Chemistry 4.0
Growth through innovation in a transforming world

São Paulo/SP, December 8th, 2017
A short video introduction into the subject
Trends

Chemistry 4.0

Recommendations
We identified 30 major trends, that have an impact on the chemicals industry until 2030

**Trends (30)**

- Energy & Raw Materials (7)
- Business-to-Business (construction, mobility, packaging) (10)
- Business-to-Consumer (3)
- Agriculture (5)
- Pharma & Health Care (5)

**Classification**

- Societally / politically driven
- Incremental
- Disruptive
- Entrepreneurial / economically driven

**Impact on chemicals industry**

- Small - **Moderate** - **Large Impact**
- **Positive** - Neutral/Winner-Loser - **Negative impact on chemicals & pharmaceuticals industry**
Incremental trends are areas, where chemicals companies perform well. Additional opportunities through digital tools

**Categorization of trends**

[12 of 30 are incremental]

**Large impact**

- **Moderate impact**
- **Little impact**

**Impact:** Positive, Neutral, Negative

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Note: D=Disruptive/I=Incremental; SP=Societally/Politically and EE=Entrepreneurially/Economically driven
Incremental trends – New, lightweight vehicles and materials

Sources: Schuberth, BMW, Boeing, Bilfinger, BBS, Deloitte
Disruptive trends will have a fundamental impact on the chemicals industry, creating “winners” and “losers”

Categorization of trends

[18 of 30 are disruptive]

Societal / politically driven

- Carbon Capture Storage / Carbon Capture Utilization
- Waste-to-Chemicals
- Self-medication

Electro mobility

- Perception of chemicals (discussion on ingredients)
- "Agrarwende"
- New medical technology

Genome editing in medical applications

- Bio-refinery
- Power-to-X

Genome editing in plants

Personalized Medicine

- Changing relations chemical supplier – end customer

Digitalization of agriculture

- New mobility concepts
- Industrial Biotechnology

Entrepreneurial / economically driven

- Self-medication
- "Agrarwende"
- Industrial Biotechnology
- E-Health

Additive Manufacturing

- Perception of chemicals (discussion on ingredients)

Large impact
Moderate impact
Little impact

Impact: Positive, Neutral, Negative

Note: D=Disruptive/I=Incremental; SP=Societally/Politically and EE=Entrepreneurially/Economically driven
Disruptive trends - New, electric drive trains in cars

Impact on chemicals & materials

- Battery materials
- High performance polymers
- Polyurethanes and polypropylenes
- Coatings
- Pigments
- Brake Pads
- Axle/transmission/engine lubricants
- Fuel & oil additives
- Coolants (except A/C)
- Catalyst

Expected volume change

Schematic
2 Chemistry 4.0
Digitalization and Circular Economy are the essential elements of Chemistry 4.0, following the 1.0, 2.0 and 3.0 developments.

**Chemistry 1.0**
Foundation and coal chemistry

**Chemistry 2.0**
Petrochemicals

**Chemistry 3.0**
Globalization & Specialization

**Chemistry 4.0**
Digitalization & Circular Economy

Source: VCI, BASF
The more disruptive the change, the bigger are customer needs. We see this as an opportunity for the chemicals industry.

- **Societal / political trends towards sustainability**
  - Entrepreneurial / economically driven trends towards efficiency and new business opportunities

**Incrmental Innovation**
- **Optimization**
  - Better products and processes
- **Offering**
  - New products and/or services (physical or digital)
- **Customer Relationship**
  - New roles, new cooperations, partnerships and customer relationships
- **Busioness Model**
  - New business models in new digital and circular economic networks
New business model – Precision farming

1. Product

2. Smart Product

3. Smart, connected product

4. Product-System

Smart Tractor + Sow + Cultivate + Harvest

5. Ecosystem

Farmer/Retailer

Integrated ecosystem

Proprietary, integrated solutions

Open, shared, publicly available technologies

Commoditization and generics

Independent farmers

AgChem and Digital Farming

AgChem, Fertilizer, Seed, OEM, Software companies

Customer needs – Value add

Digital product

Solution provider

Platform integrator

Asset intensity

Data intensity

Source: ClimateCorp, (2015), PWC Global Industry 4.0 Survey; Deloitte
Avoid the “Digital Death Zone” of incremental value steps. New business models are about thinking big and winner takes it all.

**Physical product**

- Price per unit
- Marketing Zone (physical products)
- Incremental Value Add

**Digital product**

- Price per unit
- Digital Death Zone
- Disruptive Value Add

Source: DowDuPont, Syngenta; Deloitte
Societal, political and factual requirements increasingly demand higher resource efficiency. Seven “Rs” to accommodate this need

**Application of chemicals & materials**

**Production of chemicals & materials**

(Re-) Design

**Ressource efficient and climate friendly production**

**Removal**

**Re- turn**

**Recy- cle**

**Regenerate energy**

**Residue deposition**
Application of chemicals and materials with different characteristics - determine the use of the seven circular economy levers

<table>
<thead>
<tr>
<th>Production</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chemicals/Materials</strong></td>
<td><strong>Auxiliaries</strong></td>
</tr>
<tr>
<td>(Re-)Design</td>
<td>Solvents</td>
</tr>
<tr>
<td>Ressource-efficient and climate friendly production</td>
<td>Lubricants</td>
</tr>
<tr>
<td>Residue deposition</td>
<td>Abrasives</td>
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<tr>
<td></td>
<td>Coolants</td>
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<tr>
<td></td>
<td>Heating oils, De-coating, De-icing, de-scaling chemicals</td>
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<tr>
<td></td>
<td>Mining &amp; fracking chemicals</td>
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</table>

**Revenue share***

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<tr>
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<th>10%</th>
<th>35%</th>
<th>15%</th>
<th>40%</th>
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</thead>
<tbody>
<tr>
<td>Source: VCI, Sector associations, Deloitte</td>
<td>*in Germany (estimated)</td>
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</tbody>
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2017 Deloitte
Chemistry 4.0 – From linear business models to new, complex – often circular - ecosystems

Value based on production of chemicals and materials [€/kg]

Value based on designing and building smart, sustainable solutions [€/performance or solution unit]
New business model example

**Approach & Results**
- Closed, dual-wall SafeTainer-System
- Chemical leasing paid per kg of cleaned clothing
- Ecosystem of dry cleaners, cleaning equipment manufacturers, recyclers and distributors
- Digital track-and-trace next step
- Effect – Drastic decline of mg halogenated solvent use per kg of clothings:

![Bar Chart]

<table>
<thead>
<tr>
<th>Generation</th>
<th>2017 Deloitte</th>
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<tbody>
<tr>
<td>2</td>
<td>125</td>
</tr>
<tr>
<td>3</td>
<td>60</td>
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<tr>
<td>4</td>
<td>30</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
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Quelle: Ecofys, FLK, SafeChem
3 Recommendations
Companies should secure their systems, become customer centric, enhance effectiveness & efficiency and explore new business models

**Cyber Security**
- Process data
- Customer & supplier data

**Customer Centricity**
- **Efficiency & Convenience**
  - No touch orders
  - Track-&-Trace systems
  - Integrated Omnichannels
  - Direct sales / Exclusive Distributor cooperations
  - Participate in platforms
- **Customer Experience**
  - Online technical services
  - Digital products & services
  - Personalization & integration
  - Collaborative & communicative
  - Attractive for millennials

**Effectiveness & Efficiency**
- Robot Process Automation (RPA)
- Workforce management (own & 3rd parties)
- Preventive & predictive maintenance
- Process improvement

**Smart products & new business models**
- Additive manufacturing (where applicable)
- Open innovation
- New ecosystem & Digital Business Models in a Circular Economy
  - Solution / Performance based
  - Co-operations and platforms
  - New concepts for participation

Source: Workshops Chemistry 4.0, Political dialog sessions, Deloitte
Thank you for your attention!