

White Biotech in Germany

- Chances and Obstacles

- Introduction
- Status and Activities
- Chances and Strategies
- Obstacles and Restrictions
- Conclusions



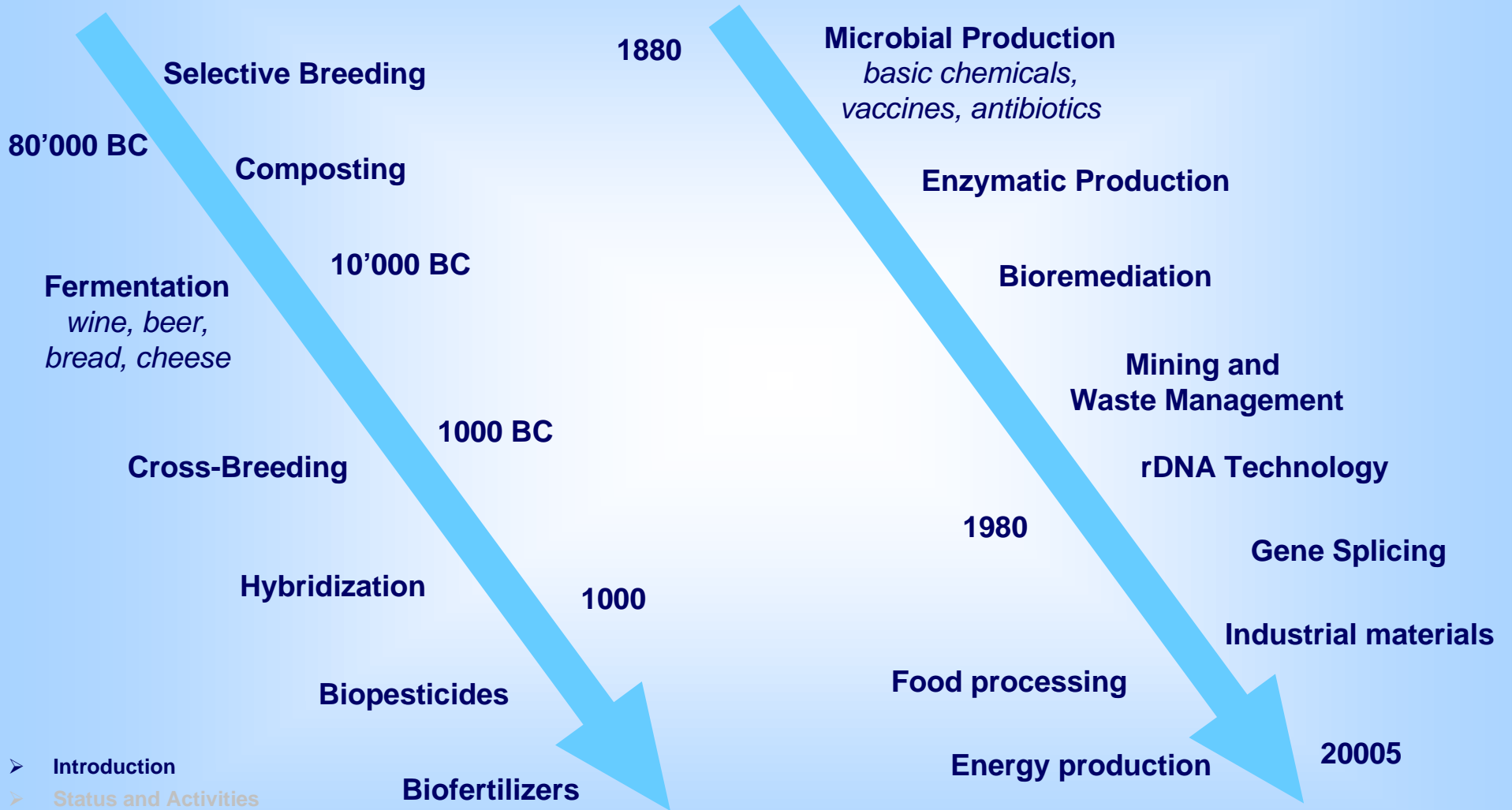


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- Degree in control engineering and technical informatics from Technische Universitaet Darmstadt (1969)
- Doctoral degree (1974) and Habilitation degree (1990) in Business Administration and Management from Universitaet Mannheim
- Associate professor at Universaet Mannheim (1990)
- Full professor at Johannes Gutenberg-Universitaet Mainz (1992), Department of Law and Economics, Chair for Business Administration and Production Management , Director of the Center of Market Oriented Product and Production Management (CMPP)
- Visiting professor of Dongbei University of Finance&Economics (DUFEE), Dalian PRC
- Visiting professor of Warsaw School of Economics (SGH)
- Joint Research Project “Biocatalytic Processes” (DBU) Economical and Ecological Evaluation in Process Developing
- Joint Research Project “Sustainable BioProduction” (BMBF) Economical, Ecological, and Social Evaluation of Biotechnical Processes



Timeline of biotechnology



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“Biotechnology include all lines of work which produce products from raw materials with the aid of living organisms.”
(Karl Ereky, 1919)

“Biotechnology is any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.”
(Convention on Biological Diversity, 1992)

Red Biotechnology
applications of genomics
and genetic engineering
to health care

White biotechnology
“... application of nature’s
own toolset to
industrial production”
(EuropaBio, Bruxelles 2003)

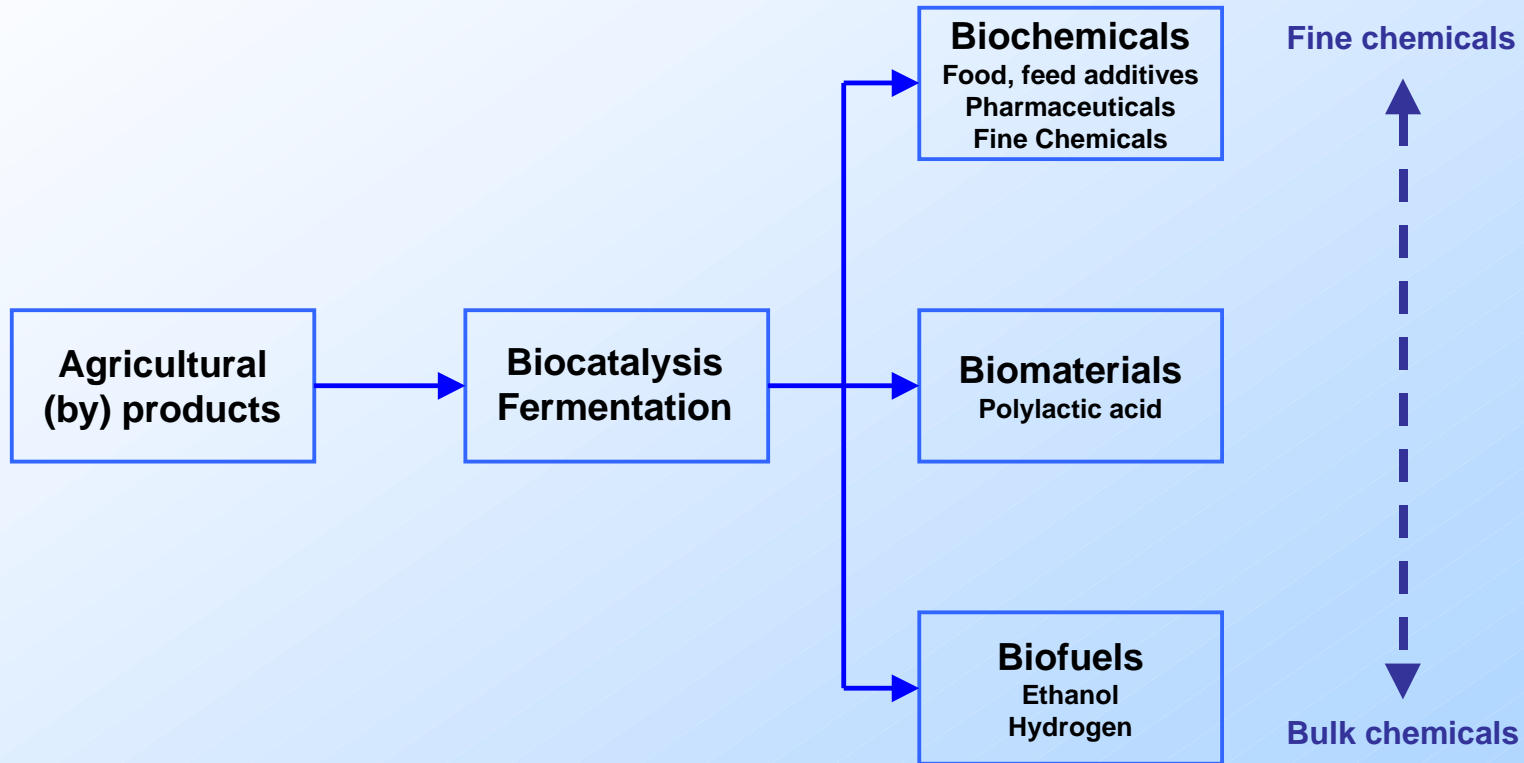
Green biotechnology
application
to agricultural
processes

Blue biotechnology
marine and
aquatic applications

Environmental biotechnology
application of biologically-engineered solutions
to environmental problems

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Simplified White Biotech Value Chain



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International Situation in White Biotechnology

USA

Energy and materials from difficult
recyclable vegetable biomass

Intensive governmental
funded research programs

Japan

Substitution of chemical
processes by enzymatic processes

Development of superenzymes
and superorganisms

Europe

Leading position in chemical,
food and cosmetics industry

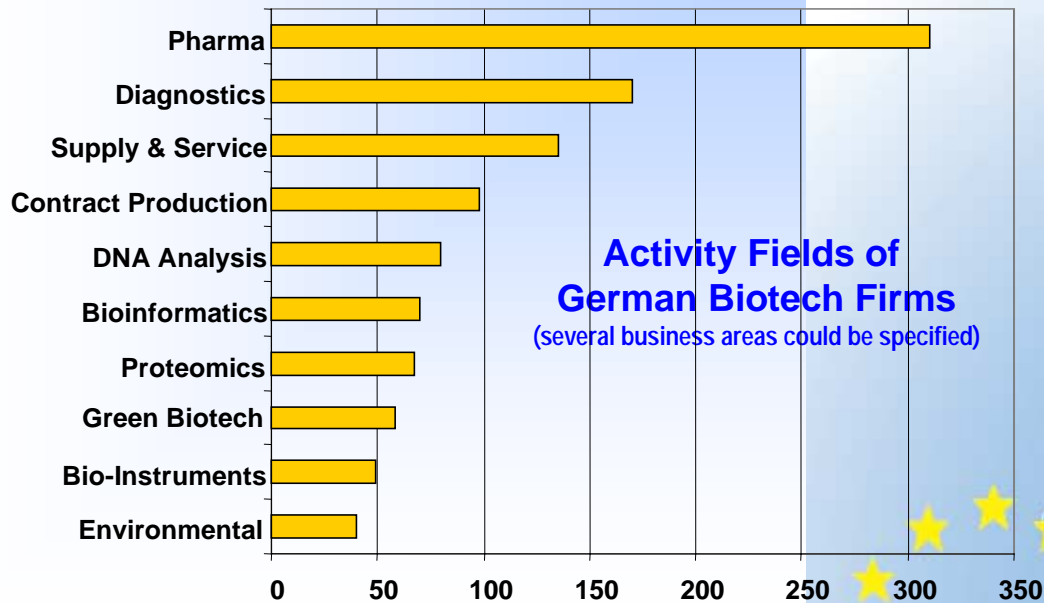
China

Production of basic
and fine chemicals

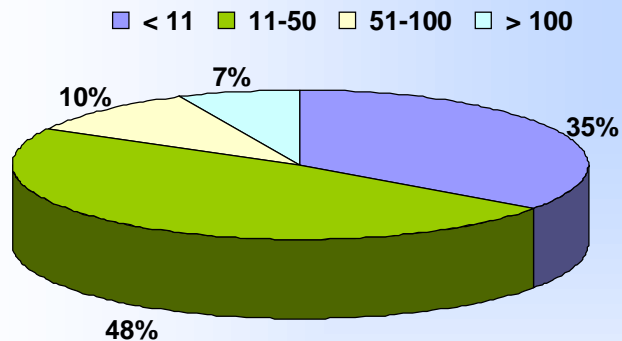
India

Development in the beginning

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Activity Fields of German Biotech Firms
(several business areas could be specified)



Employees per Firm

Germany

25 Bio-Regions

600 Biotech firms



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White Biotech in Germany

➤ Long Tradition in Fermentation and Biocatalysis

Large Firms

BASF, Degussa, Henkel, etc.
aminoacids, cyclodextrines, B2-vitamin

Medium Firms

Cognis, Rütgers, Symrise, etc.
nutrition additives, aromatics, intermediates, flavors, cosmetics

Small Firms

Amino, B.R.A.I.N., Lipoid, Jülich Fine Chemicals, etc.
aminoacids, fine chemicals, pharmaceuticals, cosmetics

Startups

Direvo, BioSpring, Dr. Riex GmbH, etc.
contract research, development

➤ White Biotech Turnover ca. 100 Mio. ? (2004)

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Examples of application

Textile Production

textile finishing, functional textiles

Pulp and Paper Production

enzymatic treatment of cellulose, enzymatic bleaching and deinking

Food & Feed Production

nutraceuticals, dietary supplements, functional foods, nutritional beverages

Plastic and Chemical Production

plastic consumer goods from renewable feedstock

Pharmaceutical and Vitamin Production

antibiotics, vitamin C and B2

Fuels Production

ethanol and hydrogen from renewable feedstock and agricultural residues

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Public funded Biotech Research Programs

No explicit funding for White Biotech in Germany

➤ Applied Research and Development

Ministry of Education and Research (BMBF)

“Sustainable Bioproduction”

Agency Renewable Raw Materials

“Renewable raw materials”,

“Bioconversion of renewable raw materials”

Study Group Industrial Research (AiF)

Funding of single projects of SME

➤ Basic Research

German Research Community (DFG)

Funding of single projects

➤ Investment (2001 – 2005)

> 800 mill. ?

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Benefits of White Biotech Processes

Processes

- ? *water-based processes*
- ? *moderate synthesis conditions*
- ? *chemo-. regio- and stereoselective reaction*
- ? *new processes*

Environment

- ? *often environment-friendly*
- ? *use of renewable raw materials*
- ? *use of agricultural byproducts and waste*
- ? *less emissions, less energy use*
- ? *less toxic substances*
- ? *less waste, less hazardous waste*

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Products

- ? *new products, not producible with chemical processes*
- ? *substitutes for chemical produced goods*

Economy

- ? *creation of jobs*
- ? *revival of farming (cultivation of energy plants)*
- ? *some cost saving processes (bulk products)*
- ? *less waste treatment costs*

Strategic Perspectives for White Biotech

- **Substitution of fossil resources by renewable resources**
- **Sustainability of industrial production**
- **Ensuring the competitiveness of industry**
- **Driving Factor behind Growth and Wealth**

Broad Application Potential for White Biotech

? *bulk chemicals and polymers*

? *fine and speciality chemicals*

? *food, feed additives*

? *agricultural intermediates*

? *pharmaceutical intermediates*

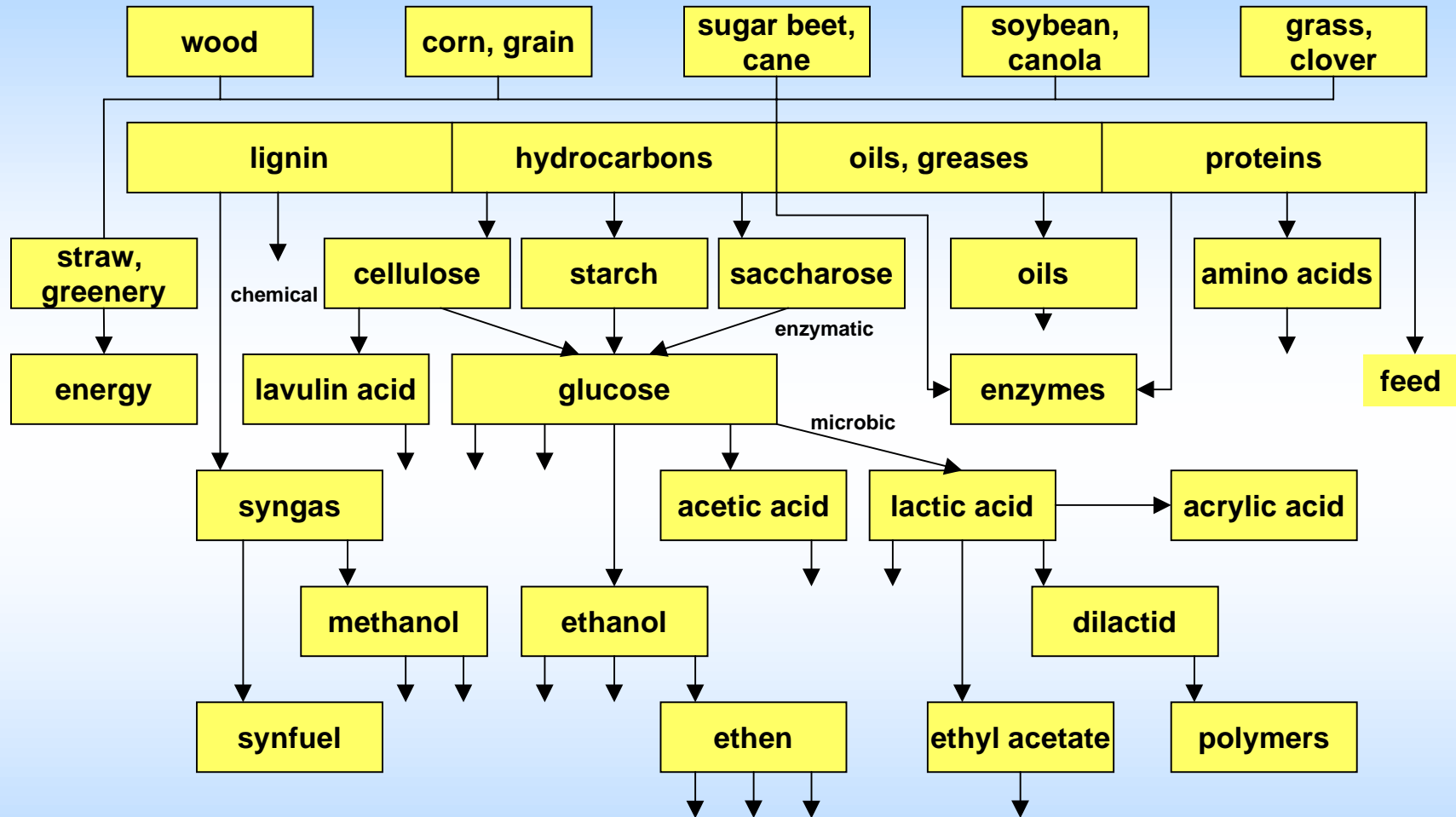
? *industrial auxiliary materials*

? *technical enzymes*

? *biofuels*

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“Biorefinery”



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Agenda for Future Development

➤ **Metabolic Engineering**

improvement of biocatalysts by phylum optimization

➤ **Designer Bugs**

genetically modified microorganisms for high efficient reactions

➤ **Genomics Research**

genome sequencing of industrial relevant microorganisms

➤ **New Technologies and Methods**

metabolic fingerprinting, metabolic profiling

➤ **Faster Development and Application**

*effective parallel screening techniques,
development of platform technologies*

➤ **Protein Engineering and Design**

*quick development of optimized enzymes by directed evolution,
genome shuffling and massive parallel analysis*

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Blocking Problems

Process

- ? small scale application*
- ? use of biomass-byproducts*
- ? low yield*

Economy

- ? higher investment, less processing costs*
- ? often not competitive (fine chemicals)*
- ? availability of feedstocks*
- ? costs of feedstocks*

Research

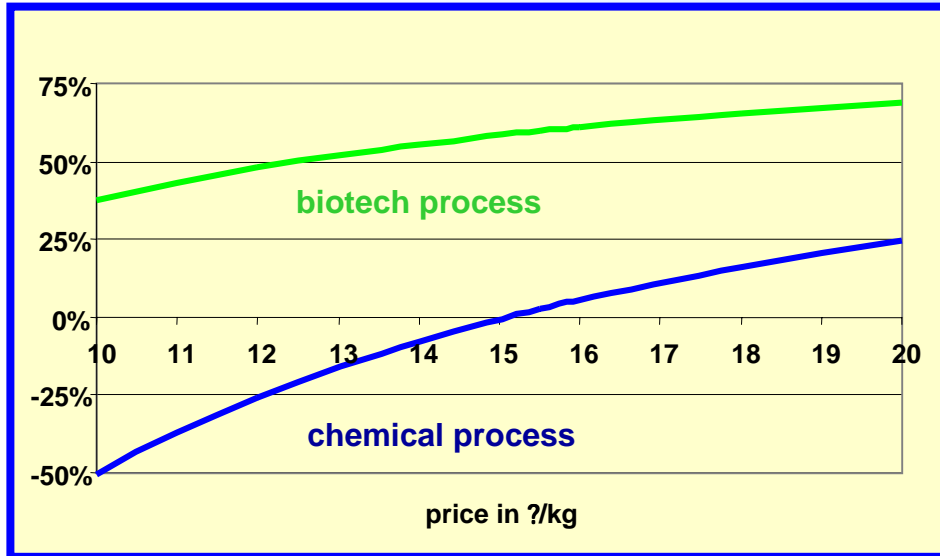
- ? high investment in research*
- ? long development times*
- ? lack of biotech oxidation processes*

Finance

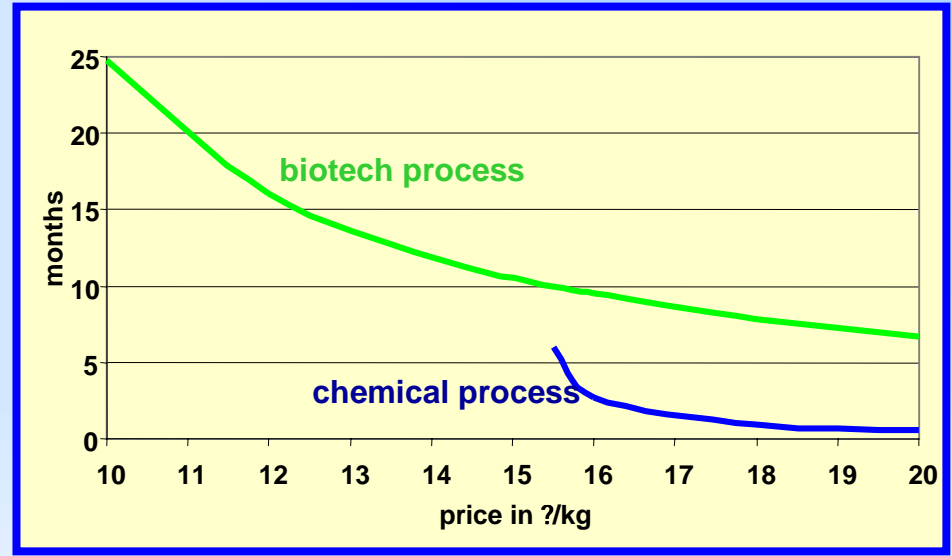
- ? insufficient public funding*
- ? insufficient VC financing*

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Blocking Problems



Operating Margin



Payback Period

e.g. Production of Pyruvat

Biotech Process: Investment 7 mill. €, Capacity 1 mill. tons/y

Chemical Process: Investment 1 mill. €, Capacity 5 mill. tons/y

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Law, Regulations, Society

➤ Construction and Operation of Biotech Plants

principally no disadvantages seen by industry

➤ Approval of Products

? Regulation 1829/2003/EC (*genetically modified food and feed*)

? Regulation 1830/2003/EC (*traceability and labeling of genetically modified organisms and the traceability of food and feed products produced from genetically modified organisms and amending*)

? Directive 2001/18/EC (*deliberate release into the environment of genetically modified organisms*) – *conversion pending*

➤ Regulation on Biopatents

insecurity due to pending conversion of Directive 98/44/EC (legal protection of biotechnological inventions) into national law

➤ Disadvantages in taxation

international competitive tax frame for (young) high-tech-enterprises

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➤ Human Reservations

wide spread anxieties of GM-products (marking requirements for GM food)

Conclusions

Strategic Justification

- ? *roadmap on white biotech*
- ? *comprehensive inventory*

Technological Reticulation

- ? *creation of big research networks*
- ? *integration of breed and process development*

Education

- ? *specialists for large scale enterprises*
- ? *generalists for small and medium sized enterprises*

Relevance of High-Tech SME

(Small and Medium Sized Enterprises)

- ? *SME are the innovative nucleus of biotech*
- ? *lack of resources for marketable products, marketing, and distribution*

Cross Sector Reticulation

- ? *cooperation across industrial boundaries*
- ? *spin off of product developments*

Capital Market

- ? *public funding of research insufficient*
- ? *VC financing for SME unsatisfactory*

Visualization of Future Importance

- ? *attention from analysts and capital market*
- ? *dissemination of successful solutions*

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