

Bioprincipled Cities in the Bioeconomy

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zef

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Bioökonomierat

Bioeconomy Council
of the German Government

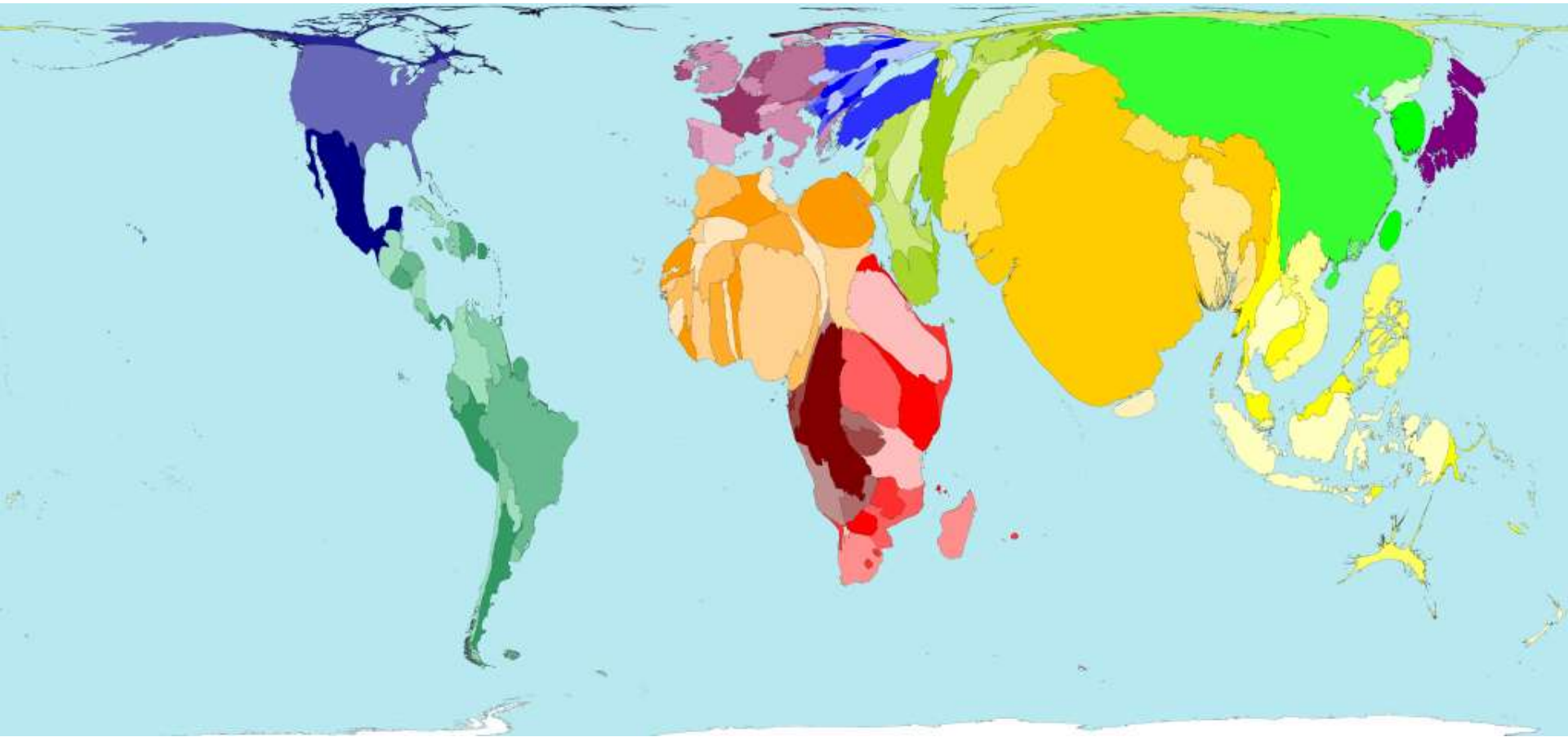


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Urban Situations to Change around the world...



Consumption of Resources: World population from 7.5 to 9 bn people in 2050 with food & water consumption equivalent to 12 bn people today; and $\frac{3}{4}$ in cities



➡ Bioeconomy Vision: Reconciling humanity with nature

Innovations for bio-principled cities

1. Bio-principled Cities in the Bioeconomy

- Bioeconomy
- Challenges and vision of bioprincipled cities

2. Bio-principled Urban Planning

- Metabolism, circular material flows
- Ecosystem services & greening

3. Bio-principled Architecture

- Architecture
- Biobased Materials

4. Biobased Urban Production

- biobased, circular industry production
- urban agriculture

5. Way Forward

What is the Bioeconomy?

Plants, Microbes, Animals, Biodiversity,
Biotechnology, „C“ in CO₂, **biological systems
knowledge, new bio-based construction
materials**

**Sustainable production and use of **biological
resources, processes and principles** to provide
products and services in **all economic sectors.****

Agriculture/Forestry/Fisheries, Food, Paper, Textiles, **Building &
Construction, Urban planning**, Paper, Chemistry, ICT,
Pharma...

Some bioeconomy innovations – examples of consumer products



Biomaterials in car industry



Enzymes lowering effective washing temperature



Bioplastics



Implants made from spider fibers



Biobased building materials



New sugar substitutes



Biopharmaceuticals based on proteins



Biofuels based on forest residues, straw etc.

Auto-parts potentially now already from bio-plastics



Priority Goals of the Bioeconomy



Population growth & life expectancy



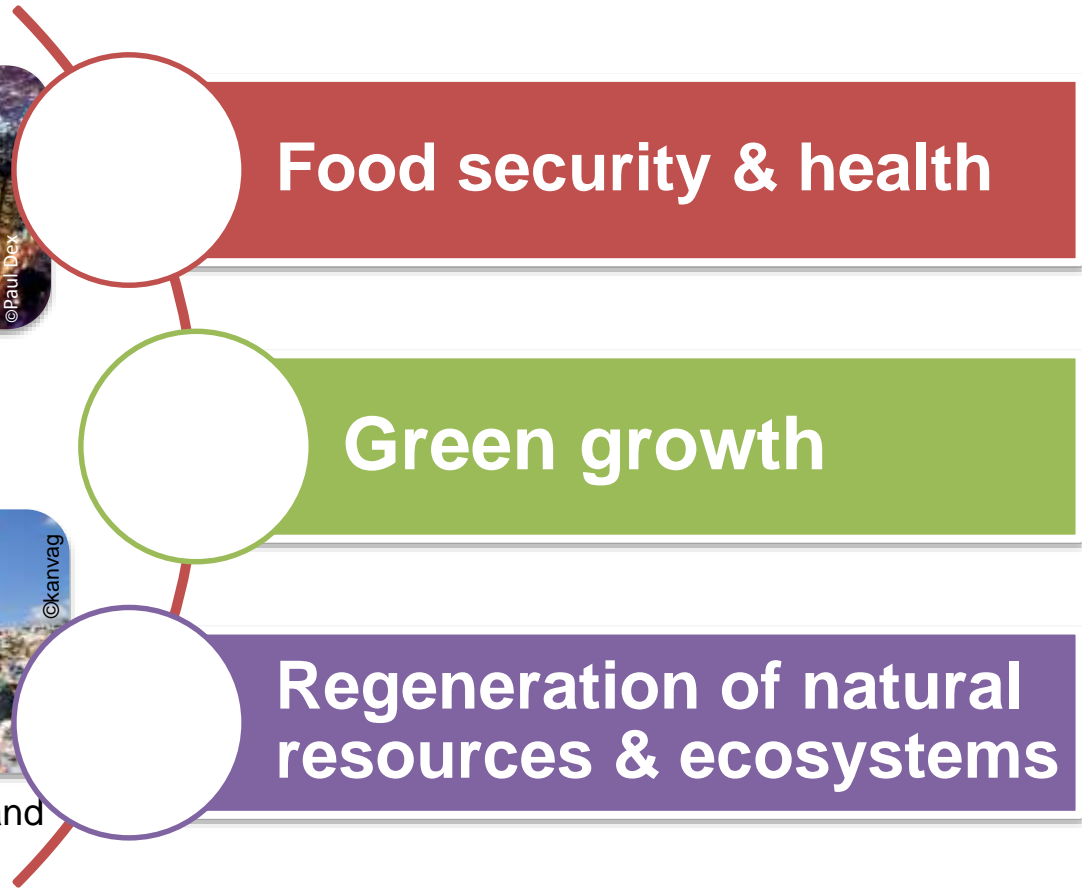
Urbanization in mega-cities



Material consumption of growing middle class



Climate change and environmental degradation



Food security & health

Green growth

Regeneration of natural resources & ecosystems

Bioeconomy is driven by...

Major changes in:

- 1. Resource conditions**
- 2. Consumer preferences**
- 3. Science & technology**

... and responses:

Policy strategy & int. negotiations

(e.g. COP21, SDGs)

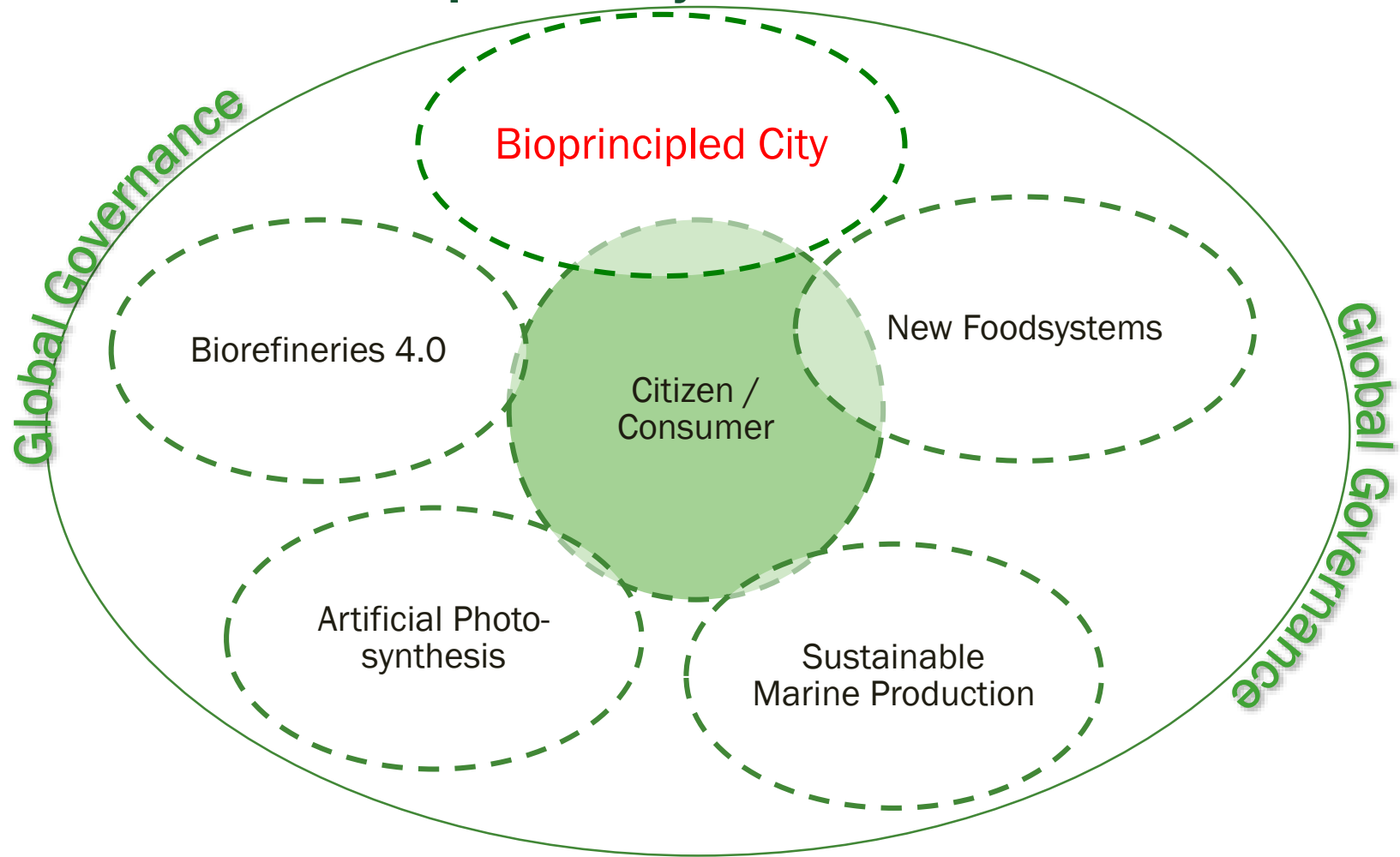
Business imperatives

(e.g. food industry, pulp & paper)

Science & technology initiatives

(e.g. agricultural sciences, industrial biotech, material science, climate science)

Candidates for global Co-operation: Results of an International Delphi-Study on Global S&T Bioeconomy



Source: Global Visions for the Bioeconomy – an International Delphi-Study, German Bioeconomy Council

Delphi-Study: Vision of a bioprincipled city



Bio City - © weiming.com.cn

Urban planning

- closed material & energy cycles (metabolism)
- cascading use of natural resources
- combined living & working spaces & biotopes
- green spaces provide ecosystem-services

Architecture

- bio-inspired design solutions (autonomy)
- biobased building materials

Urban production

- green industrial production in cities
- fresh food from urban farming

Source: German Bioeconomy Council (2015)

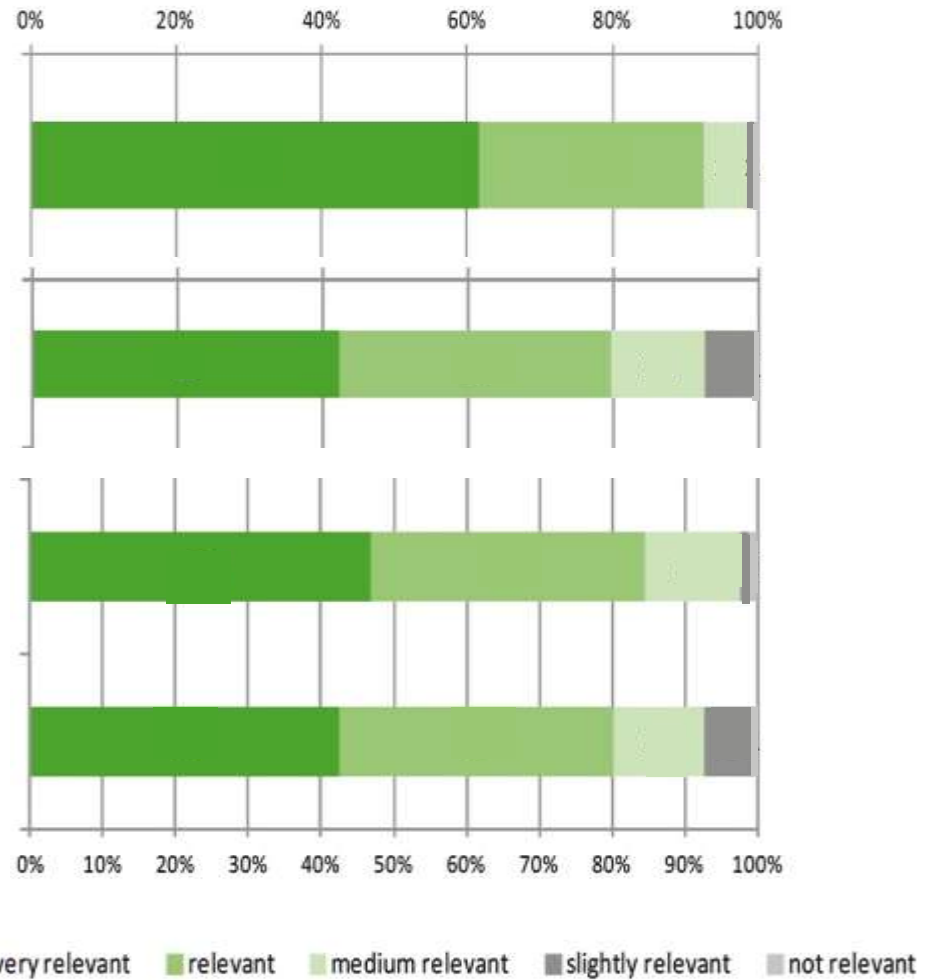
Bioprincipled city – relevant aspects according to international expert Delphi-survey

Urban planning: efficient metabolism, closing material loops, zero-waste

Green industry production in cities, integrated with residential living

Architecture: using bioprinciples & materials to achieve water & energy autonomy

Biobased building materials



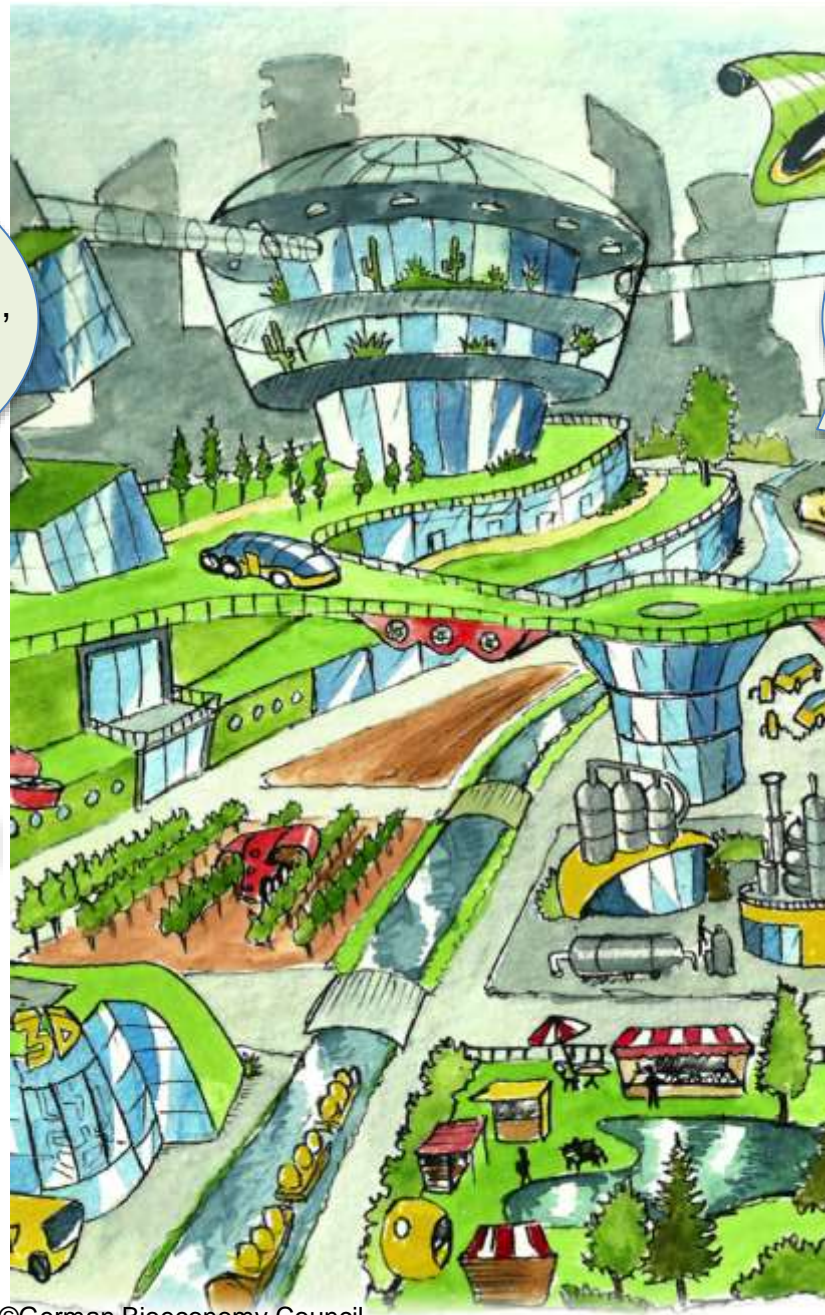
Source: German Bioeconomy Council (2015)

Urban Bioeconomy Vision --- bio-principled / bio-sensitive

Greening:

climate, biodiversity, resilience,
health, recreation,
equal access

**Renewable
materials,
mobility,** natural
lighting, shading



City metabolism
(bioeconomy; circular
approaches)

Mixed-use (living,
educating,
producing,
agriculture, leisure)

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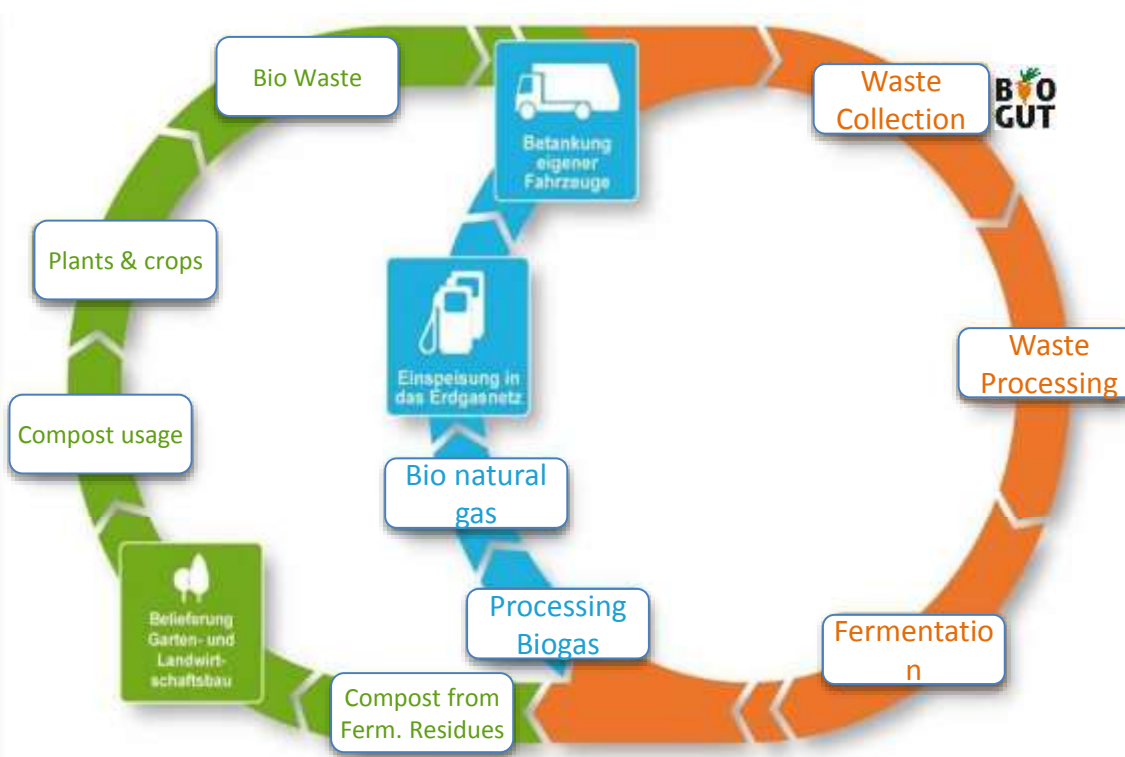
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Urban Planning - Metabolism

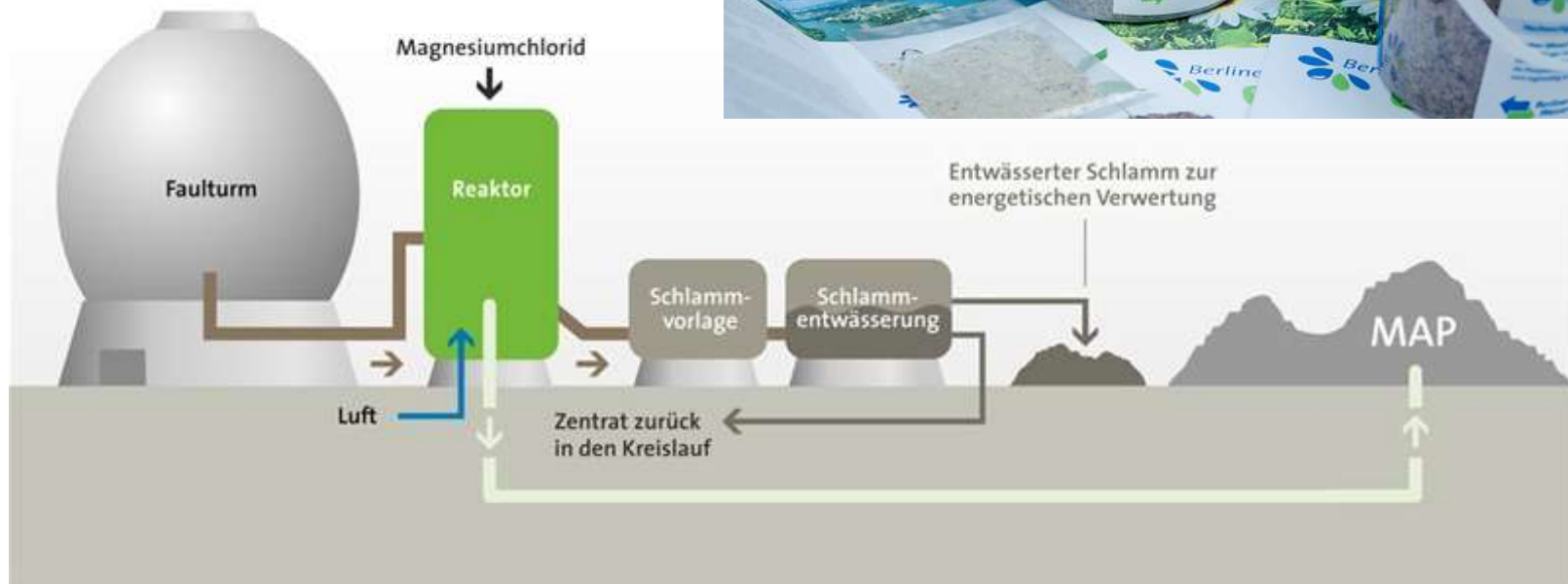


City Bio Waste
 2,5 Mio liters of Biodiesel
 12.000 Tons CO₂ Reduction
 Berlin

Urban Planning - Metabolism

Phosphat Recycling

1500 tons of fertilizer from waste water for nearby agriculture (Berlin)



Greening urban spaces for more sustainable cities

Streets, public spaces



Picture from: Naturkapital Deutschland – TEEB DE
www.naturkapitalteeb.de

Urban Wasteland →
community gardens
& beehives



©Google Earth; Pictures from: www.prinzessinnengarten.net

Roofs & Facades



Picture from: Naturkapital Deutschland – TEEB DE
www.naturkapitalteeb.de



Picture from: Naturkapital Deutschland – TEEB DE
www.naturkapitalteeb.de

Ecosystem services: Air Filtering & Greening

German-Chinese Expert Team

Air cleaning equivalent of 275 trees

Reach: 50 meters

Watering, sensors, pumps, mobile management

Basis: moss plus vertical planting



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Architecture: Biobased Demonstration House Netherlands 2016



Biobased building materials:
structure, insulation, facades, flooring,
furniture

Biobased coloring, furniture,
Plant facade produces electricity
Solar panels



Pictures from: www.rvo.nl, www.innovatie-estafette.nl

Architecture: BIQ Hamburg

1st house with photo-bioreactor facades:

Warmth and biogas from algae

Combined solar, bioreactor & geothermal

Excess energy to district heating



Architecture: Wooden High-rise Buildings – HoHo Building Vienna

World's highest wooden building

Approved in 2015, start spring 2016

83 meters, 24-storeys

Hybrid construction, 75 % wood

Energy concept incl solar, elevator energy recovery

Saves: 2800 Tons CO₂ & 300 000 MWh Energy
(compared to ferroconcrete construction)



©Hoho Wien; Picture from www.hoho-wien.at

Architecture: Biobased Building Materials



Seaweed insulation on top floor



Cellulose insulation wool



Insulation made from rice husks



Lime plasters on straw balls



Linoleum flooring

B10 Stuttgart – Energy positive, recyclable house



©Zooney Braun; Picture from: www.aktivhaus-b10.de

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Biobased production: Urban agriculture and gardening

STUDY „HYPERIONS“ from INDIA
Energy-positive, urban re-naturation
Structure: cross-laminated timber, 36 story
Facades: solar
Roof covered with orchard gardens, hydroponic balconies
Combination: office, residential, urban gardening/farming
Closed water loop



AGROECOLOGY AND SUSTAINABLE FOOD SYSTEMS GROWING UP AROUND TOWERS

Biobased production: “Kleid Eden” – Tropical Hydroponics with industrial waste heat



©BR/Ulrich Detsch; Pictures from: www.br.de/

Biobased products – Vegetables and Fish from the Capital

Resource efficiency: less water, less CO₂, short transportation
Vegetables, Salads
Fresh fish: excrements fertilizer for plants



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What and how of research agenda on Bioprincipled Cities

1. Interdisciplinary research (socio-economic, bioscience, engineering, urban planning, architecture,...)
2. Combining bioeconomy science with creativity & art (architecture...)
3. Participation of citizens in urban design

Principles for Bioprincipled Cities

1. Not isolated urbanization but linked to rural
2. Integrate new labor relations, industrialization / IT, mobility
3. Overcoming segmentation, poverty & inequality

Must be results oriented:

- Improved natural conditions
- Increased people's satisfaction

Communiqué of the Global Bioeconomy Summit (Nov 2015, Berlin)



GLOBAL
BIOECONOMY
SUMMIT 2015

“Making Bioeconomy Work for Sustainable Development”

- I. Using renewable resources efficiently, ensuring food security and protecting ecosystems
- II. Making bioeconomy's contributions to Sustainable Development Goals measurable
- III. International collaboration in education, research and development
- IV. Experience exchange on policies fostering private sector and market development
- V. Integrating bioeconomy in multilateral agendas (COP 21 and UN Agenda 2030)

For more information see <http://biooekonomierat.de/home-en.html> and publications listed there