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Biorefineries - Opportunities and Challenges

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Deutscher Bioraffinerie-Kongress 2007
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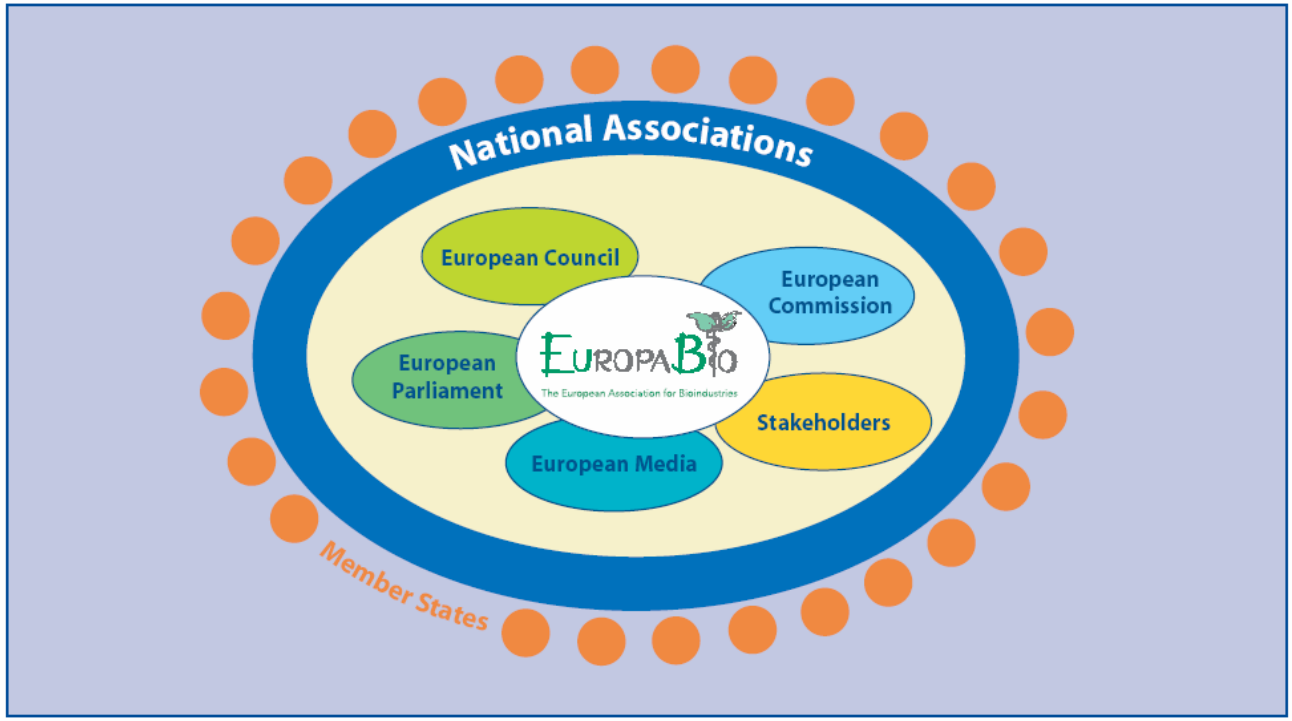
EuropaBio's role

Sharing alliances, building across policy blocks



EuropaBio represents the interests of the industry towards the European institutions so that legislation encourages and enables biotechnology companies in Europe to innovate and provide for our society's unmet needs.

EuropaBio

The European Biotech Industry´s Voice

Representing the entire biotechnology industry

➔ 83 global life science companies, 11 associate members

➔ 25 national biotechnology associations

➔ More than 1800 small and medium-sized biotech companies

Red Biotech	White Biotech	Green Biotech

➔ Representation of all Sectors

Mission

➔ To promote an innovative, dynamic and competitive environment for Biotechnology in Europe

➔ Focus on R&D stimulation, commercial development and market access

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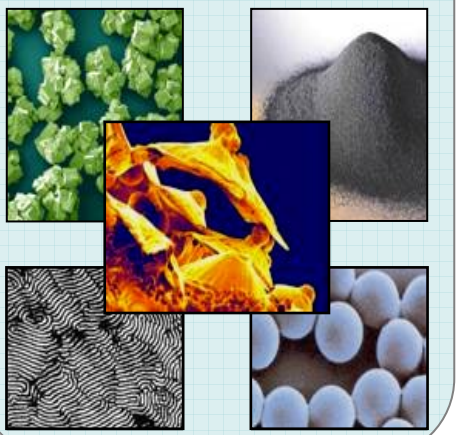
Sustainable Chemistry ETP (SusChem)

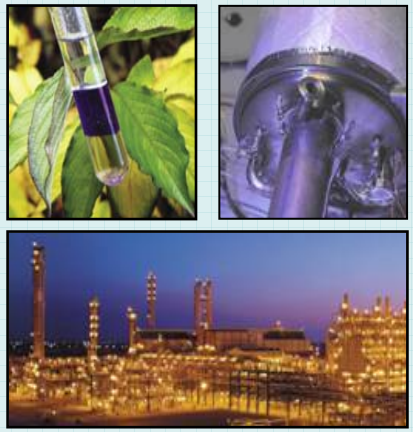
Member States Mirror Groups

Industrial Biotechnology

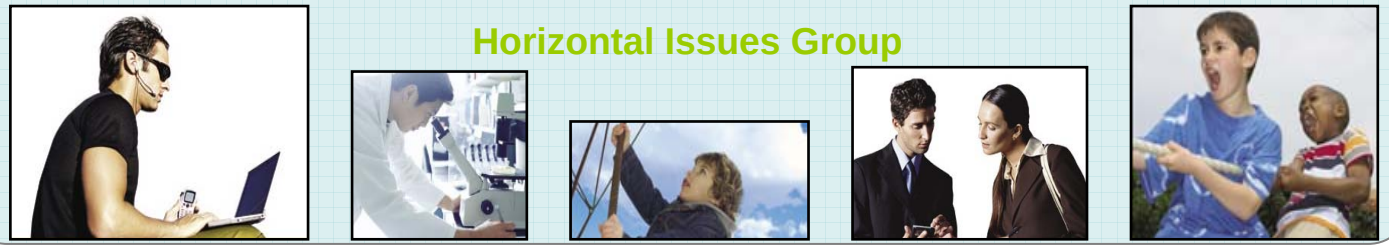
Materials Technology



Reaction & Process Design



Horizontal Issues Group



THE OPPORTUNITIES OF INDUSTRIAL BIOTECHNOLOGY, BIOREFINERIES AND THE KBBE

Industrial Biotech is key to the Biobased Economy (KBBE)

<u>The knowledge-based bio-economy</u>: Transforming life sciences knowledge into new, sustainable, eco-efficient and competitive products

BioRenewables

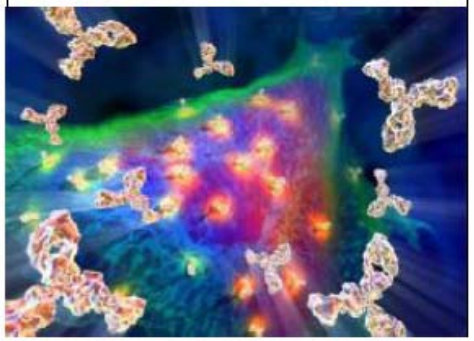
- Become more competitive
- Reduce CO_2 emissions
- Conserve fossil resources

BioProcesses / BioConversions

- More selective processes improve economy and ecolocical impact
- Processes simplified by integrating several stages

BioProducts

- Biopolymers
- Biopharmaceuticals
- Enzymes, e.g. for detergents
- Biofuels



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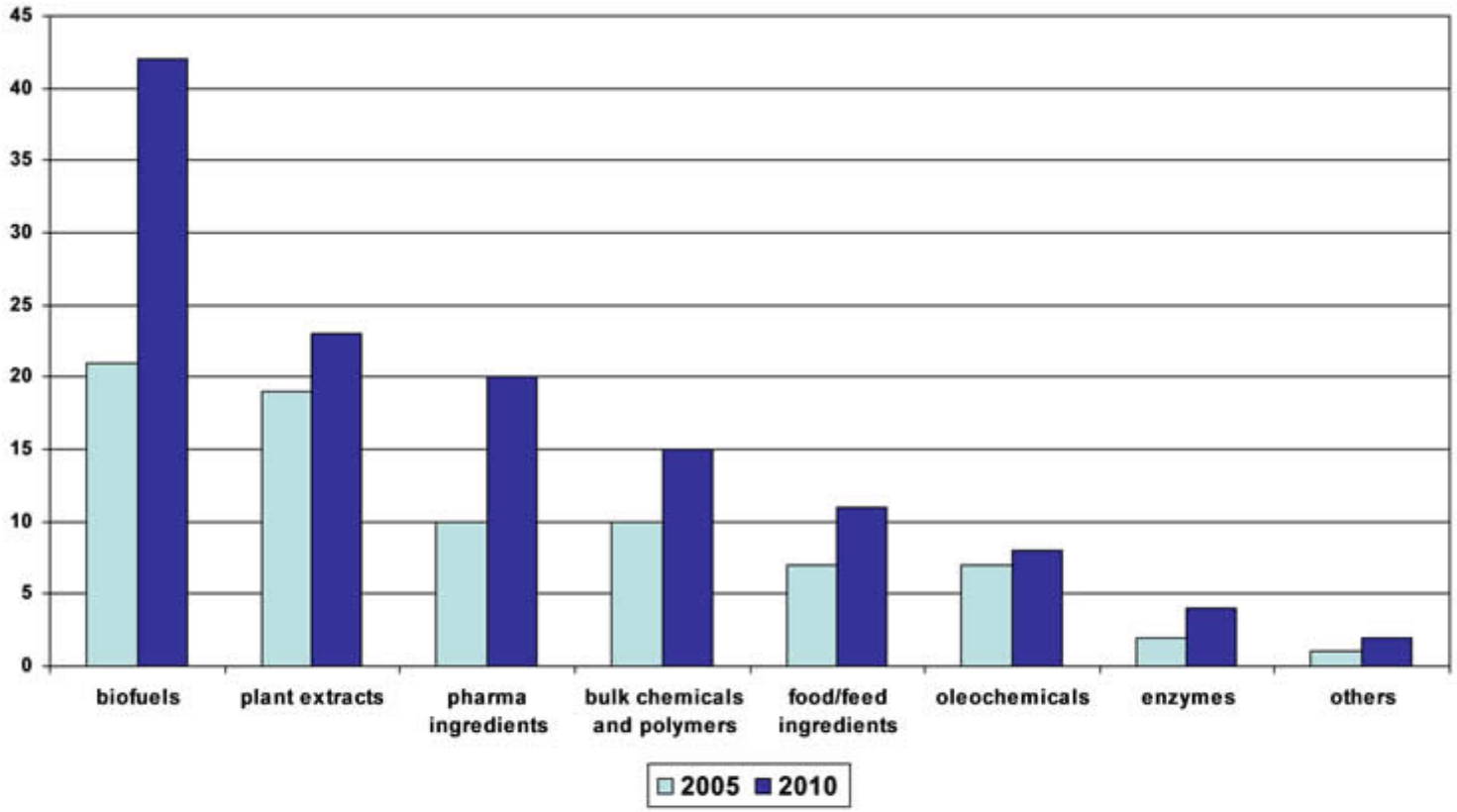
Impact of Industrial Biotechnology

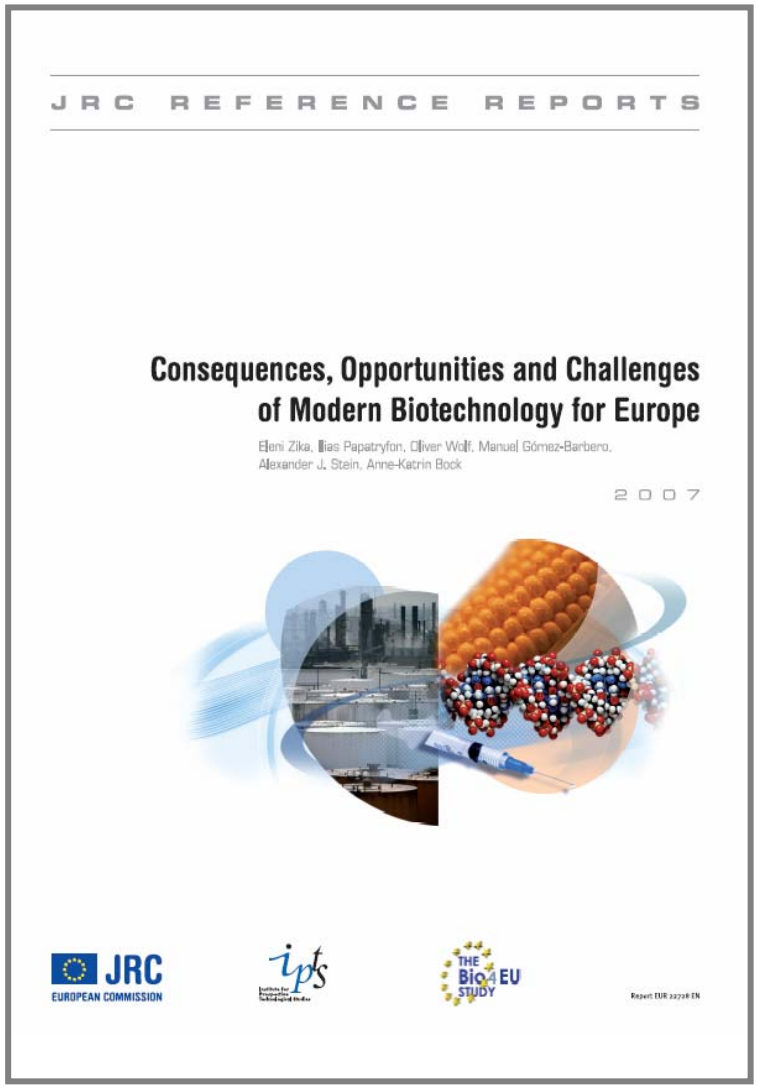
(in billion EUR)



2005: 77 billion EUR IB related sales in chemicals (7% sales of the chemical industry)
2010: 125 billion EUR IB related sales in chemicals (10% sales of the chemical industry)

McKinsey - 2006

Impact of Industrial Biotechnology



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Bio-based products in Chemical industry

Table 2.6 Examples of biotechnology-based products, annual global production volumes and prices

Product	Annual production (tonnes)	World market prices (€/kg)
Bulk chemical		
Bioethanol	>18.5 million	0.40
Amino acids		
L-Glutamic acid	1 500 000	1.20
L-Lysine	700 000	2
L-Threonine	10 000	6
L-Methionine	400	20
Acids		
Citric acid	1 000 000	0.80
Lactic acid	150 000	1.80
Gluconic acid	100 000	1.50
Vitamins		
Vitamin C	80 000	8
Vitamin B12	20	25 000
Riboflavin	30 000	NA
Antibiotic derivatives		
6-aminopenicillanic acid	10 000	NA
D-p-hydroxyphenylglycine	7 000	NA
7-Aminocephalosporinic acid	4 000	NA

Source: DECHEMA.[333]

Biofuels in Europe

Table 2.13 Comparison of the contribution of fossil fuel and bioethanol to the EU economy

	Fossil fuel in the EU	Bioethanol in the EU
Share of GVA	0.25%	0.0002%*
Share in manufacturing (NACE D)	1.10%	0.00231%
Employment: direct	40 000	525
indirect	approximately 100 000	approximately 5 000
Contribution to employment in Europe (based on direct employment)	0.05%	0.0003%
Turnover per employee	€5 300 000	€800 000
Production cost per litre	€0.33	€0.53
Production cost per litre gasoline equivalent	€0.33	€0.76
Total production	600 000 000 t*	750 000 t
Average output per plant	6 000 000 t/year	100 000 t/year*
Number of refineries	104 (2005)	16 (2005), 23 (2006)
Sales	€139 billion	€192 million
Imports		13%

*Data from the most recent year available in each case (i.e. 2002-2006). *Estimate.*

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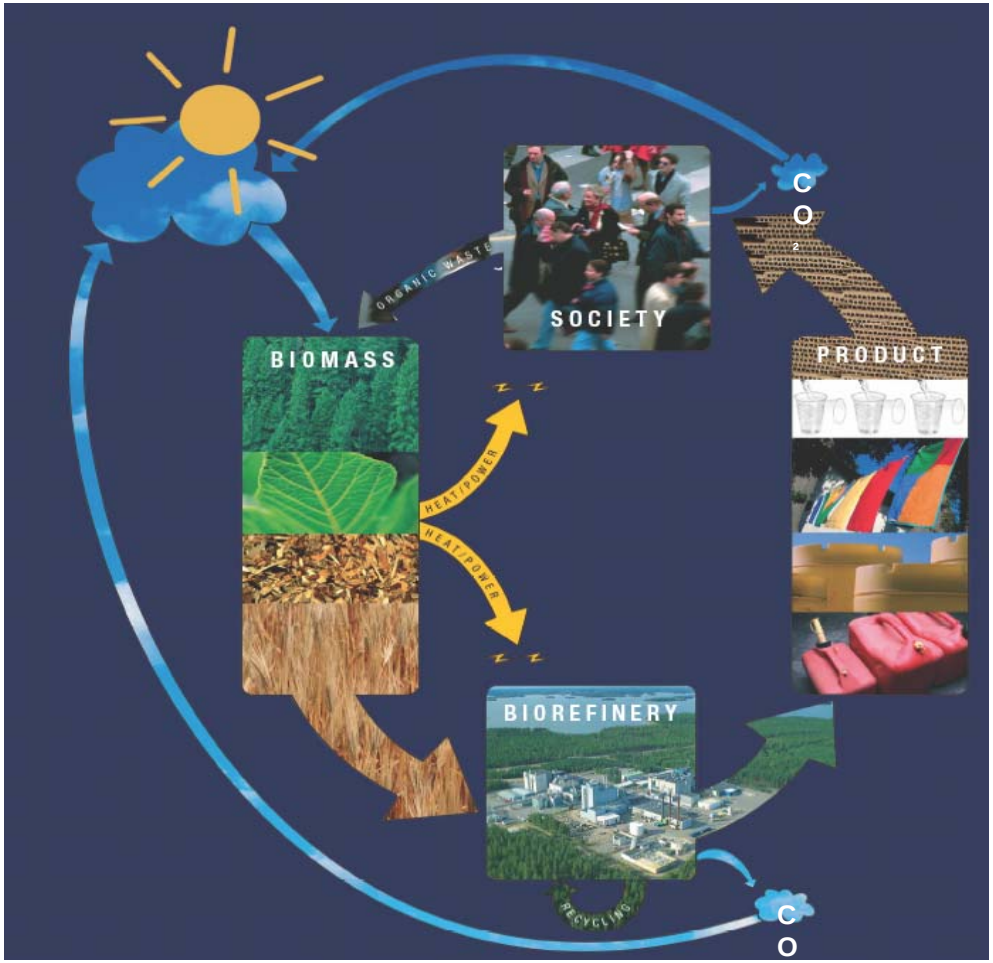
Table 2.11 EU companies producing biotechnology-based polymers

Company	Product	Production volume
Rodenburg BioPolymers, The Netherlands	Solanyl® (lactic-acid based polymer)	
Tate & Lyle, UK		
Hycail (t		
U		Pilot plant
PUR	acid	80 000 tonnes/year
Galact	Poly-lactic acid	25 000 tonnes/year
Biomer, Germany	Biomer ® (Poly-hydroxy-butyrate)	
Boehringer Ingelheim, Germany	Poly-lactic acid (Resomer®)	

Benchmark for many years:
Nature Works (USA): **140 000** tons PLA/year

EU today: at least 6 companies producing Poly Lactic Acid PLA,
Production volume **148 000** tons/year

The integrated diversified (zero-waste) biorefinery



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

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Petroleum based chemicals to finished products

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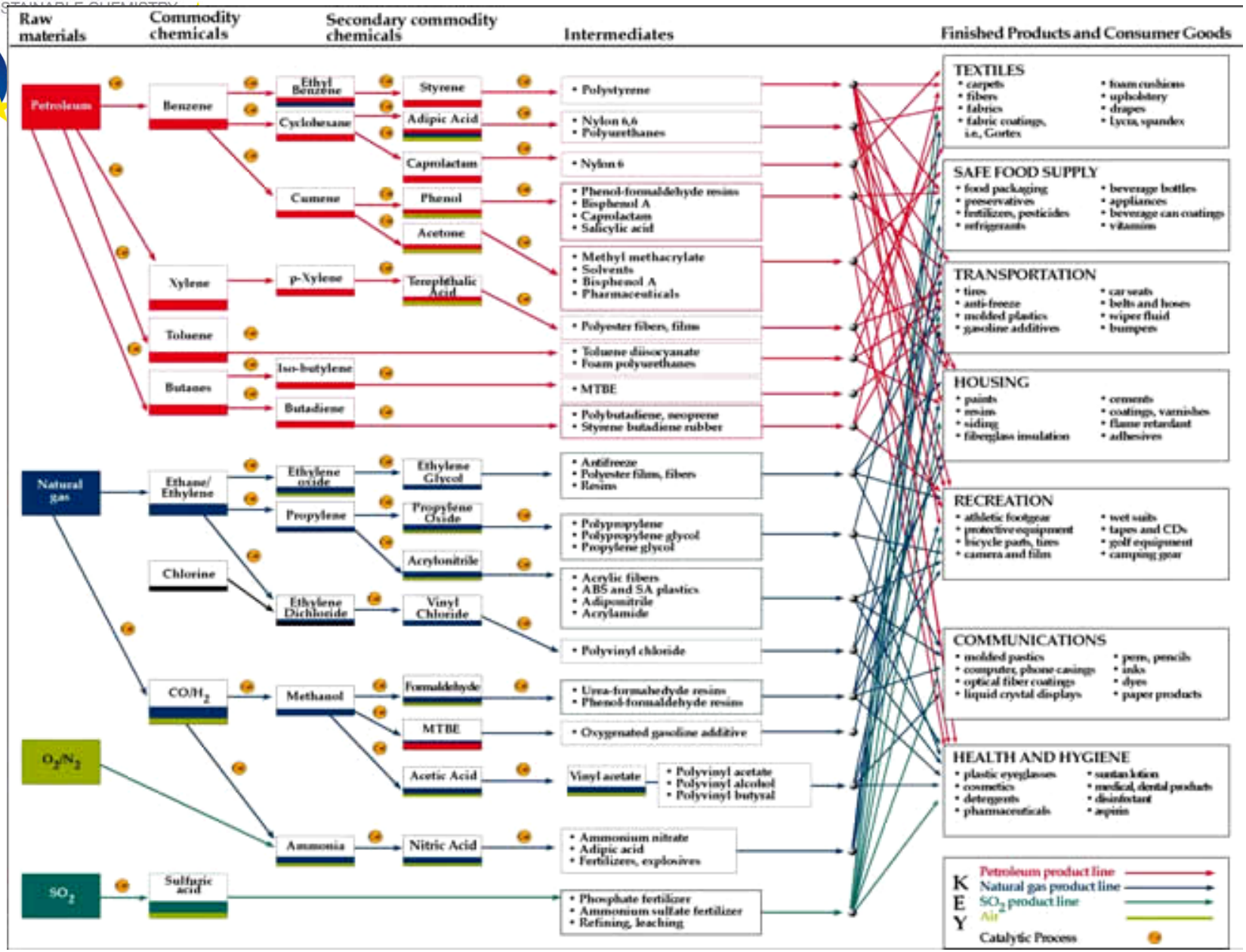
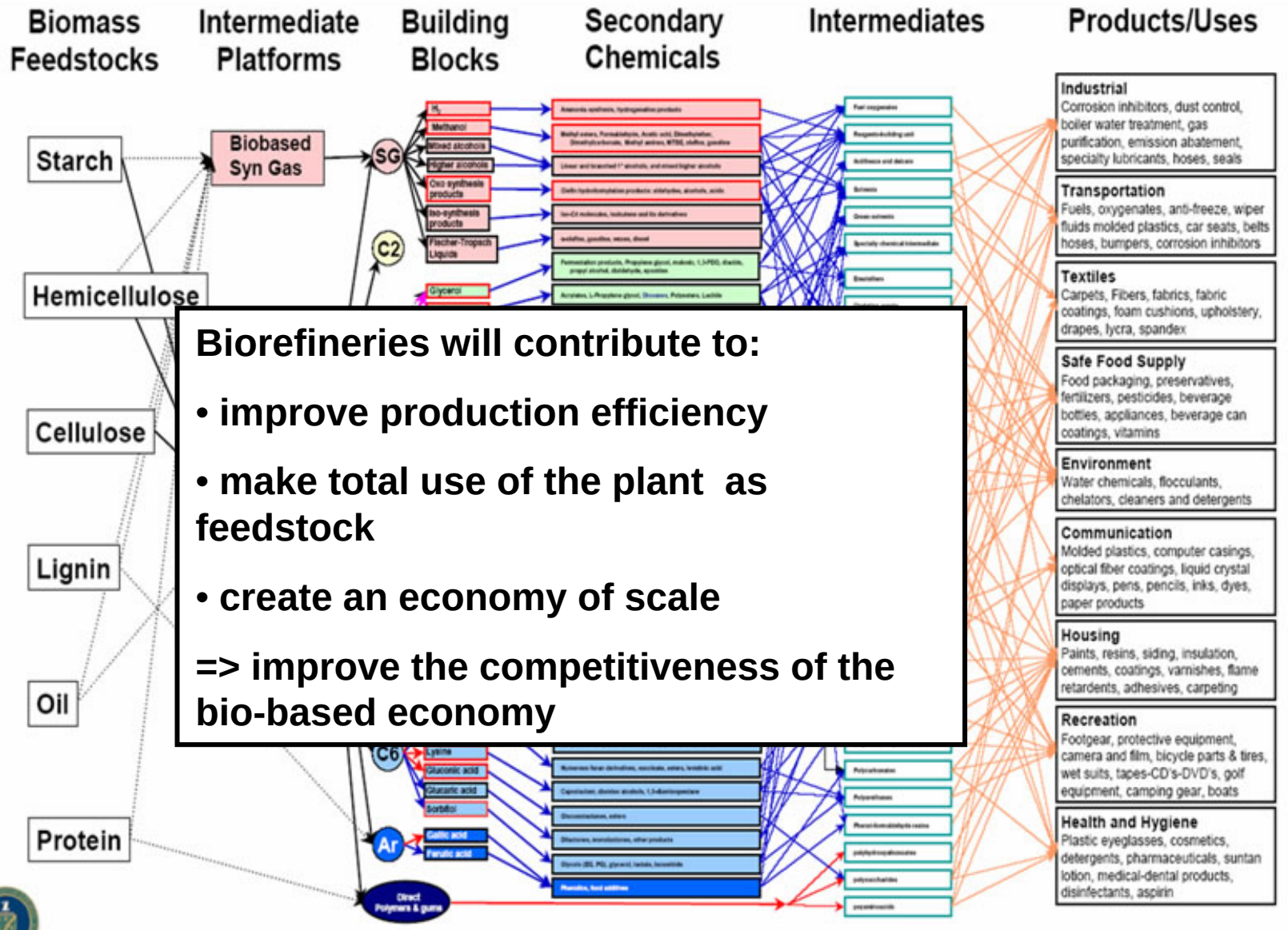


Biobased chemicals to finished products



Biorefineries will contribute to:

- **improve production efficiency**
- **make total use of the plant as feedstock**
- **create an economy of scale**

=> improve the competitiveness of the bio-based economy

Figure 3 – Analogous Model of a Biobased Product Flow-chart for Biomass Feedstocks

Europe has a good basis to build upon – the opportunities

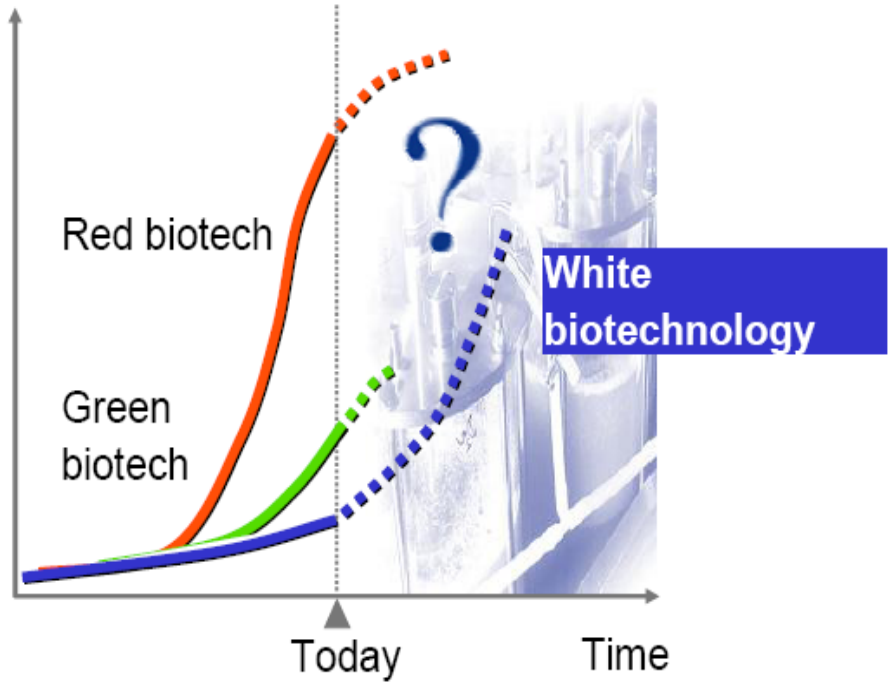
- Europe is strong in white biotechnology and has a strong R&D and technology base (enzymes, fermentation technology)
- Europe has world's largest chemical industry - infrastructure and knowledge base, and a solid development and production of bio-specialities (food ingredients, pharmaceuticals and fine chemicals)
- The recent expansion of the EU provides a large increase in agricultural biomass available as industrial raw material (rural development)
- EU institutions are committed and plans have been developed: the Environmental Technologies Action Plan (ETAP), the biomass action plan, the EU strategy for biofuels, FP7 ,Technology Platforms, etc.
- The EU Directive on the promotion of the use of biofuels for transport as a case study

WHAT DO WE NEED TO REALISE THIS POTENTIAL?

WHAT ARE THE CHALLENGES?

The future –

Do we need more …?



Impact*) dependent on:

- Technology development
- Overall demand
- Feedstock prices
- Policy framework

*) Impact means the use of biotechnological process steps such as fermentation, biocatalysis, etc.

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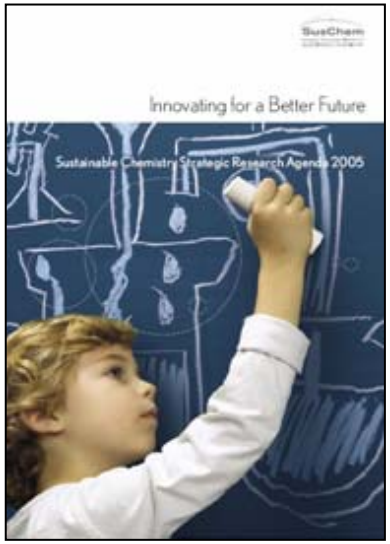
Technological Development – Need for an European research agenda …

SusChem - A Framework for Innovation

Vision

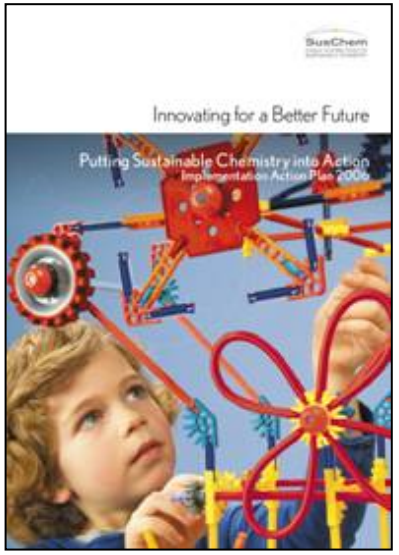
February 2005

Strategic Research Agenda



November 2005

Implementation Action Plan



August 2006

IAP – Industrial Biotechnology and biorefineries

- **Biocatalysis – novel and improved enzymes and processes**
  - Novel and improved biocatalysts
  - Biocatalytic process design

- **Next generation of high efficiency fermentation processes**
  - Novel and improved microorganisms and pathways
  - Improved fermentation and downstream processes

- **Process eco-efficiency and integration: the biorefinery concept**
  - Strategies for sustainability and competitiveness
  - Improvement of biorefining technologies

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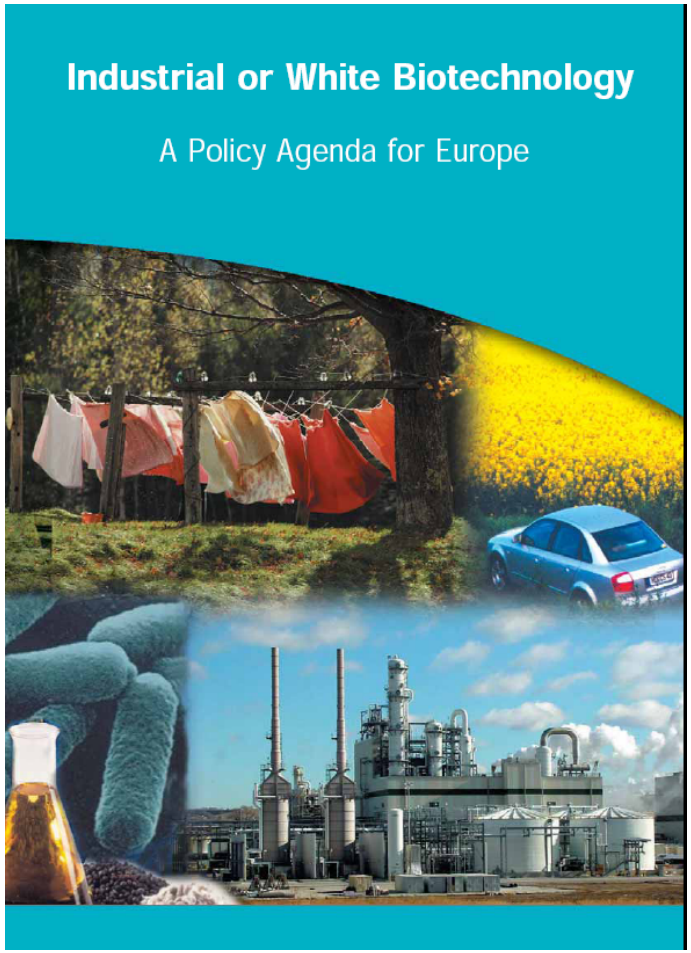
Policy Framework –

Need for an European policy agenda …

Policy Agenda for IB and the KBBE



1. Establish a coherent European Policy Agenda for the Knowledge Based Bioeconomy (KBBE)
2. Stimulate and support innovation in plant science and industrial biotechnology
3. Promote production and use of bio-based products and processes
4. Create awareness amongst all stakeholders
5. Improve investment in IB SME's

1. Establish a coherent European Policy Agenda for IB and the KBBE

- Cooperation is needed at all levels:
  - Research, Agriculture, Environment, Energy, Industry, etc.
- Ensure consistency and certainty among current EU policies and strategies:
  - KBBE, Energy and Biofuels strategy, GM food/feed regulation, Climate change, Sustainable development, Eco-innovation/ETAP, etc.
- Coherent, evidence-based policy:
  - Collect and provide sufficient data
  - Roadmap towards the bio-based economy

2. Stimulate and support innovation in plant science and IB

- Implementation of the KBBE-related SRA's at EC (FP7) and MS (ERA-Net) level

- Set up EU-wide demonstration project(s)
  → Integrated diversified biorefinery
  - Support the development of flexible research-oriented pilot plants
  - Develop funding schemes in Europe for "multiple company consortia" to build small scale plants ("first of a kind" biorefineries)

3. Promote use of bio-based products and processes

- Help convert conventional industrial processes into bio-based ones:
  - Assess opportunities for biobased products and processes to contribute and benefit from EU's Climate Change policy
  - Market incentives to overcome the hurdle of high investments

- Provide market incentives to stimulate the commercialisation of bio-based products:
  - Public procurement standards
  - Temporary pricing measures
  - Specific labeling

- Ensure secure and affordable supply of biomass feedstock (CAP + other measures)

4. Create awareness amongst all stakeholders

- Develop action plan to raise awareness KBBE potential

- Direct engagement and interaction with the public and ALL other stakeholders => insuring acceptance of the new technologies

5. Improve investment in IB SME's

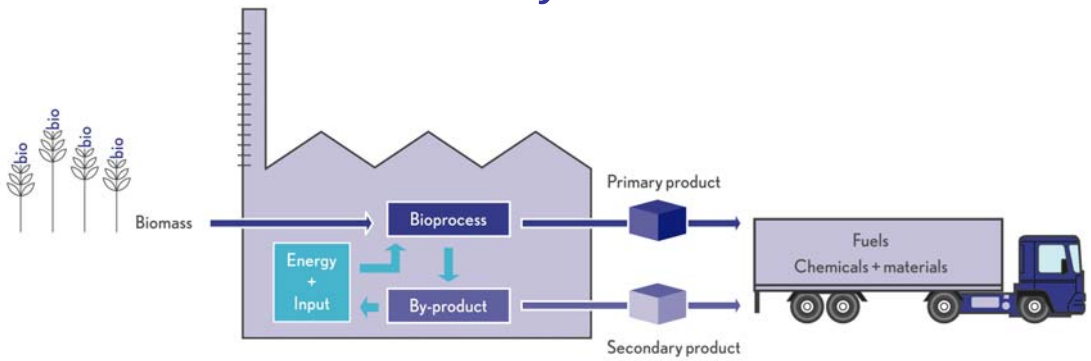
- Reduce the cost of IP protection for SMEs
- Develop specific grants for "Proof of Concept" studies
- Attract new public and private investors
- Facilitate funding by developing investment model that sits between loans and pure private equity (risk sharing)

Europe is on the good track … !!

EuropaBio and the Integrated Biorefinery

To develop the '**Integrated, diversified biorefineries**' in Europe, we have to:

- provide access to (pre)-industrial facilities for reseach and demonstration stage
- reduce both lead time and investment for product development
- use ALL fractions of biomass to produce the highest value possible in an eco-efficient way.



Mid-term review of the EU Biotech Strategy

- **Status**

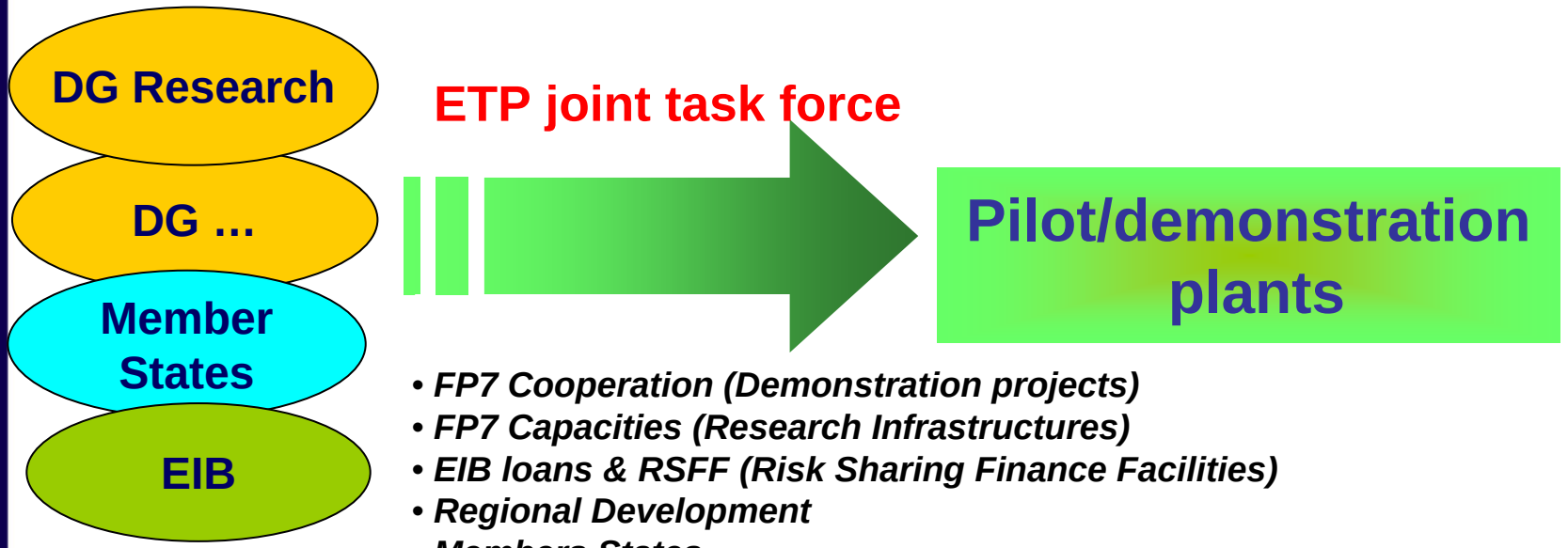
  - BIO4EU (JRC) report, and background documents available at www.bio4eu.jrc.es

  - EC published the **draft Mid-term Review in April 2007**

  - Competitiveness Council endorsed the MTR on 23 May 2007

Recommendations for biorefineries have been included in the mid-term review.

European KBBE Network



- *FP7 Cooperation (Demonstration projects)*
- *FP7 Capacities (Research Infrastructures)*
- *EIB loans & RSFF (Risk Sharing Finance Facilities)*
- *Regional Development*
- *Members States*

Lead Market Initiative
“Bio-based products”

Policy measures to stimulate uptake and demand for bio-based products:

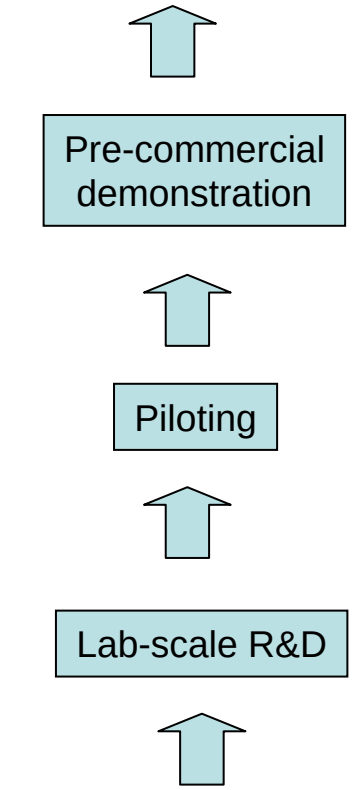
- Standards & labels
- Public procurement
- Legislation & supply market intervention
- Access to finance
- Communication
- R&D incl. international cooperation

Pre-industrial facilities

Differentiate between pilot plants & demonstration plants

PHASE

Commercial production

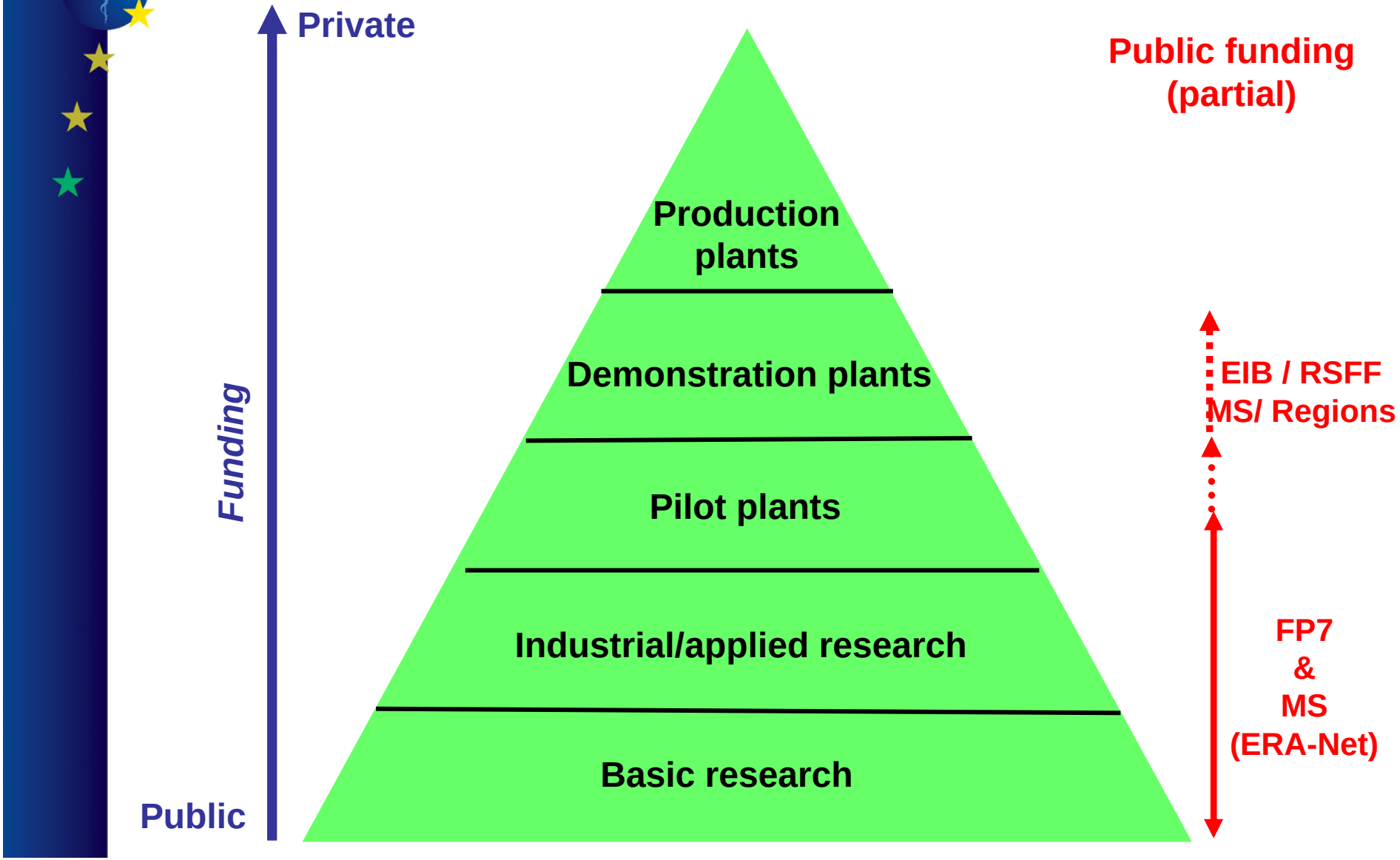


Idea, concept or hypothesis

- Dedicated plants, have to be built. Total costs >10 000 k€/project)
- Complete commercial (integrated) production process, but on a smaller scale. Dedicated plants using equipment identical to the real factory. Multi-process and/or multi-company.
- Owner: private (but often with public financial support)
- Output: Data for factory planning and final investment decision

- Aim: scaling up a specific process
- Multipurpose equipment that mimic industrial equipment. Mainly public (equipment can be “donated” by local companies). Multi-process facilities that can be rented. Owned by universities and R&D organizations
- Output: Functionality with industrially applicable equipment, proof-of-concept, scaling up, economic feasibility

Available but fragmented public funding for biorefinery



Funding possibilities

In Europe, possible subsidies for such pilot plants are very fragmented e.g.

- **EIB: the financing of large European research infrastructures ranks amongst the key priorities of the EIB.**
- **RSFF: the newly created Risk Sharing Finance Facility (RSFF), a joint EU/EIB facility for the financing of private and public research activities, should significantly increase the EU's capacity to finance research infrastructure projects through a new, innovative approach based on risk sharing with public stakeholders**
- **ERDF: the European Regional Development Fund (ERDF) resources are mainly used to cofinance productive investment leading to the creation or maintenance of jobs, infrastructure, local development initiatives and the business activities of small and medium-sized enterprises. In practice, all development areas are covered, including research and innovation, and rural development**
- **Research Infrastructures (DG Research): the overall objective of the "Research infrastructures" part of the FP7 Capacities programme is to optimise the use and development of the best research infrastructures currently existing in Europe. Furthermore, it aims to contribute to the construction of new research infrastructures of pan-European interest in all fields of science and technology.**
- **Member States & Regions Innovation and/or development funds**

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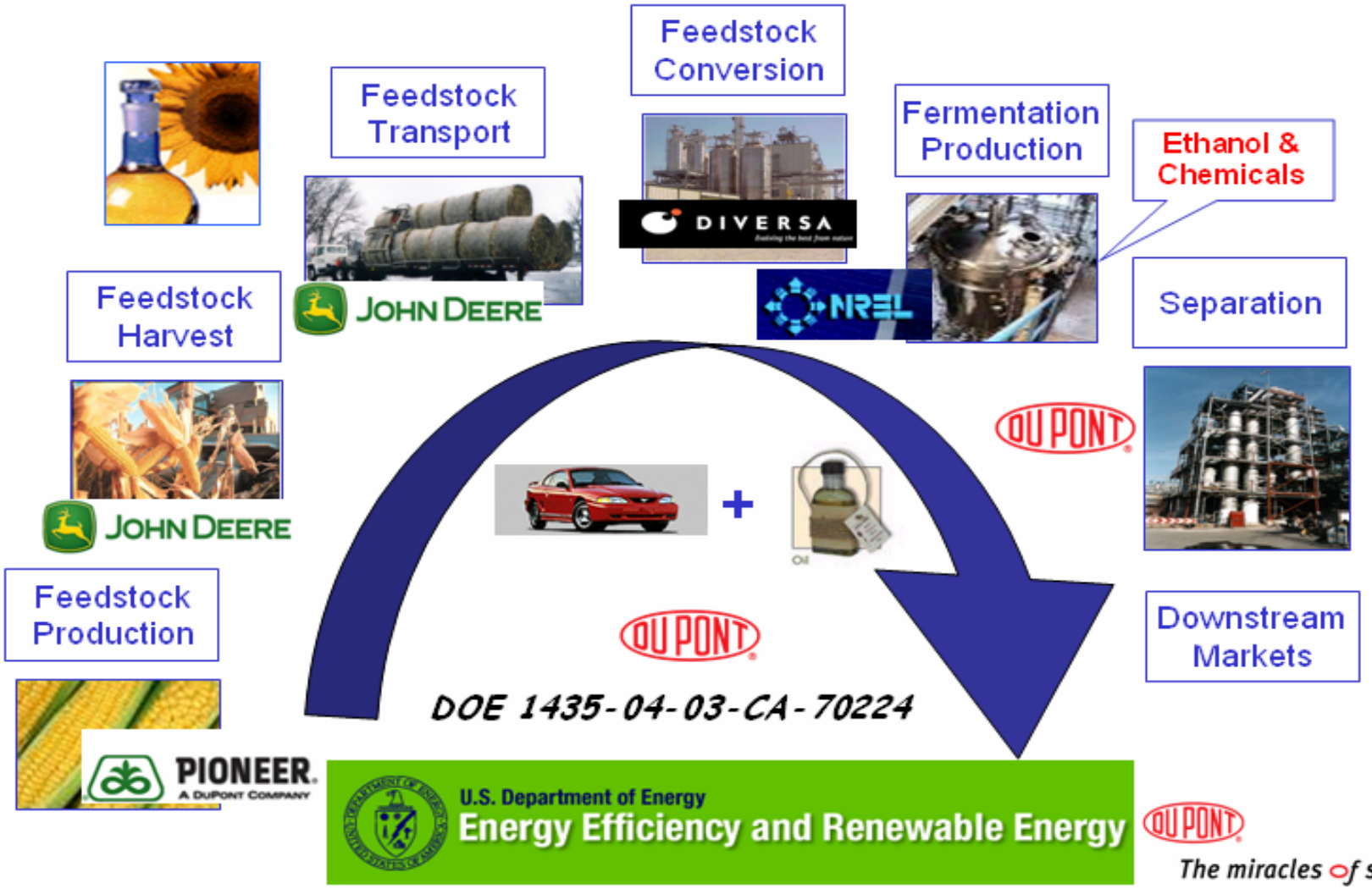
Example from the US



Bio-Hub: an European example

- The aim of the BioHub® program is to develop new production outlets for chemicals based on renewable agricultural raw materials such as grain.

- The new products produced by this research program are notably biopolymers, biosolvents, bioplasticizers, biocomplexing agents and active ingredients.

- Partners:

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Thank you !!

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