezel toepassingen



Composieten

Isolatiemateriaal  
(Isovlas, Oisterwijk)



# Ecobinders



## Milieuvriendelijke binders voor houtproducten

Ontwikkeling van nieuwe milieu-vriendelijke binders en processen op basis van lignine en furanen voor:

1. Verduurzaamd hout : alternatief voor tropisch hardhout & CCA/creosoot behandeld hout
2. Emissie-vrije, vochtresistente plaatmaterialen (MDF, multiplex)
3. Design producten zoals Wood Polymer Composites (WPC) & kurk producten (bouw materialen)

Keten benadering (grondstof leveranciers – R&D – eind-gebruikers)

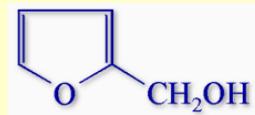


# Ecobinders concept

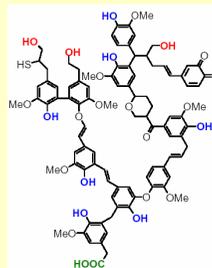


Biomassa

Bioraffinage



Furanen



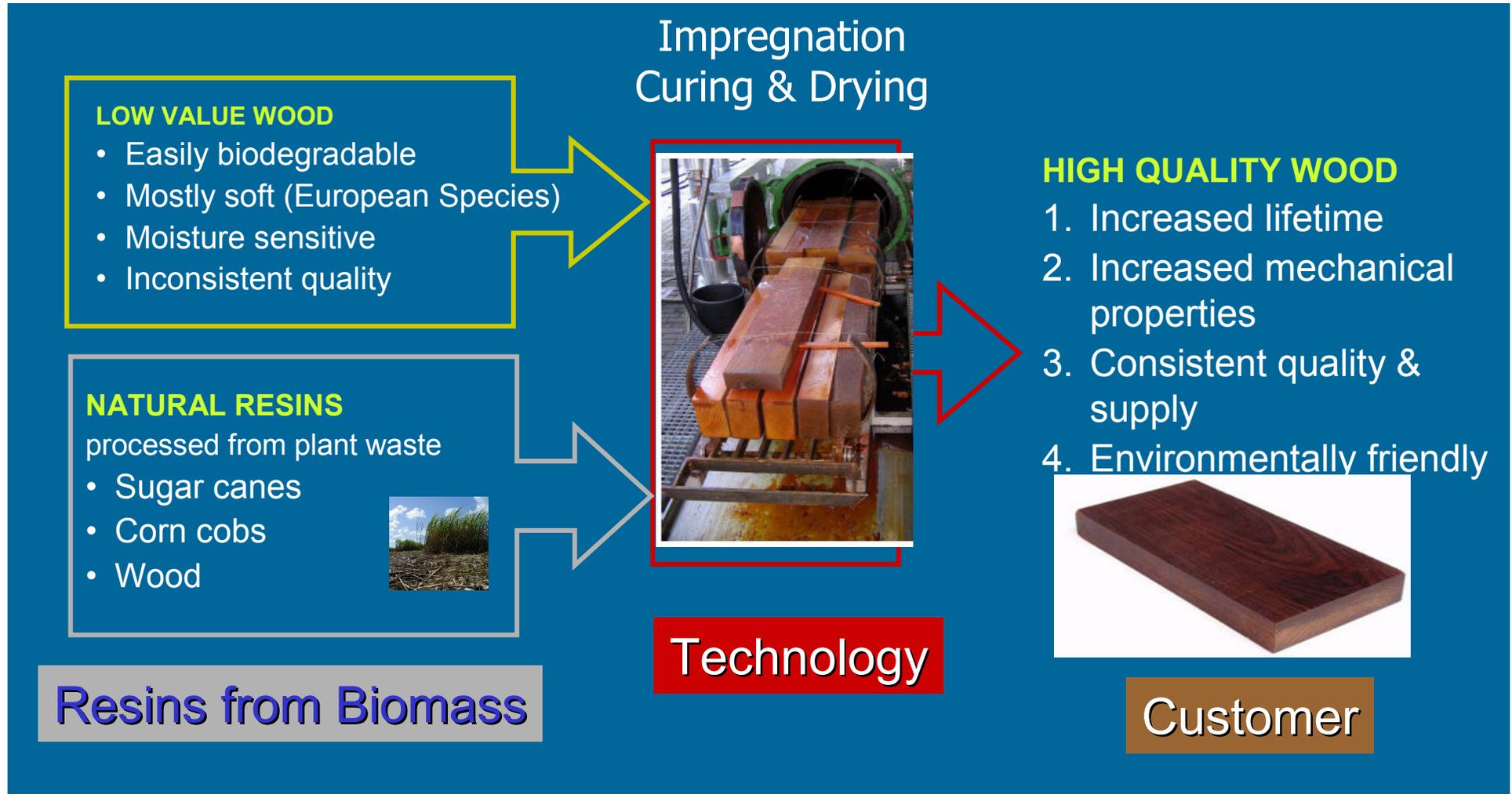
Lignine

Ecobinders



Eco-Product

# 1: Hout modificatie concept



# Resultaten

- Industrieel toepasbaar proces voor milieu-vriendelijk verduurzaamd Europees hout ontwikkeld
- Nieuwe binders ontwikkeld voor diverse bouwmaterialen (labschaal)
- Vochtresistente en duurzame biopolymeren ontwikkeld op basis van lignine, polymelkzuur en houtvezels
- Fundamentele kennis over eigenschappen en toepasbaarheid van deze binders opgebouwd
- Kennis uitwisseling via Europees congres, [www.ecobinders.net](http://www.ecobinders.net)

## Praktijk

- Productie van gefurfuryleerd (verduurzaamd) hout in No, NL
- Prototypes vervaardigd van raamkozijnen, deuren, flonders en shingles
- Demonstratie projecten voor langdurige buiten toepassingen gestart



# Process, material & product development

First generation

n<sup>th</sup> generation product



## Products:

- stretch film, shrink film, laminates
- moulded products
- foamed structures (e.g. 3 dimensional blocks)
- co-extruded structures (e.g. films, foil, sheets)
- synthesis new building blocks
- biosynthesis of new biopolymers
- polymer additives

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# Dank voor uw aandacht!

Met dank aan: Collega's BbP en LSG's

