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Raw Materials Change and Chemistry 4.0

Infraserv perspectives, 16 June 2015

Raw Materials Change and Chemistry 4.0

- Driving forces

 - Raw Materials Change
 - Energiewende

 - Digitalization

..... and/or Challenges!

Raw Materials Change and Chemistry 4.0

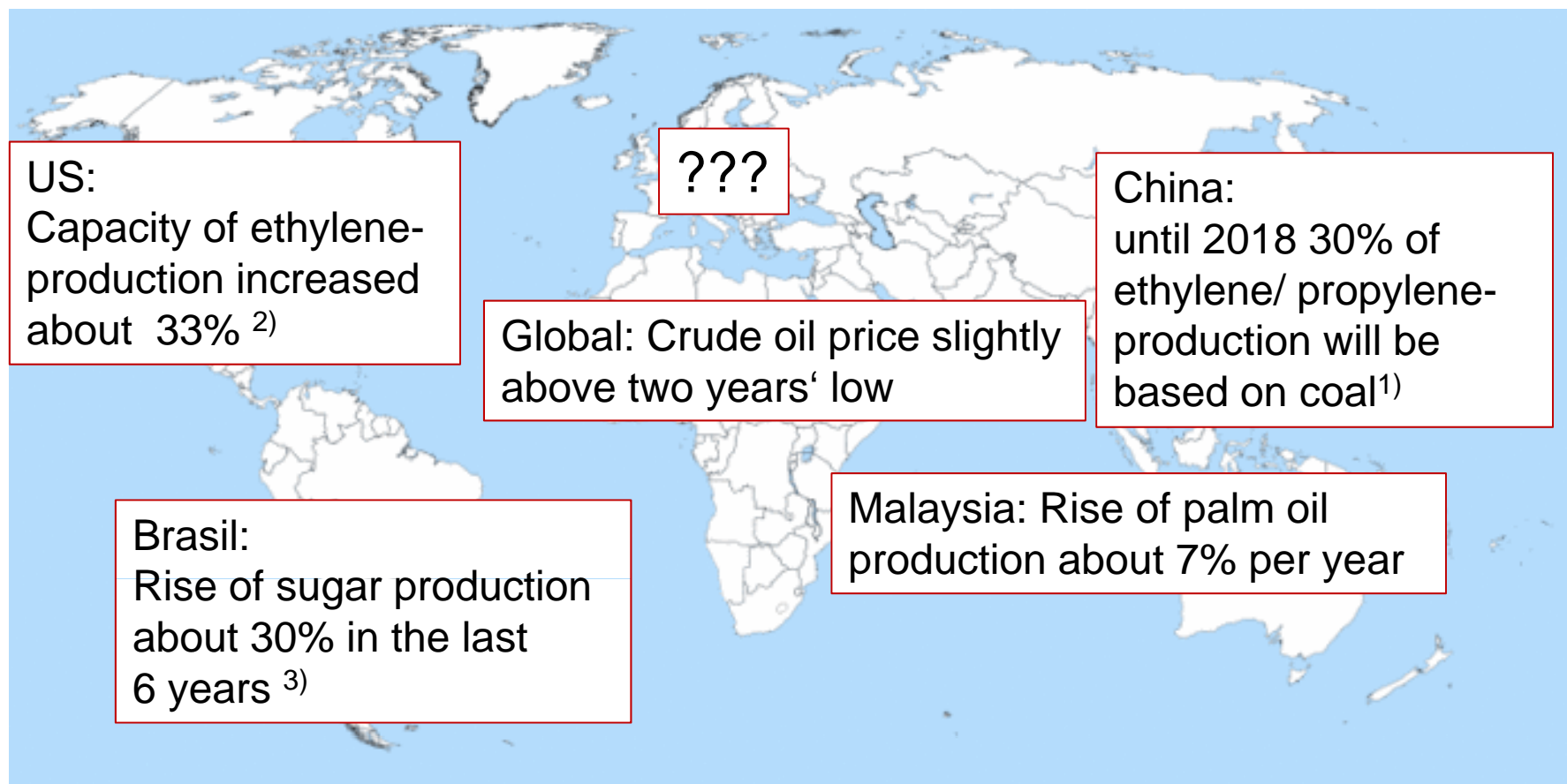
- Driving forces

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..... and/or Challenges!

Global feedstock change leads to a regional diversification



- 1) Korea IT Times 27/10/14, <http://www.koreaitimes.com/story/41908/chinese-coal-chemical-industry-poses-serious-threat-korean-petrochem-producers>
- 2) PWC, Shale gas – Reshaping the US chemicals industry, Oct 2012
- 3) <http://www.agrarheute.com/welt/zucker-grosse-produktion-drueckt-die-preise>, 29.8.2013

Composition of Natural Gases

	Natural Gas gen. *	„dry“ Shale Gas (Haynesville Well)	„wet“ Shale Gas (Marcellus Well)
Methane	70 - 90 %	95 %	79,4 %
Ethane	0 - 20 %	0,2 %	16,1 %
Propane	0 - 20 %		4,0 %
Butane	0 - 20 %		
Carbon Dioxide	0 - 8 %	4,8 %	0,1 %
Oxygen	0 - 0,2 %		
Nitrogen	0 - 5 %	0,1 %	0,4 %
H ₂ S	0 - 5 %		
Noble Gases	traces		

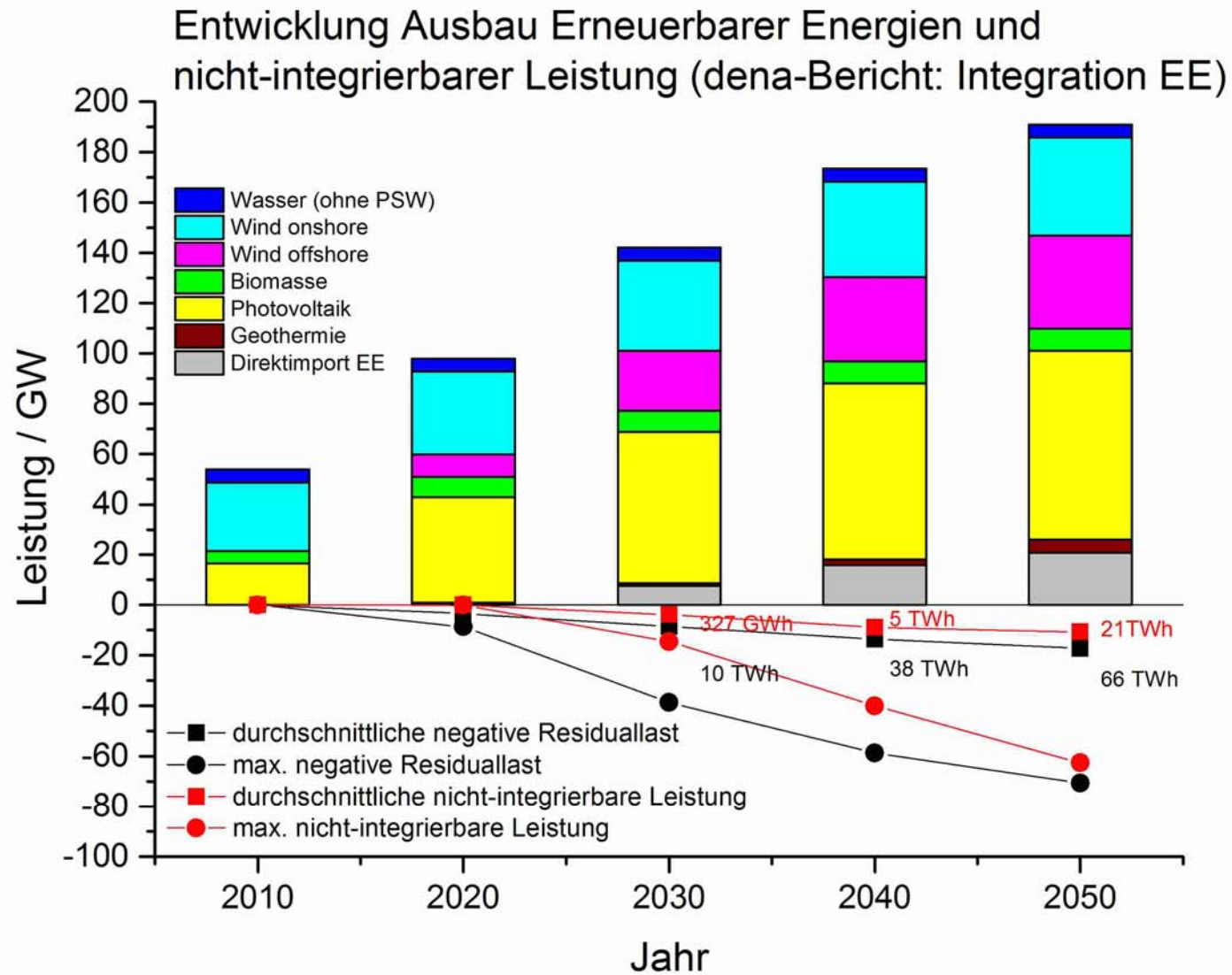
* Naturalgas.org; Oil & Gas Journal March 9, 2009

Steam-Cracker- Output

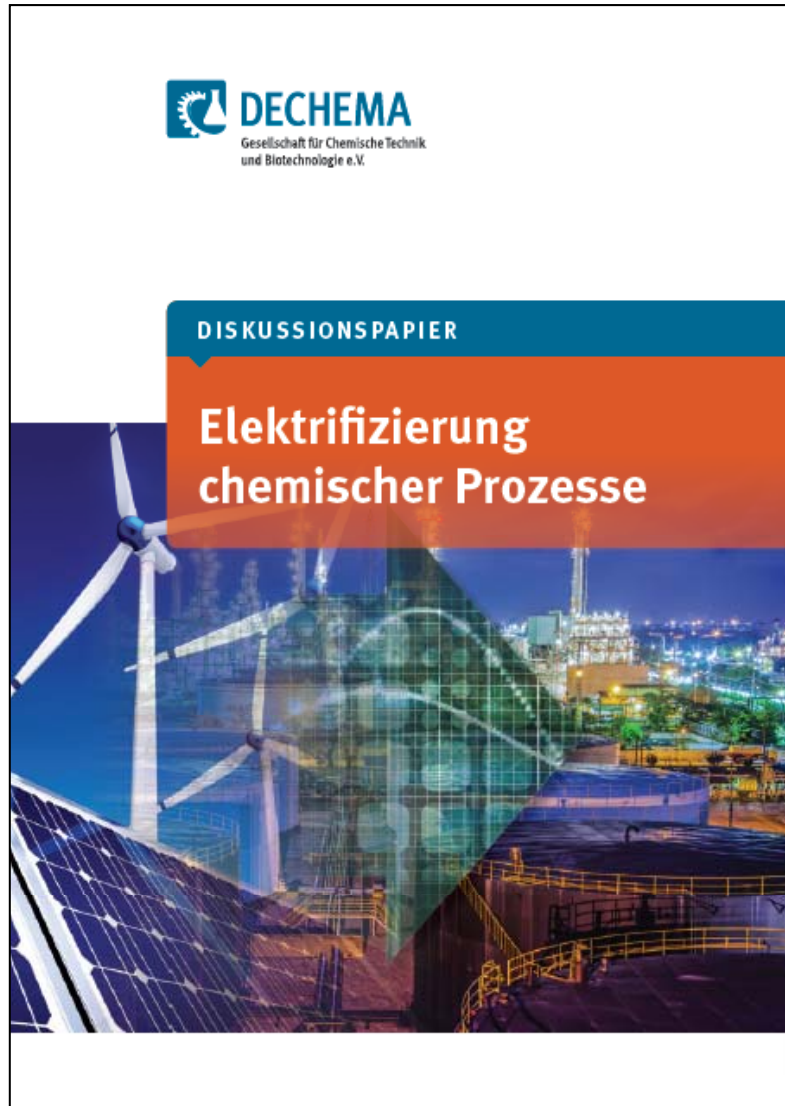
Feedstock	Ethylene	Propylene	Butadiene	Aromatics	Others
Naphtha	34,4	14,4	4,9	14,0	32,3
Gas Oil	25,5	13,5	4,9	12,8	43,3
Ethane	84	1,4	1,4	0,4	12,8
Propane	45	14,0	2,0	3,5	35,5
Butane	44	17,3	3,0	3,4	32,3

Source: <http://chemengineering.wikispaces.com/Petrochemicals>

Power2Chemicals: Increasing Share of Renewable Energies for Electricity Generation – „Surplus Electricity“



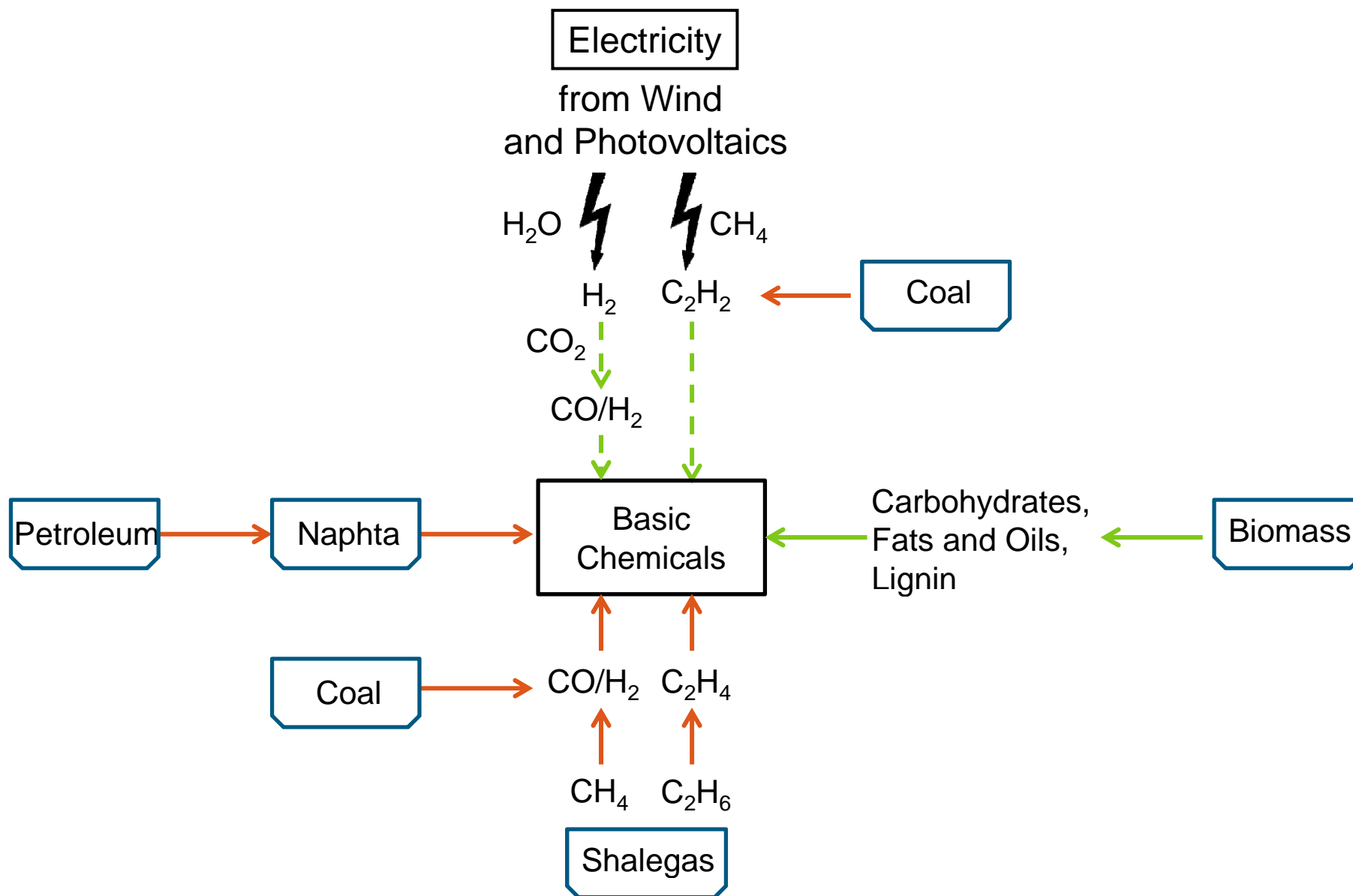
Power2Chemicals: Increasing Share of Renewable Energies for Electricity Generation – „Surplus Electricity“



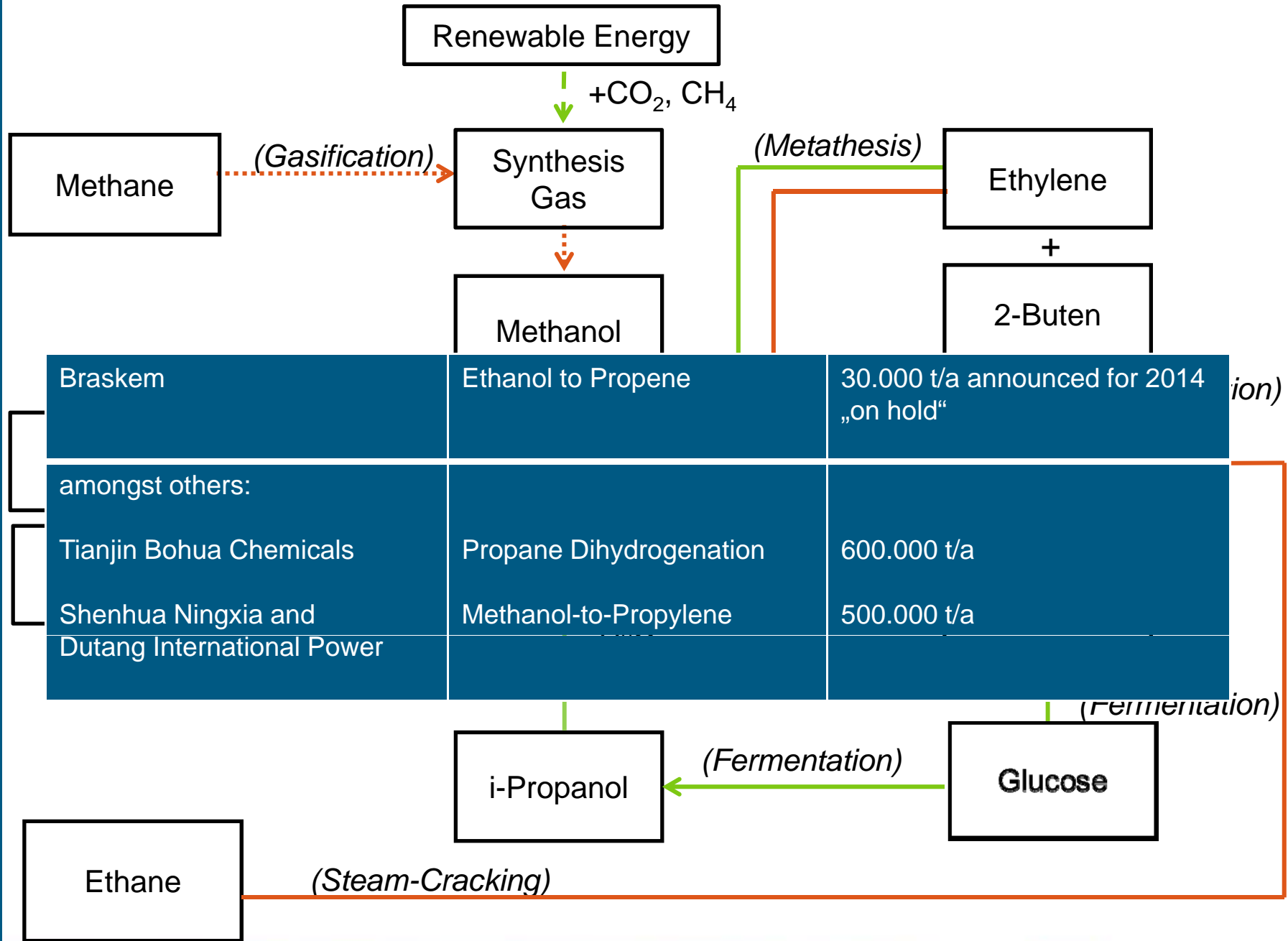
Topics:

- Inorganic Electrochemistry (Chlorine Production a.o.)
- Organic Electrochemistry
- Plasma- and Microwave driven processes

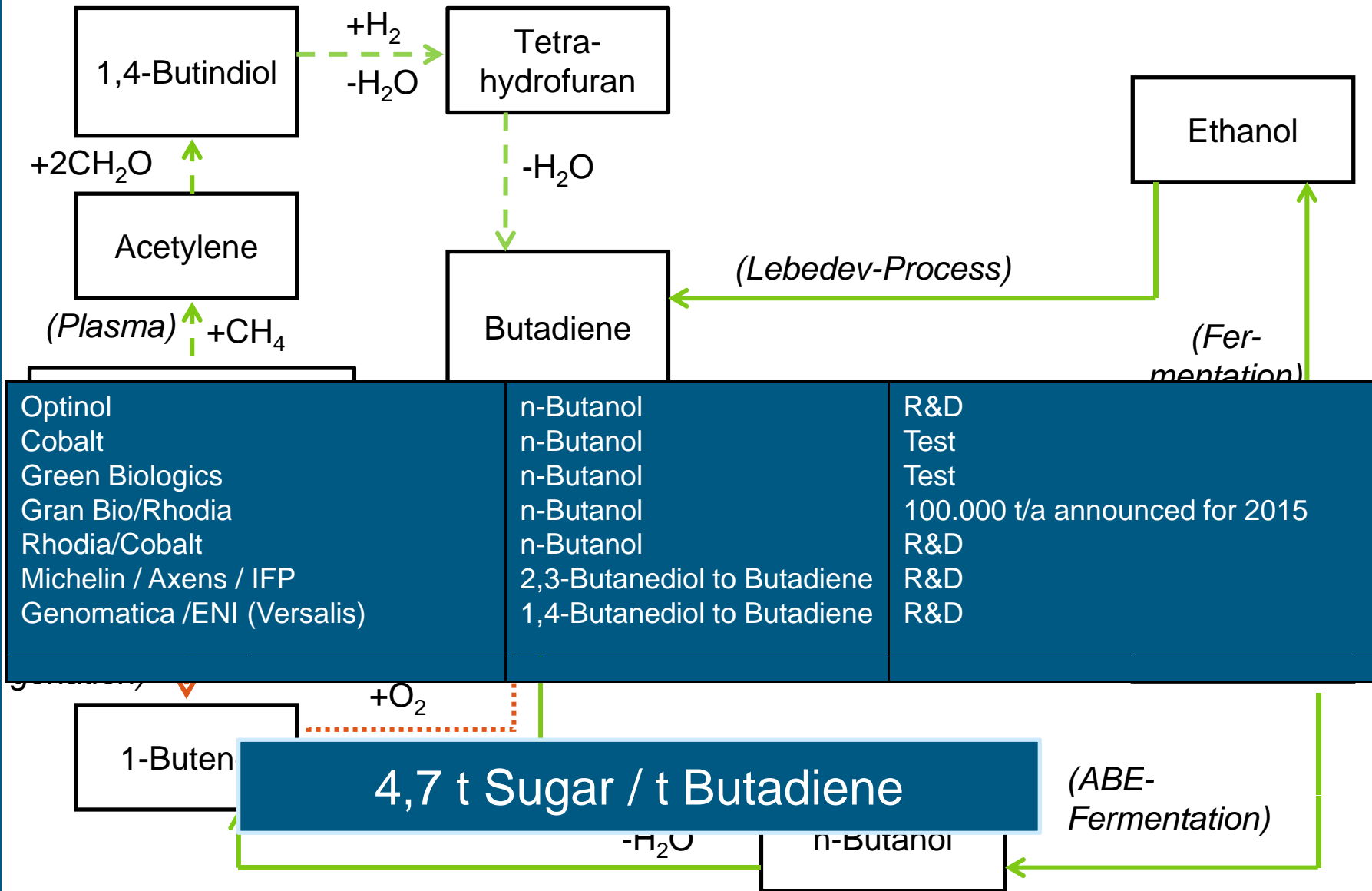
General Scheme



PROPENE



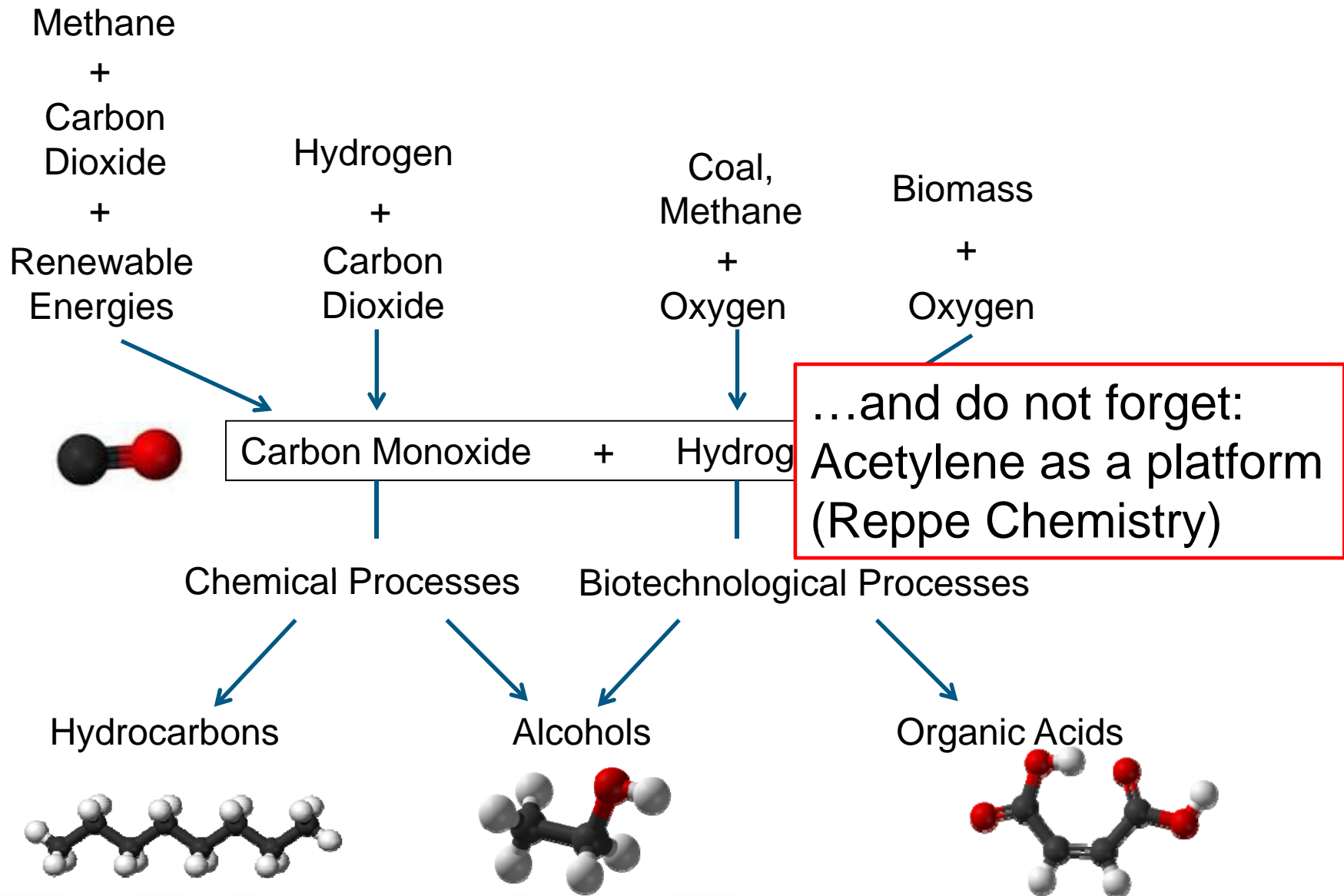
BUTADIENE



Optinol	n-Butanol	R&D
Cobalt	n-Butanol	Test
Green Biologics	n-Butanol	Test
Gran Bio/Rhodia	n-Butanol	100.000 t/a announced for 2015
Rhodia/Cobalt	n-Butanol	R&D
Michelin / Axens / IFP	2,3-Butanediol to Butadiene	R&D
Genomatica / ENI (Versalis)	1,4-Butanediol to Butadiene	R&D

4,7 t Sugar / t Butadiene

Synthesis Gas: A Universal Platform for Chemicals Production



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THE INDUSTRY 4.0 PORTAL

THE OPEN PLATFORM OF GERMAN INNOVATION CENTRE FOR INDUSTRY 4.0

BLOG

INDUSTRIES

TOPICS

I4.0 COMPANIES

INITIATIVES AND ORGANIZATIONS

EVENTS

WIRTSCHAFT

China setzt

China will seine Abhängigkeit von den USA verringern. Statt dessen will es sich auf Deutschland verlassen.
17.04.2014

Chemieindustrie

Diversifizierung und Digitalisierung in der Chemieindustrie



08.06.15 | Schmid

Industrie 4.0

Hannover Messe 2015 – Industry 4.0 everywhere, but in effect not really ...

25. APRIL 2015 BY PHILIPP RAMIN — LEAVE A COMMENT

The management team of the German Innovation Centre for Industry 4.0 has visited the HMI 2015 for several days. No doubt, Industry 4.0 was a major topic for many exhibitors. But how much actual progress can be seen at the moment when it comes to Cyber-Physical-Systems, Smart Products and Cloud Computing? Our impression is split. On the one hand, we could see exciting approaches. KUKA demonstrated with the LVW iiwa concrete applications for human-machine-collaboration.

On the other hand, many companies have not accepted the challenge i4.0 yet. All what they can offer are traditional products with just a new label on it. Additionally, Industry 4.0 and the connected production is often seen as an connectional and abstract future scenario which is not yet relevant. For cloud solutions in particular we could not find many answers. Rather, several exhibitors seemed to be very skeptical regarding cloud computing.

Our conclusion: Industry 4.0 requires a new mindset – still a long way to go.

Source: www.i40.de/en/hannover-messe-2015-industry-4-0-everywhere-but-in-effect-not-really/

Cebit: Was eigentlich ist d

ernet der Dinge
er Dinge* kommuniziert

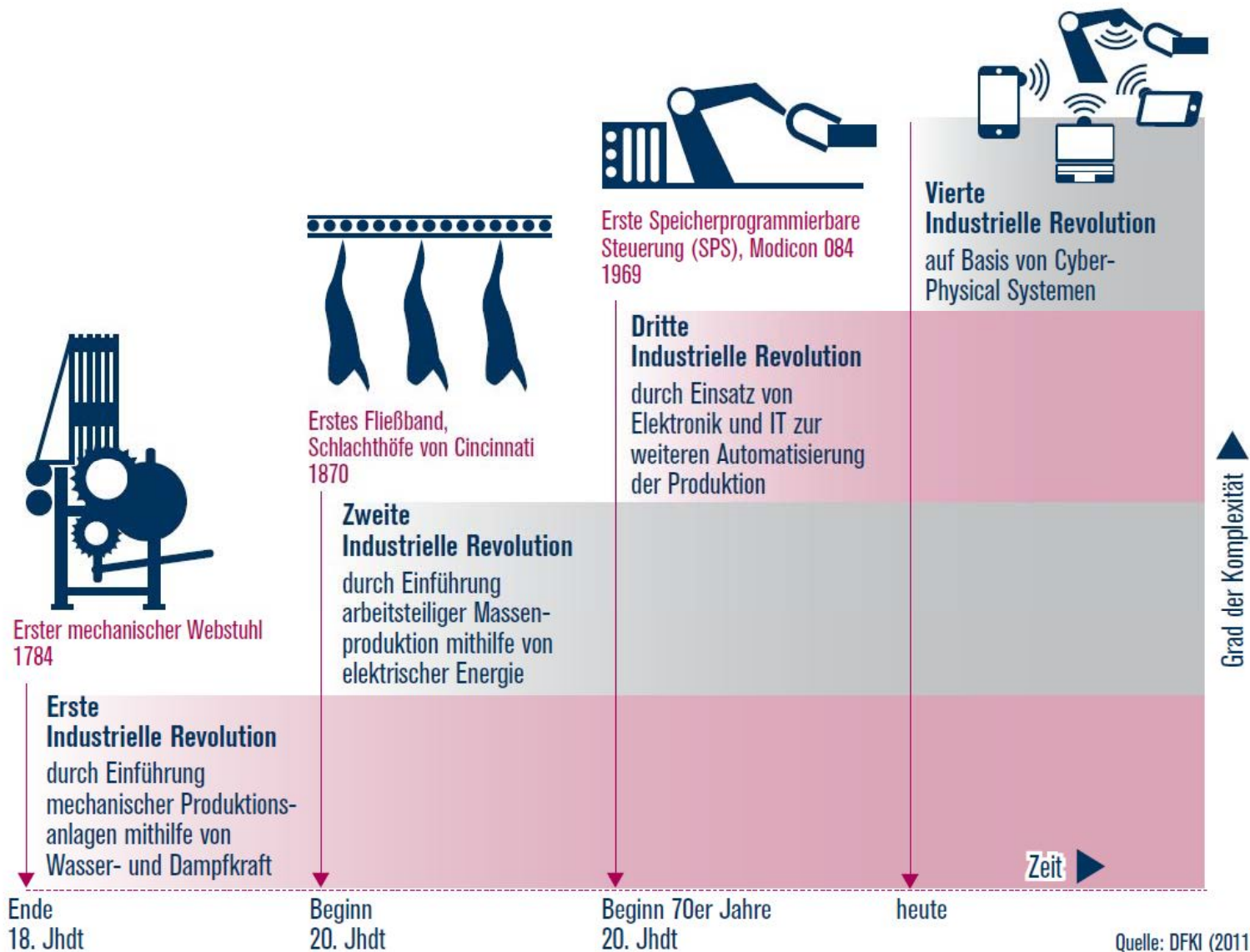
ie 4.0

nkt für

ie-4.0-Motor
nehmen auf

Sachen Industrie
Produktion mit
nik auf
knappen Jahres

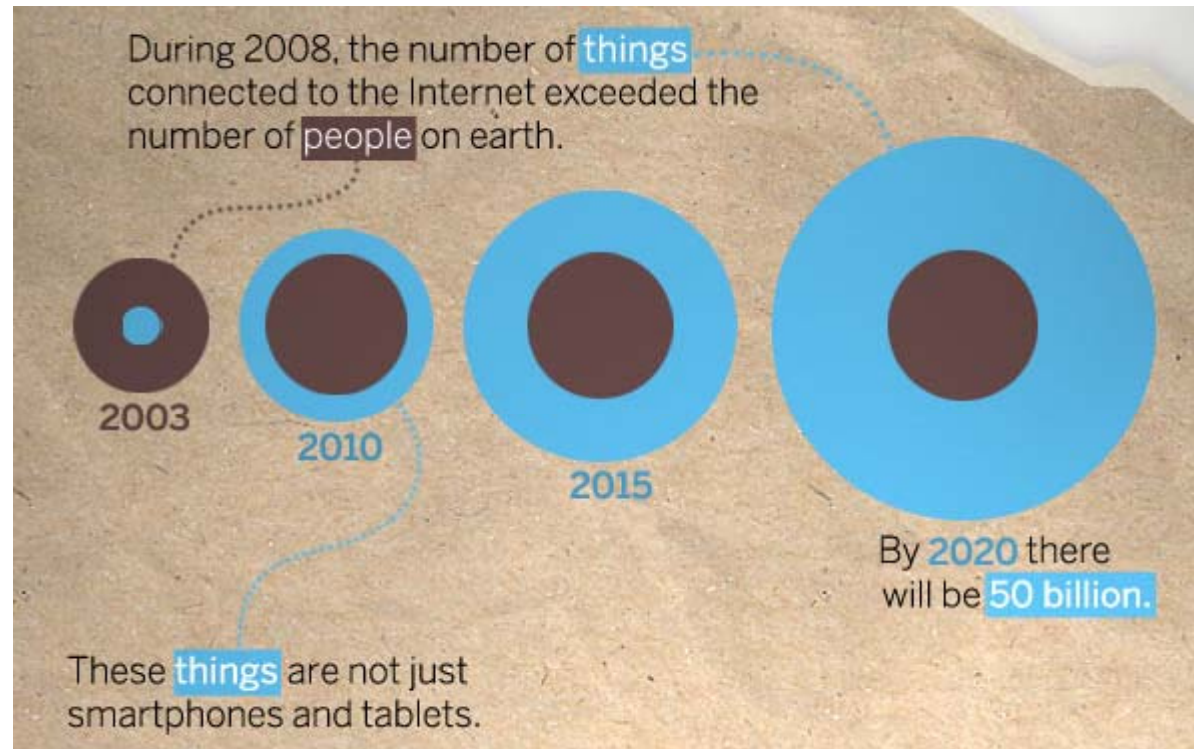
Industry 4.0 – a long way



Quelle: DFKI (2011)

Internet of Things

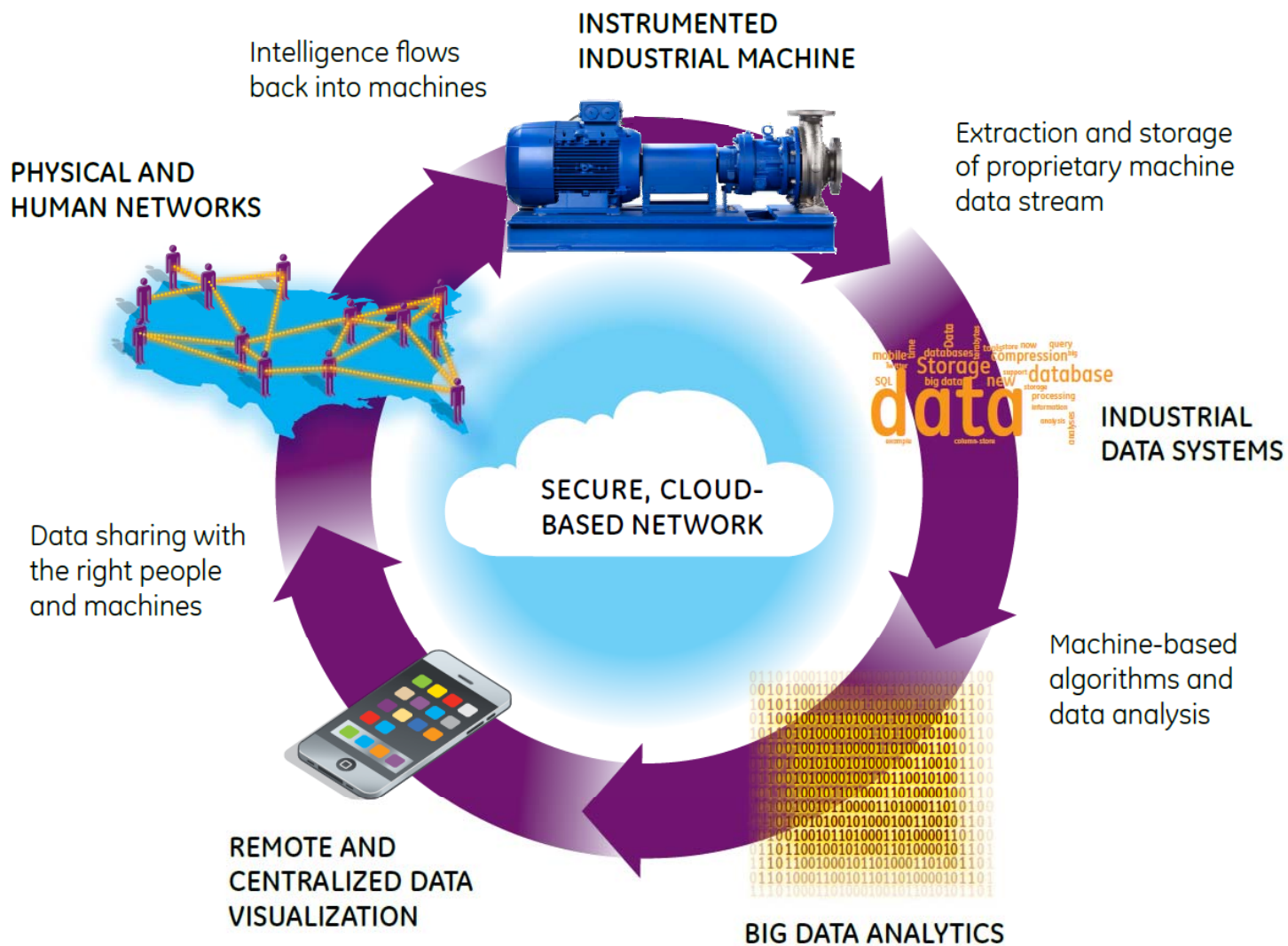
- By 2020, an estimated 50 billion devices will be connected to the Internet



© Cisco

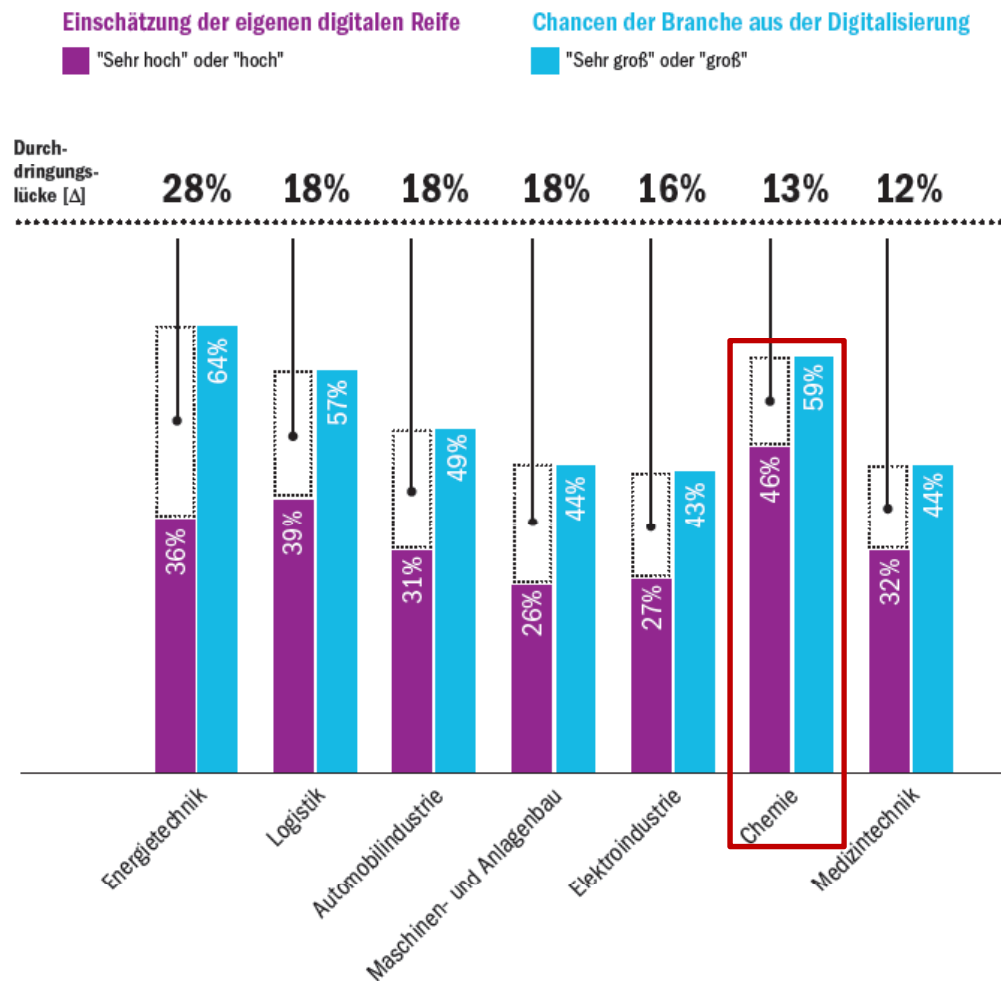
- 1/3 of them: computers, smartphones, tablets, and TVs
- 2/3 of them: sensors, actuators, and newly invented intelligent devices that monitor, control, analyze, and optimize our world

Industrial internet data loop



© GE (modified), KSB (pump)

What about your company's digital maturity?



94 % expect digitalization to revolutionize the chemical industry

87 % believe that companies failing to embrace digitalization face extinction

1) Luft- und Raumfahrttechnik aufgrund nicht repräsentativer Zahl von Antworten von Industrievergleichen ausgeschlossen
 Quelle: Roland Berger, Umfrage unter 300 Top-Managern der deutschen Wirtschaft

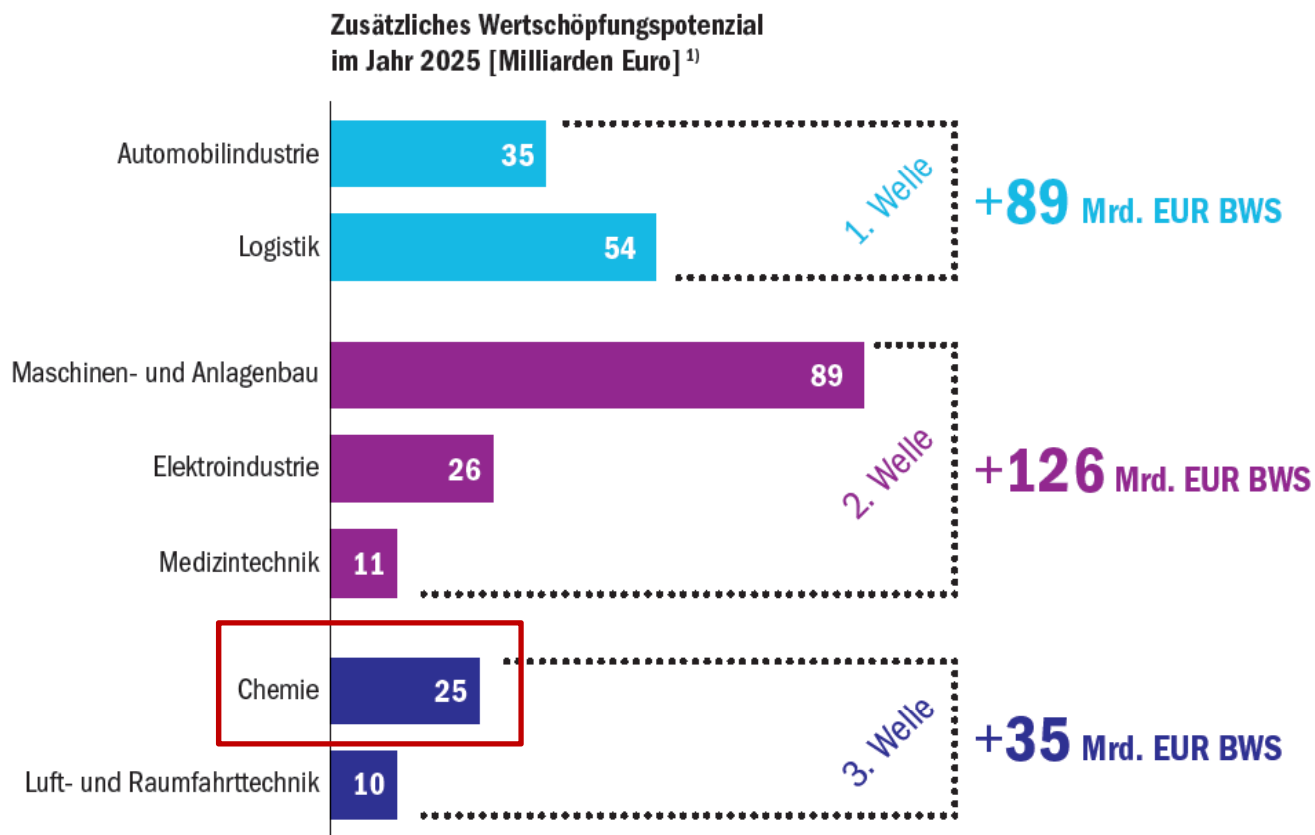
Source: Roland Berger, Survey among 300 top manager of german companies

Source: Accenture, Digital Chemical Survey, August 2014

Value-creation potential

DIGITALE TRANSFORMATION ERÖFFNET DER EUROPÄISCHEN INDUSTRIE
EIN ZUSÄTZLICHES WERTSCHÖPFUNGSPOTENZIAL VON 250 MILLIARDEN EURO P.A.

Branchenübersicht



1) Energietechnik in Maschinen- und Anlagenbau inkludiert
Quelle: Roland Berger

Source: Die digitale Transformation der Industrie, BDI/Roland Berger

Challenges on the way to Chemistry 4.0

- Overall Goals:
 - Improving operational effectiveness
 - Reducing unscheduled downtime
 - Driving higher returns on investment

- IT Challenges:
 - Big Data analytics
 - Cybersecurity
 - IPR
 - Data protection
 - High investments

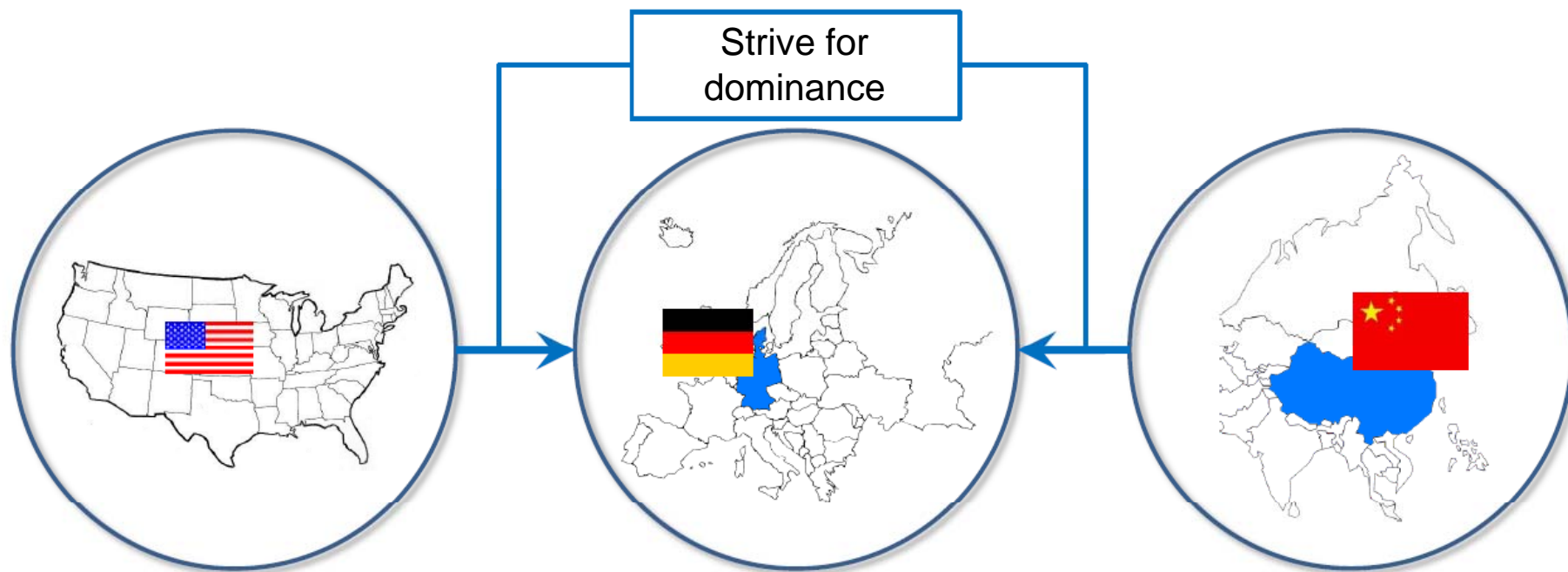
- High impact on work environment
 - Need for qualifications
 - Technology acceptance
 - Digital natives with high expectations (inside and outside the company)

- Legal implications

- Customer data mining

- Standardization

International standardization



- Leading provider of web software and IT
- Less mechanical engineering
- Top 20 dotcom companies: 83 % market capitalization

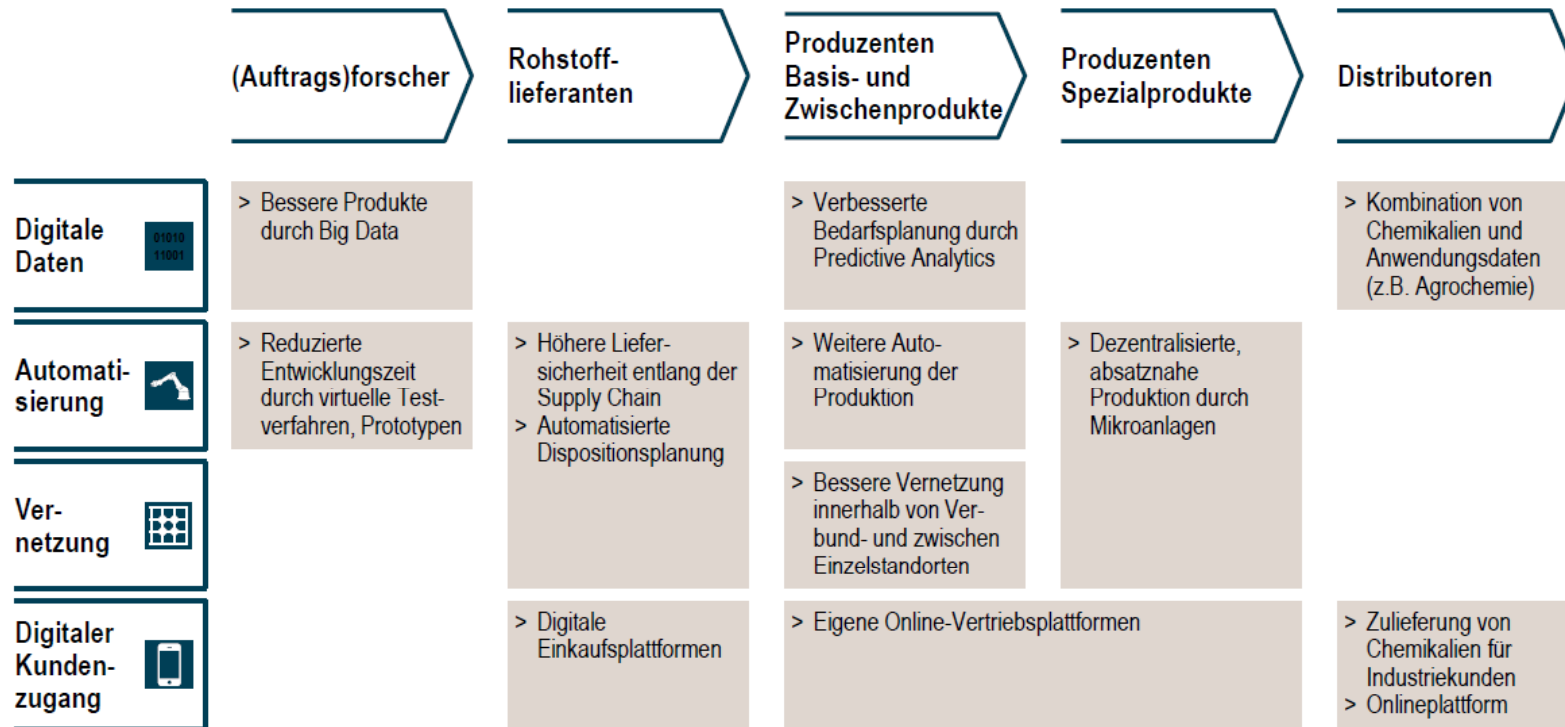
- Leading mechanical engineering
- Country of hidden champions (German Mittelstand)
- Leading provider of business software

- Leading provider of IT hardware
- Big market for mechanical engineering
- Top 20 dotcom companies: 17 % market capitalization (Asia)

Source: Wahler, DFKI; Roland Berger; modified

Digital revolution of the chemical industry

■ Some application areas of Chemistry 4.0



© BDI/Roland Berger

Digitalization as driving forces for ideas

- Augmented reality assists in maintenance
 - Reduces downtimes and installation times
 - Users can perform difficult operations with lower error rate
 - Integration of real-time information and data for quick access

- Apps for business use
 - e.g. enabling mobile devices to appraise the pump and motor load situation by smartphone listening
 - Analysis within seconds
 - World wide direct contact to manufacturer
 - Improving operational effectiveness



Source: RE'FLEKT GmbH

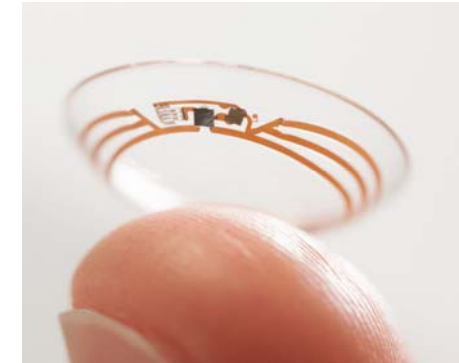


Source: C. Emde (KSB), ACHEMA Fachpresstag

Digitalization as driving forces for ideas

■ Smart Contact Lenses

- Eyewear monitors blood-sugar levels for diabetics
- Designed by Google, under license from Novartis
- Sensor relays data on glucose contained in tears via an antenna (thinner than human hair)
- Electronics are “so small they look like bits of glitter”



Source: Google/Novartis

■ „Decision Agriculture“

- Real-time field monitoring
 - Weather monitoring and simulations
 - Agronomic data, machine performance, soil moisture, etc
- Big Data-optimized seeding
- Weather insurance
- Advanced analytics to optimize yield
- Monsanto invested more than \$1bn in recent acquisitions



Source: Precision Planting, The Climate Corporation

Process Analytical Technology (PAT)

- PAT: part of Cyber Physical Production Systems (CPPS)
 - Integrated analysis of products, resources and production systems
 - Real-time analytics
 - Identifying optimum production levels
 - Getting early warnings
 - Variable and automated continuous GMP production possible
 - Shift in optical metrology from NIR to MIR
 - Strong emergence of Raman-based methods
- Innovative PAT enables the German chemical and pharma industry to improve operational effectiveness



PAT @ agriculture

Annual cycle of variety – silage maize

Nordeuropa



Prozessanalytik
Qualitätsbestimmung
während der Ernte
↓
Selektion der
leistungsfähigsten
Nachkommenschaften



Benefits:

- Cost savings of > 40%
- More efficient phenotypic selection
- Quick and accurate information on the dry matter of beets, maize, sorghum
- Better calculation basis for biogas plant operators
- Calculation of harvest
- Determination of optimal harvest time

Südamerika



Source: Hilscher (KWS SAAT AG), Tutzing Symposium 13 Oct 2014

PAT and Industrial Water Management

- Process analytics is helping to tackle challenges in water treatment
- Control of industrial (waste)water is increasingly important to avoid potential environmental and legal consequences – all over the world
- Real-time control of all water streams in industrial water systems
- Smart digitalized water management (incl. innovative process analytics) ends in an efficient energy management:
 - water will not be transported, heated or contaminated more than absolutely necessary to meet process needs
- In the next years, digital water management solutions will grow from a niche sector into a mass market: Water 4.0



Source: T. Track/DECHEMA

Raw Materials Change and Chemistry 4.0 – Wrap up

- Major Challenges and driving forces:
 - Multi-feedstock supply with regional diversification
 - Energiewende and use of Surplus Electricity
 - Digitalization and connectivity across the value chain

- Chemical industry must join the digital journey now. This will help the industry to
 - achieve feedstock flexibility,
 - build operational intelligence
 - achieve further intensification and modularization,
 - translate customers' needs into applications (better and faster than ever)

Thank you for your attention

**We are looking forward
to your questions**