Wasserwirtschaft und Umweltschutz – Gesellschaft, Technik und neue Lösungsansätze

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:metabolon institute

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Zugang

Vorlesungen Mittwochs von 14:00-15:45 Uhr
per Zoom-Meeting

https://th-koeln.zoom.us/j/85273096361

Meeting-ID: 852 7309 6361 Kenncode: 700702

Agenda

1) Vorstellung: Forschungsgruppe GECO>C und :metabolon

2) Gesellschaftlicher Rahmen - Politische Brisanz des Wassers

3) Industrie 4.0 in der Wasserwirtschaft

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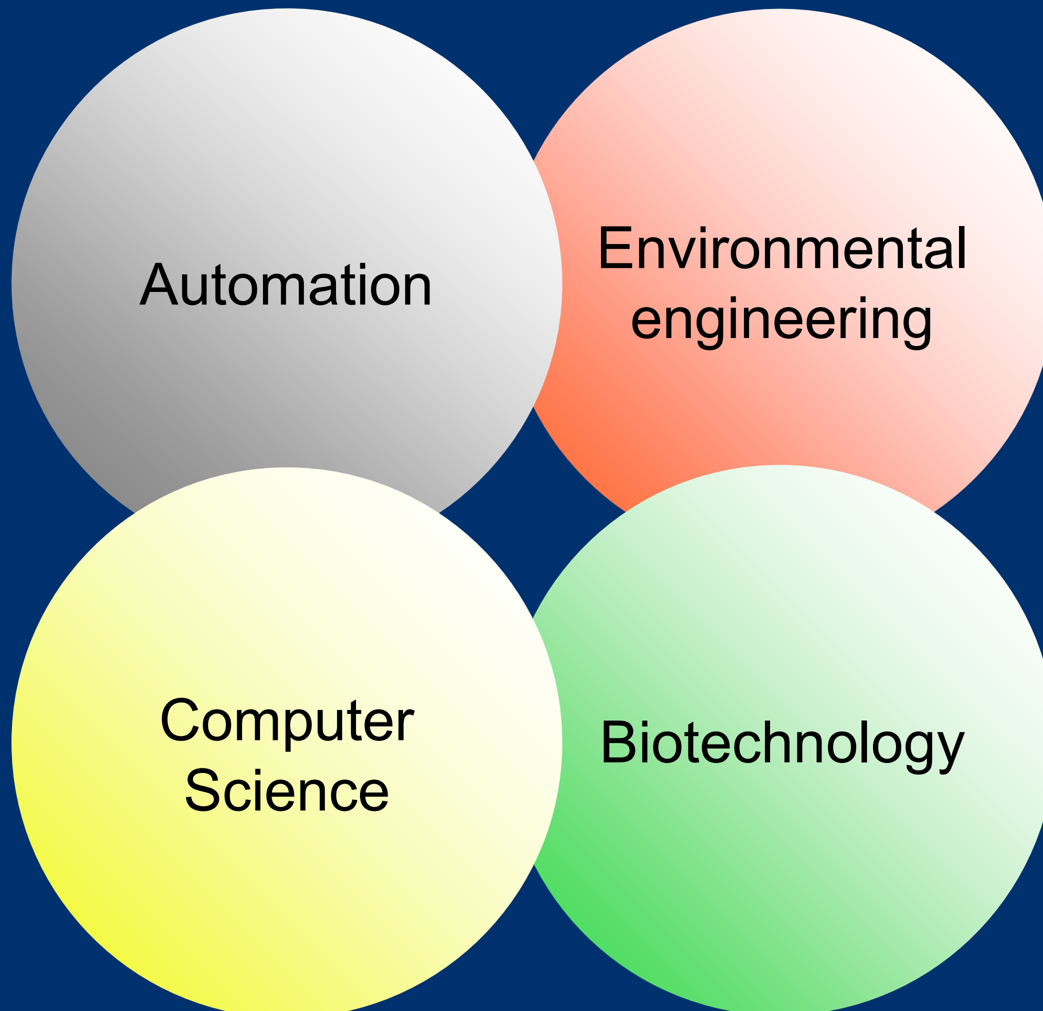
Forschungsgruppe: GECO►C



:metabolon in der Regionale 2025

Zirkuläre Wertschöpfung durch Energie- und Ressourcenmanagement

für die Kulturlandschaft im Bergischen Rheinland -

Analyse, Aufbau und Optimierung regionaler Prozesskreise

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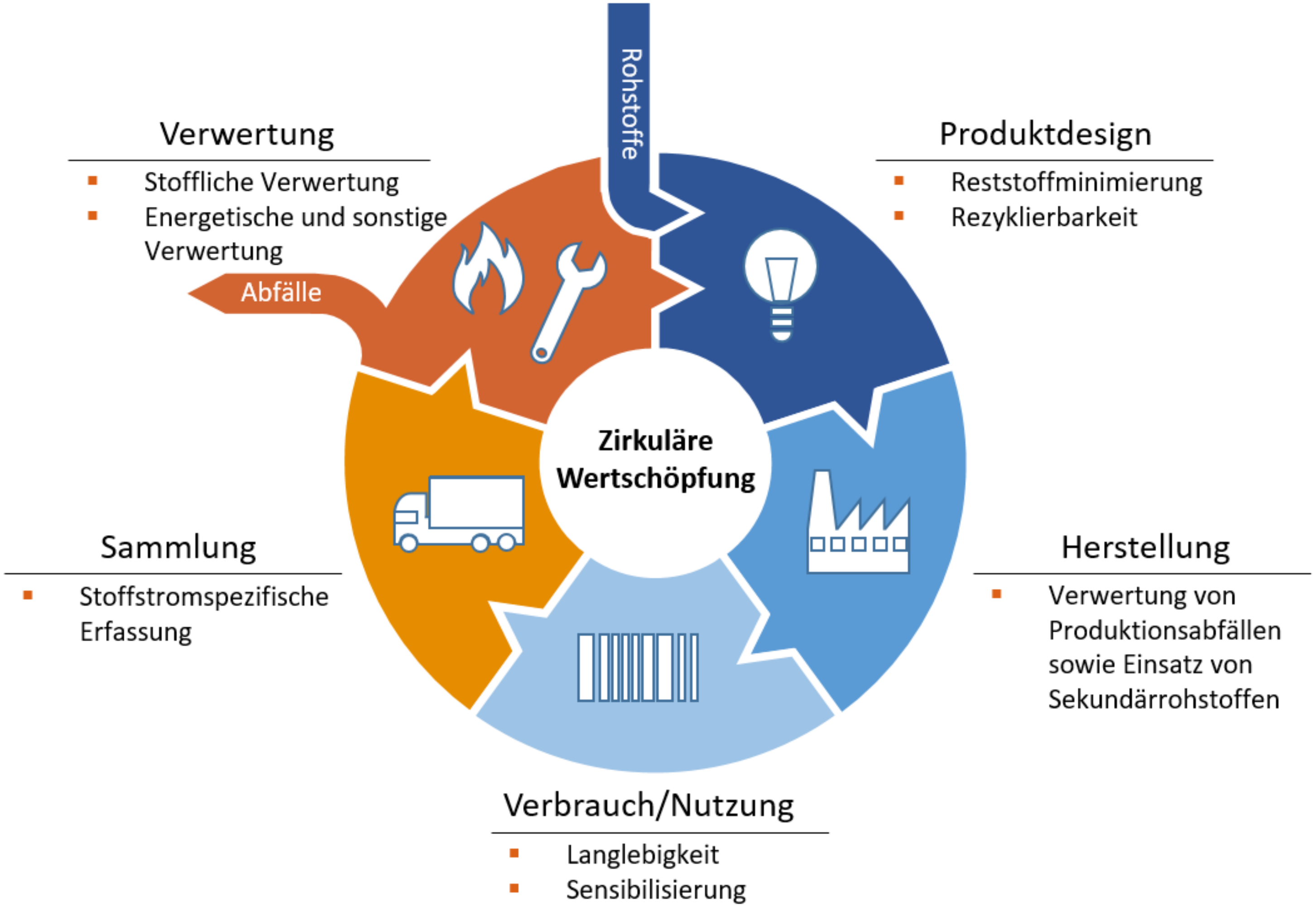
Zirkuläre Wertschöpfung



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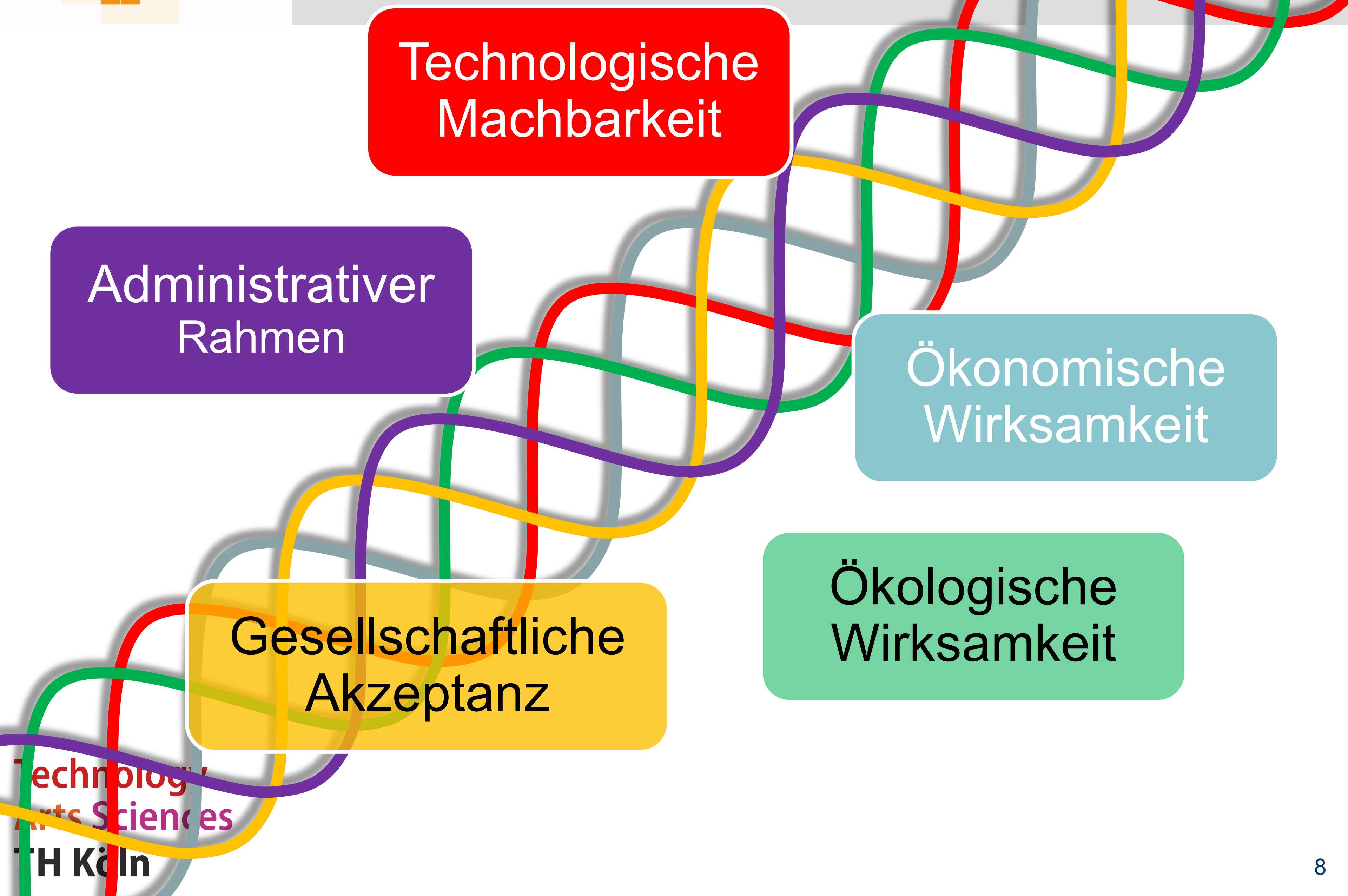
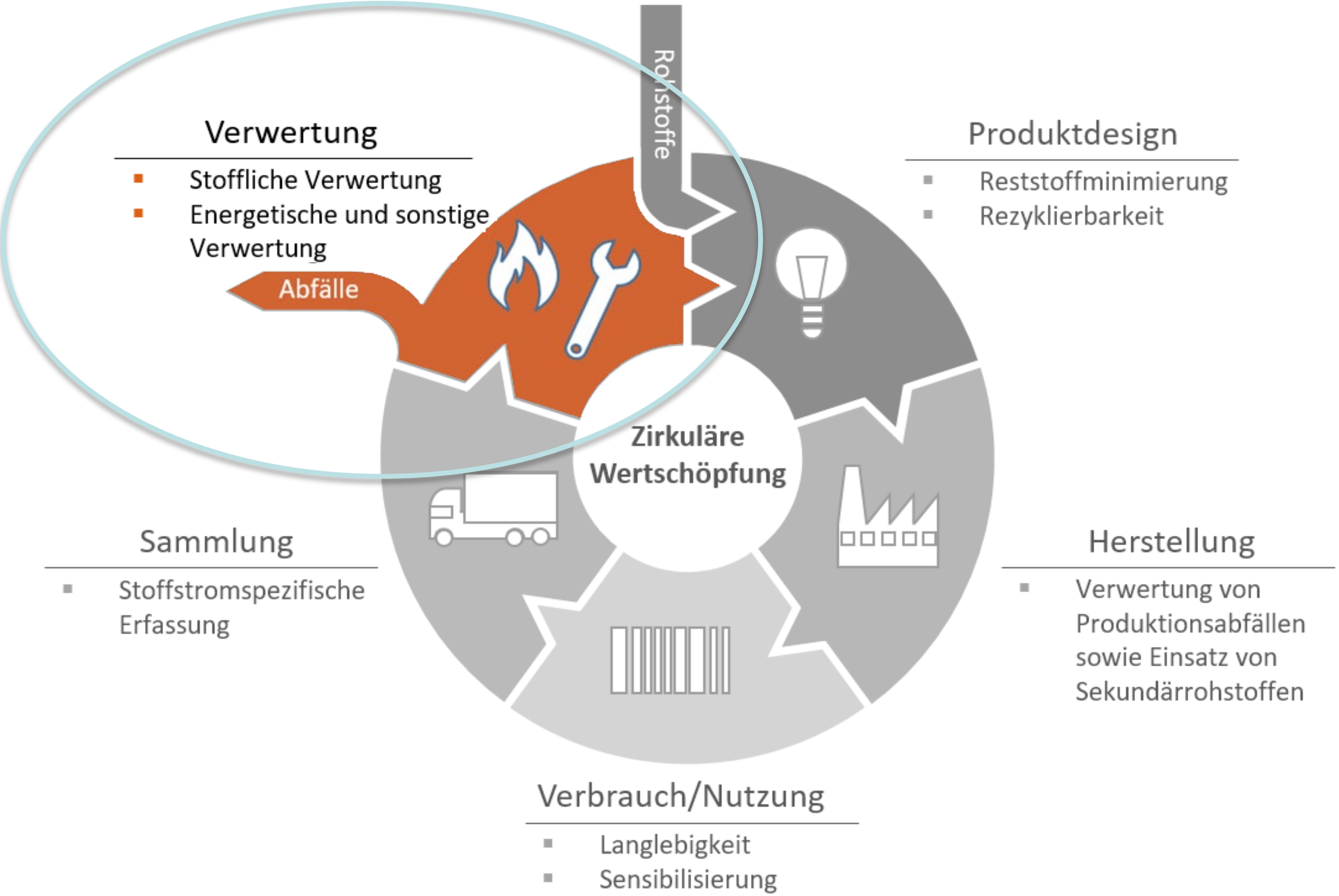
5-fach Helix :metabolon



:metabolon - Forschungsschwerpunkt



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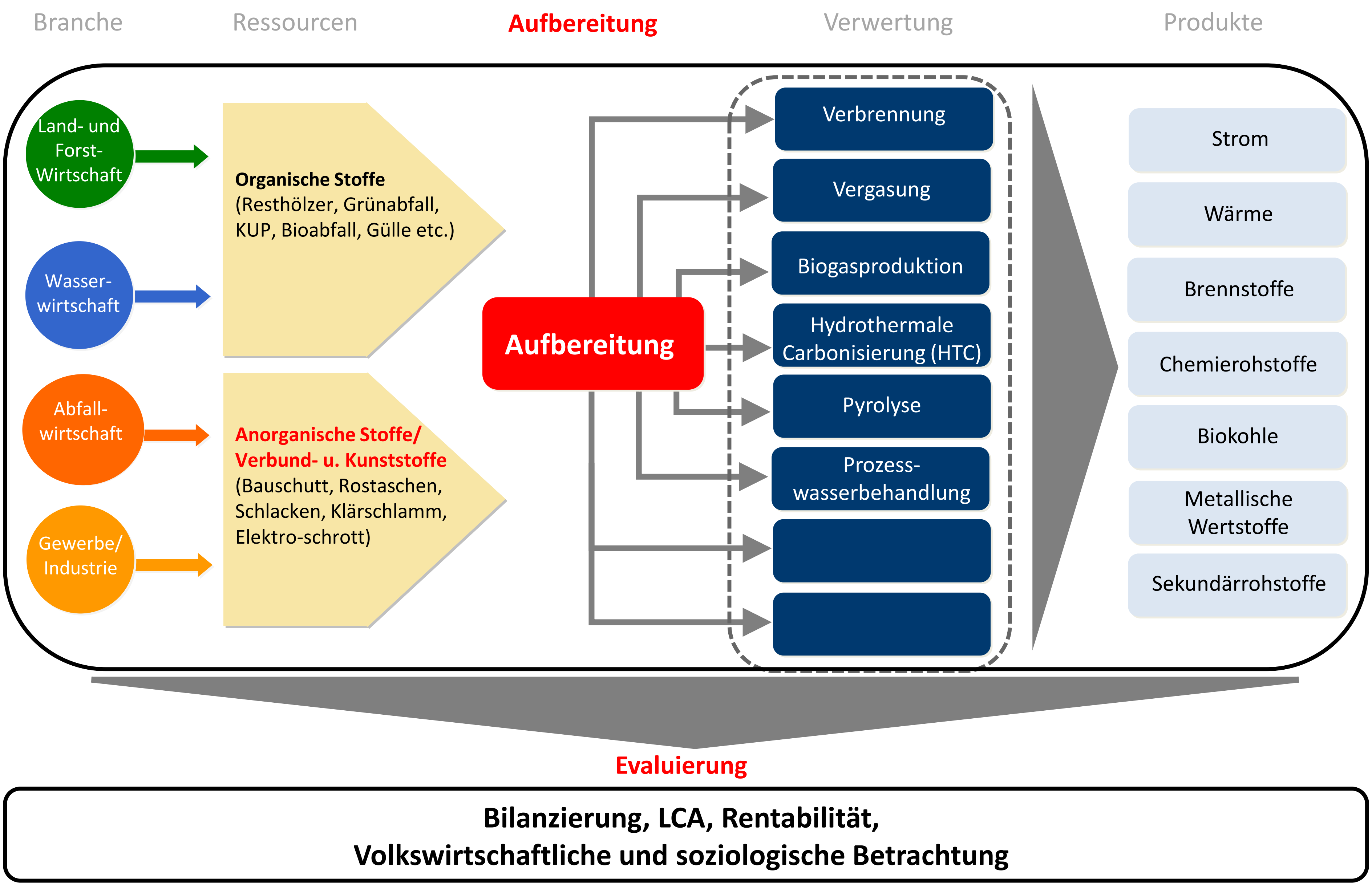
Forschungskonzept :metabolon



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Joint research faculty

Agenda

1) Vorstellung: Forschungsgruppe GECO>C und :metabolon

2) **Gesellschaftlicher Rahmen - Politische Brisanz des Wassers**

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Politische Brisanz des Wassers

Wasser waschen Singapur deckt rund ein Drittel seines Frischwasserbedarfs mit aufbereiteten Abwässern

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Politische Brisanz des Wassers

Knollen im Sand Tiefbrunnen, wie in El Oued in Algerien, lassen Kartoffeln in Wüsten wachsen, senken aber das Grundwasser immer weiter ab

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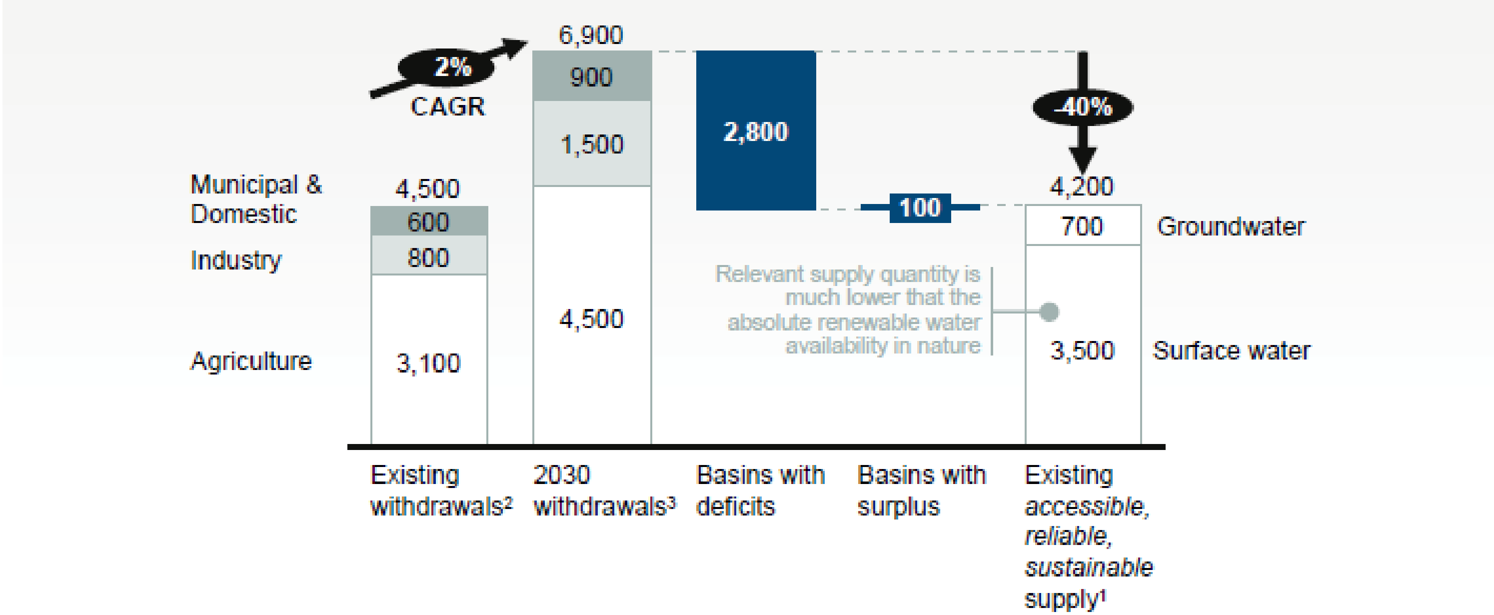
Water challenge

Aggregated global gap between existing accessible, reliable supply[1] and 2030 water withdrawals, assuming no efficiency gains

Billion m³, 154 basins/regions



1 Existing supply which can be provided at 90% reliability, based on historical hydrology and infrastructure investments scheduled through 2010; net of environmental requirements
2 Based on 2010 agricultural production analyses from IFPRI
3 Based on GDP, population projections and agricultural production projections from IFPRI; considers no water productivity gains between 2005-2030

SOURCE: Water 2030 Global Water Supply and Demand model; agricultural production based on IFPRI IMPACT-WATER base case

CAGR Compound Annual Growth Rate
IFPRI International Food Policy Research Institute

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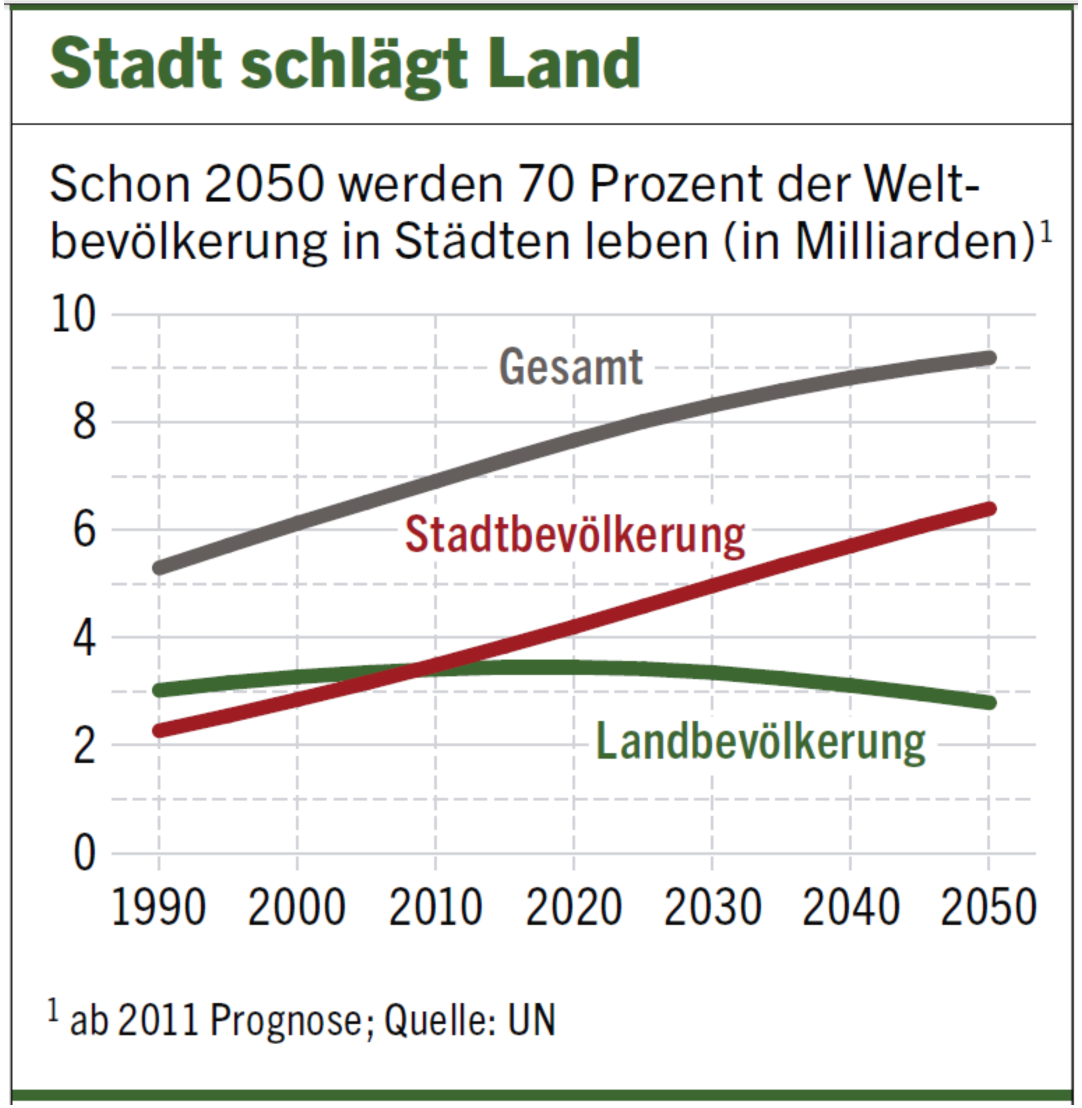
The 2030 Water Resources Group / www.2030waterresourcesgroup.com (2010)

Trend - Urbanisierung

Polit. Bedeutung



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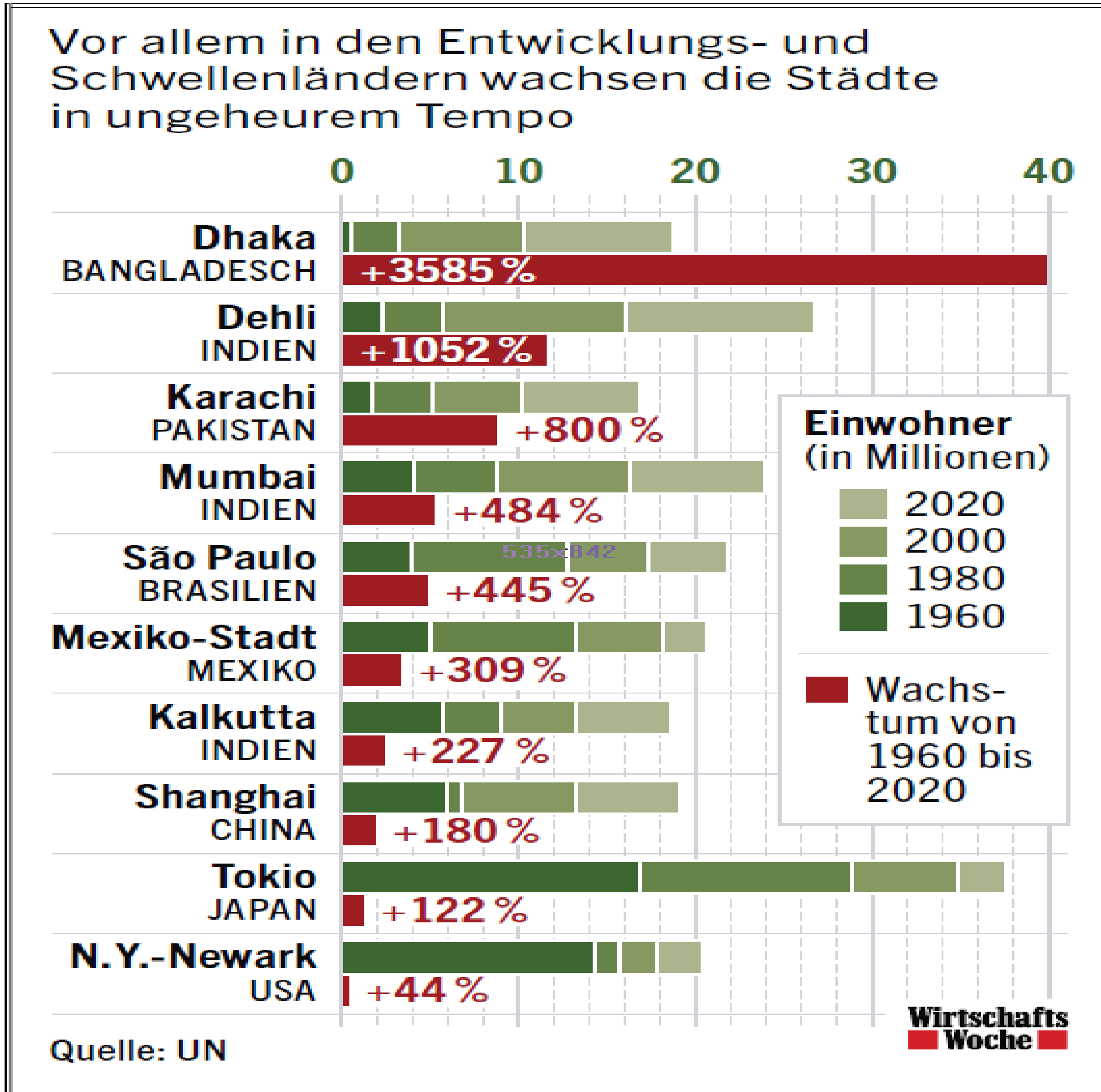
Politische Brisanz des Wassers

Polit. Bedeutung



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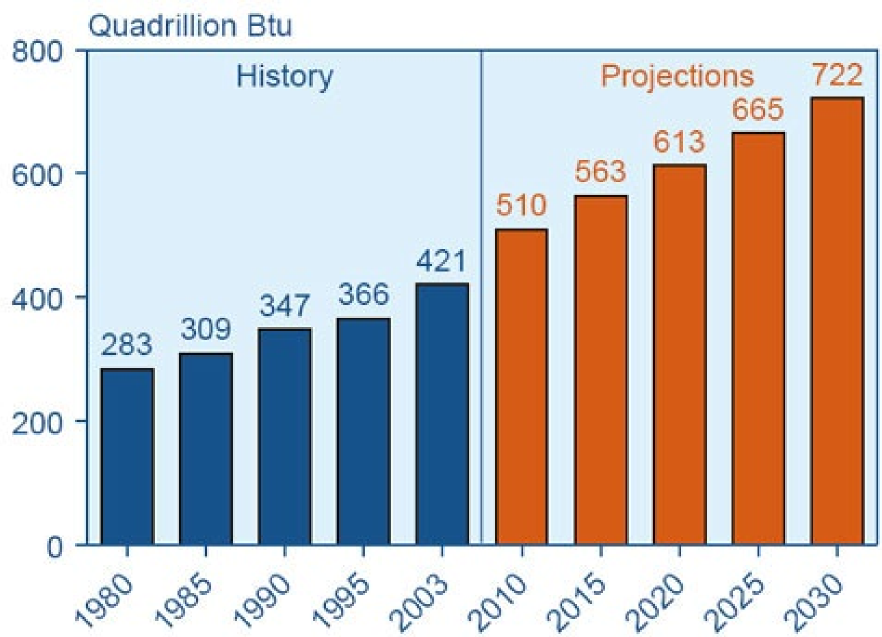
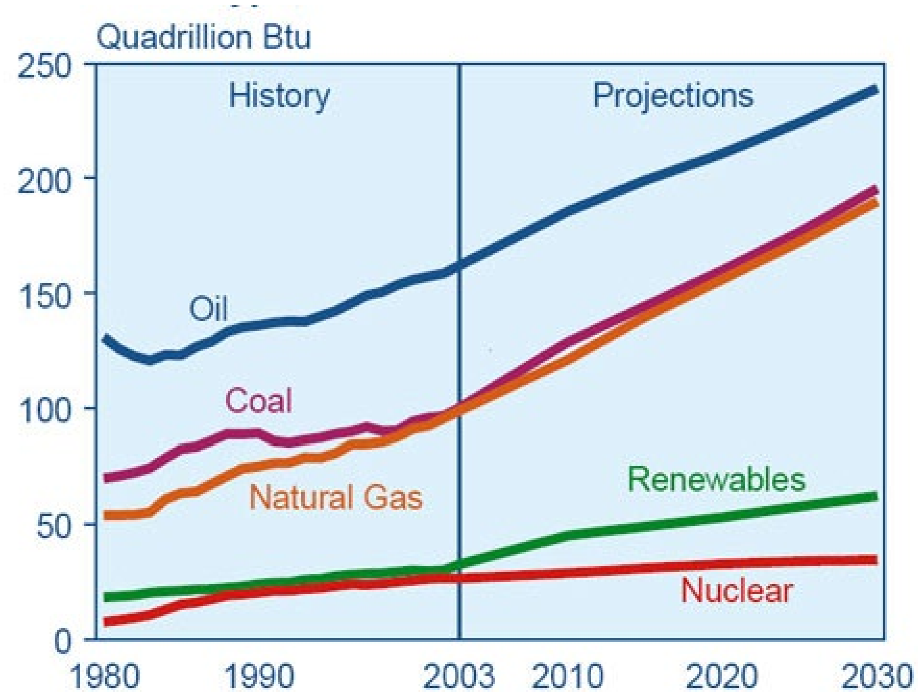
Energy challenges in 2006



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2006).

World Marketed Energy Consumption



Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2003* (May-July 2005), web site www.eia.doe.gov/iea/. **Projections:** EIA, System for the Analysis of Global Energy Markets (2006).

Energy Use by Fuel Type

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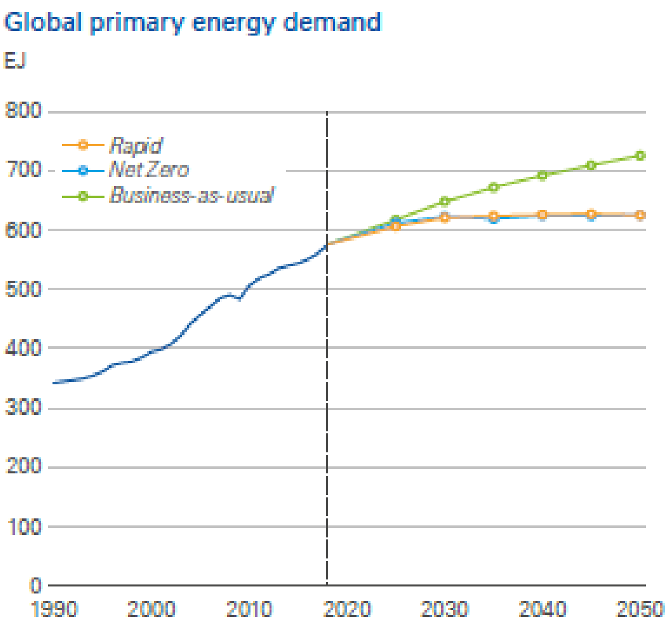
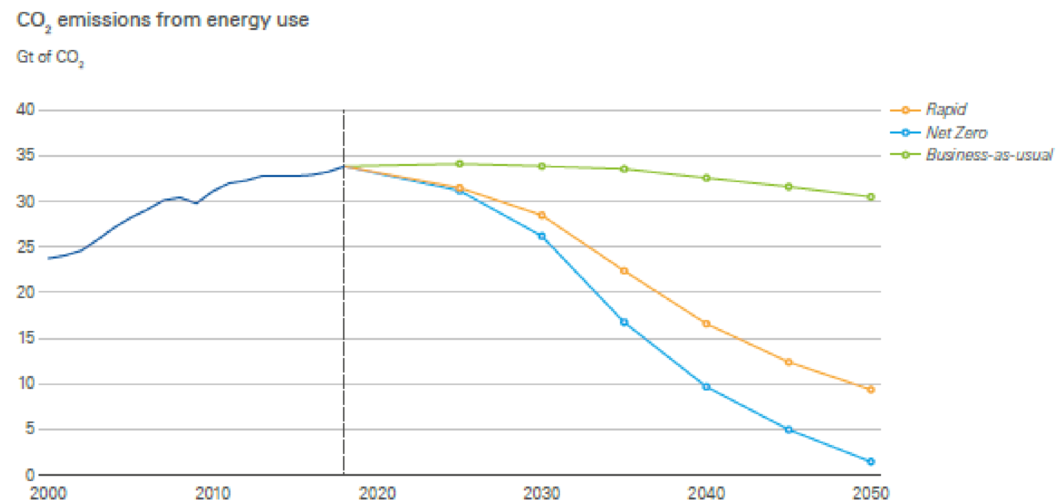
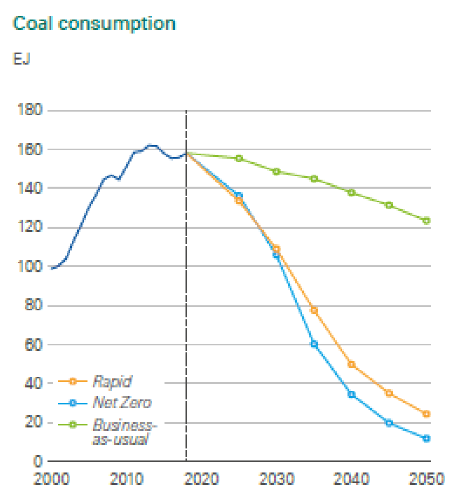
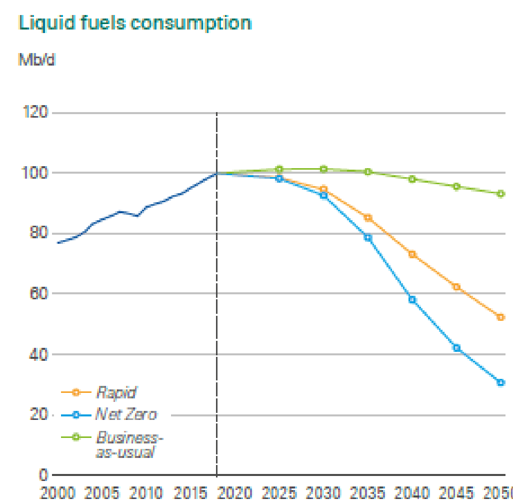
http://timeforchange.org/prediction-of-energy-consumption

Energy Scenarios in 2020





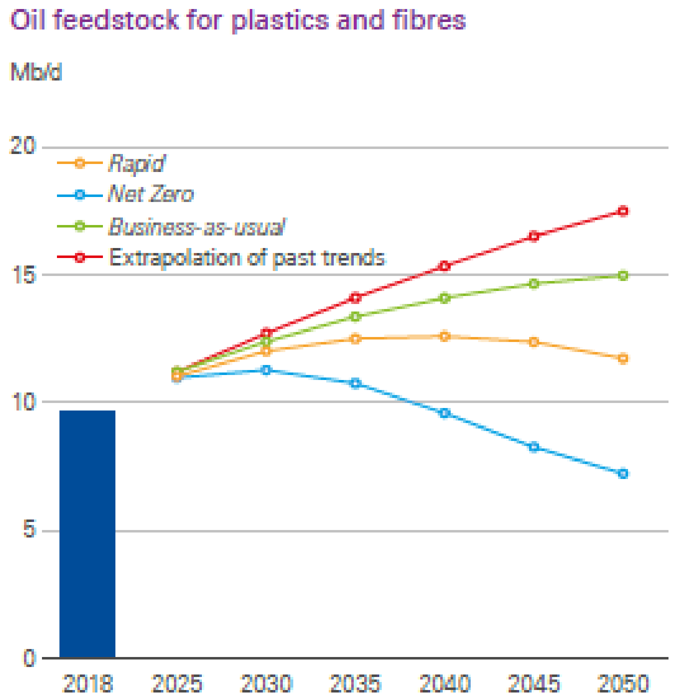


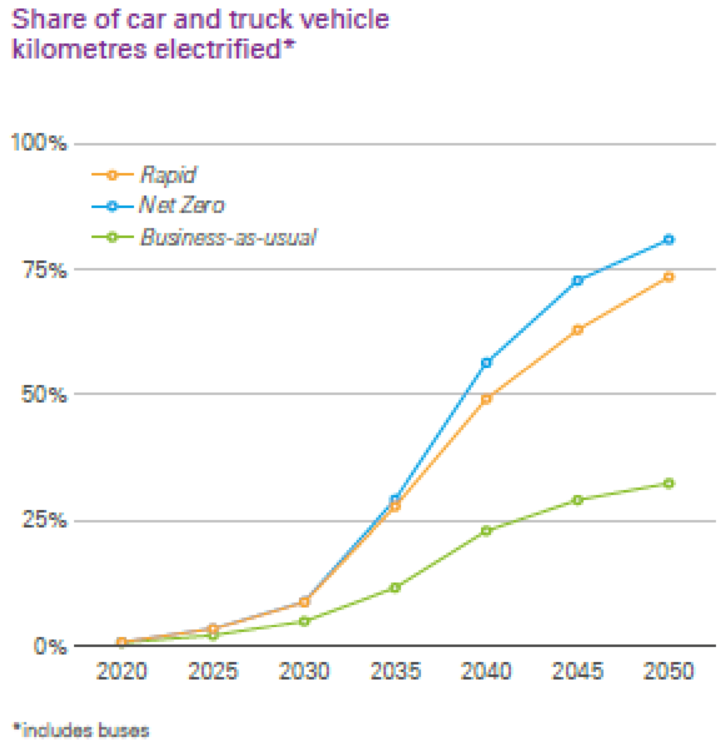


Rapid: Until 2100 temperature rise below 2 °C
Net Zero: Temperature rise below 1,5 °C

BP Energy outlook: https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html

Energy & Industries





Rapid: Until 2100 temperature rise below 2 °C
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BP Energy outlook: https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html

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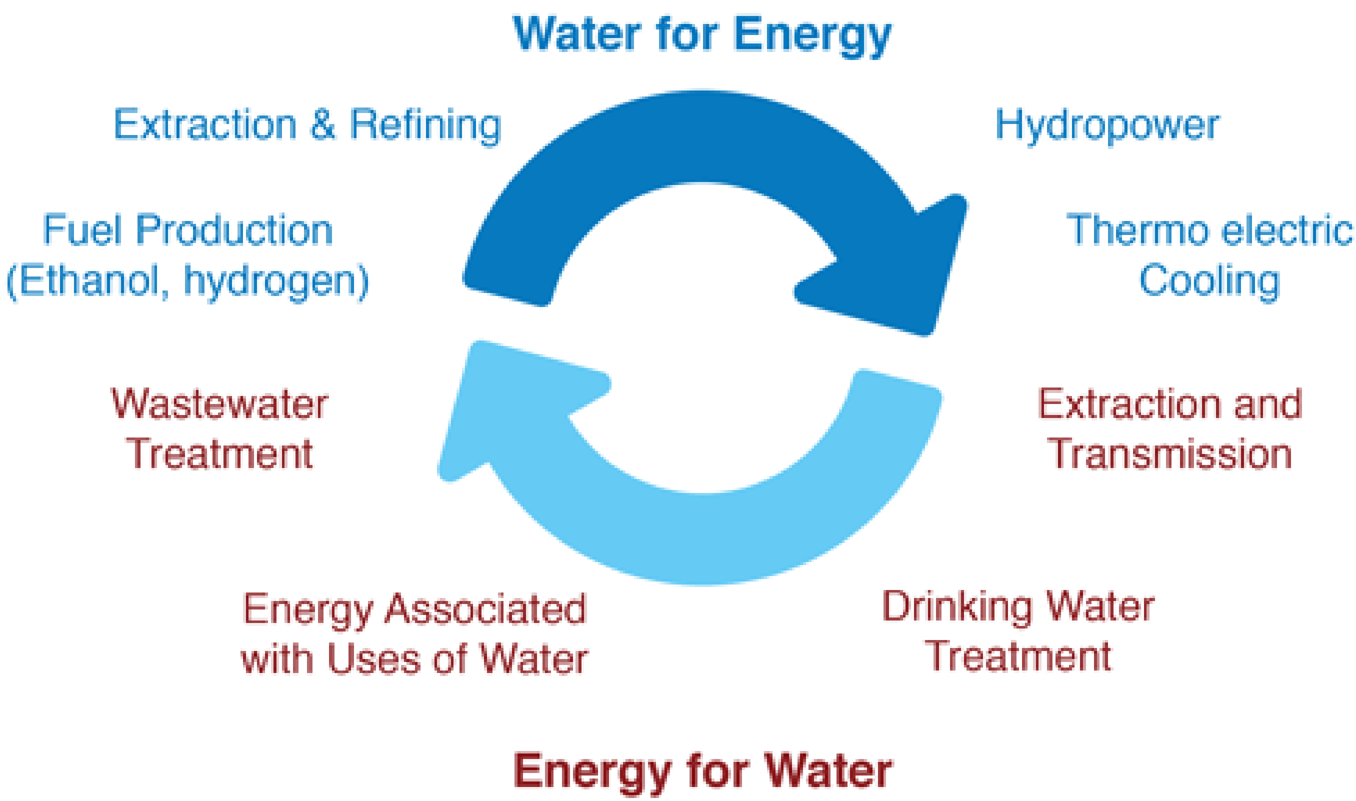
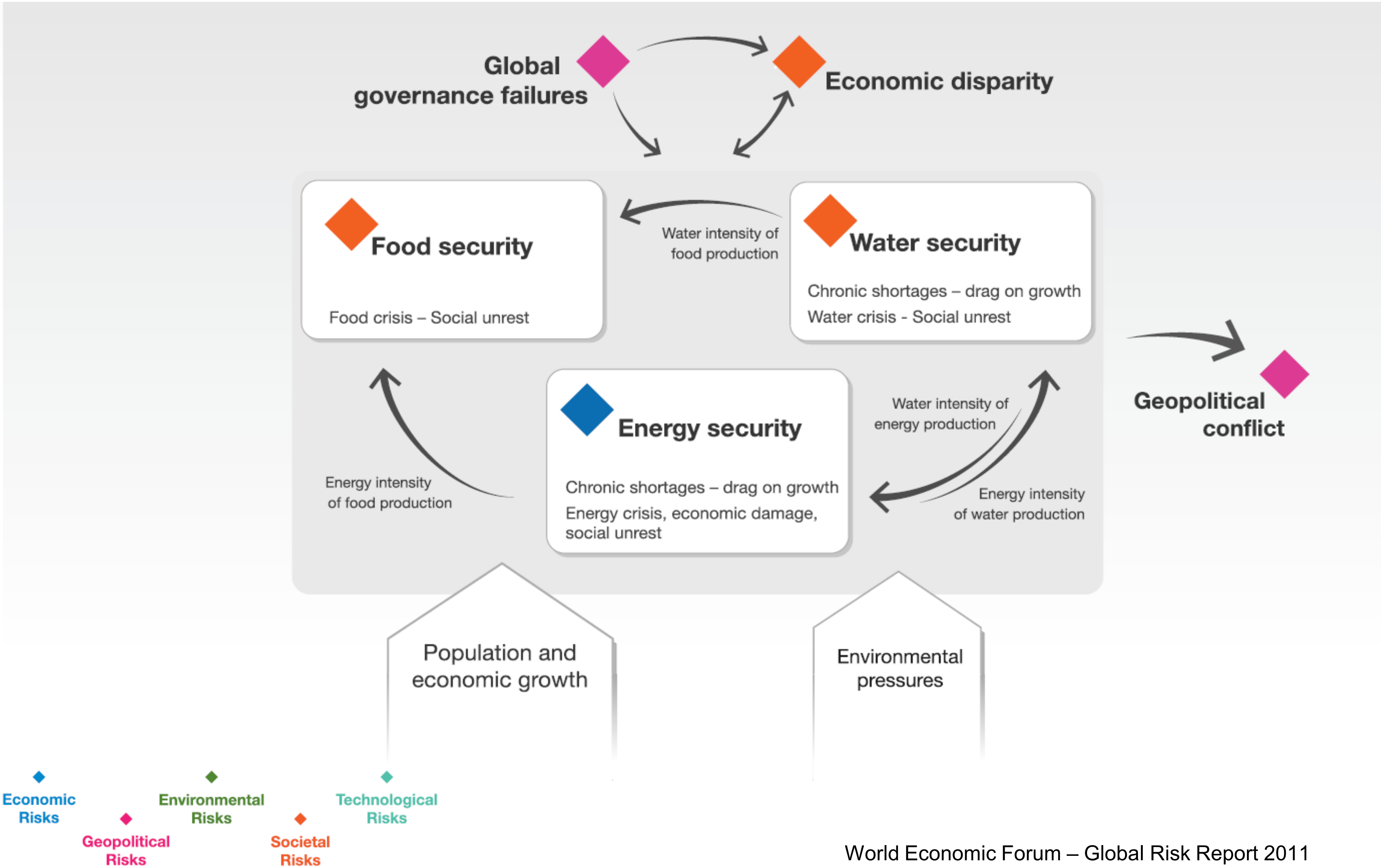
Water & Energy nexus



Source: Water, Energy and Climate Change: A Contribution from the Business Community. World Business Council for Sustainable Development. 2009
http://voxglobal.com/2011/03/the-energy-water-nexus-an-emerging-risk/

Water, Food & Energy nexus



World Economic Forum – Global Risk Report 2011
http://www.weforum.org/reports/global-risks-report-2011

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Industrie 4.0 –
viele Schlagworte, was steckt dahinter

Industrie 4.0 – Grundlage für Prozessoptimierung

Grillen ohne moderne Technik

Grillen mit drahtloser Sensortechnik

Smart Home Grillen

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Industrie 4.0 – verändert das Nutzerverhalten

Vom Buchladen

Source: *https://pixabay.com/de/bibliothek-buchladen-b%C3%BCcher-1124718/*
Last visit: 21.06.18 13:08

Von Schallplattenläden

Source: http://www.largeup.com/columns/impressions/page/4/
Last visit: 21.06.18 13:41

Vom Taxi

Source: http://www.limousinen-taxi-eren.de/img/bg-image-limousinen-taxi-eren-5.jpg
Last visit: 21.06.18 13:52

Hin zu eBooks

Source: https://www.tgregione.it/wp-content/uploads/2018/03/read-ebook.png
Last visit: 21.06.18 13:24

Zu Musikstreaming Diensten

Source: https://www.bnnbloomberg.ca/streaming-services-need-to-pay-up-to-save-cancon-crtc-1.1085790
Last visit: 21.06.18 13:49

Hin zu Uber und Car Sharing

Source: https://getcell411.com/2016/10/27/decentralized-ride-sharing-is-here-no-driver-fees-any-payment-method/
Last visit: 21.06.18 13:45

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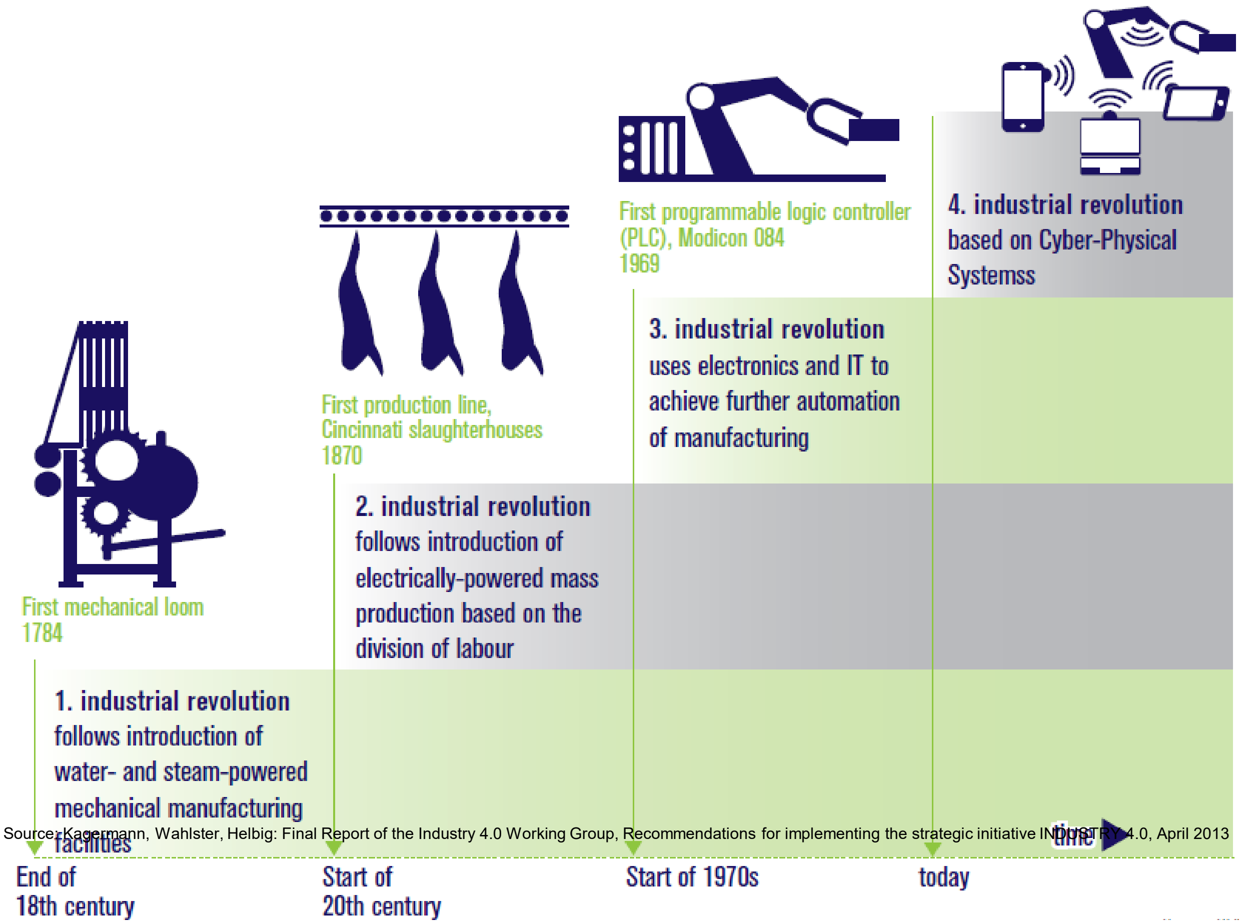
Industrie 4.0 – verändert das Sozialverhalten

Source: https://www.sozialdynamik.at/blog/beziehungskiller-handy-zu-viel-smartphone-schadet/
Last visit: 21.06.18 13:18

Source : *https://www.cosmopolitan.de/smartphone-studie-smartphones-im-schlafzimmer-stoeren-das-sexleben-65119.html*
Last visit: 21.06.18 12:59

Industrie 4.0 – eine Definition

Die vier Stufen der Industriellen Revolution



Source: Kagermann, Wahlster, Helbig: Final Report of the Industry 4.0 Working Group, Recommendations for implementing the strategic initiative INDUSTRY 4.0, April 2013

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1. Industrie 4.0
2. Industrie 4.0 in der Wasserwirtschaft
3. Beispiele aus der Forschung
4. Fazit

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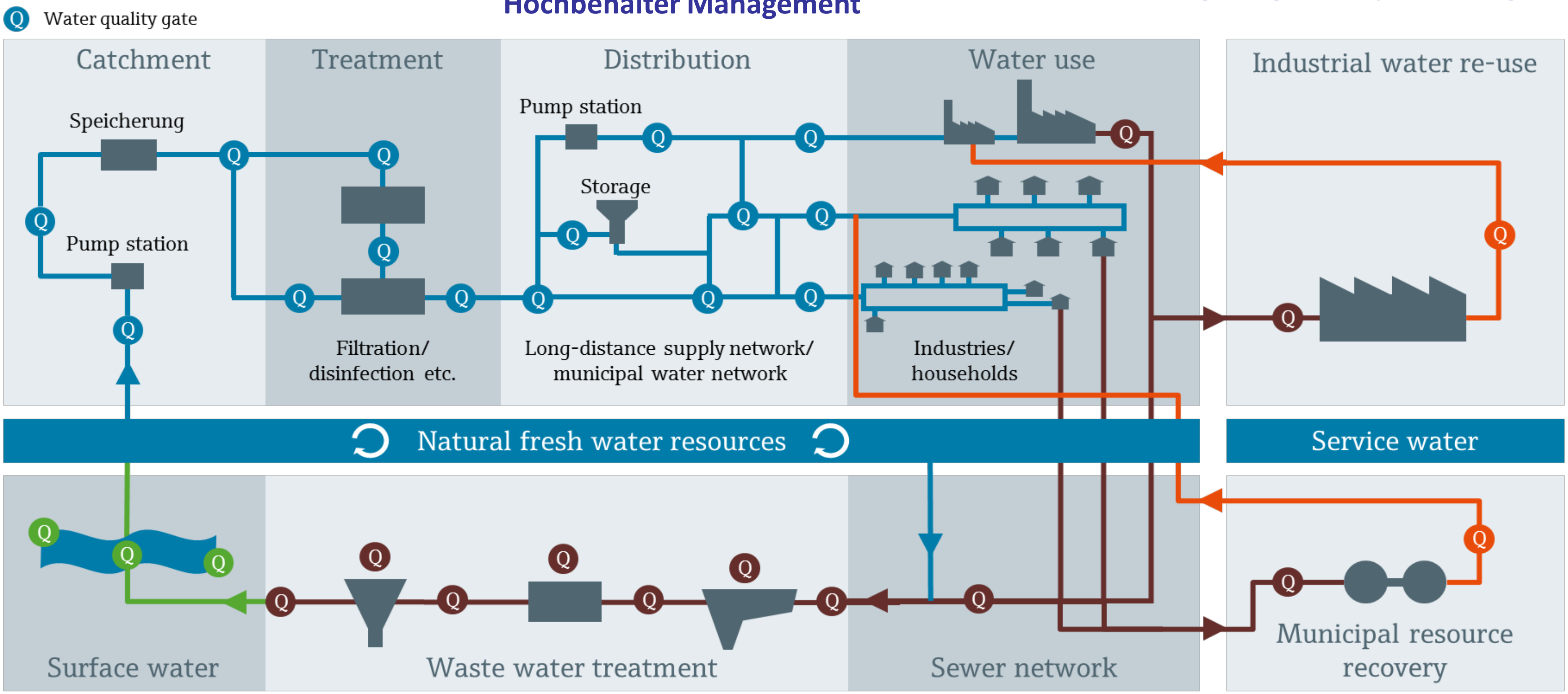
Industrie 4.0 in der Wasserwirtschaft

Event monitoring und Grundwasserschutz

Remote Netzwerkzustandsüberwachung und Hochbehälter Management

SCADA Systeme für Abwasserregelung und -optimierung



Regenüberlaufbecken und Hochwasserschutz

Virtuelle Prozessregelungssysteme

Virtuelle Überwachung von Kanalsystemen

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Industrie 4.0 in der Wasserwirtschaft
Datenflut führt zu Überforderung

97% der gemessenen Felddaten bleiben ungenutzt!

47 Mio. Datensätze werden übertragen.

(Quelle Endress + Hauser)

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1 Industrie 4.0

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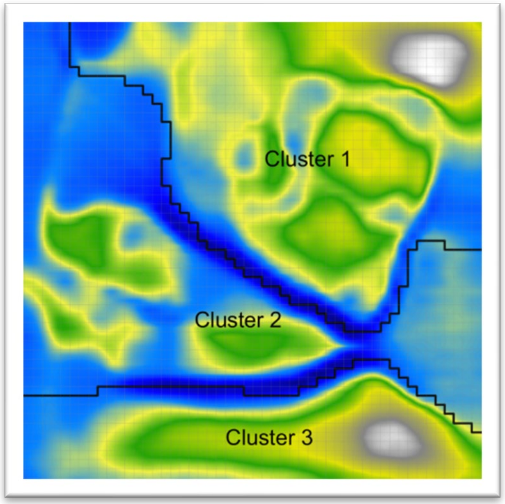
Abwasserbehandlung

Zustandsbasierte Regelung von Kläranlagen

- Gruppierung vorhandener Betriebsdaten nach ihrer Ähnlichkeit.
- Visualisierung auf einer 2D-Karte
- Anpassung der Anlagenregelung auf den jeweiligen Betriebszustand.



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Überwachung von Trinkwassernetzen bei der Thüringer Fernwasserversorgung

Messpanel an Hochbehälter 2

Messpanel an Hochbehälter 3

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Überwachung von Trinkwassernetzen Plausibilitätsprüfung und Eventerkennung

Messwerte → Algorithmus → Abweichung (Ja/Nein)

Herausforderung:
Messfehler können genauso aussehen wie Störungen im Netz.

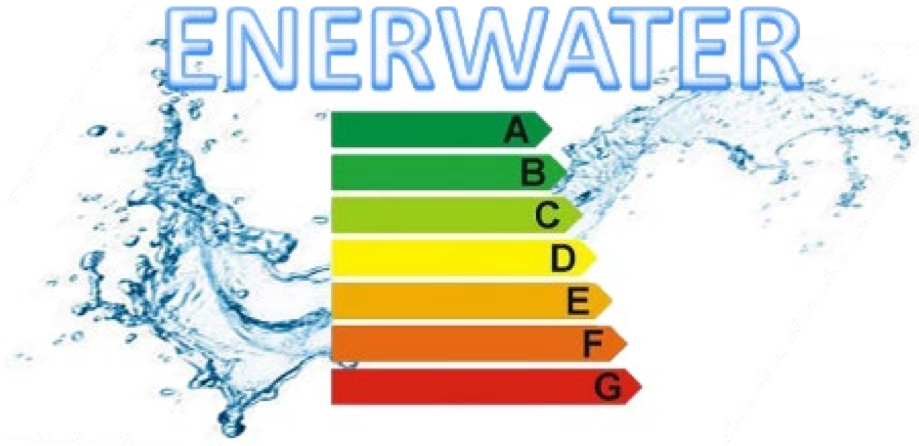
Plausibilität → Qualität der Daten

Eventerkennung → Qualität des Wassers

Messwerte → Plausibiliäts-bewertung → (Abgesicherte Messwerte) → Event-erkennung

Enerwater

Development and Test of a Benchmark Tool for Analysis and Improvement of the Energy performance of Wastewater Treatment Plants on a European Scale



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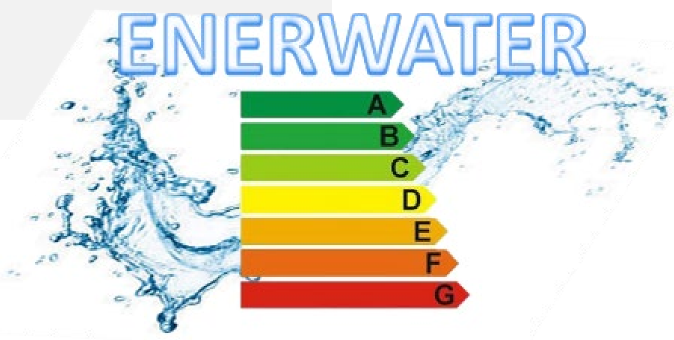
ENERWATER Challenges

- Wastewater Treatment Plants (WWTP) are still the highest energy consumer in non-industrial municipalities.
- The comparison of WWTPs is complex due to:
  - Different plant designs
  - Different climate (dry vs. wet)
  - Different geography (mountainous regions vs. flat regions)
  - Different effluent values
  - Etc.



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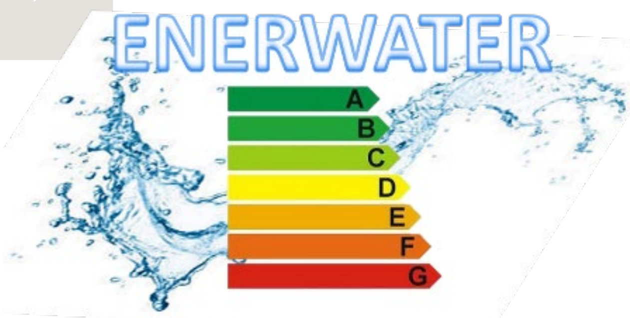
National Benchmark Activities – No European comparison

DWA-M 216 Energy check and energy analysis – Measures for energy optimisation of waste water treatment plants factsheet (DWA, Hennef, Germany)	2010 Manual Energy in WWTP. (BFE & VSA, Bern, Switzerland)	Waste Water Collection and Treatment Services – Product Category Rules according to ISO 14025:2006 (Version 1.01 2013:14) (EPD ®System)
Smart cities. Infrastructures. Public Service Networks. Part 1: Water Networks. (Spanish standard draft PNE 178101-1)	Energy management - Energy audits - General requirements for the energy audit service (Italian Technical Report UNI-CEI/TR 11428:2011)	



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ENERWATER Research Project (2015-2018)

- A Horizon 2020 Projekt with Partners from 4 EU Countries
- Project duration 2015 - 2018
- Project partners are researchers, SMEs and plant operators.
- Goal is the development of a standard method for the evaluation of the energy consumption of WWTPs.

Project Meeting and Stakeholder Event in Rimini

WWTP Wiehl - Aggerverband

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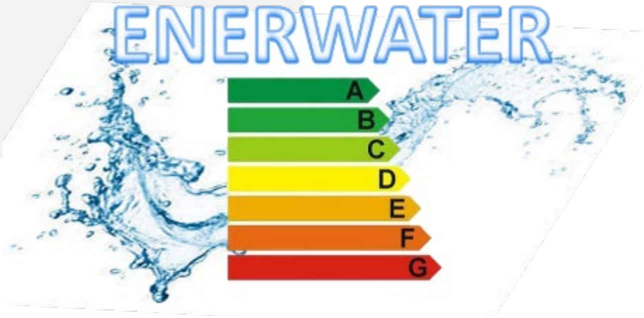
ENERWATER Objectives

- Studying the current energy status of existing WWTPs.
- Establish energy consumption benchmarks.
- Define a methodology for energy assessment and classification of WWTPs.
- Develop an online energy diagnosis of a WWTP.
- Foster the discussion and dialogue among member states.
- Disseminate the methodology for a faster replication and market acceptance.
- Assess the impact on the society, economy and environment of the developed method.



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ENERWATER – Progress

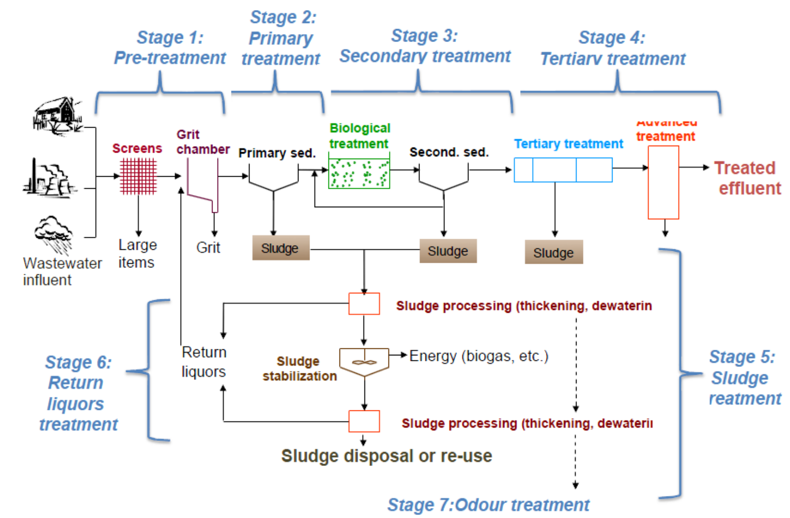

Figure 1. General schematic representation of a WWTP with the various stages.

Data collection

- **588** Plant data collected → Objective: 500 plant data
- 58 Case Studies for disaggregated data
- The first draft of the methodology has been created (version 0)
- 50 WWTPs have been selected and are equipped with measurements.


Summation Current Measurement Unit


Toroidal Clamp


Data Measurement Unit (DMU)

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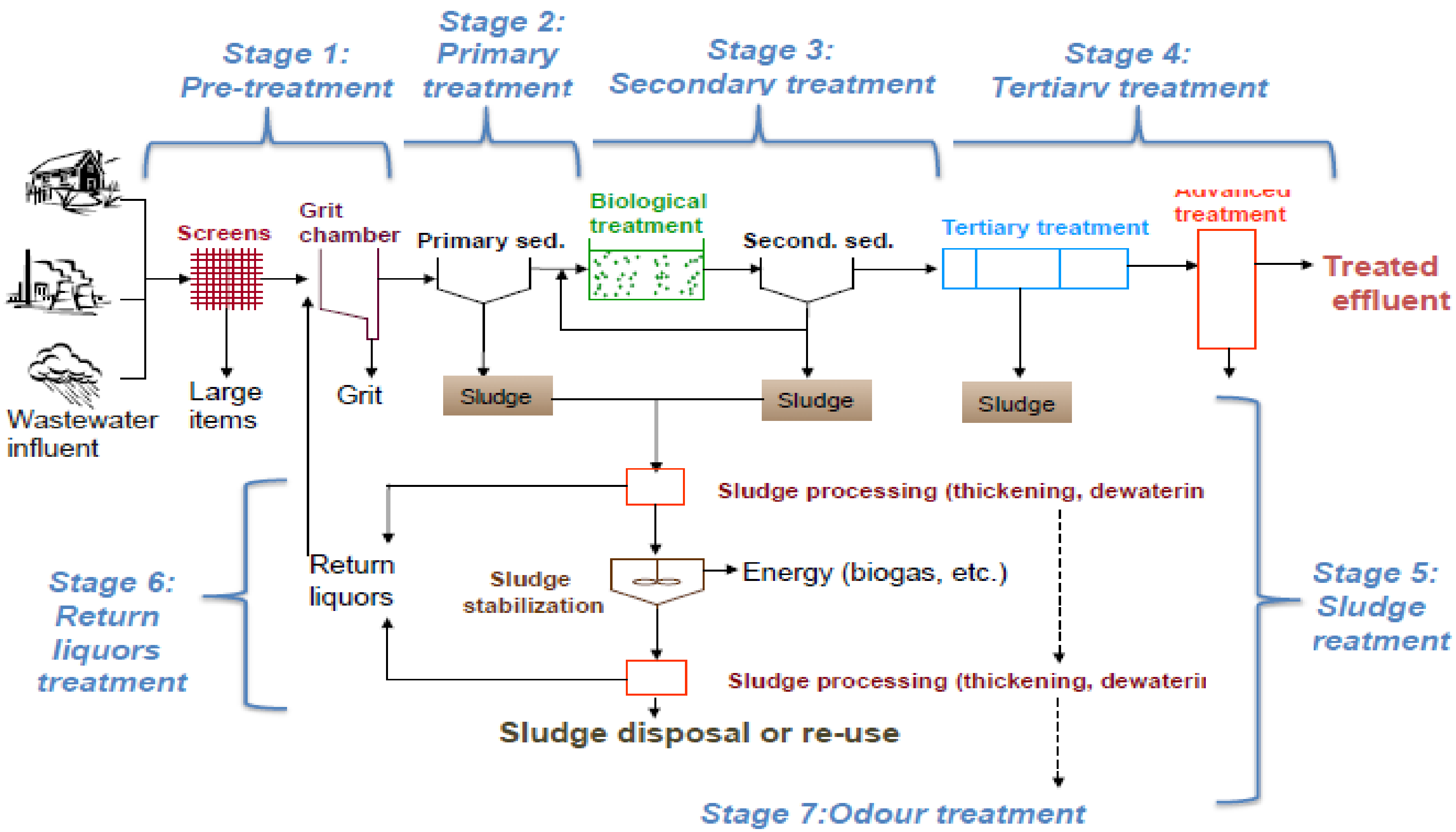
STAGE CLASSIFICATION

In order to disaggregate the energy consumption data, taking into account the different processes and treatment schemes applied in municipal WWTPs, 7 stage were used.



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Calculation of Energy Performance Index from KPIs

How to combine KPIs?
How to add apples and oranges?

$$KPI_{norm} = \frac{KPI - min(KPI)}{max(KPI) - min(KPI)}$$

How to weight each KPI for the composite index?

EPI (per Stage) $= \sum_i w_i KPI_i = w_1 KPI_1 + w_2 KPI_2 + w_3 KPI_3 + \cdots + w_i KPI_i$

EPI (whole Plant) $= 0.14\, KPI_1 + 0.003 KPI_2 + 0.70 KPI_3 + 0.04 KPI_4 + 0.11 KPI_5$

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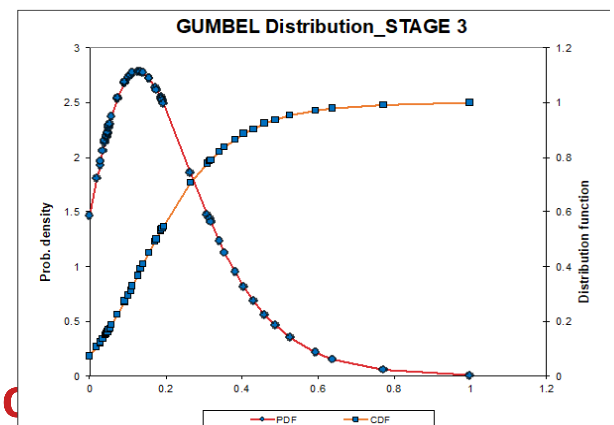
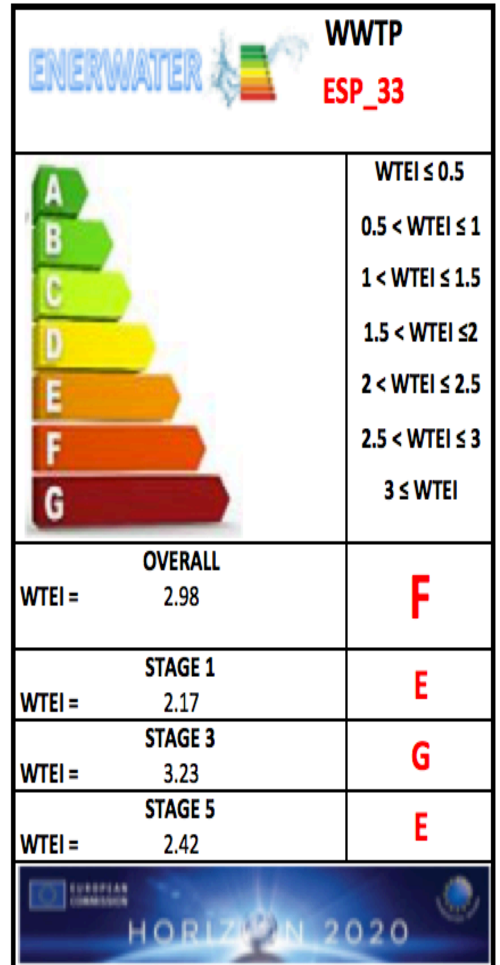
Determination of WTEI and energy class

WTEI - Water Treatment Energy Index

DATA TREATMENT (EPI)





Communication
Water Treatment Energy Index - WTEI

Diagnosis
Which stages are less efficient?

Assignment of the WTEI to Energy Classes

- Class A if WTEI < 0.5
- Class B if 0.5 ≤ WTEI < 1
- Class C if 1 ≤ WTEI < 1.5
- Class D if 1.5 ≤ WTEI < 2
- Class E if 2 ≤ WTEI < 2.5
- Class F if 2.5 ≤ WTEI < 3
- Class G if 3 ≤ WTEI

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Energy Labels

WTEI results by size-classification

ENERWATER	IT 2K<S<10K
A	WTEI ≤ 0.5
B	0.5 < WTEI ≤ 1
C	1 < WTEI ≤ 1.5
D	1.5 < WTEI ≤2
E	2 < WTEI ≤ 2.5
F	2.5 < WTEI ≤ 3
G	3 < WTEI
OVERALL WTEI = 2.9239	F
STAGE 1 WTEI = 2.371	E
STAGE 3 WTEI = 3.0555	G
STAGE 5 WTEI = 2.8023	F

ENERWATER	IT 10K<S<50K
A	WTEI ≤ 0.5
B	0.5 < WTEI ≤ 1
C	1 < WTEI ≤ 1.5
D	1.5 < WTEI ≤2
E	2 < WTEI ≤ 2.5
F	2.5 < WTEI ≤ 3
G	3 < WTEI
OVERALL WTEI = 2.6504	F
STAGE 1 WTEI = 2.7255	F
STAGE 3 WTEI = 2.7063	F
STAGE 5 WTEI = 2.2051	E

ENERWATER	IT 50K<S<100K
A	WTEI ≤ 0.5
B	0.5 < WTEI ≤ 1
C	1 < WTEI ≤ 1.5
D	1.5 < WTEI ≤2
E	2 < WTEI ≤ 2.5
F	2.5 < WTEI ≤ 3
G	3 < WTEI
OVERALL WTEI = 2.4950	E
STAGE 1 WTEI = 1.8803	D
STAGE 3 WTEI = 2.7579	F
STAGE 5 WTEI = 1.6314	D

Agenda

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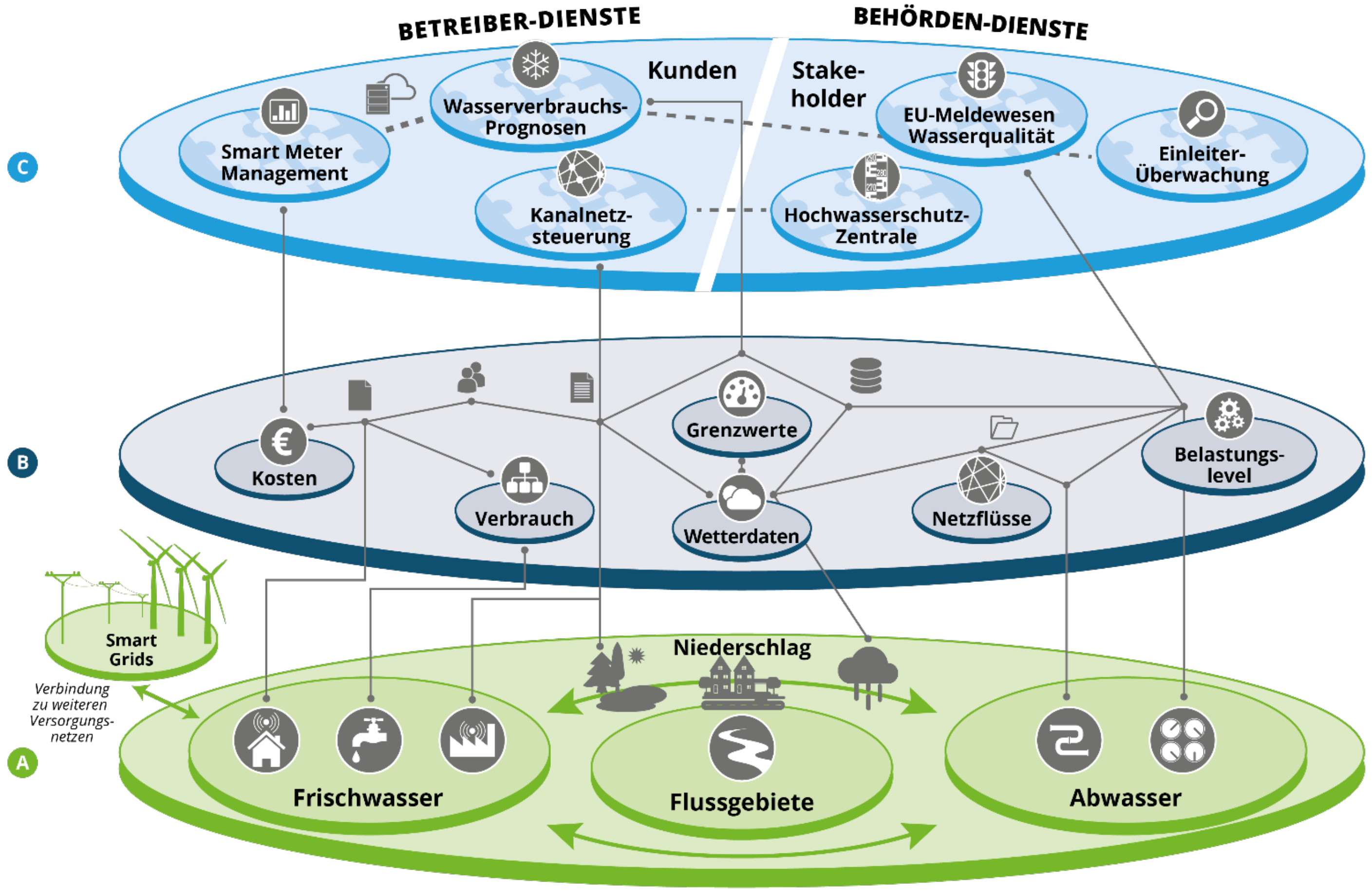
Fazit

Management-
ebene

Leitebene

Feldebene



Quelle: Forschungsinstitut für Wasser- und Abfallwirtschaft an der RWTH Aachen, November 2017

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Fazit –
Was ist Industrie 4.0 in der Wasserwirtschaft nicht!

Industrie 4.0 ist keine alles umfassende Innovationsstrategie und auch kein magisches Werkzeug, um die globalen Herausforderungen der Wasserwirtschaft einfach zu lösen.

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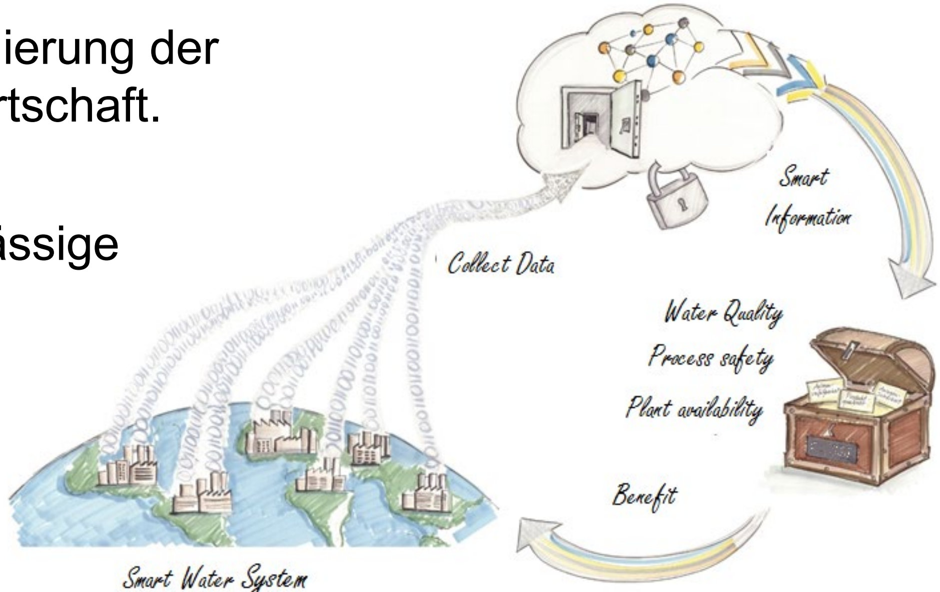
Fazit –
Was ist Industrie 4.0 in der Wasserwirtschaft?

- Es ist eine visionäre Perspektive eines digitalisierten, vernetzten und automatisierten Wassermanagements.
- Es basiert auf modernen Informations-, Kommunikations- und Überwachungstechnologien.
- Es benutzt Werkzeuge zur Optimierung der Businessprozesse der Wasserwirtschaft.
- Es steht für effiziente und zuverlässige Wassersysteme.
- Es liefert einen entscheidenden Anteil zur Lösung der lokalen und weltweiten Herausforderungen der Wasserwirtschaft.



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Thank you for your attention

Prof. Dr. Michael Bongards
TH Köln
Gummersbach – Germany

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http:// www.th-koeln.de
E-Mail: michael.bongards@th-koeln.de