The Role of Biotechnology in the Bioeconomy

Annual Congress Biotechnology 2020+
Berlin, 4th October 2018

Prof. Dr. Christine Lang
Founder, ORGANOBALANCE AG (now Novozymes AG) & BELANO Medical AG
Manager, MBCC Group - Consulting and Coaching in Microbiotics and Bioeconomy
Co-Chair, German Bioeconomy Council
Overview

1. Concept & understanding of bioeconomy
2. Biotechnology – key pillar of the knowledge-based bioeconomy
3. Transforming research into marketable applications
4. Bioeconomy policy in Germany
5. The German Bioeconomy Council
1. Concept & understanding of bioeconomy
Comprehensive understanding of bioeconomy

- Knowledge-based production & utilization
- of biological resources,
- innovative biological processes & principles
- to sustainably provide goods and services across **all** economic sectors.

Source: German Bioeconomy Council, 2016
Biologization of the economy

>> Collective term for the increasing integration of principles of nature in modern economic sectors, or the development of products and solutions with the help of the life sciences*.

*Life sciences:
Medicine, Biomedicine, Pharmacy, Biochemistry, Chemistry, Molecular Biology, Biophysics, Bioinformatics, Human Biology, Agricultural Technology, Nutrition Science and Food Research, to the scientific processing of biogenic natural resources and biodiversity research.
Knowledge-based bioeconomy: focus on value-added

1. Biomass production (agriculture, forestry, marine)
2. Direct biomass use (food, feed, energy)
3. Processing of biomass (food, feed, materials)
4. Biobased products (plastic, composite materials, chemicals, fibers, etc.)
5. Biological intelligence (IT, design, pharma, bionics)

Knowledge components (incl. IP)

Biomass
2. Biotechnology – key pillar of the knowledge-based bioeconomy
Drivers of biotechnology development

- Technical drivers
  - emerging technologies (e.g. DNA sequencing, synthesis, and editing etc.)
  - public & private biofoundries
  - open-source approaches
  - digitalization
  - peer-to-peer sharing platforms
  - cloud-based experimental platforms
  - biotech incubator spaces

- Economic drivers
  - addressing societal challenges (e.g. food and energy security, climate change etc.)
  - producing economic benefits (e.g. job creation, economic growth etc.)
  - governmental investment (e.g. public R&D, policy strategies)
  - private sector investment
  - crowdsourcing, accelerating organizations etc.

- Social drivers
  - governmental investment (e.g. public R&D, policy strategies)
  - private sector investment
  - crowdsourcing, accelerating organizations etc.

Biotech revenues in Europe

<table>
<thead>
<tr>
<th>European biotechnology at a glance (US$b)</th>
<th>2016</th>
<th>2015</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Public company data</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues</td>
<td>27.2</td>
<td>22.8</td>
<td>19%</td>
</tr>
<tr>
<td>R&amp;D expense</td>
<td>6.9</td>
<td>6.7</td>
<td>3%</td>
</tr>
<tr>
<td>Net income (loss)</td>
<td>(1.3)</td>
<td>1.0</td>
<td>-235%</td>
</tr>
<tr>
<td>Market capitalization</td>
<td>164.2</td>
<td>150.1</td>
<td>9%</td>
</tr>
<tr>
<td>Number of employees</td>
<td>67,460</td>
<td>48,590</td>
<td>39%</td>
</tr>
<tr>
<td><strong>Financing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital raised by public companies</td>
<td>3.6</td>
<td>7.4</td>
<td>-52%</td>
</tr>
<tr>
<td>Number of IPOs</td>
<td>23</td>
<td>33</td>
<td>-30%</td>
</tr>
<tr>
<td>Capital raised by private companies</td>
<td>2.1</td>
<td>2.5</td>
<td>-18%</td>
</tr>
<tr>
<td>Number of companies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public companies</td>
<td>259</td>
<td>238</td>
<td>9%</td>
</tr>
</tbody>
</table>

Source: EY, Capital IQ and company financial statement data.
Biotechnology industry in Germany

- 646 Enterprises (+5%)
- 21,860 Employees (+7.8%)
- 50.5% of the companies are active in the health/medical sector
- 4,105 Mrd. € Turnover (+15.8%)
- 1,117 Mrd. € R&D Investment (+1.2%)
- 673 Mio. € Financing (+33.3%)

Fields of activity of dedicated biotech companies in Germany

Trends in biotech patents in the last 20 to 25 years

Development in biotechnology patent applications, 1990-2012

Share of biotech patents by sub-areas, 1990-2012

- Bioinformatics on the rise, however on low level
- Share of other sub-areas quite constant

Biologization & Digitalization

- Big data & “omics“-technologies
- Genome editing of organisms & breeding
- Biorobotics
- Bio-sensors & chips
- Bioprospecting in pharma
- Agriculture & forestry 4.0
- Plastics moulding & 3D-printing
- Personalized nutrition
- Bioinspired algorithms & software
- Storage technologies (DNA)
- etc.
3. Transforming research into marketable applications
4. Bioeconomy Policy in Germany
Bioeconomy Policy in Germany

**Vision:**
Ensuring the transition to a biobased economy that is in accordance with technology and ecology.

- National Research Strategy
  BioEconomy 2030 (2010)

Bioeconomy in the wider policy arena (I)

2014  Coalition Agreement
• promotion of the bioeconomy (concepts for cultivation, processing & utilization of biomass)

2015  Framework research program on sustainable development (FONA³)
• bioeconomy as pillar of green economy
• research on new industrial-value chains of biomass

2016  German Sustainable Development Strategy
• bioeconomy contributes to SDGs on growth, industrial innovation, sust. production & consumption (8, 9, 12, 15)

2017  Recommendations of the High-tech Forum
• bioeconomy as one of six future topics
• Biologization of the industry

2018  Coalition Agreement
• developing an overall concept for the planting, processing and use of biomass with regard to bioeconomic considerations
• Using the principles of nature & interdepartmental agenda „from biology to innovation“
Bioeconomy in the wider policy arena (II)

High-tech Strategy 2025

- National Bioeconomy Strategy
- National Research Agenda
- Utilization of CO₂
- Dialogue Platform Industrial Bioeconomy

- Interdepartmental Agenda „From Biology to Innovation“
- Materials Strategy
Latest policy developments

En route to **ONE** bioeconomy strategy

- **03/2016**: BMBF stakeholder workshops
- **11/2016**: Recommendations of the Bioeconomy Council
- **03/2017**: Evaluation report of BE research strategy
- **08/2016**: Evaluation report of BE policy strategy
- **End of 2018**: Further development of BE strategy papers
- **Spring 2019**: New BE strategy
- **06/2018**: BMBF Agenda conference
5. The German Bioeconomy Council
# About the German Bioeconomy Council

## Objectives and tasks

1. encouraging R&D of new technologies
2. setting up positive framework conditions for a biobased economy
3. improving interdisciplinary training & professional development
4. dialogue with stakeholders

It is the German Bioeconomy Council’s aim to establish a **cross-sectoral knowledge-based bioeconomy** which generates sustainably created products and services, thus combining economic growth with the objective of environmental compatibility.
Thematic expertise of the Council

- Ethics, Consumer, Sociology
- Chemistry, Biology, Ecology
- Agro, Forestry, Soil
Policy recommendations of the Council

Agriculture (2015)

Plant Research (2015)

Wood (2016)

Chemical Industry (2015)

Bioenergy (2015)

Protein Supply (2017)

Genome Editing (2018)
Genome editing: call for new EU legislation

Guidelines for amending the legislation & accompanying measures:

- legislation that is more suited to the many different applications of the new technologies
- official registration & monitoring of Good Practice
- strengthening the infrastructure for voluntary certification
- increasing research funding for applications of high social relevance
- funding for accompanying research
- developing new formats of dialogue for a constructive social debate
- intensify international exchange & collaboration to guarantee greater transparency and regulatory harmonization
Challenges in the German innovation system

Despite progress and promising product developments, there are still too few biobased innovations on the market.

Reasons for that are:

• competition with fossil-based or energy-intensive products
• missing venture capital and growth financing
• unfavorable legal conditions
• missing network of BE centers at federal and state level
• lack of knowledge on the bioeconomy concept among the public
• no clear definition of the product attribute “biobased”
Recommendations for the further development of the national research strategy „BioEconomy 2030“

Higher-level recommendations

**Objective:** supporting the change to a more sustainable society and in particular to a biobased, sustainable economic system.

- full range of biological resources (incl. knowledge)
- holistic understanding of the bioeconomy & visionary agenda setting
- collaboration from research to application
- establishment of a national bioeconomy platform
- targeted education, training & promotion of young researchers
Thematic research priorities: cross-cutting issues

- Society
- Digitalization
- Implementation
Thematic research priorities: 5 areas of activity

1. Bioeconomy for a high quality of life in cities
2. Healthy and sustainable food system
3. Resource protection and biobased circular economy
4. Sustainable biobased consumption
5. Conversion and storage of solar energy, hybrid energy systems
Area of activity 1

Bioeconomy for a high quality of life in cities

- greening technologies, green spaces & green belts
- new concepts promising buildings worth living in with a low resource footprint & more flexible use
- conversion of traffic to electric drives and alternative fuels
- new concepts for consumer-oriented cultivation of food in the city and close to the city

*personal interpretation of the artist ©Benjamin Stolzenberg
Area of activity 2

Healthy and sustainable food systems

- sustainably produced, healthy food
- fertile soils
- supply of high-quality proteins
- product innovations & incentives and accompanying measures for sustainable and healthy eating habits
- supply concepts at the interface between nutrition science, medicine and digitalization

©Benjamin Stolzenberg
Area of activity 3

Resource protection and biobased circular economy

- further development of biorefinery concepts
- support of demonstration projects illustrating technological feasibility
- assessment of environmentally and economically beneficial conversion paths
- bioeconomic innovations with a clearly smaller resource footprint
- measuring external effects of using renewable resources
- analyzing & communicating trade-offs, developing possible solutions
- promoting genome and microbiome research, integrated biodiversity research, biodiversity informatics and phenotyping
Area of activity 4
Sustainable biobased consumption

- identify and encourage society’s opportunities to influence and shape the development of a sustainable bioeconomy
- experiments
- involvement in innovation networks, grassroots research projects and biobased products developments („consumer co-creation“ & „citizen science“)
- measurement and communication of the sustainability and climate relevance of consumer behaviour
Area of activity 5
Conversion and storage of solar energy, hybrid energy systems

- generating high-energy hydrocarbons directly from water and CO₂
- distributed use of renewable energies

*personal interpretation of the artist ©Benjamin Stolzenberg
Bioeconomy research in context

- more strongly research-oriented funding on long-term socio-political models
- intelligent use of innovation capacities and resources
- linking together and implementing the goals & ideals of important strategies:
  - federal bioeconomy policy strategy
  - federal strategy on sustainable consumption
  - EU strategies on bioeconomy & circular economy
  - Convention on Biological Diversity
  - etc.
- Integrating the bioeconomy in the high-tech strategy
Thank you!

Prof. Dr. Christine Lang
Co-Chair, German Bioeconomy Council

Contact:
Secretariat of the German Bioeconomy Council
Beate El-Chichakli b.elchichakli@biooekonomierat.de
Phone.: +49-30-46776743 www.biooekonomierat.de

Imprint (photos):
Weissblick/fotolia.de (S28, Head with Digital Zeros and Ones), kasto/fotolia.de (S28, Audience in the lecture hall), Jacob Lund/fotolia.de (S28, Stack of hands showing unity)
How does bioeconomy relate to SDGs?

- Food security & nutrition
- Health & well-being
- Clean water & sanitation
- Affordable & clean energy
- Economic growth
- Industry, innovation & infrastructure
- Responsible consumption & production
- Climate action
- Life below water (aquatic resources)
- Life on land (terrestrial resources)

How does biotechnology contribute to SDGs?

1) low-carbon protein

2) functional foods

3) food waste processing

Source 1: Prolupin GmbH [http://madewithluve.de/index.php?id=34]
How does biotechnology contribute to SDGs?

1) biotechnology-derived nanocellulose

2) Biopharmaceuticals

3) probiotics

Source: Jenacell [http://www.jenacell.com/en/]
How does biotechnology contribute to SDGs?

1) water treatment & phosphor recovery from waste water

2) biological cement-based building materials

Source 2: bioMASON [http://biomason.com]
1) Biotechnological spider silk for ecological high-performance fibers

2) Recyclable and/or biodegradable plastics

3) Functional textiles

How does biotechnology contribute to SDGs?

1) bioenergy

2) algae cultivation systems

3) carbon capture & usage systems

Source: LanzaTech [http://www.lanzatech.com]