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

Nairobi, 7 - 8 March 2018
Objectives

1. Overview of megatrends with global and regional impact
2. Technological changes with profound impacts
3. Shifting of economic power, emerging markets and manufacturing hubs
4. Industry sector trends and driving forces
Factor 1

OVERVIEW OF MEGATRENDS WITH GLOBAL AND REGIONAL IMPACT
Overview of megatrends and drivers

- Major global forces creating disruption and opportunity for chemical companies over the next decade.
- These trends are generating growth in new markets up and down the value chain and prompting unprecedented shifts in the industry.

Source: DTTL’s Global Manufacturing Industry Group analysis.
### Overview of megatrends and drivers

Impacts on end market and value clusters

<table>
<thead>
<tr>
<th>End market</th>
<th>Megatrends likely to have high impact</th>
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<td>Resource scarcity</td>
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<td>Construction</td>
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<td>Apparel and textiles</td>
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<td>Mining and metals</td>
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</tbody>
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### Selective value networks

- **Life sciences**
  - Personal care
  - Nutrition
  - Pharmaceuticals
  - Supporting industry: Machinery, Paper and packaging, Agricultural products

- **Mobility**
  - Automotive
  - Transportation
  - Supporting industry: Machinery, Solar, Apparel, textile, and leather, Battery, Electronics, Mining and metal

- **Housing and infrastructure**
  - Construction and infrastructure
  - Household appliances
  - Home furnishings
  - Supporting industry: Machinery, Mining and metal, Solar, Electronics, Packaging

- **Digital life**
  - Electronics
  - Medical devices
  - Commercial printing
  - Supporting industry: Machinery, Solar, Battery, Machinery, Mining and metal

- **Energy**
  - Oil and gas
  - Solar/renewables
  - Wind/renewables
  - Energy/electric utilities
  - Supporting industry: Machinery, Solar, Wind, Battery, Electronics

Source: DTTL Global Manufacturing Industry group.
Example: Sustainable urbanisation

Example: Sustainable urbanisation – Challenges

Concentrating economic resources in one place can cause:

- Overcrowding,
- Overloaded infrastructure,
- Pressure on ecosystems,
- Higher costs of living,
- Higher labour and property costs.

Balancing need for more environment-friendly & less resource-consuming process for growing urban population and middle class, due to:

- 75% of world’s natural resources,
- 75% of global energy supply,
- 50% of global waste,
- Account for ~ 60% - 80% of global carbon dioxide emissions
- Emerging health related challenges (air pollution, unsafe water, unsafe sanitation)
- Provision of food, water and energy, transport
- Provision of housing
Example: Sustainable urbanisation - Africa

- By mid 2030, 50% of African’s population expected to become urban dwellers.
- Urbanisation likely to continue and level off at about 56% around 2050.
- Africa urbanising twice as fast as did Europe.

Source: African Economic Outlook 2016
Factor 2

TECHNOLOGICAL CHANGES WITH PROFOUND IMPACTS
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

Internet of Things
• Opportunities in health and healthcare (e.g. health monitoring and provision remote health service);
• Smart manufacturing reducing waste & loss;
• Embedded sensors in waste containers & water management.

Big data analytics
• Improvement to different dimensions of healthcare, e.g. patient care, health systems management, disease research and control;
• Enhancing agricultural productivity.

Artificial intelligence
• Smart production lines

Neurotechnologies
• Opening ways forward in diagnosis and therapy for healthy ageing and general human enhancement.

Nano/microsatellites
• Geospatial technology opening opportunities for around-the-clock observation, e.g. the monitoring of oceans’ health and inland waters;
• Monitor agricultural crops, improve crop productivity and keep track of deforestation.

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

Nanomaterials
• New areas for application of advanced nanomaterials in medicine, e.g. development of molecular imaging
• Expected to enhance medical treatment, e.g. biocompatible nanocellulose could be applied in treating burns;
• Uses in biodegradable packaging.

Additive manufacturing - new manufacturing paradigm
• 3D-printing processes, e.g. new products in health, medicine and biotechnology
• DNA printers: body parts, organs from the patient’s own cells
• Direct product delivery and product tailoring
• Manufacturing & local delivery service and maintenance of highly complex replacement parts
• Advance digital transportation, storage, creation & replication of products

Advanced energy storage technologies
• On demand release to supply energy or power services boosting use of renewable energies
• Small-scale applications to advance e-mobility

Synthetic biology
• Design and construction of new biological parts & re-design of natural biological systems, genetic manipulations

Source: OECD Science, Technology and Innovation Outlook 2016, 40 key and emerging technologies for the future
Factor 3

SHIFTING OF ECONOMIC POWER, EMERGING MARKETS AND MANUFACTURING HUBS
Shifting of economic power, emerging markets and manufacturing hubs

Economic outlook and aspiration - Africa

- Positive outlook on GDP growth rates after slowdown (2018: 4.3%)
- By 2050: Population of 2 bn
- 62% of people <25 years; accounting for world`s largest young & working population
- 6 out of 10 fastest growing economies (Kearney, 2014)
Shifting of economic power, emerging markets and manufacturing hubs

Positive outlook on African GDP growth rates

Regional weighted real GDP growth outlook (%), 2017f-18f

- East Africa: 6.3%
- Southern Africa: 1.7%
- Central Africa: 1.6%
- West Africa: 2.9%
- North Africa: 4.4%

Source: Deloitte analysis based on IMF, 2017
Shifting of economic power, emerging markets and manufacturing hubs

Industry structure by 2050 (East Africa)

- In all countries, the contribution of agriculture is projected to decline while that of services and industry increases.
- However, the contribution of agriculture is not projected to fall below half of its 2010 level in any of the six countries.

Source: Social protection in East Africa: Harnessing the future; © OECD 2017
Shifting of economic power, emerging markets and manufacturing hubs – Challenges & Strategies

Most important **problems** cited by African citizens: **Unemployment & health**

(Source: Afrobarometer 2014/15 survey)

**By 2035:** 375 million young Africans to become of working age

**Projections:** only a quarter may find wage jobs

- Creating employment/ industrialisation
- Agriculture and agro-food industry to absorb large share of new workers into gainful employment

Source: African Economic Outlook 2017
Shifting of economic power, emerging markets and manufacturing hubs – Challenges & Strategies

Most of Africa’s industrialisation strategies target specific economic sectors:

- **Light manufacturing** as key area for development, particularly agro-processing, wood products, clothing, textiles, leather & footwear (19)
- **Aspects of environmental sustainability**, such as renewable energy use and water conservation (16)
- **Agriculture**, including livestock, forestry and fishery products (15)
- **Tourism & high-tech services** (13)
- **Mining & resource extraction** sectors such as copper, oil and gas (11)
- **Energy** (8)
- **Construction** (5)

Source: African Economic Outlook 2017
Shifting of economic power, emerging markets and manufacturing hubs

Relocation and shifting to emerging manufacturing hubs in Africa

Investment driven mainly by local demand

- As per AFDB, investment growth in local manufacturing sectors driven by increase in local (pan-African) demands rather than by cost of production reasons → moving closer to consumer

Potential of integration in global value chains

- 1995 – 2011: significant increase in global & regional value chain participation with highest level in manufacturing (e.g. leading automotive followed by electrical machinery & metal products)
- Selective regional benefitting from availability of critical input resources (minerals, oil/gas, fibres/ livestock) and backward/forward integration

Taking advantage of emerging intra African economic integration

- Temporary production relocation for exploring advantages of quotas & preferential access to international markets, but more focus on emerging Africa’s Continental Free Trade Area (CFTA) (AEO 2017)
Factor 4

INDUSTRY SECTOR TRENDS – DRIVING FORCES
Chemical industry – Focal sectors

Source: Deloitte, 2011 „End market alchemy Expanding perspectives to drive growth in the global chemical industry“
Chemical industry – Focal sectors (outlook 2035)
Global chemical market more than doubling till 2035, with 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
Construction

African construction trends

**Northern Africa**: Real estate, transport

**Western Africa**: Mining, transport (bridges/road & railways), energy & power

**Central Africa**: Transport (bridges/road & railways), energy & power

**Eastern Africa**: Substantial increase of project 65.1%, transport (bridges/road & railways, energy & power)

**Southern Africa**: mainly in South Africa, slight increase, real estate, (energy & power, oil & gas)

Prepared by IFOK
Chemical industry

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, growing number of new projects for housing, commercial spaces, and public infrastructure in the Asia-Pacific region and other developing countries such as Brazil, Colombia, UAE, and Saudi Arabia.

Trends:

• Increasing awareness about construction quality and technological advancements
• Changing lifestyles, growing urbanization trend, and demand for enhanced esthetics of residential and infrastructures are also supporting the growth of the market,

Outlook Africa

• Market with huge growth potential, fastest-urbanizing regions, with annual growth rates between 2-10% (Source PwC African Construction Outlook 2017)

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
• Comfortable and healthy living
• Climate resilience (Water-resistant, higher load-bearing, and breathable foils and compounds, extreme weather resistance)
• Digitisation in living

Green/sustainability driving eco-efficient building

• Heating/cooling systems used without electricity
• Noise- and heat-insulated windows that reduce heating costs and enhance the lifespan of a building
• Foaming insulation that reduces heating costs and the CO2 footprint over a building’s lifecycle
• Self-energy-generating homes
• Materials free of halogen and solvents
• Replacement of plastics with biological or fiber-based materials
• Replacement of steel with lightweight materials
• “Ever clean” facades with special paints
Chemical industry
Automotive and mobility

- 2015 – 2040: Global transportation demand growing about 25%
- 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
- Heavy duty growth is the largest by volume, but marine and aviation grow the largest by percentage
Chemical industry
Automotive and mobility

Outlook Africa

- **Increasing infrastructural developments and rising urbanization**: African commercial vehicles (CV) market is expected to grow at annual growth rate (CAGR) of 6.1%.
- **Until 2025**: Nigeria, Kenya and Morocco expected to be fastest-growing markets & only ones to increase share in the overall CV market.
- **Asian OEMs** (China & India): expected to further proliferate at a rapid pace and spearhead the supply of value trucks in the region.
- **No presence** of natural gas (CNG) vehicles, or broad adoption of basic telematics services.
- **New vehicles** predominantly imported as knocked-down kits and assembled in local facilities, whereas used vehicles are imported as fully built units; Asian manufacturers into setting up shop in the region.

**e-mobility outlook:**

Most documented experience from initiatives in Cape Town, South Africa.

- Annual purchase of 4 000 electric vehicles through the planned Public Procurement Programme (target 3000 – 5000 annually) and 1 500 private electric vehicles per year (based on stakeholder opinions), rising by 10% per year,
- Mainly imported, however vehicle cost issue!
- Expected expansion by Chinese EV market leaders into Africa “Geely”, BYD (e-taxis, buses)
- Demand for 100% electric cars in Africa not expected to take off until continent’s power crisis marked by insufficient generating capacity, unreliable supplies, high cost.
Chemical industry
Energy production and consumption

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 in China and India, with people moving from rural areas to cities, will add to economic growth

Africa for about **30 percent** of the increase in global energy demand.
Chemical industry
Energy production and consumption

- Household energy use continues to improve, reflecting more efficient buildings and appliances
- Energy use evolves to favor use of electricity
- Residential electricity use in Africa likely to increase about 250 percent though continue to lag in terms of electricity use per household (about 1.8 MWh/a per household)

People in Africa still rely on biomass products to a large degree; for cooking due to lack of access to electricity
Chemical industry
Energy production and consumption

African countries with a majority living without electricity access

- Zambia: 50%
- Mozambique: 44%
- Tanzania: 42%
- Malawi: 39%
- Uganda: 34%
- Madagascar: 32%
- Mali: 31%
- Liberia: 31%
- Guinea: 30%
- Niger: 29%
- Sierra Leone: 25%
- Burkina Faso: 17%

ATLAS | Data: Afrobarometer
Chemical industry
Energy production and consumption

- Industrial energy demand rises by about 25 percent by 2040, led by growth in the chemicals sector
Chemical industry

Electronics

Fast-moving end market with shorter innovation cycles than most & shifting consumer preferences
Opportunities for chemical companies include:
• **Electronic chemicals** catering to materials for portable electronic devices, solar cells, organic light-emitting diodes, and batteries for electric vehicles
• **Recycling & substitution** of rare earth materials
• Bioplastic as a substitute for plastic & other materials
• **Materials for power generation**, transmission & distribution
• **Materials for local power generation**, such as solar panels, micro-generators & wind-power
• Bottom-up new **semi-conductor technology** using nanotechnology
• **Electronic displays**, light-emitting diodes, portable communication & information tools such as navigation devices, tablet personal computers (PCs) & photovoltaics
• Chemicals used in etching & cleaning **semi-conductors** for mobile Internet devices such as smart phones and tablet PCs

Main drivers of innovation
• Changing **consumer preferences**
• **Regulations** such as in terms of energy reduction, recyclibility, (circular economy)

Africa
• Market with **huge growth potential**, with expected growth rates
• Need for moving production closer to consumers?
Chemical industry
Apparel, textile, footwear

- Textile and clothing industry currently ranked amongst fast growing economic sectors, with Asia ranked first in terms of market share (World Bank statistics); fashion industry is expected to double in next 10 years
- Relocation from Asia to Africa overrated (still in competition with other Asian manufacturing hubs) → yet to overcome cost competitiveness issues

Chemical industry
Apparel, textile, footwear

- **Today:** Ten countries (all located in Eastern & Southern Africa) see some US$ 2.5 billion in apparel exports from sub-Saharan Africa, representing **only 0.55%** of world apparel exports.

- Strong emerging African fashion/textile/shoe industry, strong differentiation in terms of backward integration under umbrella of AGOA, quotas (e.g. US market, pan African market) → AFDB “Fashionomics” initiative

**Challenges from chemical perspective:**

- In-production and end-of-pipe impacts => Less in ready-made garment (RMG) or leather product manufacturer, but with TIER 2 and TIER 3 (textile finishing, tanneries, fibre production)

- Emerging legal and other requirements with regard to restriction of chemicals as well as integration of circular economy

Cotton-producing countries (seed cotton, 2004-2014 average); Source: adapted from FAOSTAT, 2017
Chemical industry
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 produce packaging (demand quadruple, EllenMcArthur Foundation 2016)
- Increase in food prices up to 84% by 2050, due to global 2 degree Celsius target (IPCC)

Possible ways forward

- New systemic approaches to food systems
- Overcome food losses (currently 1.3 billion tons), incl. post-harvest food loss, food loss during production, storage or transport & food waste (FAO)
- Develop & resort production systems/methods that reduce strains on agricultural land, forests and water
- Encouragement of consumers increasingly to make choices for more sustainable lifestyles (*WEF 2014 consumer survey: 72% were willing to buy green products, only 17% actually did*)
Chemical industry
Agriculture & food industry

Global demand for agrochemicals

- **Europe:** Fastest growing region for agrochemicals, with precision farming & fertilizers leading the way.

- **China:** Agricultural sector major demand channel for chemicals, remaining largest agrochemical market by revenue, with highest growth rates in the world.

**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

**Drivers**

- **Growing population** & declining acreage of arable land → increased use of precision agriculture (smart farming) as concerns over food production heighten;

- **Rise of start-ups** drives productivity in agriculture due to the use and benefits of IoT.

- **Growing demand** from other sectors (bio-based feedstocks, bio fuels, cotton for textile sector)
Prepared by

Chemical industry
Agriculture & food industry

Urbanisation trends boosting agro- and agro-food industry:

- **Upward demand for food production** (incl. 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

**Outlook Africa:**

- African Union’s Agenda 2063 focusing on improvement of agricultural productivity → “the hand hoe will be ‘banished’ by 2025 as agriculture on the continent relies more on science, technology and innovation.”
- Urbanisation and demographic changes together with climate change related **dwindling arable land leading to major changes of regional food systems.**
- Benin, Burkina Faso, Ghana, Mauritania, Niger and Nigeria may face water scarcity by 2025 (Montpellier Panel, Dec 2014)
## Chemical industry

### Agriculture & food industry

#### Demand for agrochemicals (fertilizer)

<table>
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<tr>
<th>Compound annual growth rate (CAGR) 2015 – 2020 and 000 tons in 2020</th>
<th>Phosphate fertilizer demand</th>
<th>Potash fertilizer demand</th>
<th>Nitrogen fertilizer demand</th>
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<td>%</td>
<td>000 tons</td>
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[Image]

United Nations Environment Programme
Agriculture & food industry

Example – Sustainable Agriculture

Technology innovation in accelerating food systems transformation

Source: World economic Forum/McKinsey 2018
Factor 5

CHEMICAL AND MATERIALS INDUSTRY
Chemical and Materials Industry

Ways forward

- Chemical industry products and services can ensure a sustainable future
  - Solutions provider for energy-efficient buildings, sustainable transportation and water purification (e.g. helping to improve ecosystems by degrading pollutants, plastic)
  - Development of Advanced Materials with enhanced functionalities
  - Incorporate advances in the field are permitting a full lifecycle without waste in line with Circular Materials Economies (e.g. plastic, bio-mining, urban mining)
  - Contribute to “precision agriculture”, additive manufacturing, and a faster, more precise subtractive manufacturing
Top trends shaping the future of the African chemicals industry

• An uptake in digitisation by chemical companies in Africa due to major business hubs such as South Africa, Nigeria, and Kenya;
• Increased local manufacturing, intra-Africa trade, and diversification in business models, portfolios and economics;
• Additive manufacturing disrupting the industry with significant growth potential over the next three to five years;
• Increased use of precision agriculture (smart farming) as concerns over food production heighten;
• Rise of start-ups drives productivity in agriculture due to the use and benefits of IoT.
“Everything is possible. The impossible just takes longer”

Somewhere in Africa....

„A chemical plant to go, please!“

Adapted from 24.12.2017 Chemiefabrik im Klein-Format: Die Vorteile der Miniaturisierung - WELT