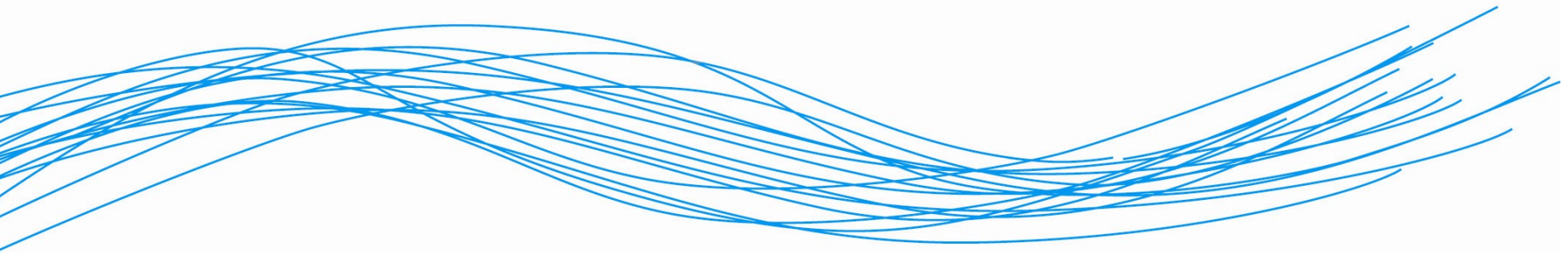


# The Knowledge-Based Bio-Economy - from Concept to Practice: Experiences in Germany and Europe



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# The European Union

- The first economic institutions were based on energy (such as coal and nuclear energy), industry (such as steel) and agriculture.
- Today, the progress in Europe grows by trading knowledge and innovation including bio-sciences.
- An European Knowledge Based Bio-Economy is emerging.

# What is the Knowledge-Based Bio-Economy?

**The knowledge base:** Advances in Life Sciences and Biotechnologies in convergence with other technologies such as nanotechnologies, chemistry, information technologies..,

**The Bio-Economy:** Includes all industries and economic sectors that produce, manage or otherwise make use of biological resources including bio-waste.

The European bio-economy has an approximate market size of over €1.5 trillion, employing more than 22 million people

## → 4 Fs: Food, Fiber, Fuel and Feed

Sector	Annual turn-over (billion €)	Employment (million)	Data source
Food	920	4.4	CIAA
Agriculture	210	15	COPA-COGECA
Paper/Pulp	400	0.3 direct (4 ind.)	CEPI
Forestry/Wood industry	150	2.7	CEI-BOIS
Industrial Biotech.	50 (est.)		McKinsey*
Total	1730	22.4	

\* estimated to be 10 % of sales within the chemical industry accounting for €125 million by 2010

# What are the driving forces behind the Knowledge-Based Bio-Economy beyond competitiveness ?

## Global challenges like :

- **Growing and aging populations**
- **Increased demand for high quality food and sustainable food production**
- **Increased incidence of food-related disorders (cardiovascular, obesity..)**
- **Increased demand for feed**
- **Increase in infectious animal diseases and zoonoses**
- **Danger of plant diseases, new pathogens and pesticides**
- **Limited resources of raw materials and energy**
- **Threat of global warming and other global changes (biodiversity loss etc)**

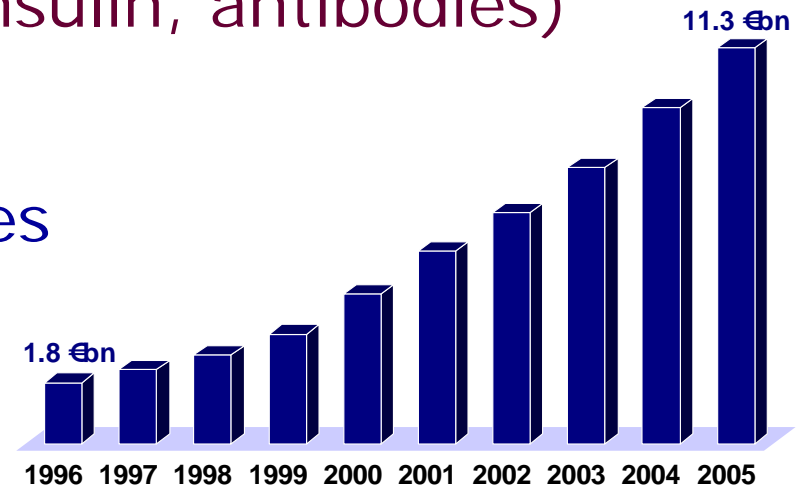
# What is the Knowledge-Based Bio-Economy offering?

- **Improved health**
  - Food with improved nutritional value, increased food safety, new treatments, diagnosis and vaccines against human and animal diseases, improved feed...
- **Sustainability and a cleaner environment**
  - Energy and water saving production and processes in agriculture and industry ; decreased dependence of fossil resources;
- **Support to rural development**
  - Use of “set-aside” land; cultivation of new crops; decentralised production facilities
- **Increased industrial competitiveness through innovative eco-efficient bio-based products**

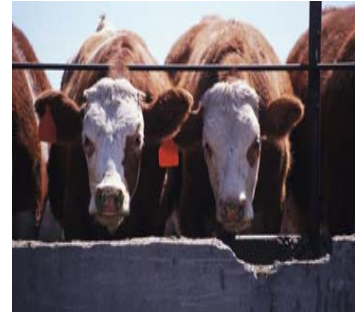
# BIO4EU Study: The impact of modern biotechnology in human medicine & healthcare



- 9% - 30% of total turnover of applications in
  - diagnostics (e.g. HIV testing, cardiac assays)
  - vaccines (e.g. hepatitis B)
  - pharmaceuticals (e.g. insulin, antibodies)
- Biopharmaceutical market increased more than 6 times during last 10 years



# BIO4EU study: The impact of biotechnology on primary production and agro-food



- Supporting ~18% of the input sectors' turnover, e.g.
  - breeding and propagation,
  - veterinary and food diagnostics,
  - enzymes for food production
- Downstream use of these biotech products indirectly supports ~35% of the sector's turnover



# Biotechnology not (yet) widely applied in industrial production , processes, energy and environment, but...

- Current applications and forecasts
  - In 2005 biobased chemicals represents 7% of the market( \$77b in value) – in 2010 it is forecasted to cover 10% ( \$125b in value)
  - 50,000 tons bio-plastic was produced in 2005 in EU (0.1% of the market share) - A market share of 1-2% by 2010 and 2-4% by 2020 are projected.
  - Increase of biofuels in transport to 10 % by 2020 and of renewable energy to 20% within the total energy mix by 2020
- Traditional biotechnology still prevails in bioremediation



# BIO4EU study: Contribution of modern biotechnology to environmental sustainability

- Environmental benefits
  - agriculture (production efficiency)
  - industrial biotechnology (resource use, emissions)
- Opportunity for helping address e.g. global warming or energy supply security (e.g. production and use of feed additive phytase)



# The Knowledge-Based Bio-Economy also raises societal concerns

- New issues arise, e.g.
  - use of human tissue and cells
  - use of personal and genetic data
  - food versus fuel
  - environmental issues incl. sustainable use of biomass in countries of the third world
  - animal welfare issues, incl. animal cloning

which require monitoring and informed societal debate on its benefits and risks

# The European Knowledge-Based Bio-Economy and globalisation

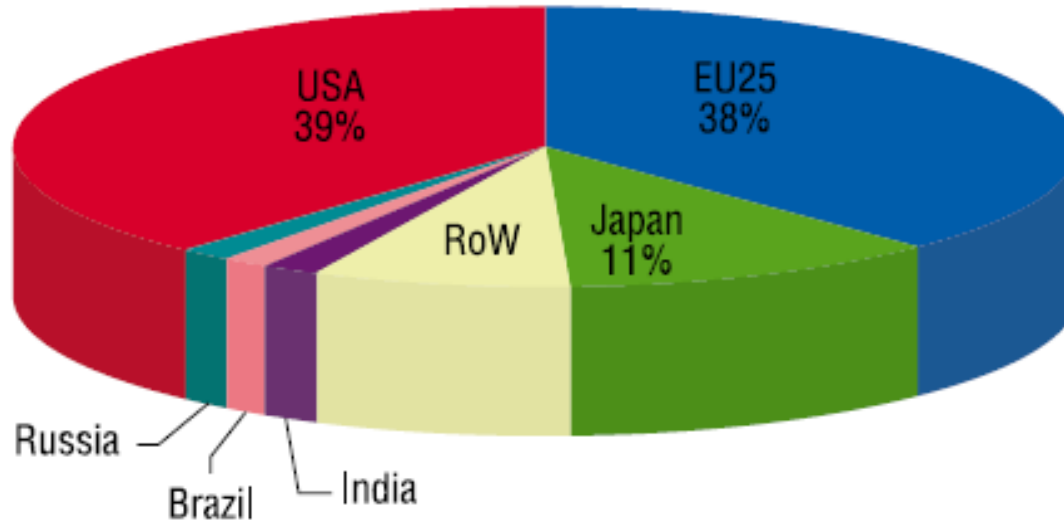
Europe has strengths for example:

- Excellent life sciences and biotechnology research base
- Strong chemical and enzyme industries
- Strong vaccine industry
- Strong food and feed industry, in particular food additives (70% world market share)
- High-tech textile industry

# Biotech-Publications 2002-2004

■ *Figure 3-1 Distribution of biotechnology publications in the period 2002-2004 by country/region*

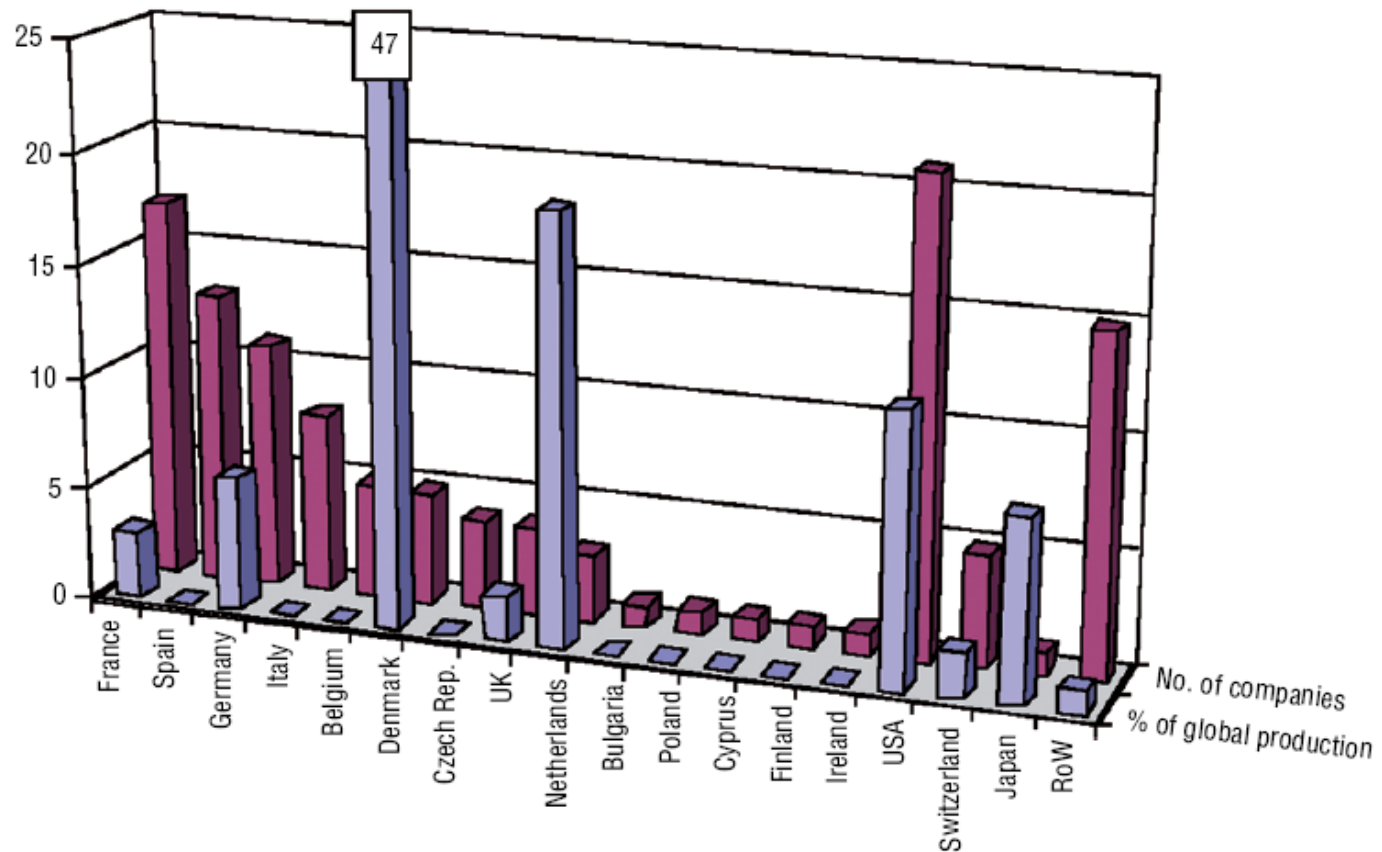
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Source: ETEPS,<sup>479</sup> IPTS calculations.  
RoW: rest of the world.

64% of the worlds enzyme –producing companies are located in Europe. They produce about 75% of the global production of enzymes.

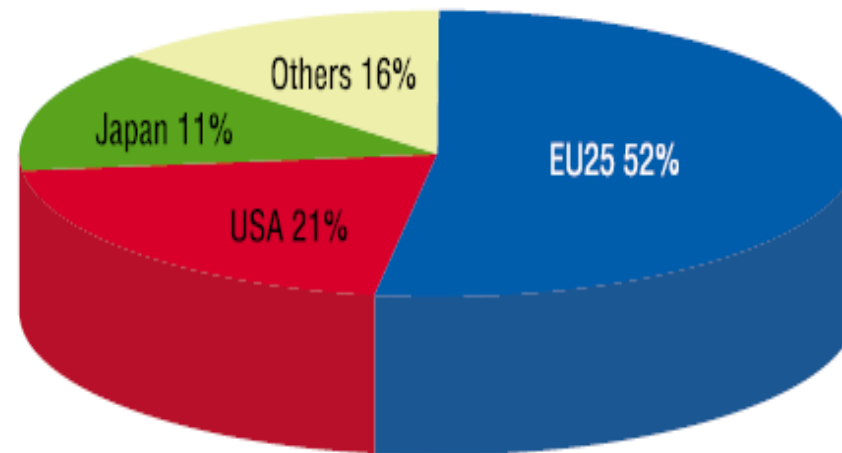


RoW: rest of the world

Source: ETEPS.<sup>338</sup>

# The EU is the main world producer of vaccines

EU companies has developed about 26% of all recombinant vaccines currently available



Share of global vaccine production in 2005, by location of company headquarters.

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Source: ETEPS<sup>74</sup>, IPTS calculations.

# The European Food Industry

- The food industry is the **leading manufacturing sector** in Europe in terms of turnover, value added, employment and number of companies, before automobile and chemical industry.
- The turnover of the food industry was 920 billions of euros in 2008, and is constantly rising by 1% annually
- 20% world market share, but declining by 1% annually during the last five years

# High-Tech Textile Industry

- Next generation of intelligent personal protective equipment for better prevention and management of personal hazards, e.g.
  - New medical and health care textiles
  - Innovative textiles for protection against industrial hazards
- New light-weight –high strength construction materials
  - for safe, energy-efficient and easy-to-build/produce buildings or transport systems



# The European Knowledge-Based Bio-Economy and Globalisation

Europe has strength - but our old and new competitors are moving forward:

**US** invest 3 times more than Europe in Biotech R&D

**US DoE** is co-financing bio-refinery pilot plants for \$500m.

**BP** will invest \$500m in a Energy Biosciences Institute at Univ. of California over the next 10 years and \$250-300m together with Verenum to establish a cellulose refinery in Florida.

In addition DOE and the Department of Agriculture will invest approx. the same amount in collocated research institutes, primarily in California

# The European Knowledge-Based Bio-Economy and Globalisation

Europe has strength -but our old and new competitors are moving forward:

**China** invested between 2001-2005 12 billion Yuan (1.1 billion Euro) in biotech R&D- and is expected to double the investment within the next 5 years.

**China** is setting up a pilot factory for second-generation biofuel production.

The **Brazilian** government announced in 2006 a R\$7b11 (2.6 billion Euro) Investments program to foster over the next 10 years the development of biotechnology.

**India** tripled its research budget for biotech from the period 1997-2002 to 2002-2007.

# Bioeconomy in Europe

- **2002** –The EU launched a Strategy on Life Sciences and Biotechnology including a 30 points action plan.
- **April 2007**- The European Commission published a Mid Term Review of the Strategy putting forward a revised action plan
- **May 2007**- The new action plan incl. the KBBE-concept was welcomed and endorsed by the Competitiveness Council
- **January 2008** – The EC launched the Lead Market Initiative incl. Bio-Based products as one of the 6 areas of lead markets to be supported
- **February 2008** – The Commission proposed a new directive on Renewables with particular emphasis on sustainable biofuels

## EU actions proposed in the mid-term review of the European Strategy on Life Sciences and Biotechnology:

- Promoting research and market development for a Knowledge-Based Bio-Economy
- Foster competitiveness, knowledge transfer and innovation
- Encourage informed societal debates on the benefits and risk of biotechnology
- Ensure a sustainable contribution of modern biotechnology to agriculture
- Improve the implementation of legislation

# EU actions proposed in the mid term review of the European Strategy on Life Sciences and Biotechnology:

## Actions promoting research and market development for a Knowledge-Based Bio-Economy

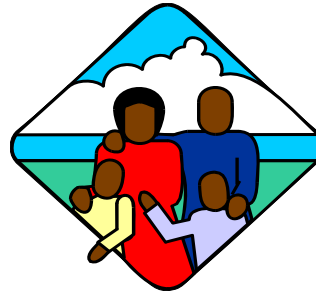
- **Generating knowledge** under the 7th Framework Programme (2007-2013) from basic research to applied research, research infrastructures, training and specific support to SMEs.
- **Mobilise public and private research funding** and reinforce coordination
- **Launching of Joint Technology Initiatives** among others on Innovative Medicine.
- **Promote pilot plants** to demonstrate the potential of bio-based applications
- **Stimulate lead markets initiatives** for eco-efficient bio-based products

# THE EUROPEAN KNOWLEDGE-BASED BIO-ECONOMY

QUALITY ASSURANCE  
STRATEGIES TRACEABILITY,  
CONSUMER SCIENCE

STABILITY -  
BIODEGRADABILITY  
FUNCTIONALITY (Chirality)

SOCIETAL NEEDS



"Fork to Farm"  
Food, health and  
well-being

Life sciences &  
biotechnology for  
sustainable  
non-food products +  
processes

ADVANCED FOOD  
TECHNOLOGIES, FOOD QUALITY  
DETERMINANTS, NUTRITION

PROCESSING

WHITE BIOTECH  
CLEAN BIOPROCESSES  
RAW MATERIALS/WASTE

LOW INPUT FARMING - BIODIVERSITY  
ANIMAL HEALTH - RURAL DEVT.

PRODUCTION

GREEN/BLUE BIOTECH  
OPTIMISED RAW MATERIALS

Sustainable production and management of biological resources  
from  
land, forest, and aquatic environments



# EU-US Summit Conclusions

## April 2007

### Lighthouse Priority Project:

“Develop a science-based work plan for EU-US collaboration on innovative and eco-efficient bio-based products”

# Decision of the EU-Commission – Lead Market Initiative for Europe Dec. 2007

## **6 Lead markets** identified:

1. eHealth
2. High Tech Textiles
3. Sustainable Construction
4. Recycling
- 5. Biobased Products**
6. Renewable Energy



# Biobased Products

Definiton: Products of renewable, biological plant resources

## Bottle-necks:

- Delays in public acceptance because of uncertainties regarding product properties
- Unsatisfactory transparency of market

→ **Demonstration plants are essential for higher acceptance and transparency !**

# How is KBBE implemented in various **EU Member States** ?

## 3 Different Stages of Implementation of KBBE:

- **Integrated concepts and strategies** with different levels of integration (AT, BE, DE, IR, NL, TR)
- **No integrated strategies** BUT specifically KBBE-related policies and activities (CZ, FR, SE, UK)
- More or less **no specific activities and policies**, but acknowledgement of its political importance and potential (EE, GR, LT, SI, PT)

# Integrated KBBE Concepts - **Germany**

- **“Cologne“-Paper** - „En route to the Knowledge-Based Bio-Economy“ during the German EU presidency in 2007
- Several **Calls for Proposals** with direct KBBE references
- **High-Tech Initiative** of the German Federal Government, linking with the KBBE-concept
- **National Bio-Economy Technology Council**, directly reporting to the Chancellor

# Current Calls for Proposals with direct reference to KBBE in **Germany**

## Federal Ministry of Education and Research:

- **Competence Networks** in Agricultural and Food Research
- **Bioenergy 2021**
- **BioIndustry 2021**
- Industrial Genome Research on Microorganisms (**GenoMik-Industry**)
- **SynRG** – Systems Biotechnology for sustainable resource production
- “Transnational **PLant Alliance for Novel Technologies** - towards implementing the Knowledge-Based Bio-Economy in Europe” (**PLANT-KBBE**) – Cooperation between DE-FR-ES-PT
- **Excellence Cluster Competition**
- Breeding research and Breeding for energy plants
- Support of the use of biomass for energy
- Nutrition research for a healthy life

# Current Calls for Proposals with direct reference to KBBE in **Germany**

Federal State Ministry of Innovation, Science, Research and Technology NRW:

- **Bio.NRW** - Industrial Biotechnology

ERA-NETs (with strong German participation):

- ERA-NET "**Bioenergy**"
- ERA-NET "**Industrial Biotechnology**"
- ERA-NET "**Plant Genomics**"
- ERA-NET "**Eurotrans-Bio**"

# Example Agro cluster

- up to 40 Mill. € / 5 years

- Competence Network Food Chain Plus (**FoCus**), (coordinator: Univ. Kiel)
- **Phänomics** – a systems biological approach for geno-phenotype mapping in the context of performance, health and wellness of the companion animals cattle and swine (coordinator: Univ. Rostock)
- Complex sensor technology for agricultural crop research, breeding and canopy controlling: **CROPSENSE** (coordinators: Univ. Bonn, Forschungszentrum Juelich)
- **Synbreed** – Innovation cluster for synergistical plant and animal breeding (coordinator: TU Munich)

# **KBBE Implementation in North-Rhine Westfalia - Some reflections**

# Bio-Economy Turnovers 2006 in Manufacturing Trade in **NRW**

	Billions €	
• Chemical Products	52,7	→ 75% of Chemical Intermediates in Germany come from NRW (20 bill. €)
• Rubber & Plastic Goods	13,1	
• Paper Trade	8,1	
• Wood Trade	3,4	
• Food Trade	30,2	
• Textile Trade	3,9	
Manufacturing Trade total:	26,6	

**At least 30% of Manufacturing Trade in North-Rhine Westfalia is based on Bio-Economy**



# KBBE activities in **NRW-1**

- Installation of 16 specific clusters by the Government of **North-Rhine Westfalia** (i.e. on Chemistry, Biotech, Energy, Plastics) with strong links of content towards KBBE
- Foundation of a **Cluster of Industrial Biotechnology (CLIB 2021)** in NRW with funds of about 20 Mio. € by the Federal Government
- Foundation of an umbrella organisation “Bio.NRW” for bundling and linking-up of 8 various Bio-Regions in NRW, *now speaking with one voice !*
- Installation of a “local” agency for Bio.NRW by the State Government

# KBBE activities in **NRW-2**

- Establishment of an KBBE Coordination Office for better coordination and streamlining of KBBE-activities in NRW
- Establishment of a competence cluster "Agro.NRW"
- Analysis of the potential of biobased products, processes and technologies in NRW
- NRW Stake-holder take part in the National Technology Council for Bio-Economy, founded by the Federal Republic of Germany in 2009

# KBBE activities in **NRW-3**

- 1<sup>st</sup> NRW call (Bio.NRW, 2008/2009) – “Industrial Biotechnology” (25 Mill.€)
- Call “Food” (2008), 10 Mill.€
- Energy research programme (3 pillars; 3<sup>rd</sup> pillar: “Biological production of energy sources” with 3 elements:
  - Efficient crop cultivation to ensure the need of raw materials
  - Biorefineries – Production system of the 21<sup>st</sup> century
  - Knowledge-based Bioeconomy
- Call “Forest and Forestry” being planned

# KBBE Office at Forschungszentrum Juelich

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**Thank you for your attention !**