
PRIORITIES FOR ADDRESSING **O**PPORTUNITIES AND **G**APS OF INDUSTRIAL BIOTECHNOLOGY FOR AN EFFICIENT USE OF FUNDING **R**ESOURCES **(PROGRESS)**

The Impact of Industrial Biotechnology



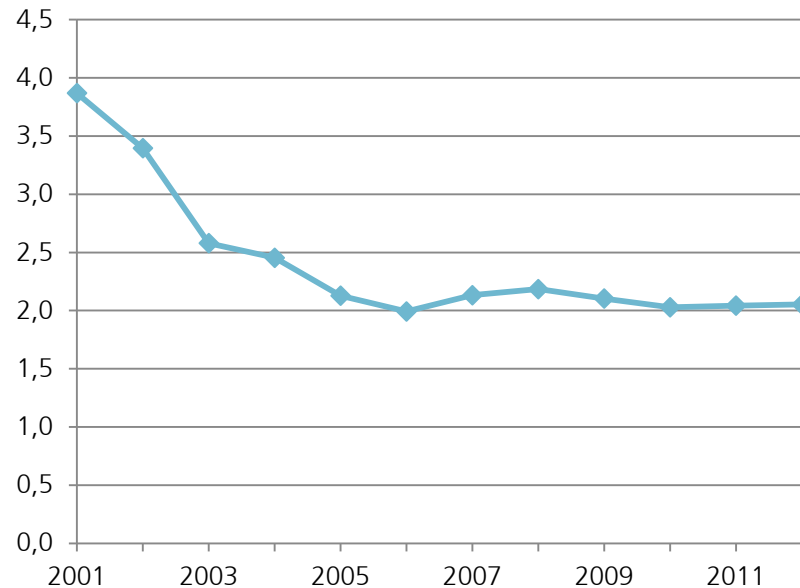
IB as a key enabling technology

- **Future key enabling technologies (KET)** are expected to **facilitate new products and processes** and to pose **disruptive qualities to markets**. They can generate **new growth, spur innovation, increase productivity, tackle environmental and climate challenges**, and give rise to **new applications**.
- Industrial Biotechnology is one of the six KETs. Its fulfillment of the following KET characteristics is presented on the next slides:
 - Technology intensity ⇨ slides technology generation
 - Capital intensity ⇨ production capacity and investment
 - Economic Potential ⇨ slides employment, market
 - Enabling and disruptive character ⇨ slides spillover

Technology generation

The KETs Observatory measures the technology significance, which indicates how important a certain KET is in a country's total patent activity

Technology significance in the EU-28 in %

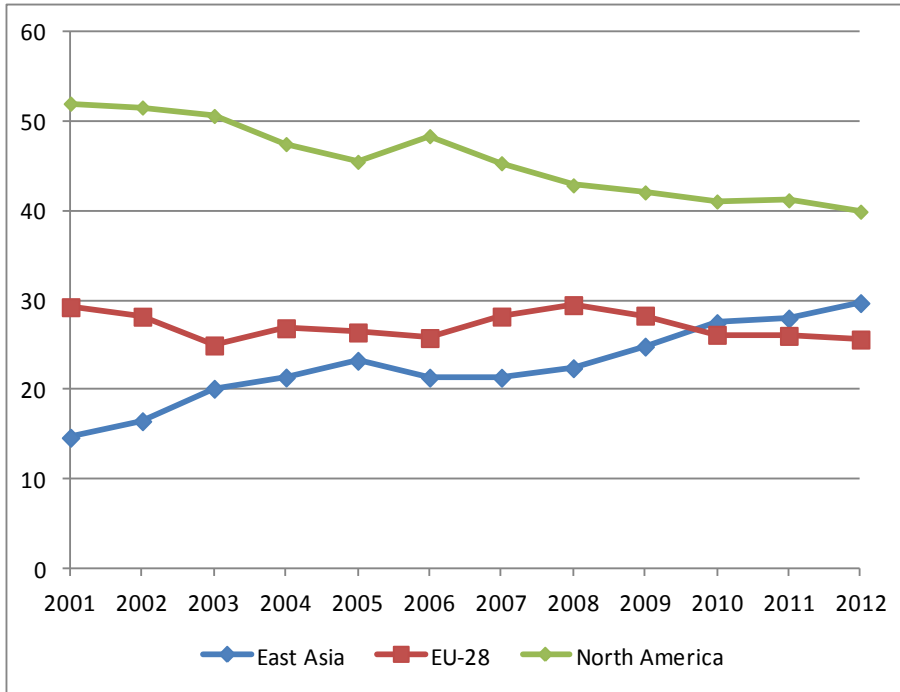


Source:
KETs Observatory

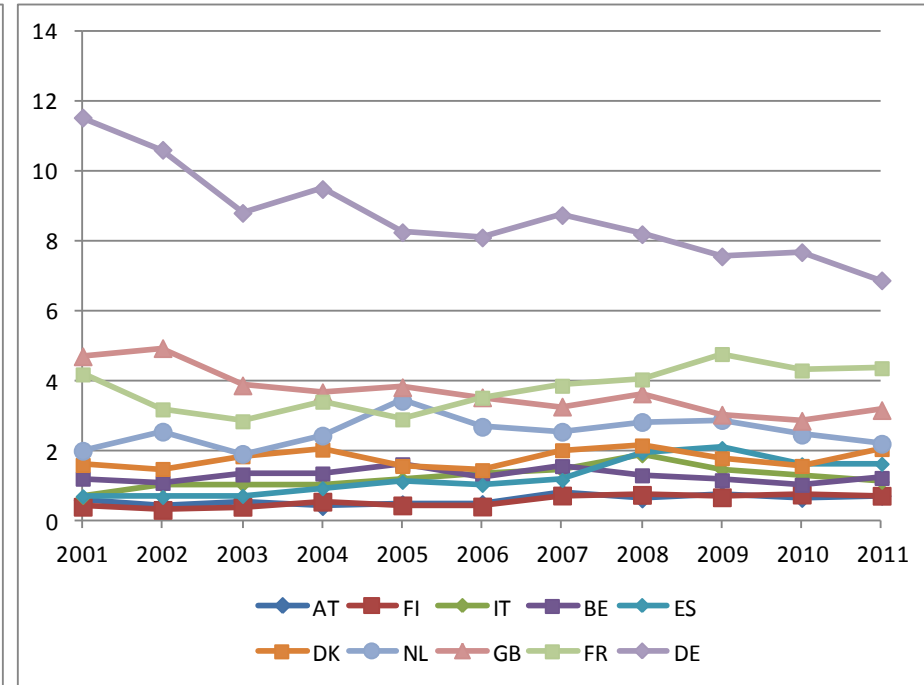
⇒ After down swing between 2000-2005, IB contains a stable share of all patents (2 % of all patents in the EU-28)

Technology generation

Share in IB patents* for world regions (in %)



Share in IB patents* for the TOP 10 EU-28 Countries (in %)

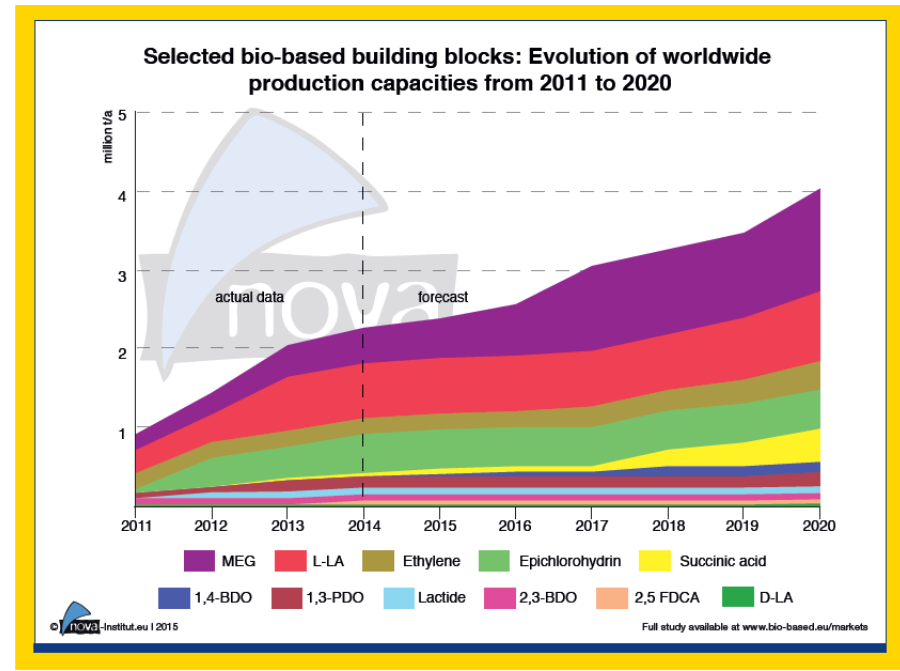
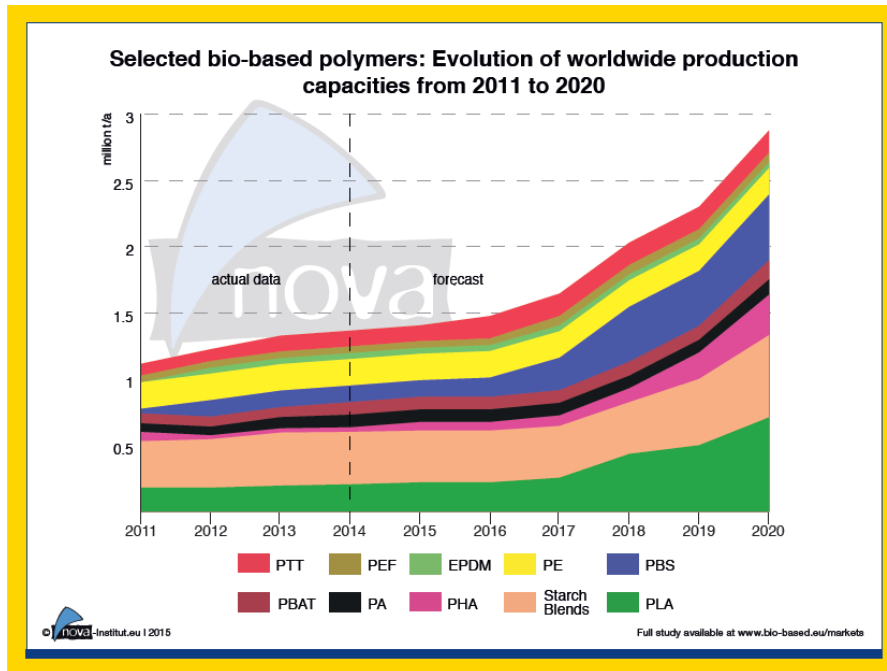


⇒ East Asia is on the rise, to maintain competitiveness is a key challenge for EU-28

⇒ Distribution of IB patents across EU countries is rather high (compared to other KETs)

Production Capacities: Worldwide trends

Production capacities are only available for large volume application of IB: Bio-based chemicals* and bio-based plastics*

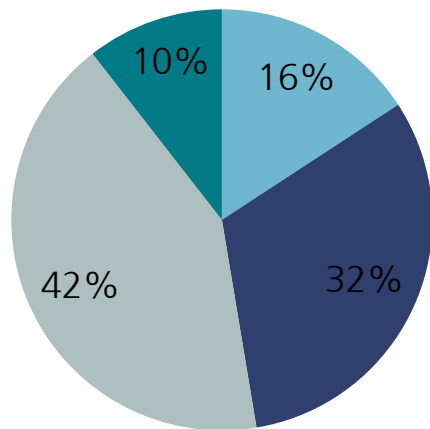


•Source: Nova-Institute 2015 •* Also bio-chemicals and bio-based plastics without biprocessing are included

⇒ Worldwide production capacities for bio-based polymers and bio-based building blocks are expected to double between 2014 - 2020

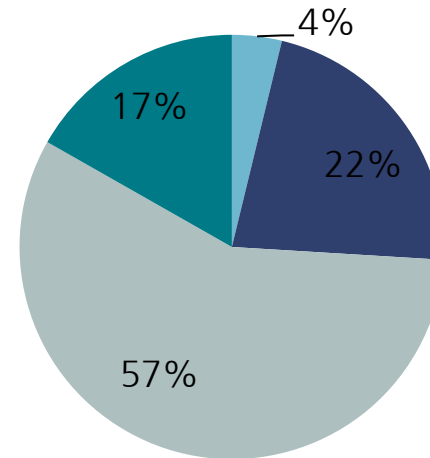
Production Capacities: Bio-based chemicals* capacities across the world

Share of world regions at the number of operating production plants



■ Europe ■ North America
■ Asia ■ South America

Share of world regions at the capacity of operating production plants



■ Europe ■ North America
■ Asia ■ South America

.*

*** Source: Fraunhofer ISI compilation. Only bio-based chemicals with using IB processes larger than >10.000 kt/a are included

⇒ Europe is lacking behind regarding large scale facilities

Production Capacities: Large bio-based chemical plants (using IB) in Europe

Commercial Plants

| Product | Firm | Capacity | Location | investment costs |
|----------------------|-----------|----------|----------|------------------|
| Bio-based butanediol | Novamont | 30 kt | Italy | 100 million € |
| Succinid Acid | Reverdia | 10kt | Italy | n.a. |
| Succinid Acid | Succinity | 10kt | Spain | n.a. |

Selected Demonstration Plants

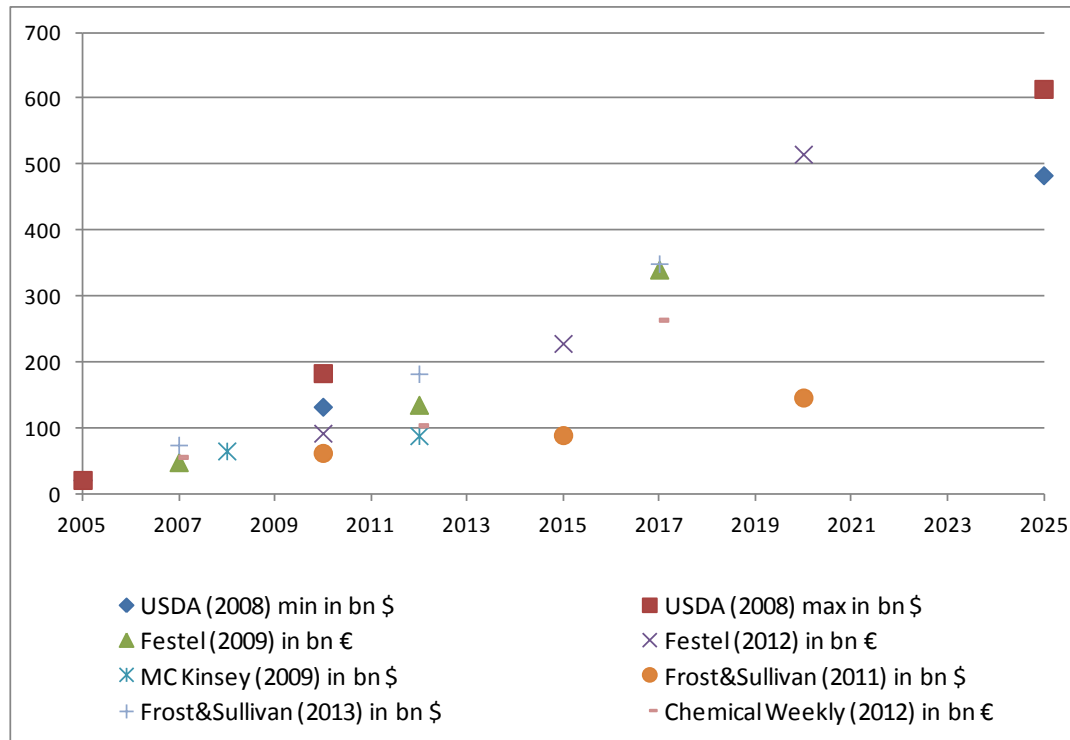
| Product | Firm | Capacity | Location | investment costs |
|---------------------------|--------------------|----------|----------|------------------|
| Isobutene | Global Bioenergies | 100 t/a | Germany | > 10 million € |
| <i>Different products</i> | ARD | 2 kt | France | 22 million € |

- While investment costs are often not disclosed there are various examples of the non European plants that 100 mio euros for 30kt plants are common

⇒ The investment intensity of pilot/demonstration and production plants in IB is undisputed

Market forecasts for IB

Market estimations for Industrial Biotechnology in the chemical industry, worldwide



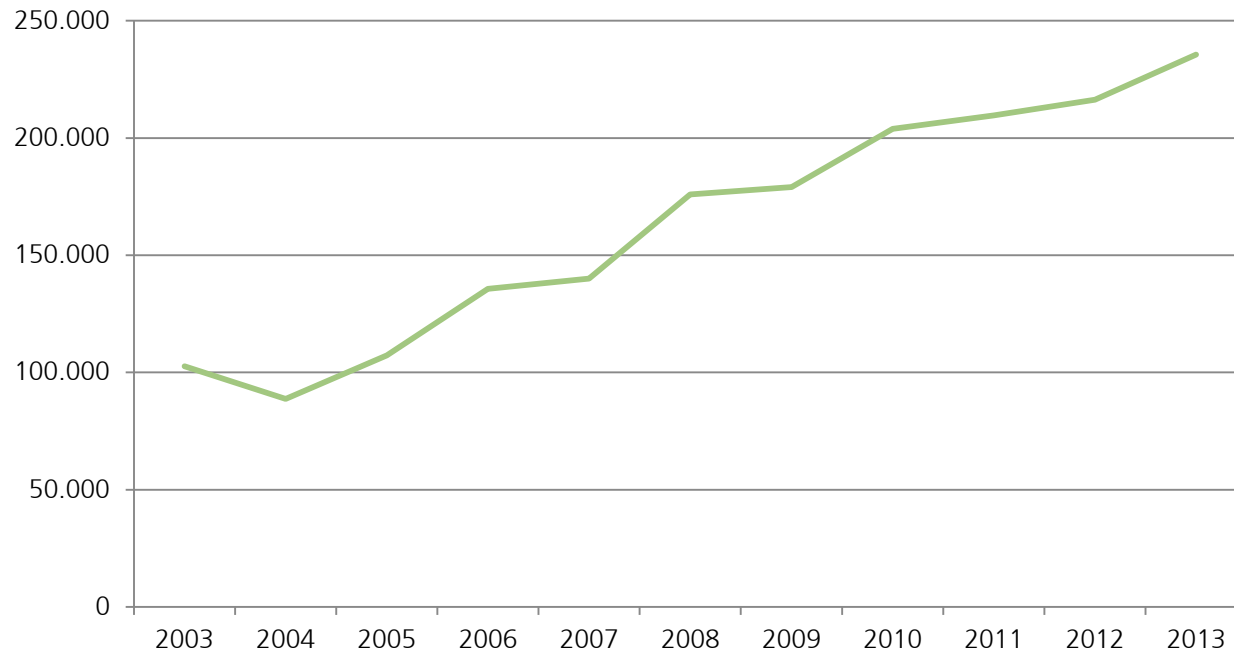
*Source: Fraunhofer ISI compilation of market studies



Market study significantly differ from each other, but all studies show strong signs of growth in the IB market

IB Employment in Europe

IB employment in the EU-28*



Source: KETs Observatory

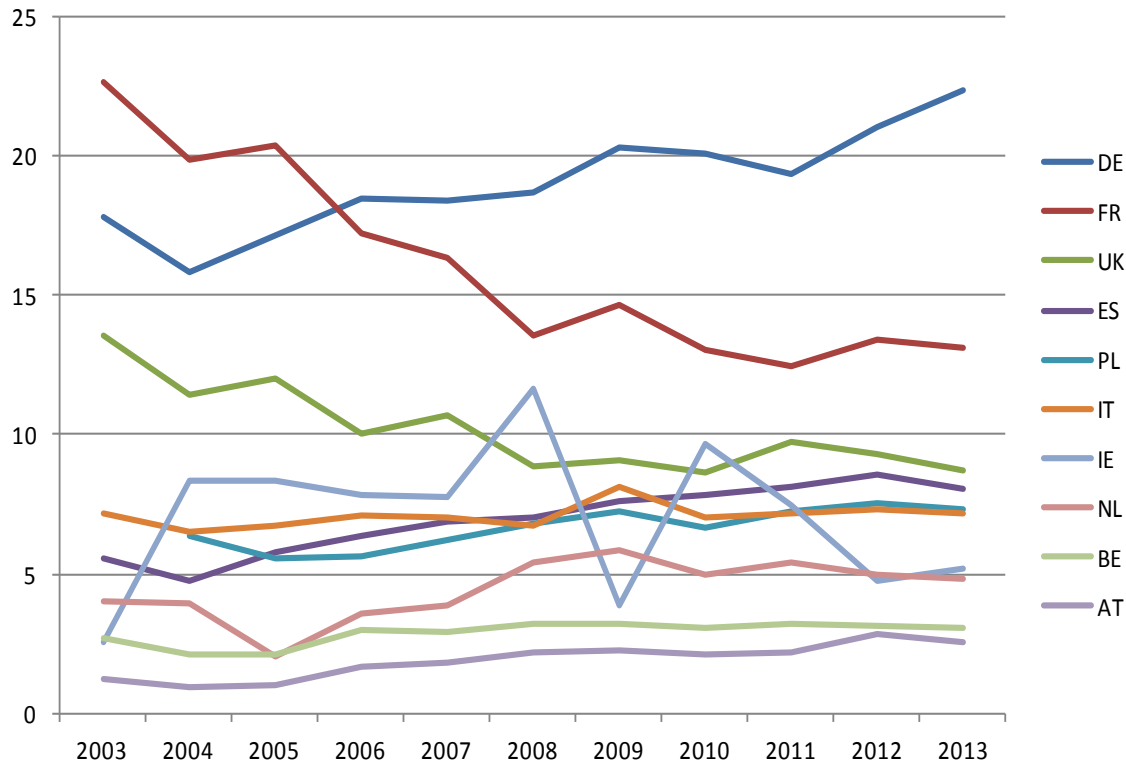
*The related employment is estimated with the Technology Diffusion approach and it is interpreted as employment that is dependent on the production and use of KETs based products

⇒ Industrial Biotechnology provides and secures more and more jobs

⇒ Based on assumption of trend extrapolation of production trends and market studies, new study by Europabio (2016) **projects a doubling or tripling of IB employment in 2030****

IB Employment in Europe: Country shares of member states

Share in IB employment* for the TOP 10 EU-28 Countries (in %)



Source: KETs Observatory In contrast to patent statistics the shares refer only to employment for Europe, not world wide

➔ Although large European countries have the highest shares, IB employment is relatively evenly distributed across European countries compared to other KETs

Disruptiveness and spillover effects of IB for the wider economy

Disruptiveness:

- IB has high potential to contribute to the societal challenges
- IB changes the boundaries and interplay of sectors (e.g. chemicals-agrar) and actors
- IB requires often changes in business models that comprise sustainability as its core

Spillovers: Industrial Biotechnology enables the development of new goods and services and the restructuring of industrial processes in the whole economy

Empirical assessment for KETs state:

- IB increases the total regional technological performance of EU regions; the magnitude is higher than of other KETs*
- IB is increasingly important for a range of application products**

* Based on finding for Technological Spillovers: Montresor / Quartero (2015) that all KETs “enable” European regions to increase their total portfolio of new technologies in total over time, with IB having the highest positive impact of the six KETs

** Based on finding for Production Spillovers: According to the KETs Observatory, the significance of IB for technology generation & exploitation is modest and constant (0,16% for EU-28 in 2012), but for technology diffusion IB significance rises continuously in the last decade (2,12 % for EU-28 in 2012)

References

- Montresor, S., & Quatraro, F. (2015).: *Key Enabling Technologies and Smart Specialization Strategies. European Regional Evidence from patent data* (No. 2015-05). Institute of Prospective Technological Studies, Joint Research Centre.
- Europabio (2016): Jobs and growth generated by industrial biotechnology in Europe; written by IDEA Consult
- NOVA Institute (2015): Market study on bio-based building blocks and polymers in the world -Capacities, production and applications: status quo and trends toward 2020