



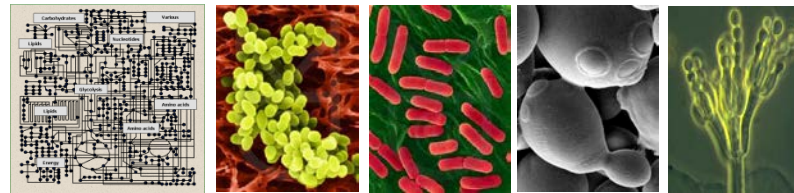
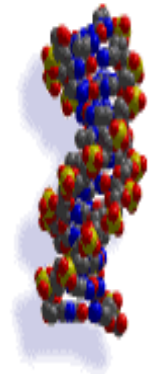
Universiteit  
Leiden  
The Netherlands

# Growing the Bioeconomy

## A European Perspective ...

Han de Winde

30-10-2013



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The Netherlands

Growing the Bioeconomy – Gent, 2013







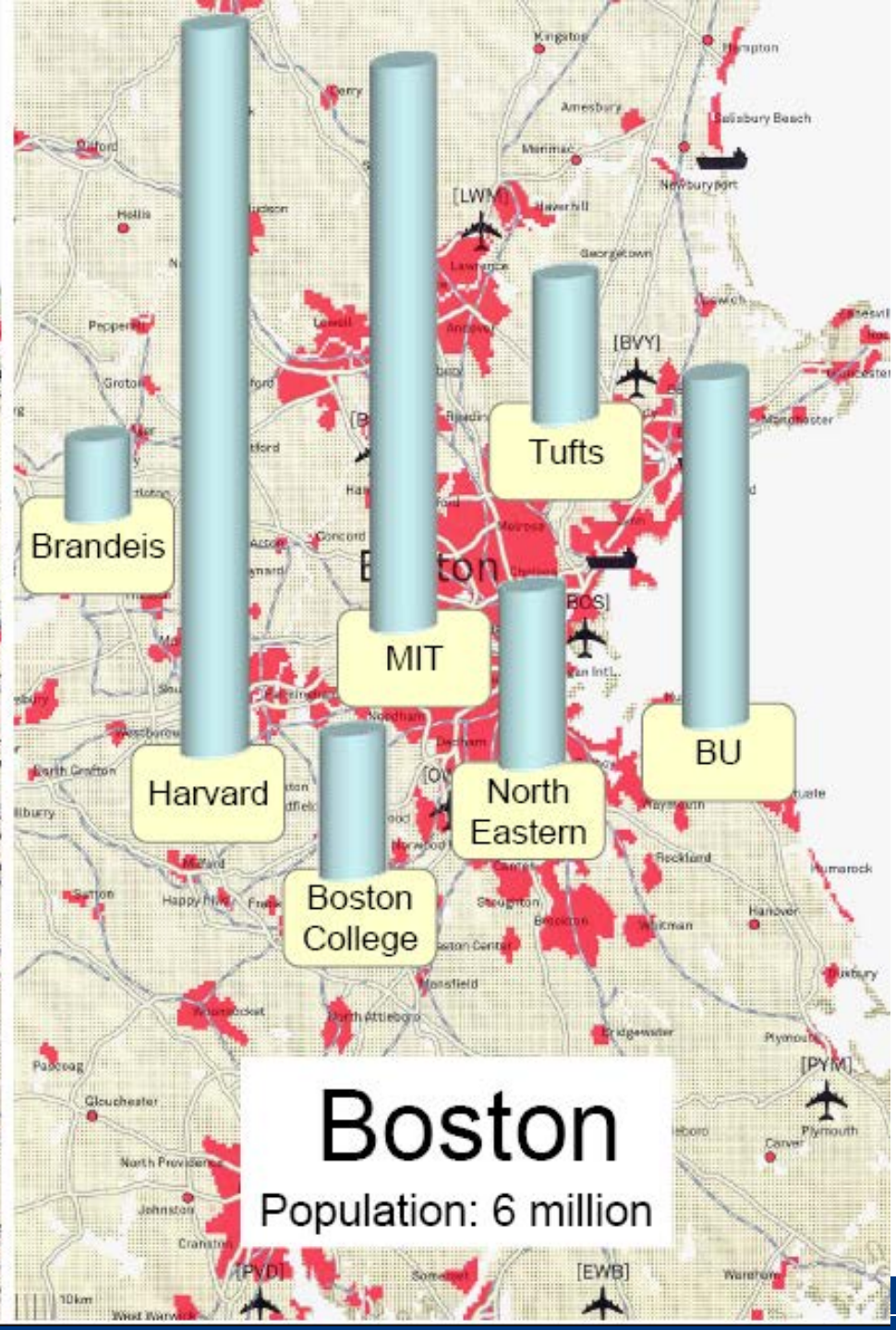
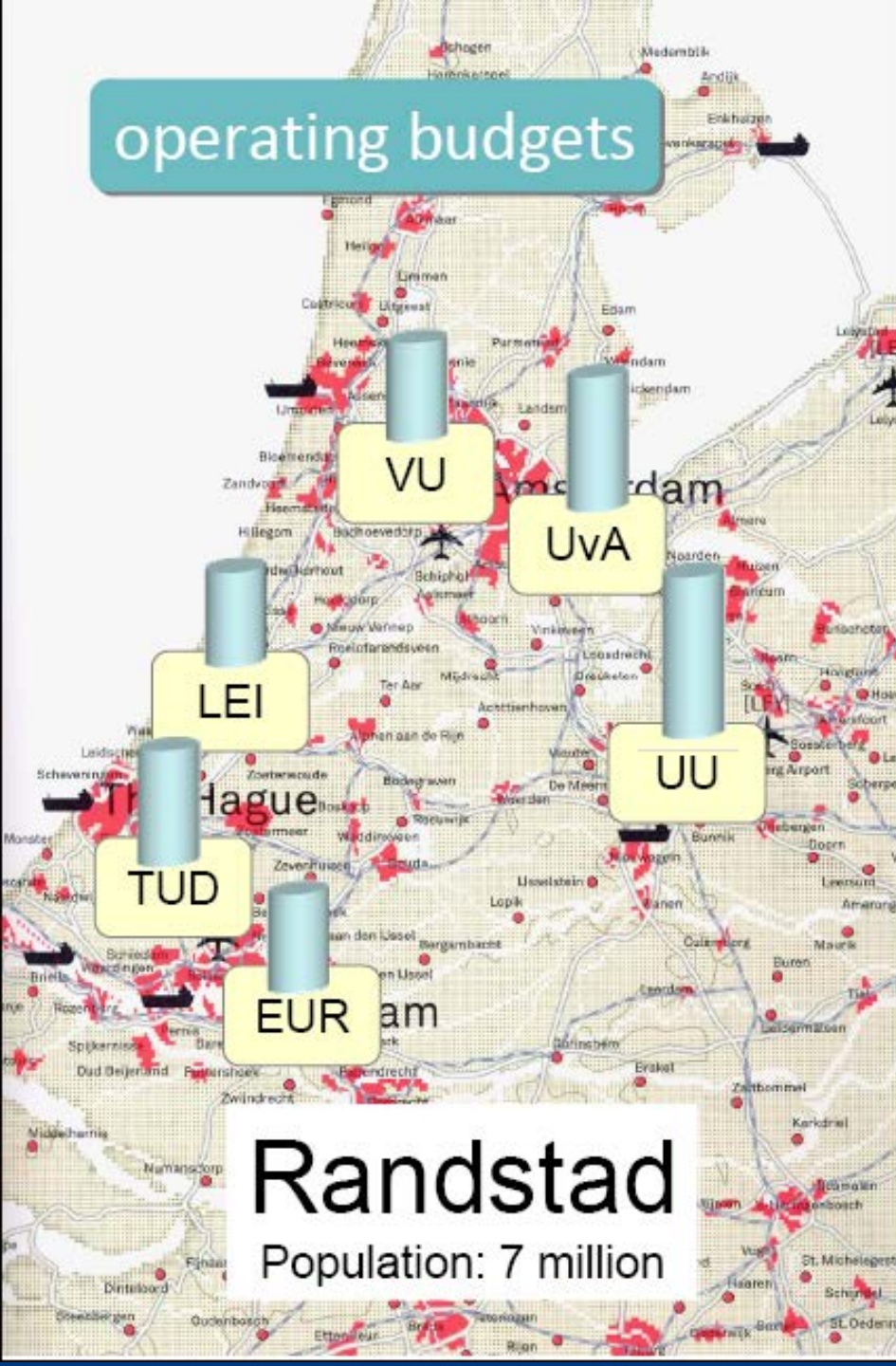
# Leiden University

## In the Netherlands

- Thirteen universities in the Netherlands
- Three universities of technology
- Programmes in science, design and engineering



# operating budgets





# What Bio-economy!

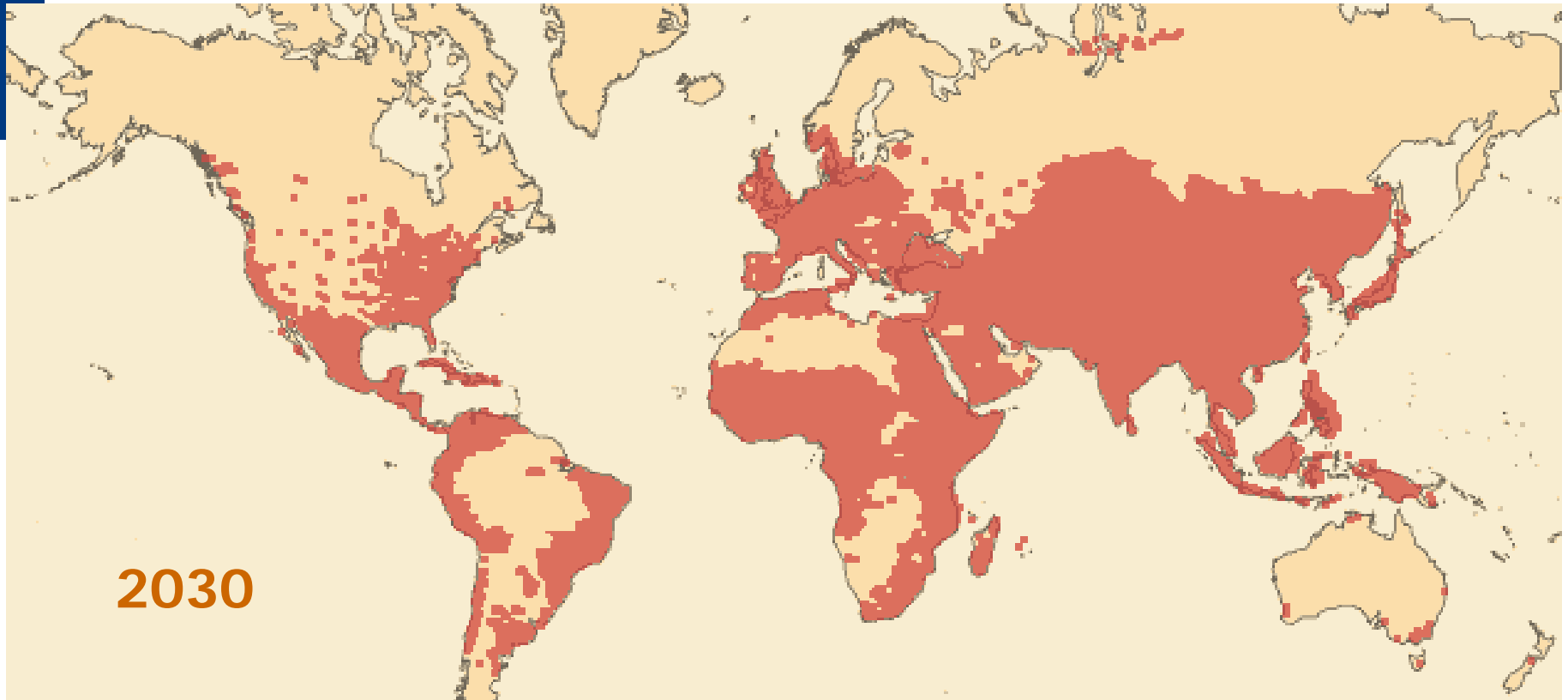


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Growing the Bioeconomy – Gent, 2013

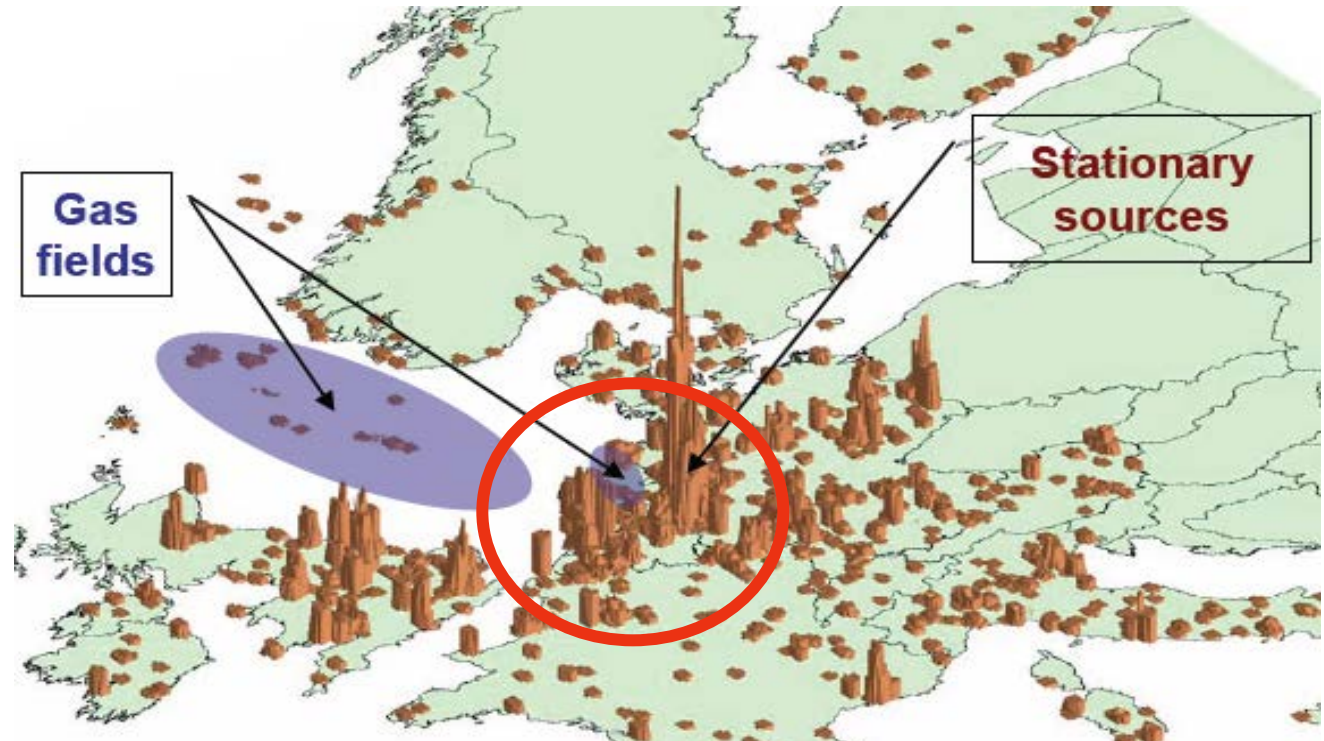
# World population – threat ?...

■ = 1 million people



Source: [www.pbs.org/wgbh/nova](http://www.pbs.org/wgbh/nova)

# Western EU - emission 'hotspot'

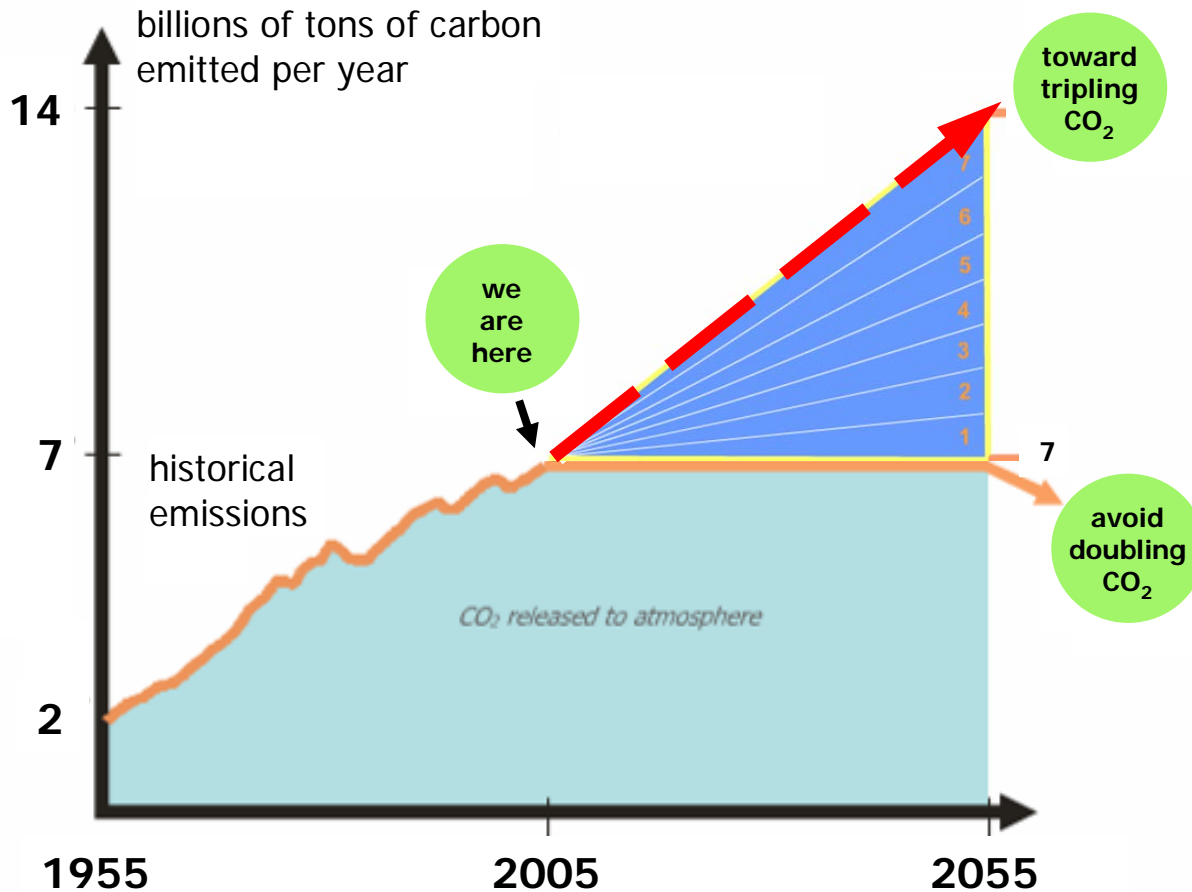


- Job density
- Economic activity
- Main logistics

- Population density
- Energy use
- GHG emission

# Stabilizing CO2 emission

*... and quickly please !...*



stabilisation triangle:  
cut emissions by  
7 Gton/year



# How to avoid 7 x 1 Gton carbon emission/year

## here are the options (1 Gton/year each)

### Savings



Double the fuel economy of the world's cars



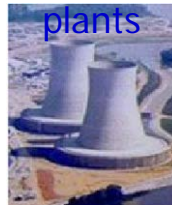
Halve the number of car kilometres



Use the best efficiency in all residential and commercial buildings

### 'Transition'

**Nuclear power:**  
Triple the number of nuclear power



**Clean Fossil:**

Capture and store carbon from 800 coal-fired power



### Renewables

**Solar cells:**

700 x the current capacity



**Wind energy:**

50 x today's wind energy

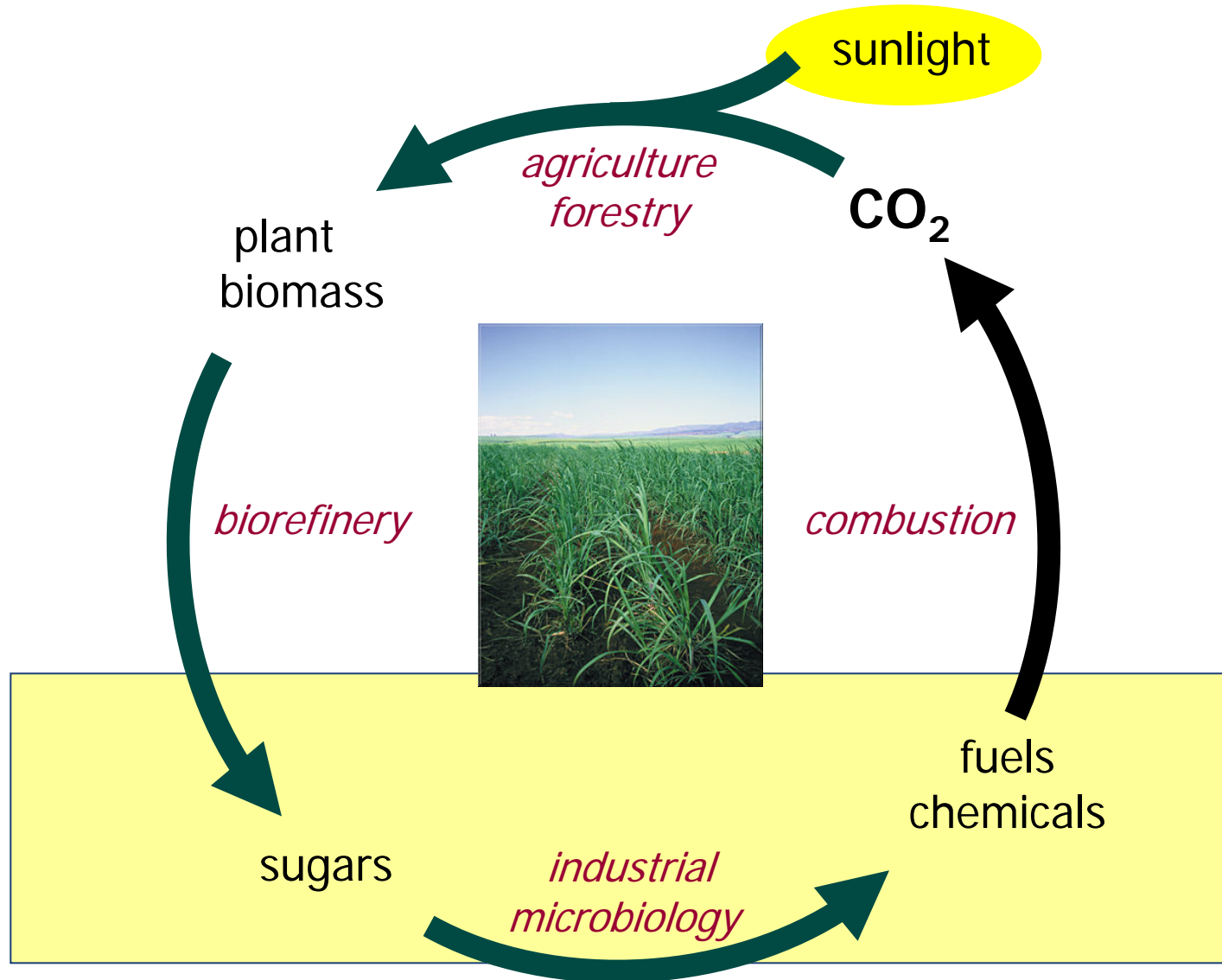


**Biofuels:**

50 x more ethanol production

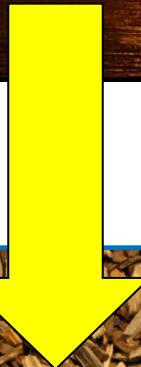


# Sustainable Future – Balanced Carbon Cycle

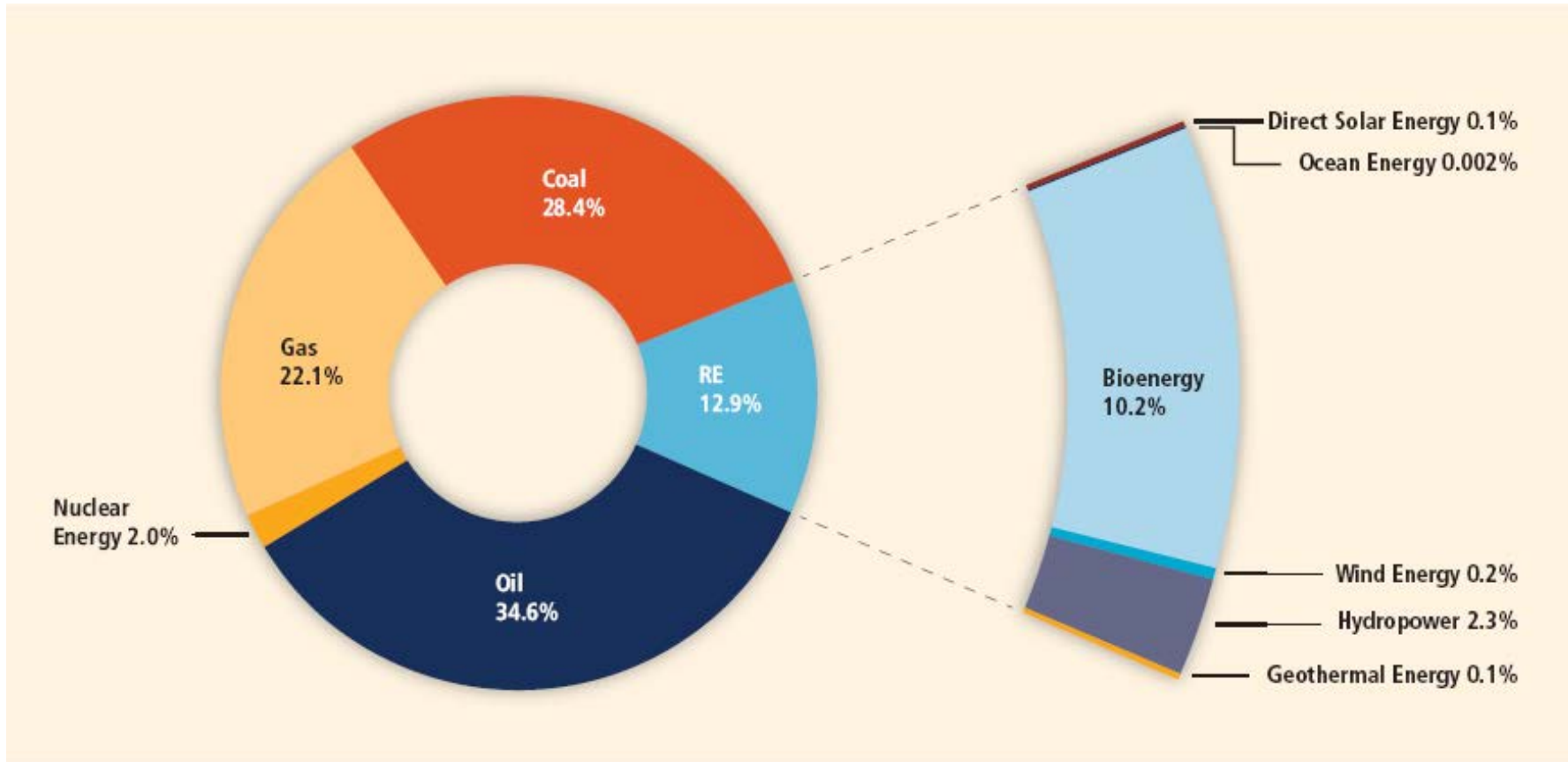




# Towards a sustainable bio-based economy



# Renewable vs Bioenergy ...

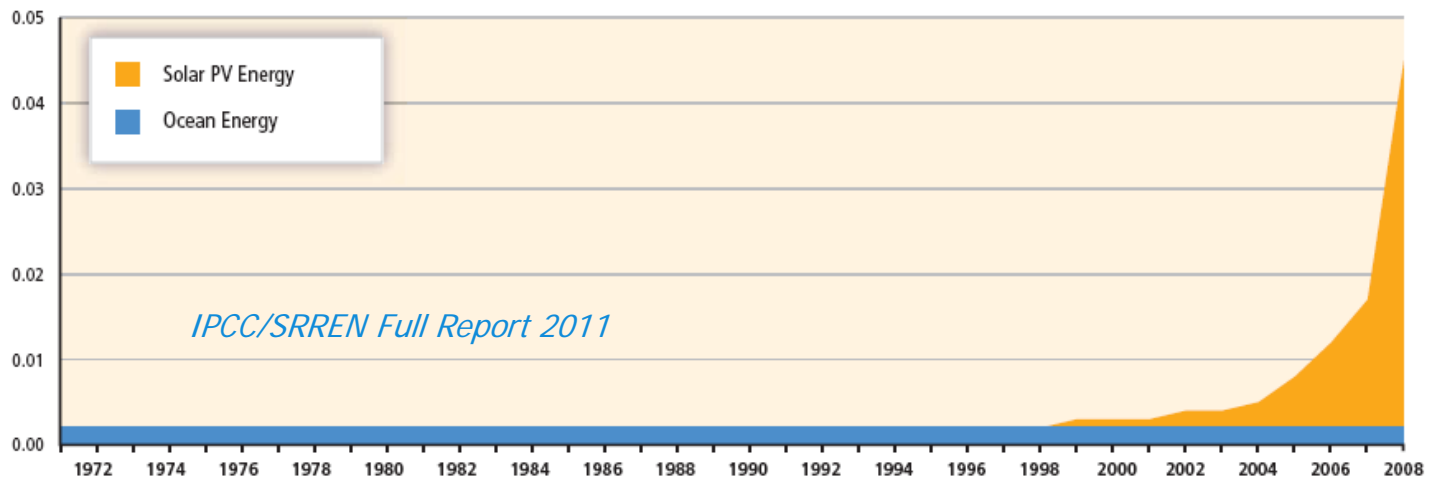
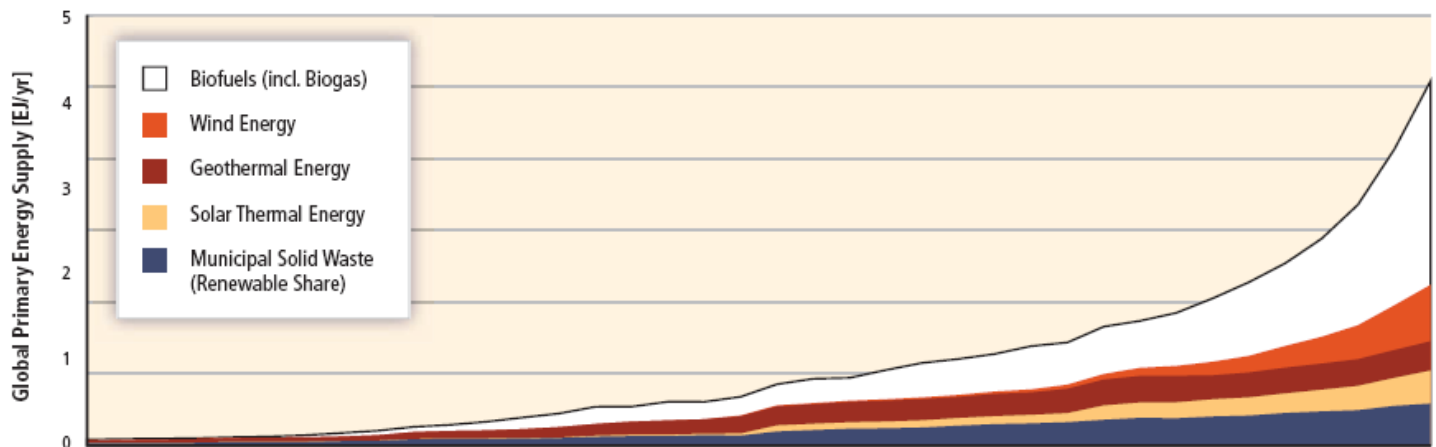
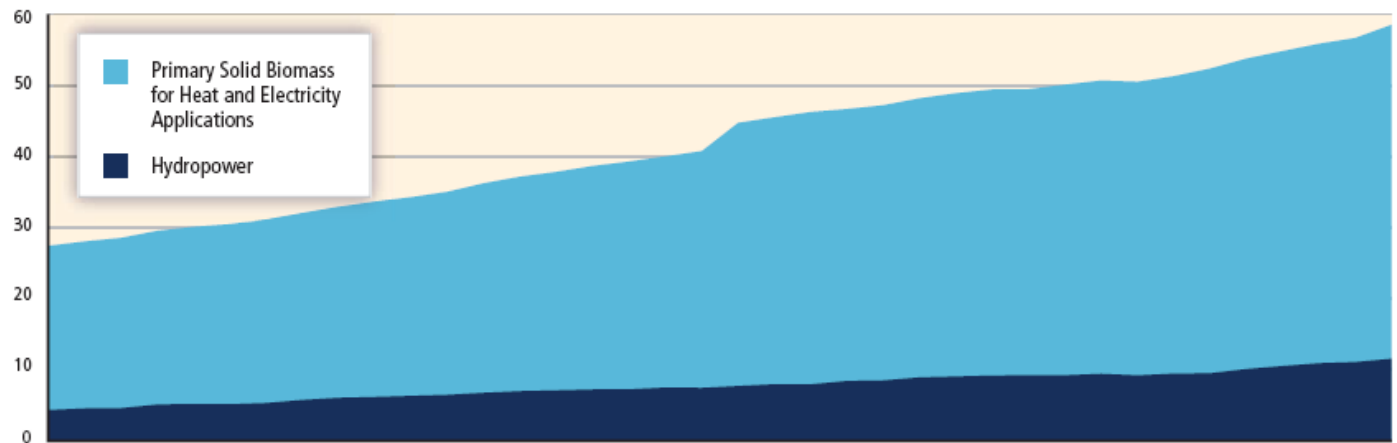


Shares in total global primary energy supply 2008

*IPCC/SRREN Full Report 2011*

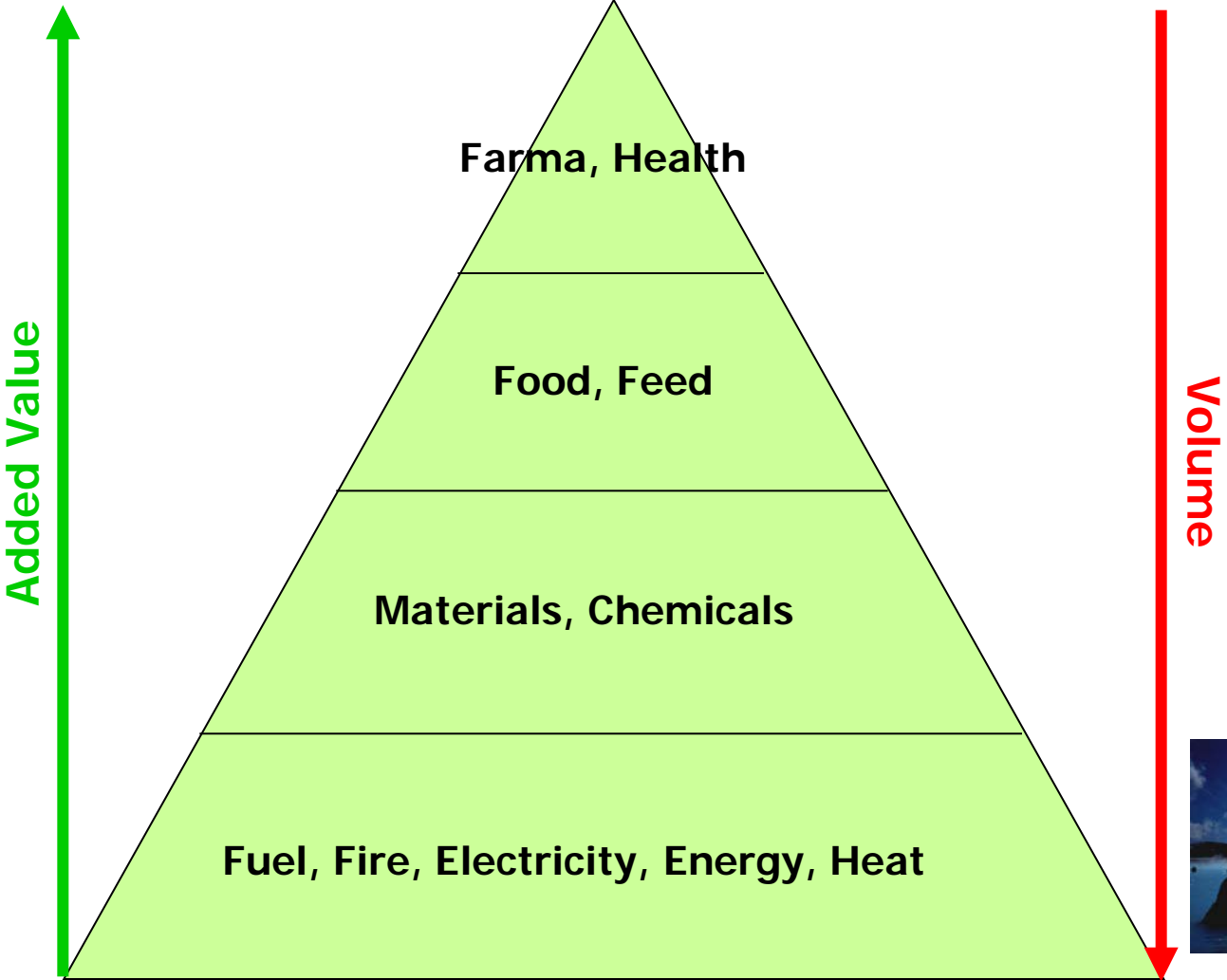






IPCC/SRREN Full Report 2011

# Bioenergy paradox – cascading the pyramid !





# Biomass: Cascading!

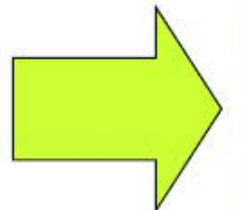
## Biomass crops



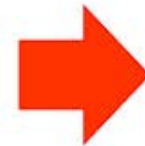
## 1st priority: material use



## Residues/wastes



## End of cascade: energy use



# Biomass Futures project EU

- EU biomass capacity estm. 375-430 MtOE
  - > 2x total bioenergy demand from EU 2020
- ~37% EU biomass capacity effectively used in 2020
  - Rest imported
  - Too little use of agri-waste
- Current stimulation (policy, taxes, ...) too little
- Technology & economy development lagging in most countries

## Chances:

- >10% of agricultural arable land free and available (2005-2020)
- Stimulus of **re-utilization technology** will enable more rapid development and implementation

**BIOMASS FUTURES**



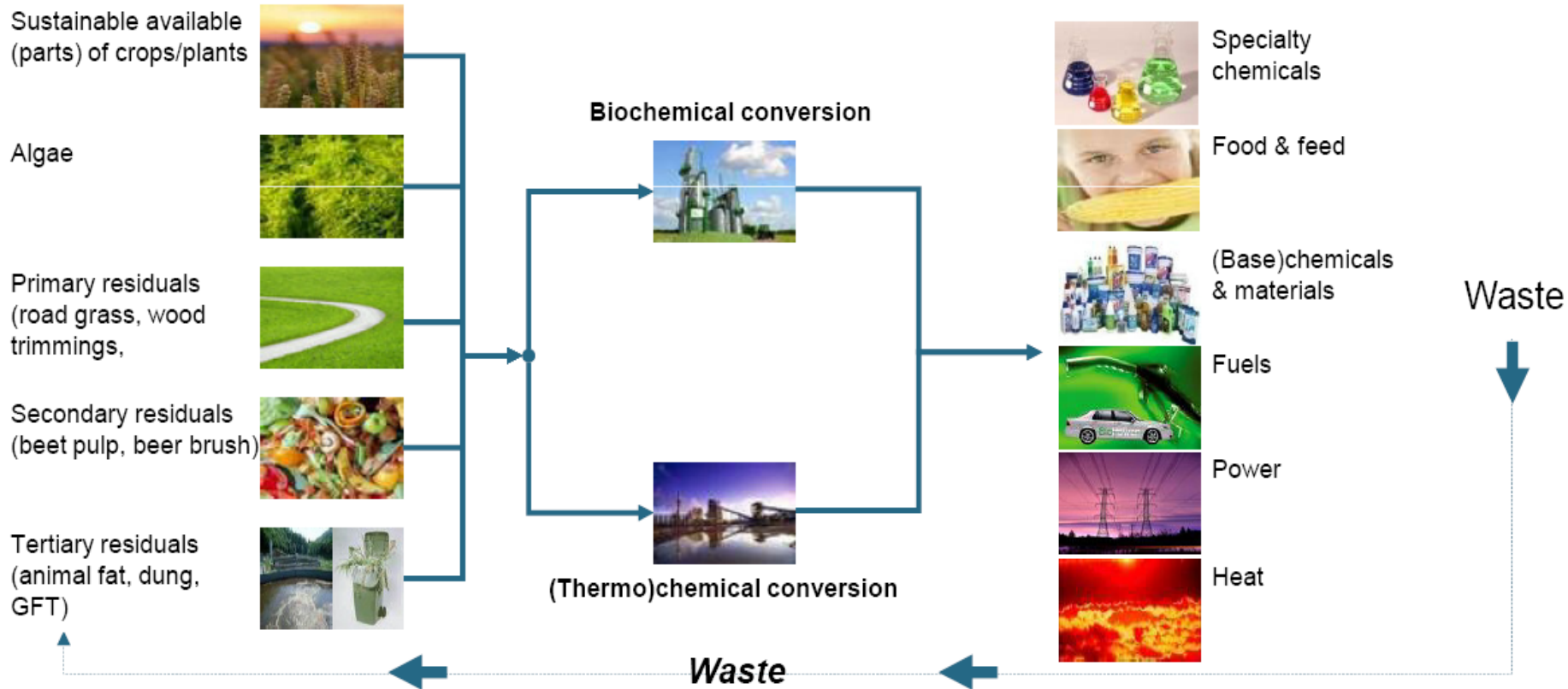


# Biorefinery is the sustainable conversion of biomass into a plethora of products en energy

## PRODUCE BIOMASS

## CONVERT BIOMASS

## PRODUCE BIO-BASED PRODUCTS





*for a living planet*<sup>®</sup>



*for a living planet*<sup>®</sup>

- WWF Report  
September 2009
- Industrial Biotechnology  
Impact  
Potential



## **INDUSTRIAL BIOTECHNOLOGY**

**MORE THAN GREEN FUEL IN A DIRTY ECONOMY?**

Exploring the transformational potential of industrial  
biotechnology on the way to a green economy



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# Industrial Biotechnology report WWF

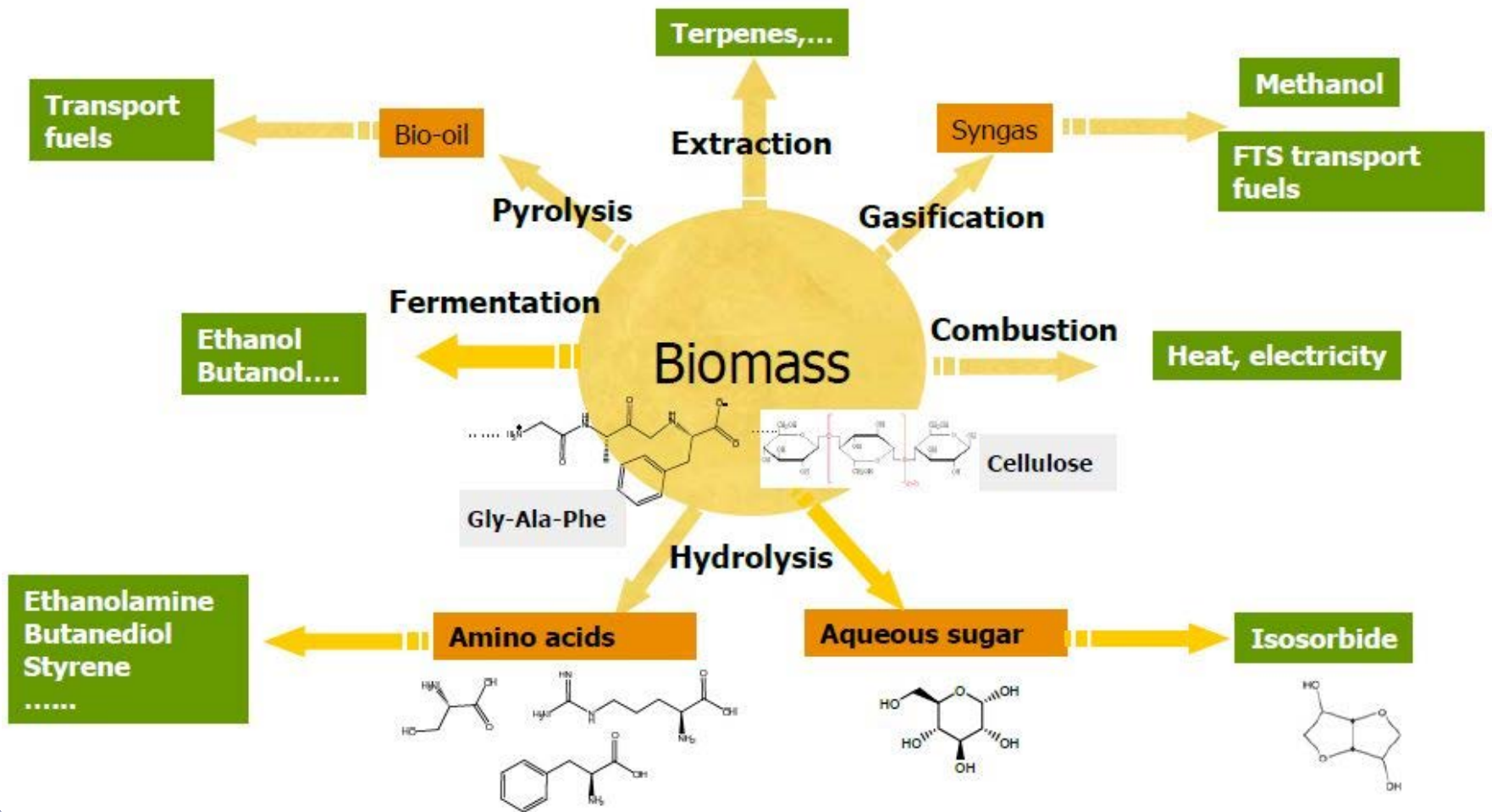
**In summary, industrial biotechnology can enable a shift toward a biobased economy.**

*A biobased economy is based on production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are reused in the ecosystem.*



# Broad technology portfolio required ...

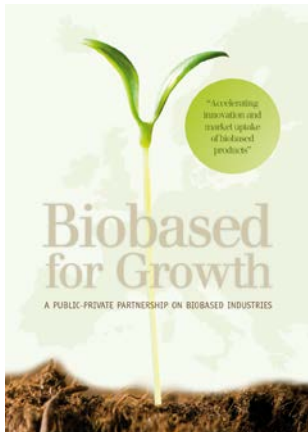
## Biomass Conversion, potential routes & products



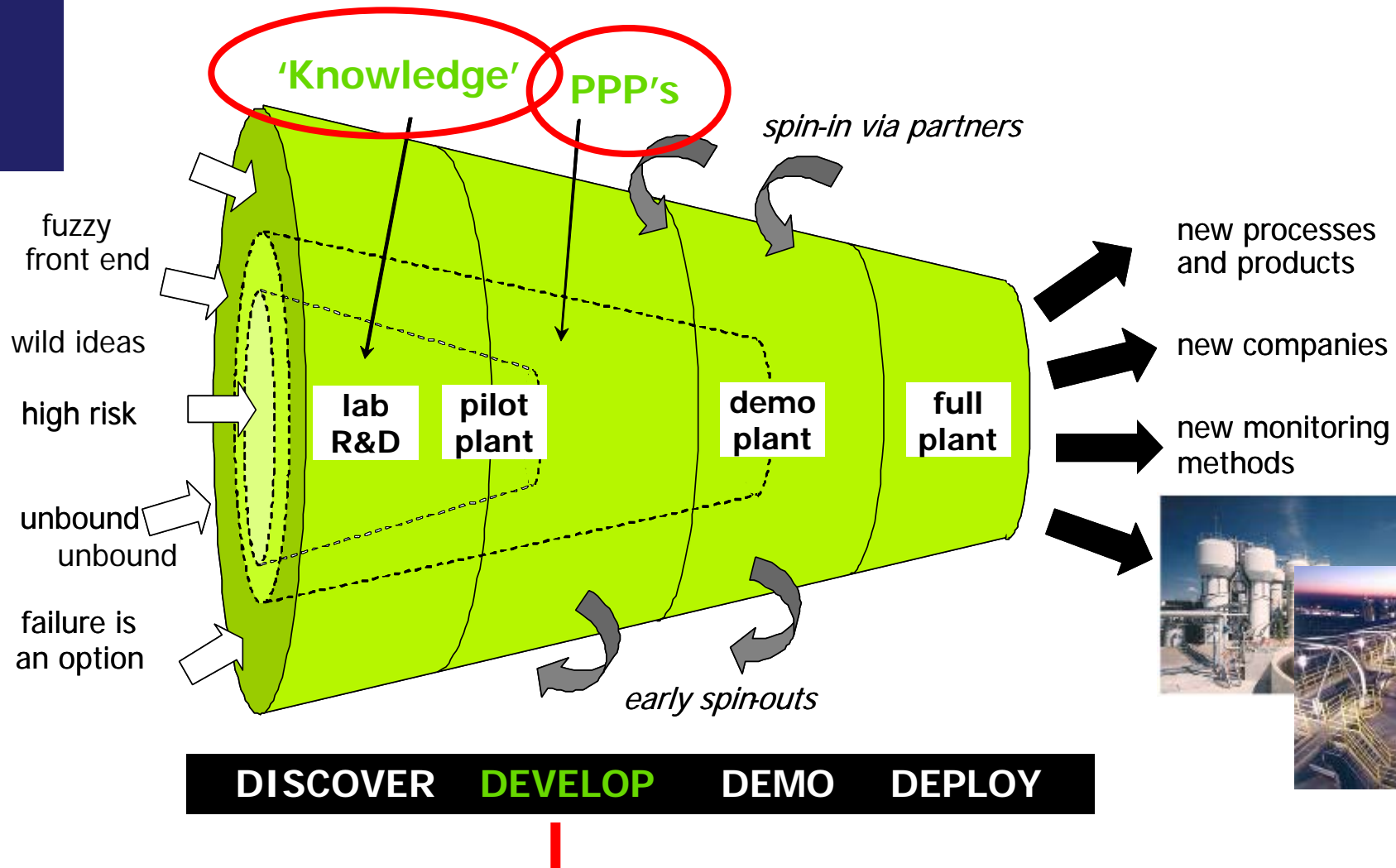
# Integrated Bio-based value chains



EUROPEAN INITIATIVE



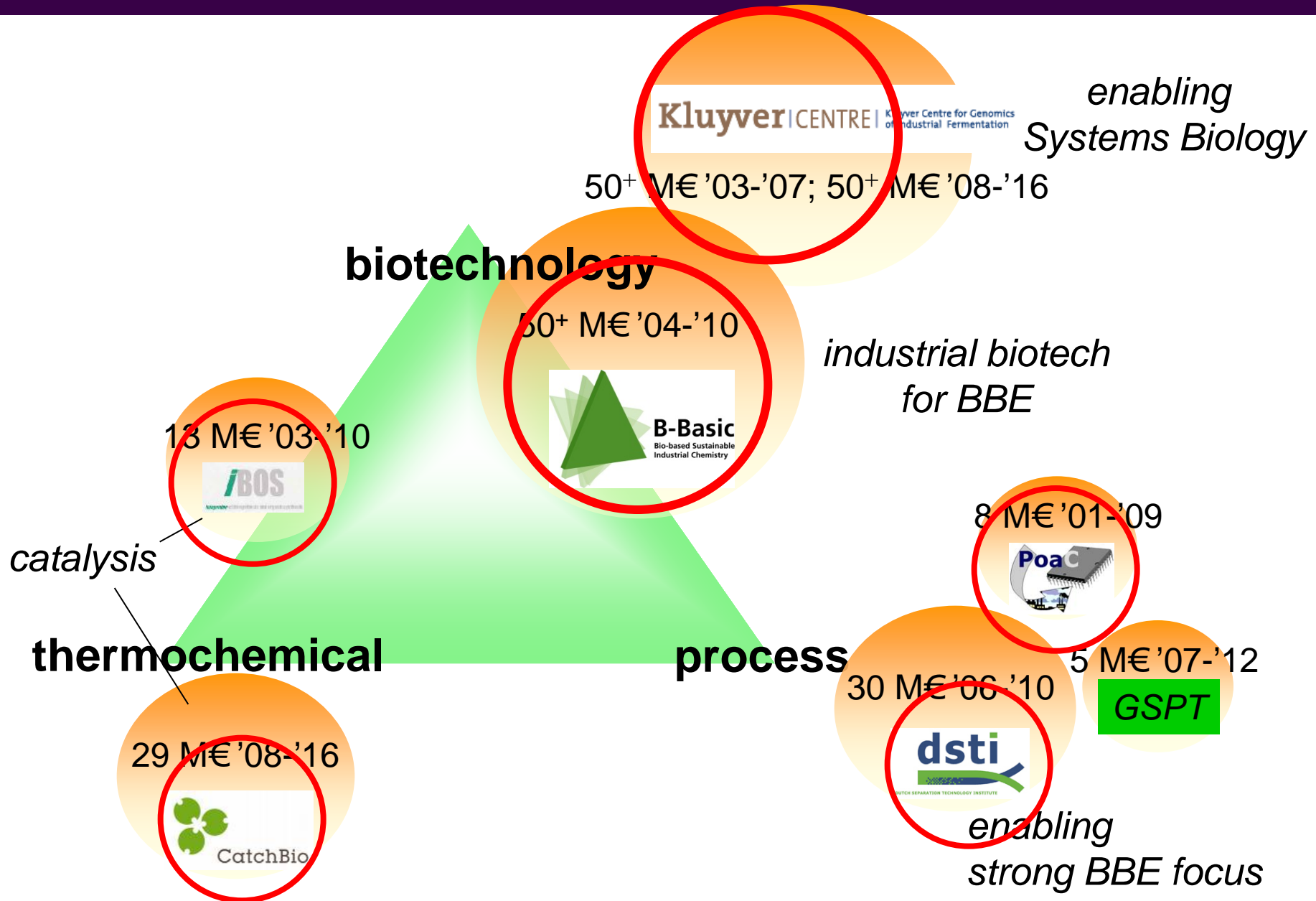
# Innovation = Collaboration



Focus: (1) start-ups , (2) training engineers, (3) pilot facilities



# Bio-Chem-based Public-Private Partnerships in NL



# Netherlands International ?! ...

- Holland is NOT an island !!!
- S&T, R&D per definition international
- BBE challenges per definition international
- Grand challenges
  - Biomass availability ; *Nederland ???*
  - Biomass handling, treatment, transport, logistics ; *Rotterdam !!!*
  - Biomass certification, rules and regulations
  - Biomass conversion, processing, trading ...





# Biobased Industries Consortium



bridge<sup>20</sup>/<sub>20</sub>





OBJECTIVE:

Diversify farmer's income and provide them with additional margins by up to 40% by using available residues<sup>4</sup>



4 Bloomberg New Energy Finance, "Bio-products: diversifying farmers' income", 2011

OBJECTIVE:

Enable 30% of overall chemical production to become biobased.

For high added value chemicals and polymers (specialties and fine chemicals), the proportion is more than 50%, while less than 10% of bulk commodity chemicals are derived from renewable feedstocks.








OBJECTIVE:

Supply 25% of Europe's transport energy needs by sustainable advanced biofuels



OBJECTIVE:

Support the European market for biobased fibre and polymers such as viscose, carbon fibres, nano-cellulose derivatives and bioplastics to grow rapidly.

Traditional fibre products such as paper remain 100% biobased to create more value out of the same resources








OBJECTIVE:

**Reindustrialise Europe  
by creating a new  
rural infrastructure of  
biorefineries**



OBJECTIVE:

**Realise a new generation  
of biobased materials  
and composites**

Produced in biorefineries, allowing the production  
of better-performing components for industries  
including automotive, construction and packaging.





# Water & Food Security - World Water Week 2012

*Stockholm International Water Institute*

<http://www.siwi.org/sa/node.asp?node=1609>

- > 900 million suffer from hunger !
- > 1500 million overeat !
- > 33% of all food is lost or wasted !
- > 25% of water use is spilled over spoiled food !
  
- Demand for food & fibre growing with >70% until 2050
- Threat on water resources and security !
  
- **Reducing Food Waste**
  - ~ reducing pressure on water and land use !!!



# Biobased Economy TODAY: efficient bio-mass utilization ?



"CO<sub>2</sub>"

1<sup>e</sup> generation



biofuels

2<sup>e</sup> generation



bioplastics



biobricks



agro-emissions  
(run-offs, N<sub>2</sub>O)

nutrients



# Crop residues and paper waste



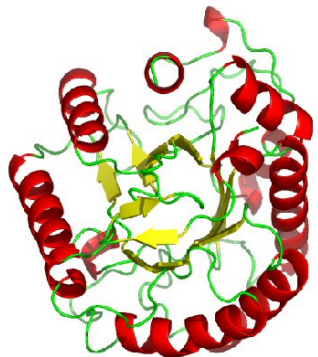
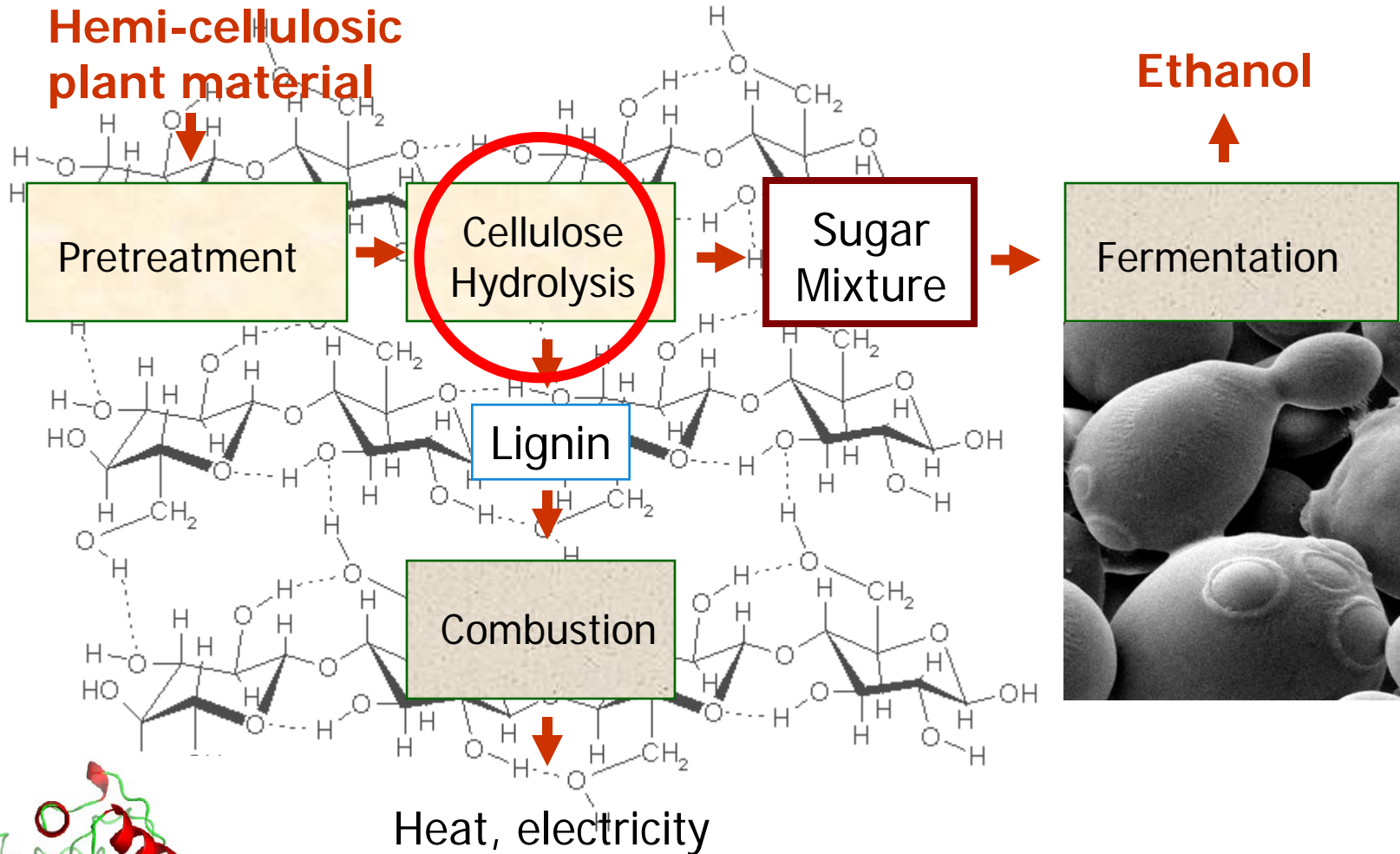
Abundant, **NO** competition with food production  
(Hemi)cellulose instead of starch/sucrose





# Ethanol from Ag-waste: 2<sup>nd</sup> generation biotech

Hemi-cellulosic  
plant material



Cellulase

# Delft pilot facility for innovations in sustainable bioprocesses

Research consortium BE-Basic has chosen Delft as the site for a unique facility where companies and knowledge institutions can develop new sustainable production processes. These processes serve many purposes, such as converting biobased residues into useful materials or fuels. The facility has been specially designed to enable the transition from the laboratory to production on an industrial scale. It allows users to construct complex operations by linking separate process modules.

## Pre-processing and treatment

In this module, dry and wet residues are hydrolyzed and prepared for the fermentation phase.



## Pretreatment

## Permanent crew

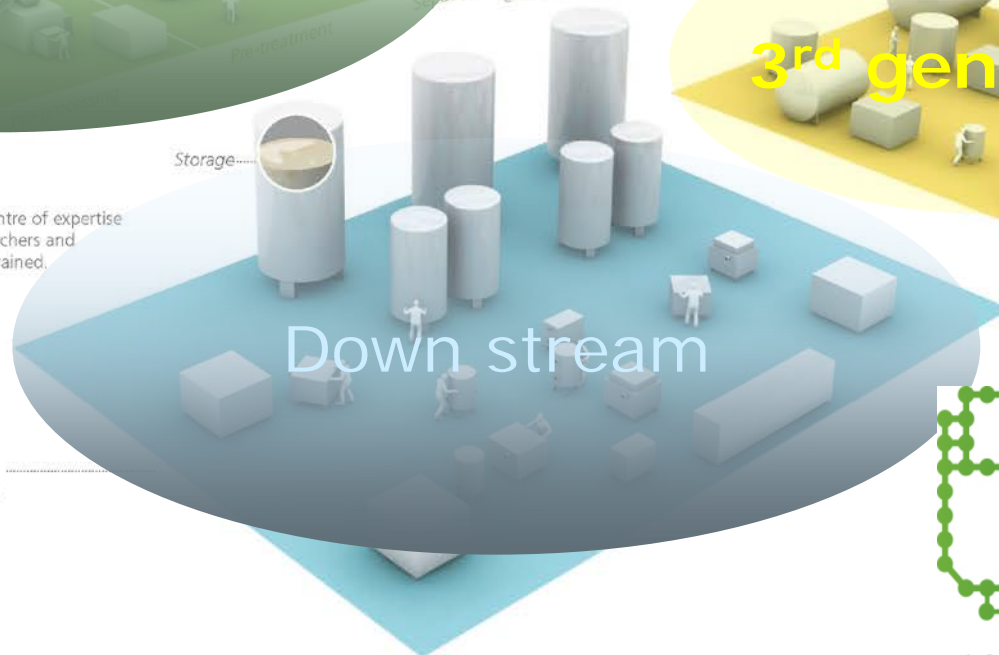
The facility has a permanent and experienced crew whose services are available to every user.

## Training

The facility is also a centre of expertise where students, researchers and technologists can be trained.

## Downstream processing

This is where products are extracted and refined. The modules can be combined at will to produce all kinds of products, such as raw materials for the construction sector, chemicals for biofuels or raw materials for the chemicals and pharmaceuticals industry.



## Fermentation

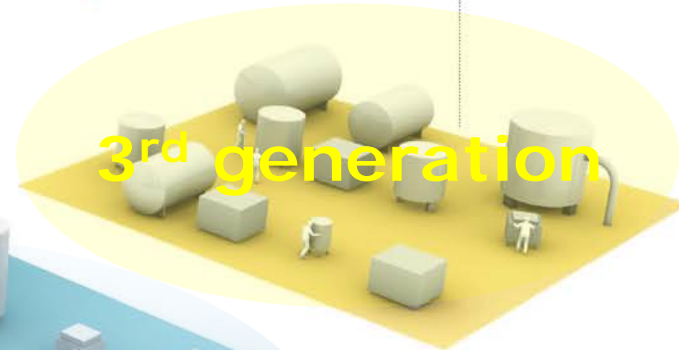
## Fermentation

In the fermentation module, enzymes and bacteria are added to the waste to convert it still further. This process takes place in bioreactors with a capacity of up to 8000 litres.

## Third-generation bioprocesses

These modules are designed to increase efficiency and lower costs in the production of biofuels and biochemicals.

## 3rd generation



BIOPROCESS  
PILOT FACILITY

# Conclusions

- Bioeconomy is all for efficient utilization of available biomass for food, feed, materials, chemicals and energy
- Including efficient waste reutilization and management
- Bioeconomy has a global perspective, and require public awareness and understanding
- Growing the Bioeconomy requires vast investment in innovation portfolios
- Transnational, open innovation and public-private collaboration are key



