An overview of global megatrends and regional industry sector trends relevant for chemicals management and sustainable chemistry innovation

Regional Perspectives on Sustainable Chemistry Innovation and the Global Chemicals Outlook II: Understanding Trends, Risks and Opportunities

Regional Expert Workshop

Frankfurt, 26 – 27 March 2018

Prepared by
There are more people living inside this circle than outside of it.
China used more cement in the last three years than the U.S. used in the entire 20th century.

U.S.
in 100 years

4.5 gigatons
(1901-2000)

CHINA
in 3 years

6.6 gigatons
(2011-2013)

Factor 1

OVERVIEW OF MEGATRENDS WITH GLOBAL AND REGIONAL IMPACT
Megatrends: Definitions

• “Mega trends are global, sustained and macro-economic forces of development that impact business, economy, society, cultures and personal lives thereby defining our future world and its increasing pace of change.”
  – Frost and Sullivan 2014

• “large-scale social, economic, political, environmental or technological changes that are slow to form but which, once they have taken root, exercise a profound and lasting influence on many if not most human activities, processes and perceptions.”
  – OECD 2016

• “Massive cultural and market changes currently underway” / “Major global forces”
  – Deloitte 2010
Overview of megatrends
Global economic shifts

- OECD highly contested leader; US and EU challenged
- China on the rise:
  - Surpassed US in GDP PPP,
  - Overtaking US before 2030 in absolute GDP
- „Economic G3“: USA, China, EU
- How will the related political power be used?
Overview of megatrends

Population growth

Figure 3. Population by region: estimates, 1950-2015, and medium-variant projection, 2015-2100

Estimates (1950-2015)

Overview of megatrends

Population growth

Figure 3. Population by region: estimates, 1950-2015, and medium-variant projection, 2015-2100

Overview of megatrends

Urbanisation

Figure 2.
Urban and rural population of the world, 1950–2050

A majority of the world’s population lives in urban areas

Overview of megatrends
Urbanisation

Global urban population growth is propelled by the growth of cities of all sizes

Overview of megatrends
Pollution (and climate change)

Pollution Kills 3x As Many As AIDS, TB & Malaria Combined
Global estimated deaths by major risk factor and cause in 2015

- Total pollution (air, water and soil) 9.19m
- Tobacco smoking 7.17m
- AIDS, malaria and tuberculosis 3.04m
- Alcohol use risk 2.31m
- Malnutrition (child and maternal) 1.41m
- Road accidents 1.36m
- Drug use risk 0.49m
- War and murder (interpersonal violence, 2015) 0.41m
- Ebola* 0.01m

* 2014
Sources: The Lancet, NPR

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Overview of megatrends
Impacts on end markets

<table>
<thead>
<tr>
<th>End market</th>
<th>Megatrends likely to have high impact</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Resource scarcity</td>
</tr>
<tr>
<td>Construction</td>
<td>X</td>
</tr>
<tr>
<td>Electronics</td>
<td>X</td>
</tr>
<tr>
<td>Household</td>
<td>X</td>
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<tr>
<td>Agriculture</td>
<td>X</td>
</tr>
<tr>
<td>Paper and packaging</td>
<td>X</td>
</tr>
<tr>
<td>Automotive</td>
<td>X</td>
</tr>
<tr>
<td>Health care</td>
<td>X</td>
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<tr>
<td>Energy</td>
<td>X</td>
</tr>
<tr>
<td>Transportation</td>
<td>X</td>
</tr>
<tr>
<td>Nutrition</td>
<td>X</td>
</tr>
<tr>
<td>Personal care</td>
<td>X</td>
</tr>
<tr>
<td>Machinery</td>
<td>X</td>
</tr>
<tr>
<td>Apparel and textiles</td>
<td>X</td>
</tr>
<tr>
<td>Mining and metals</td>
<td>X</td>
</tr>
</tbody>
</table>

Source: DTTL Global Manufacturing Industry group.

- Major forces creating challenges and opportunities for chemical companies over the next decades
- These trends are generating growth in new markets up and down the value chain
- They can also be disruptive and prompt massive and potentially unprecedented shifts
Factor 2

TECHNOLOGICAL CHANGES WITH PROFOUND IMPACTS
Technological changes
Accelerating progress

- On average, CAS has registered one substance every 2.5 minutes since 1965.
- In 2016, this has increased to **one new substance every 1.4 seconds.**
Technological changes
Accelerating adoption

Adoption of Technology in the US (1900 to the Present)

Source: BlackRock
Technological changes
Disrupting economies & societies over next 10 – 15 yrs

- Internet of Things
- Big data analytics
- Artificial intelligence
- Neurotechnologies
- Nano/microsatellites
- Nanomaterials
- Additive manufacturing
- Advanced energy storage technologies
- Synthetic biology
- Blockchain

Source: OECD Science, Technology and Innovation Outlook 2016, 40 key and emerging technologies for the future
Technological changes
Disrupting economies & societies over next 10 – 15 yrs

Media mentions of “disruptive innovation“

Source: EY analytics using Factiva database. Figures show number of media articles mentioning “disruptive innovation” in each calendar year, excluding duplicates.

Real transformations; mere disruptive potentials; or just a buzzword?
Factor 3

SHIFTING OF INNOVATION CENTERS AND MANUFACTURING HUBS
Innovation: Expenditures on R&D

Gross domestic expenditures on R&D (GERD)

Source: www.innovationpolicyplatform.org
Innovation: Expenditures on R&D

Gross domestic expenditures on R&D (GERD)
Shifting of innovation hubs: Regional differentiation

Patent grants on: Organic fine chemistry; biotechnology; pharmaceuticals; macromolecular chemistry, polymers; food chemistry; basic materials chemistry; materials, metallurgy; surface technology, coating; micro-structural and nano-technology; chemical engineering. Source: WIPO

Intellectual property right: Patent; Year range: 1987 – 2016; Reporting type: Total count by filing office; Indicator: 5 - Patent grants by technology
Patents on: Organic fine chemistry; biotechnology; pharmaceuticals; macromolecular chemistry, polymers; food chemistry; basic materials chemistry; materials, metallurgy; surface technology, coating; micro-structural and nano-technology; chemical engineering. Source: WIPO
Number of patents filed in Europe by technology

Intellectual property right: Patent; Year range: 1987 – 2016; Reporting type: Total count by filing office; Indicator: 5 - Patent grants by technology

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## Chemical industry – Global chemical turnover

<table>
<thead>
<tr>
<th>Region</th>
<th>2016 (in billion US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>870.1</td>
</tr>
<tr>
<td>Latin America</td>
<td>216.0</td>
</tr>
<tr>
<td>Western Europe</td>
<td>1,048.9</td>
</tr>
<tr>
<td>Central &amp; Eastern Europe</td>
<td>109.5</td>
</tr>
<tr>
<td>Africa and Middle East</td>
<td>161.0</td>
</tr>
<tr>
<td>Asia-Pacific</td>
<td>2,792.1</td>
</tr>
<tr>
<td>World Total</td>
<td>5,197.6</td>
</tr>
</tbody>
</table>

Chemical industry – Focal sectors (outlook 2035)

Global chemical market more than doubling till 2035; agrochemicals and engineering plastics delivering strongest growth

Issues to focus on:

1. Access to & cost of feedstocks
2. Shifts in chemical manufacturing hubs (China, India, others)
3. Development of policy & regulatory framework → levelling playing field?
4. Shifts & relocations in application manufacturing
5. Shifts in terms of new products demands as well as markets
Chemical industry – European perspective

EU chemical industry sales by sectoral breakdown

Source: Cefic 2017: Facts and Figures 2017 of the European Chemical Industry
Factor 4

INDUSTRY SECTOR TRENDS – DRIVING FORCES
Industry sector trends
Construction

General market outlook

• Construction chemicals market worth 33.98 Billion USD by 2020
• Concrete admixture, construction adhesive, construction sealant, and flame Retardant, paints.
• Largest markets China, India, Japan and US.

Main drivers of innovation:
• Building codes and footprint regulations
• Growing demand for green/sustainable living and solutions that can help to reduce costs of building and living
• Climate resilience
• Digititalisation
Industry sector trends
Automotive and mobility

- 2015 – 2040: Global transportation demand growing about 25%
- Heavy duty growth is the largest by volume, but marine and aviation grow the largest by percentage
- Personal mobility demands continuing to increase, but more efficient vehicles leading to a peak and eventual decline in light-duty vehicle (LDV) energy demand
- Growth in economic activity and personal income drives increasing trade of goods and services, leading to higher energy demand in the commercial transportation sectors
Industry sector trends

Energy

Energy underpins economic growth

- Middle class will more than double in the next 15 years
- Demand for energy increases with more people expecting access to air-conditioned homes, cars and appliances like refrigerators, dishwashers and smartphones
- Continuing urbanization will add to economic growth
Industry sector trends

Energy

- Industrial energy demand rises by about 25 percent by 2040, led by growth in the chemicals sector
Industry sector trends
Agriculture & food industry

9 billion people projected for 2050

- **Today:** 70% of total water withdrawals globally (FAO)
- One fifth of **greenhouse gas emissions** generated by agriculture, forestry and land-use change (FAO)
- **2050:** Increase of global food demand by at least 60% over 2006 levels (FAO)
- Threats to global food system: rising raw material costs, limitation of future availability & climate change are
- **Side effects:** significant increase in plastic produce packaging (demand quadruple, EllenMcArthur Foundation 2016)
- Increase in food prices up to 84% by 2050, due to global 2 degree Celsius target (IPCC)
Industry sector trends
Agriculture & food industry

- More diverse food diets, particularly with growing disposable income
- Increasing demand in post-farm segments efficiency → preservation, packaging, productivity enhancing investments in cold-chain & storage facilities, food preparation away from home
- Transformation of rural on-farm and non-farm economy → emergence of local food industries and processing facilities
- Need and opportunity for urban/vertical farming and non-traditional food production

Crop protection sales by region ($ million)

<table>
<thead>
<tr>
<th>Region</th>
<th>2015</th>
<th>% change</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>14,052</td>
<td>-6.9</td>
<td>13,076</td>
</tr>
<tr>
<td>Asia</td>
<td>14,040</td>
<td>-1.2</td>
<td>13,866</td>
</tr>
<tr>
<td>Europe</td>
<td>11,604</td>
<td>-1.3</td>
<td>11,453</td>
</tr>
<tr>
<td>North America</td>
<td>9,356</td>
<td>+1.3</td>
<td>9,475</td>
</tr>
<tr>
<td>Rest of the world</td>
<td>2,158</td>
<td>-2.0</td>
<td>2,115</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>51,210</strong></td>
<td><strong>-2.4</strong></td>
<td><strong>49,985</strong></td>
</tr>
</tbody>
</table>

Source: Phillips McDougall

Use of fertilizer per hectare of cultivated land
- 22 kg in Africa
- 125 kg in South Asia
- 220 kg in Germany
- 506 kg in China

Prepared by
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IFOK
A CADMUS COMPANY
Conclusion

CHEMICAL AND MATERIALS INDUSTRY
“Everything is possible. The impossible just takes longer”
(Dan Brown)

„A chemical plant to go, please!“