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

Report on Regional Expert Workshop
Frankfurt am Main, 26 - 27 March 2018

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Summary

On 26 - 27 April 2018, the second of four regional expert stakeholder scoping workshops took place in Frankfurt am Main, Germany. This initiative was part of a strategic partnership, in which ISC3 and UN Environment examined the long-term perspectives and roles of sustainable chemistry. This workshop brought together a select group of specialists from the European countries as well as Russia, including innovators and entrepreneurs, policy-makers and scientists, regional experts and futurologists from relevant stakeholder groups. The event resulted in some key takeaways:

1. Technological change, and digitalisation in particular, pose both a tremendous challenge and a significant opportunity for the chemicals sector for improving internal processes and enhancing resource efficiency, and for downstream users when it comes to information sharing and more integrated supply chains.
2. When examining issues pertaining to sustainable chemistry innovation in European countries, challenging regulatory frameworks are one of the most pressing issues.
3. The chemical industry is an important enabler of sustainability transformation and needed for achieving the 2030 Agenda, but negative effects of hazardous substances on human health and the environment have led to a challenging societal perception.
4. To address sustainable chemistry issues, specific strategies to engage and involve the entire value chain are needed. The chemical industry is perceived to be aware of and addressing its issues in sustainability (e.g. high energy consumption), but still is not using its full potential due to the risk of loss of market share.
1. Introduction and context

Innovation is key to sustainable development. Sustainable chemistry, as a cross-cutting and interdisciplinary concept, is a major driving force for innovation and provides new intelligent solutions paired with diverse ecological, social and economic benefits. Sustainable chemistry is the single largest opportunity to move entire supply chains towards circular economy models, avoid waste and make better use of natural resources. It is strongly linked to a variety of topics including, among others, renewable energy, climate change, sustainable cities, healthcare, agriculture and buildings and living.

As a new and independent organisation, the International Sustainable Chemistry Collaborative Centre (ISC3; www.isc3.org) aims to accelerate the global breakthrough of sustainable chemistry by promoting innovation, assessing processes and products and stimulating international debate on the future of chemistry. As a first step into the debate, UN Environment and the ISC3 have joined together to discuss global megatrends and regional perspectives on innovation, technology change and new business models relevant for advancing the implementation of sustainable chemistry solutions worldwide.

As part of this strategic partnership, ISC3 and UN Environment organised a series of interactive multi-stakeholder workshops in various regions. The objective of the partnership was to gain expert insights from different actors on the future role of chemicals and chemistry by examining important factors such as global and regional megatrends, sustainable development needs, the potential of disruptive technologies and innovative business models, etc.

The workshops served two purposes: the ISC3 aim to facilitate a scenario-building process on shaping the transition towards more sustainable chemistry. Various inputs from different actors have been carefully and holistically considered. The workshops provided a unique opportunity for a) civil society representatives to voice expectations and concerns, b) industry representatives to refine strategies and investments, c) policy-makers to gain insights on shaping effective policies and d) academics to spur further research.

This series of workshops has also contributed directly to the UN Environment’s second edition of the Global Chemicals Outlook II (GCO-II). The results and contributions from all workshops will flow into a collating overall picture illustrating what the future of sustainable chemistry can look like, and what role chemicals and chemistry will play in addressing emerging and future challenges in implementing the UN Sustainable Development Agenda 2030 and its corresponding Sustainable Development Goals (SDGs). These results will form the foundation for international expert decisions at the GCO Steering Committee Meeting in June 2018 and provide significant input on how the issue of sustainable chemistry and underlying mega-trends will merge into the next GCO-II.

The GCO-II is being prepared in response to the second session of the United Nations Environment Assembly (UNEA) and will be released globally in early 2019. Designed to be forward-looking and policy relevant, the GCO-II is expected to capture the state of scientific, management and policy knowledge to support policymakers and stakeholders in their efforts to assess the implementation of the 2020 SAICM goal, and in deliberating on the sound management of chemicals and waste beyond 2020. Structured in four parts, the GCO-II will address relevant global and regional trends and developments, review chemical management topics and instruments, identify enabling environments and drivers of change, and provide options for implementing actions towards relevant SDGs.

The two-day regional expert workshop, held in Frankfurt am Main, Germany on 26 and 27 March 2018, was the second of four regional workshops examining Regional Perspectives on Sustainable Chemistry Innovation and the Global Chemicals Outlook II: Understanding Trends, Risks and Opportunities. This workshop specifically focused on:

- identifying regional and industry sector trends in Europe and Eurasia,
- reviewing chemical management topics and instruments,
- identifying an enabling environment and drivers of change in Europe, and
• reviewing options for implementing actions towards relevant Sustainable Development Goals (SDG)

The results of these four workshops serve as inputs for subsequent initiatives from the ISC3 and UNEP/GCOII. In case of ISC3, the insights gained during the workshops will form the basis for a scenario development process on sustainable chemistry with a long-term perspective (by 2050). This scenario development process will, among other functions, help to further define “sustainable chemistry” and its future role in shaping a sustainable world. For UN Environment, the workshop inputs will immediately contribute to preparing the second Global Chemical Outlook (GCOII), which will officially launch in early 2019. The GCOII, in its chapters 3 and 4, will capture issues pertaining to innovation in the context of sound chemicals management by 2020 and beyond.

To prepare and implement these workshops as well as the preparation of the ISC3 scenario development process, the GIZ ISC3 engaged an external consulting consortium, consisting of experts from adelphi (www.adelphi.de) and IFOK (www.ifok.de).
2. Proceedings

The workshop was structured to provide a suitable platform and forum for participants from different countries in the Europe and Eurasia to share their views, concerns and ideas. The approach consisted of snapshot presentations, brainstorming and discussions in full plenary, moderated by an expert team from adelphi and IFOK (Dr Nils Simon, Melissa Allen).

To gather a wide variety of diverse views, participants representing policy-makers, research and development, academic institutions, industry, start-ups, business intermediaries and non-governmental organisations were invited to attend. The workshop brought together 34 participants from Europe (including Austria, Belarus, Belgium, Czech Republic, Germany, Italy, Macedonia, Russia, Serbia, Sweden, Switzerland, UK, and Ukraine), representing various stakeholder groups (industry, government, NGOs, research and academia as well as UN organizations and affiliated regional centres).

The workshop started with a brief welcome and an introduction to ISC3 by Friedrich Barth, and to UNEP/GCOII by Anna Makarova and Jost Dittkrist, outlining the respective roles and missions of the two partners behind this series of workshops. This was followed by four sessions, for which details are provided in the following sections.

Session 1 – Overview of the Chemicals Sector and Sustainable Chemistry Innovation in Europe

The purpose of this session was to share preliminary findings on the European chemical industry and its links on regional industry sector trends, as well as to collect regional perspectives and snapshots on chemical management and innovation in Europe and Eurasia. This session, moderated by Nils Simon, started with a presentation on “Chemistry 4.0 – Growth through innovation in a transforming world” in Europe, held by Dr Henrik Meincke from the German Chemicals Association (VCI – Verband der chemischen Industrie).

The presentation showcased the following key points:

- Today’s overall dynamics imply partly disruptive developments as new technologies, customer demands and new competitors around sustainable chemistry develop and therefore create new opportunities and threats.
- There are many incremental and disruptive changes in the chemical industry and its environment, driven by societal, political, entrepreneurial or economic factors. Lightweight vehicles, electromobility, genome editing and breeding, personalised medicine, industrial biotechnology and digital farming were only a few of the many examples presented.
- Digitalisation as a technological revolution has tremendous implications for the chemical industry, incorporating the topics of IoT (Internet of Things), big data analysis, cloud computing, additive manufacturing, augmented reality, artificial intelligence and the technology of blockchain.
- Three main technologies linked with digitalisation are highly important for the chemical industry. Some examples include intra-company processes like data sharing and collection, as well as data based operation models for the development of business models and decision-making support. Another important implication is the development and maintenance of external networks. The transformation of business activities towards cloud-computing and working requires efficient determining factors.
- The circular economy model (decoupling economic growth from the consumption of finite resources) also plays a major part in the industry, as it is gaining more influence on product portfolios, value creation structures and business models.
Examples mentioned in the presentation from the chemical industry with regard to circular economy included: (re-)design, return, resource efficient production, chemicals recycling.

Session 2 – Global Megatrends and Industry Sector Trends in Europe: Risks and Opportunities for Chemicals Management and Sustainable Chemistry Innovation

The purpose of this session was to share preliminary findings on global megatrends and its links to regional industry sector trends, as well as to collect regional perspectives and snapshots on chemical management and innovation in Europe and Eurasia. This session, moderated by Melissa Allen, started with a presentation by Nils Simon on preliminary findings from research on mega- and industry sector trends, and referred to outcomes of regional workshops in Nairobi.

Building on the presentation by Mr. Meincke and Mr. Simon, Mr. Simon moderated a plenary discussion on the results and invited participants to share their expertise and experience, specifically focusing on the sectoral implications of megatrends and on innovation to advance sustainable chemistry. Workshop participants contributed several thoughts, ideas and opinions on the overall topic, covering the following:

The plenary discussion reflected on the current state of the chemical industry and its opportunities for the future. Despite a shared view that the industry has been focused on satisfying consumer demands and increasing volume, it is also clear that consumer demand has shifted substantially towards sustainability and sustainable products. Therefore, this new demand will force the industry to move more quickly towards sustainable processes, also by making the effort to highlight that sustainability is of economic value. The chemical industry is perceived as major enabler for sustainable changes with the ability to encourage other industries to make an impact on the sustainability movement. Since the industry is very energy intensive, changes that harness energy efficiency can be applied as demonstration projects. This kind of transformation would feed into the economic pillar of a holistic sustainability approach, in which growth is only possible without exploiting available resources, and which connects to the social pillar and the question of how much growth the industry can afford in jeopardising its social responsibility. Although sustainability also implies trade-offs, driving change would foster proactively participating in B2C and prioritising a sustainable approach over industry compliance. Instead of operating as a reactive industry, moving sustainability forward within and along the value chain could positively influence involved stakeholders to follow a similar approach.
Referring to the outcomes of the brief discussion during the first session, Melissa Allen facilitated the following discussion to select three key sectors to be examined more deeply during the subsequent sessions. The participants selected (1) agriculture, (2) construction and (3) transportation to discuss in more detailed break-out groups, moderated by Nils Simon, Melissa Allen and Ulrich Golüke. Participants specifically focused on how megatrends affect regional industry sectors and related chemical use patterns, risks and opportunities for sustainable chemistry innovation. After discussing the three sectors in detail, the breakout groups reported their findings back to the audience. The process evolved along the following guiding questions:

1. What are potential impacts of relevant megatrends on the selected sectors?
2. How will the expected trends in the selected industry sector affect chemicals production, use, disposal and exposure?
3. What are chemicals-related opportunities (e.g. jobs, economic growth) and risks (health, and environment) associated with these trends?

Summary of sectoral discussions

Construction

A common opinion within the group was that the topic was both complex and widespread. It was therefore helpful to discuss the sector closely using the three guiding questions. Urbanisation and population growth will be the main drivers for the construction sector, resulting in big impacts, but also challenges. A declining European middle-class in Europe and a rising worldwide demand for cheap(er) housing, construction costs will become a challenge across the globe. Modular building may meet the need of smaller and single housing demand. Another major challenge will be the conflict between land use for construction and agriculture, particularly in densely populated areas.

With regard to the megatrend of resource scarcity, the group agreed that it is inevitable to develop new resource-efficient construction materials for smart housing within the meaning of the Sustainable Development Goal 12.4 (By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment). Discussing what kind of implications megatrends will have on chemical production, use and disposal within the construction sector, one major point was the persuasion of challenges for sound chemicals management due to a globalised market for construction materials, its increasing variety of materials and total volume. A solution could be the implementation of chemical leasing to bring resources and production closer to producers and regions in need. Handling (global) waste streams along the value chain without specific and proper knowledge of material contents and compounds will cause complications and therefore, create a strong demand for clean and efficient construction materials, especially keeping in mind the end of life of buildings.

Another implication stressed during the discussion was human health. Indoor air pollution due to chemical emissions and chemicals exposure may cause a rise in health care costs, if inaction continues. In response to the listed challenges in the sector, participants contributed many valuable ideas in the direction of chemicals-related opportunities and risks associated with the trends mentioned above. There was strong commitment towards a standardisation of (sustainable) construction materials, which was closely linked to a commitment towards phase-outs of restricted substances, especially in developing countries. A harmonised database of materials and information on hazards could foster the movement towards a more sustainable construction sector. In support of harmonised databases, digitalisation is perceived as a major support factor in establishing an inventory of material and substances, and which could also be used to develop a track and trace system with integrated certification schemes of sustainable products and labels. Such labels could assess sustainable compositions of materials also with regards to recyclability. Keeping an eye on the present situation, where materials are not yet as sustainable and clean, awareness of the need for sustainable
construction materials must be advanced along the value chain, and education must be fostered within the workforce on proper usage to decrease chemicals exposure.
Agriculture

To narrow the scope of the discussion, the participants within the group defined agriculture as the farming of food and livestock. Participants in Frankfurt shared a common view that the megatrend of population growth is less an issue in Europe than in other regions. However, urbanisation will cause competition for land use with regard to construction vs. farming. An increasing resource dependency, e.g. water, will cause additional challenges and complications. Nitrate levels in water in agricultural areas are very high and municipal water management institutions continually call attention to cost explosions caused by high and increasing agrochemical inputs (pesticides, fertilisers etc.). One implication on production and disposal is the ongoing implementation of precision farming. Precision farming allows the targeted use of pesticides and fertilisers where a decrease in input can be advanced.

As in the construction group, participants discussed the option of chemical leasing. Farmers are often obliged to buy a certain volume of product even if they do not need the full volume. Chemical leasing could be a sustainable option to foster a sustainable and resource-efficient use of agrochemicals while simultaneously driving precision agriculture.

Digitalisation and its implications for soil health were also discussed in more detail. Various contributions addressed bio-degradable microchips for soil health assessment, creating an efficient growing environment and the reduction of the overall use of chemicals. Additionally, local sourcing vs. transportation were highlighted as important factors that need more societal attention. Society in Europe increasingly emphasizes the importance of a healthy lifestyle and healthy eating habits. Organic produce is thus globally shipped without societal awareness that both agricultural production and produce transportation are closely linked to emissions. Agriculture contributes negatively to emissions, and the oversupply of food in Europe results in massive food waste. This point brought the discussion back to the opportunities of digitalisation. Vertical farming in smart greenhouses may heavily contribute to a decrease in input usage (on target application, soil, drip irrigation etc.) and emissions. New technologies assessing soil health and waste water management in conventional farming also imply major opportunities for the chemical industry to contribute to a sustainable future. Genetically modified produce could extend the life-cycle of fruits and vegetables, avoiding food waste that results from food becoming aesthetically unattractive. Similar to the Nairobi workshops, participants in the regional European workshop mentioned that traditional and integrated pest management farming practices and crop rotation have been major contributors to healthy soil and supporting biodiversity. One example mentioned was fertiliser made from waste.

Audience members commented that trade issues and policies do not contribute positively to sustainable production. Although farmers are attempting to advance input-reduction, soil contaminations from past activities may still lead to high residue levels. A counter-movement is artificially produced functional food. Not only is artificially produced meat on the rise, but lab-produce high in nutritional value is a trend,
especially in urban areas. Mentioning that agroecology was one of the trends discussed in Nairobi, the audience shared a common view that it is not a prominent topic in European regions.

Transportation Sector
A growing population has led to a growing middle-class with increasing disposable income, urbanisation and pollution were identified as the three main megatrends affecting the transportation sector. Due to an increase in disposable income, car sales (combusting engines, electric vehicles) will rise and cause an increase in overall traffic. Therefore, the group agreed that a boost in the (public) transportation sector in Europe would lead to various challenges and opportunities, which would also impact each other. An increase in transportation would lead to a high demand in production materials and energy and fuels. Even the production of batteries for electric vehicles would perpetuate exploitation of scarce raw materials. Creating space for a growing transportation sector generates conflicts in land use (expansion of urban areas, traffic systems etc.), but also creates opportunities for new sustainable infrastructure construction materials. However, air pollution will increase, taking a toll on public health and health sector costs. The participants identified opportunities for sustainable chemistry in developing new (lightweight) materials and implementing sustainable life-cycles. Therefore, the effects of trends on production, use and disposal are leading to a shift towards clean, renewable and energy-efficient fuels, keeping in mind that the solutions for battery production are still not fully-developed and need further development to avoid exploiting rare materials. Digitalisation and IT solutions will continue to play an important role in the sector, leading to the creation of chemical based solutions and jobs in the industry. Participants also discussed that another opportunity could be decreasing car production and expanding car sharing models, especially in urban areas. The widespread development of public transportation in
rural areas could also lead to a decrease in privately-owned cars. In Germany, the discussion around the automotive sector is particularly heated in the context of Germany-based and globally known brands. Although e-mobility is part of the discussion, the development of e-vehicles is still emerging. Another major factor is the lack of energy supply infrastructure. In the view of the participants, the main driver in this sector is societal demand given that the overall opinion is that neither the automotive industry nor the chemical industry reflects demand, but rather takes a business-as-usual approach.
Plenary

After results were presented by the three breakout groups, the audience agreed in plenary that the three sectors have a lot in common in finding ways to make sustainability economically viable. The continued plenary discussion led to various statements that the chemical industry is too reactive instead of proactive, and that it moves at different speeds throughout the regions. One suggestion for the industry to follow a more proactive path could be transforming into a service-providing industry. In this model, providers would scale back producing volume and would instead cover monetary losses with income from providing solutions. Participants had an alternative opinion on the chemical industry’s ability to be proactive. This opinion expressed that the chemical industry is continually looking out for innovative solutions, keeping in mind that research and development of a product may take up to 10 to 15 years and that at any point it is unclear if a product will be permitted into the market, especially due to challenging European regulations. In response to this statement, a Clariant representative mentioned that there was a sustainability assessment in place for every existing and new product. The challenge for chemical companies is that they are predominantly operated at a business-to-business level, and that there are only a few chemicals directly sold to customers. There is therefore limited room for companies to invest in consumer-oriented marketing. Friedrich Barth from ISC3 challenged the common opinion about the little effort within the chemical industry by mentioning that companies may not be used to business-to-customer, but can be perceived as solution providers for sustainable chemistry. He expressed that the chemicals sector is increasingly providing services rather than products. Nonetheless, participants expressed their perception of the chemical industry as incredibly productive and volume-driven, with the main incentives focused on selling more. The industry could transform into a pioneer in providing services, using the music industry as a guiding example. As of today, few people continue to purchase CDs, but instead listen to music streaming services led by Apple, Spotify and others. Such a switch might occur with changes in incentive structures to incentivise providers to sell less, and also incentivise the consumers to consume less. Service provision is an expanding market, though companies might widely publicize this in an attempt to avoid an increase in competition. Another comment referred to the gap between compliance and sustainability, expressing that the industry is very compliant within the regulatory framework, but far from being seriously sustainable. One example given by Clariant with regard to compliance vs. sustainability was the phase-out of the Audi A2, which was a small lightweight car, using only 3 litres per 100 km, but was in low demand; although the chemical industry does have sustainable solutions in the pipeline, the value chain needs to adopt them. This example raises questions on demand fostering change, which factors are driving change and how to get information on (customer) expectations that then become a demand. In conclusion, the question of what is driving change can be explored even further.

UNEP raised the issue of trade-offs, also including the SDGs. There may be a solution available solving one problem within the SDGs, but creating another one for a different development goal. The use of plastic packaging might help to increase food security, but becomes a severe issue for oceans. Building insulation does help to combat climate change, but can be hazardous and toxic, especially at the end of its life-cycle. Another example is the use of DDT for malaria prevention, but its use in agriculture through the provision by the informal sector (despite being banned) causes high levels of residues and poisoning of farmers and consumers. The underlying question is: how to successfully address all three dimensions.

In response to the ongoing discussion beforehand about traditional and innovative business models, one statement clarified that the business-to-business level must be about more than doing business. Companies must have courageous conversations about what they want and what is expected for the future, comparing the status quo with what can be done. Multiple participants shared the view that ethical discussions must be part of business models and plans, with one participant using the example of LED lights invented by Philips, when everyone was still using conventional lightbulbs. At that time, Philips was not able to sell LEDs economically because they were still too expensive. With their mindset of LEDs being the best product, Philips lobbied the EU successfully for the ban of conventional lightbulbs.
The chemical industry might be predestined to a similar scenario, precisely because it does not operate at a business-to-consumer level. Public procurement could be a solution on a broader scale, including the possibility to offer a service instead of a material.

Session 3 – Shaping the Future by Advancing Chemistry Innovation: Actions in the Americas

Building on the insights from the previous sessions, the purpose of this session was to further analyse how to enhance the conditions for innovation to advance sustainable chemistry. In this regard, the plenary and group work discussions during this session evolved around the following three questions:

1. What are key drivers for further innovation (in general and with regard to sustainable chemistry)?
2. Which factors would need to be overcome/changed to drive innovation in the region?
3. Which measures will/would enable innovation to happen or increase in the region?

Following an introduction by Nils Simon, in which he outlined key findings from day 1, two participants shared input statements from different perspectives along the three key questions.

- Rinus Broxterman from InnoSyn B.V. in the Netherlands shared his perspective that there is a crisis in the European „molecules making” industry, due to a lack of capacities in lab inventory, scientists, expertise and interest within the chemical companies. Companies strive to move closer to end-customers offering formulations, increasingly ignoring traditional molecule design. The Asian region records a high demand and sourcing for molecules as well as manufacturing, which is taken over by venture capitalists, hand in hand with the production for more waste materials. Pricing is also strongly influenced by Asia putting on the market that have undercut market prices. Sustainable manufacturing in Europe is declining, although it needs to be mentioned that a product or process with improved sustainability measures does not necessarily lead to sustainable innovations. Thus, the overall question is how to motivate the chemical industry and companies to shift back to classical molecules design in Europe?

The answer can be found in financing small and medium enterprises. Since corporate companies changed their process to cutting out the early phases of research and development they have to outsource these services. Focusing on their core capabilities SMEs can contribute to breakthrough innovations scaling up sustainability. Bio-based solutions for the chemical industry have kept down the cost side and increased the overall functionality of a solution. A helpful measure to foster sustainability and profitability would be an international cost assessment for the sustainability dimension along the development process since processes have high performance, but the sustainability dimension cannot be accounted in the final pricing. Unfortunately, SMEs are facing challenges to participate for subsidies and funding schemes selling their services hourly to companies.

- Rajni Hatti Kaul is a Professor in Biotechnology at Lund University in Sweden who does research on speciality chemicals from renewable energy involving relevant stakeholders along the value chain. Referring to a programme on biobased platform chemicals and building blocks for sustainable plastics, Mrs. Kaul mentions that consumers are clearly driving change. To successfully invest in new molecules research institutions, have to work closely with stakeholders along the value chain from plastics producers to waste management services. The process of research and development implies that successful technologies will get transformed and embedded into a start-up, but it still takes time to bring a molecule or a technology to the market. The risk along the process is price vs. performance, because sometimes it is not clear
how a molecule will perform. Nonetheless, to foster sustainable chemistry innovation there has to be a demand, and brand owners can support it by increasing pressure on the supply chain. It is also necessary to create a shared vision for how sustainable chemistry can increase innovations and motivate start-ups and SMEs to come forward with their business models. Incentives with that regard are supporting education, research and innovation by favourable tax frameworks for green chemistry innovations and the support of demonstration projects. On the consumer side, purchase supports of less toxic services and products could have a highly positive impact on sustainable consumer choices and share industries best practices to spread the word on how far we have already come, but there is still room for improvement.

After the snapshot presentations the audience was invited to a Q&A. It was mentioned that the Germany industry already works along the value chain, but that a matrix must be established to assess the measures and way forward. A stakeholder engagement dialogue with the entire value chain and without political involvement and regulations to assess standardisations for sustainability would be a desirable next step. Mrs. Kaul agrees that standardisation is an important factor of the process towards sustainability therefore, the institute at Lund university does have a responsible liaison person connected to EU institutions and evaluating next steps. A contrary statement from an Austrian participant highlights that even though standardisation is helpful in some cases, and especially for industrial companies, it excludes startups and SMEs who do not have the financial resources to be part of such a process. A question on designing new molecules raises the point that it is not exactly clear where the problem of molecule design and invention are coming from. Another point referring to standardisation emphasizes that is helpful to define goals and a certain framework, but trying to define sustainability or sustainable chemistry will be an ongoing challenge, especially as the topic has risen in prominence. The audience agrees that implementing standards is a complicated issue and highly challenging and difficult to bring together all the different stakeholders to discuss the various needs, even though a way forward is crucial for the industry. The industry must think about sustainable chemistry through a global lens, thus research has to be given and done to independent institutions to move sustainable chemistry to the next level. Chemicals are available at a relatively low-cost level consequently better margins from raw material to final product need to be established.

Following the snapshot presentation and plenary discussion participants gathered back at their breakout groups from day 1 revisiting the discussion on the three selected sectors (see session 2) to consider the following guiding questions:

1. What innovations (both readily available as well as disruptive technologies and business models) have potential to shape a sustainable chemistry transformation and make trends in the sector sustainable?
2. What is needed to drive sustainability innovation forward, e.g. in terms of education, information, collaboration?
3. Where might innovation go in the wrong direction and how can this be prevented?

Overview of key sectoral findings

Construction sector

Innovations already available in the construction sector are technical innovations such as energy efficient insulation materials. Nevertheless, there is still a need for improving green architecture, not only from an energy efficiency point of view, but also with regard to ecological material production. The participants agreed that innovation in the construction sector needs to keep life-cycle issues, e.g. recycling and sound management in mind. Behavioural issues like difficulties with liabilities with indoor solutions might lead to non-sustainable products even though innovative solutions to meet increasing
demand for sustainable housing have to be developed. Another opportunity to shape sustainable chemistry transformation is regulations on eco-design, certifications for sustainable building materials. Non-sustainable processes continuously move forward due to the lack of inventory of used materials and material composition, and therefore, to the incorrect recycling management. A joint acceptance of a reference framework combined with lifecycle management could lead to successful implementation of sustainability certification, although liability for something such as indoor air would have to be clarified beforehand. These kind of challenges, lead to strong barriers in the sustainable chemistry innovation. There are no harmonised EU wide sustainability criteria in place, and existing labels are prohibiting enhanced labels for sustainability. To overcome these barriers information on the sector has to be provided to foster green and sustainable processes.
**Technological Innovation**
- Energy efficiency + metering
- Recyclability + eco-design
- Battery/energy storage
- Green design by design
- Enhanced waste sorting technology
- Innovative chemicals needed for advanced new building

**Social + Behaviour**
- Second life of materials, hindered by poor acceptance
- Liability for non-toxic materials

**Enabling Environment**
- Regulation on eco-design
- Regulation on recyclability of building materials
- Certification of building materials
- Scale up existing eco-certificates (e.g., DANA Biogas)
- Inventory of used materials and chemicals
- Reference framework (CF regulation)

**Barriers**
- Composite materials not recyclable
- Hazardous, moderate expensive or impossible to recycle
- No harmonized European-wide sustainability criteria
- No producer responsibility
- Existing labels prevalent, advanced sustainability labeling
- Very long life-cycle of building (50 years), remanufacturing long & complex lifecycle
- Lack of accessible information
- Information processing challenges (complexity)

**Sustainability vs. sustainability through construction chemicals**
Transport Sector

The group discussed the sector along the topics of classical vs. sustainable chemistry and its process towards sustainability. Participants agreed that to shape a sustainable transformation within the sector, chemical companies need to walk away from shareholder value to free up investments for sustainable innovations. Consumer habits are continuously changing towards sustainable goals and opportunities for investment in sustainable solutions. Drivers for sustainable solutions are profound research on chemicals, but also on service oriented business models. Developing new solutions should also include the reuse of the old ones to foster closing the loop on material usage. Even though it is difficult to allocate producer responsibility for certain products, best cases should be highlighted and their visibility expanded along the value chain. Another important fact to shape the transformation is the education and information of society highlighting tangible products, processes and results. The education on the concept of sustainability has to address social behaviour to increase pressure on the production side. An internalisation of external costs would also urge the industry to move towards sustainable processes. One challenge highlighted again as well as in day 1 was the difficulty of recycling batteries for e-vehicles, bringing into question whether e-mobility is a long-term solution.
Agricultural Sector
In connection to the discussion from day 1, participants agreed that given conflict of land use due to an increase in urbanisation, it is necessary to speed up the development of precision and vertical farming. Technologies already available are on target application tools and agricultural equipment and data assessment tools. Since the agricultural sector is moving towards becoming highly specialised, natural scientists with IT education and knowledge are needed in the sector. Changing consumer pattern towards sustainable products and healthy diets (e.g. artificially grown meat as alternative protein source) will lead to an increase in vertical farming decreasing pressure on available land for agricultural and livestock production. To implement smart greenhouses/vertical farming successfully the industry needs to develop clean construction materials suitable for agricultural produce (e.g. clean indoor air), as well as manage energy supply through renewable energy sources, meaning the expansion of renewable energy production and its infrastructure. With protected farming methods input could be decreased and the loss of market share on products could be covered with highly targeted service solutions. A vertical farming infrastructure would decrease production and transportation emissions and therefore, contribute positively to CO₂ reduction. Unfortunately, the agricultural sector made a wrong turn contributing negatively to eating habits. The massive food supply and an increase in processed food lead to overconsumption and an increase in post-harvest food waste mainly from the consumer side, which links to the discussion of day 1 to extend product life-cycles through research and development of suitable GMOs. Overall agreement was that even if the agricultural sector will swiftly change towards more sustainable production processes, the whole value chain has to be involved, especially the packaging industry to foster a decrease in resource consumption for production and plastic waste.
Session 4 – Chemicals Management in the Americas: Enabling environment and key concerns

Referencing the Global Chemical Outlook II as well as the ongoing work under the Strategic Approach for International Chemicals Management (SAICM), Jost Dittkrist (UNEP) and Anna Makarova (UNESCO – Green Chemistry for Sustainable Development) presented snapshots of recent major regulatory developments relevant for sound chemicals management and innovation as well as emerging policy issues (EPIs) and its implementations in the Eastern European regions.

Participants discussed plenary challenges and opportunities related to EPIs and their development beyond 2020. What's more, experts agreed that SAICM is a very useful and successful platform to bring various stakeholders. On the other hand, within existing legal frameworks, which chemical companies try to abide by as best as possible, communications between the industry and SAICM has a very negative. Improving communications would be desirable to improve the proceedings towards sound chemicals management. There is significant progress in the work and effort on present policy issues from the regulatory side, as well as already available and implemented tools to assess chemicals from the industry side. Nevertheless, there is still lack of transparency. Changing consumer patterns have led to an inaccurate perception that chemical free is necessarily better, feeding into the conflict of chemicals vs. Chemistry free. Nonetheless, there is a need for alternatives, which will progress within the millennial generation driving innovations with more of a focus on sustainability issues.

A supportive factor for bringing alternatives to the market would be if SAICM would be a global standard instead of a voluntary initiative. With SAICM as a basis, the industry could continue to build up on what is already available and use good examples and best practices. A holistic approach, not only with regard to sustainability, but also along the value chain, would foster a harmonised progress of sound chemicals management. Civil society stakeholders are calling for better integrating instrumental roadmaps and clear product standards. Partnerships between industry would foster the development of the best available technologies with a harmonising effect on chemicals management. Policy processes could lead and support the development of disrupting innovations, if adaptations of regulations could be put in place. Unfortunately, the policy making process is becoming more and more complicated and complex and is not harmonised at all within the European regions. Raising the question if it would be helpful to develop a standard framework on shared principles on life cycle assessments the common opinion was that OECD would be most powerful institution to initiate such a framework. Another question mentioned if innovation could be addressed within the future process as an approach within SAICM. Beyond 2020 it is foreseen to establish a future platform on chemicals management with a broad scope (proposition of new additional principles) and expanded financial resources and instruments.
3. Findings

Key points to draw from

- Today's overall dynamics imply partly disruptive developments as new technologies, customer demands and new competitors around sustainable chemistry develop and therefore create new opportunities and threats.

- There are both incremental and disruptive changes in the chemical industry and its environment, driven by societal, political, entrepreneurial or economic factors. Lightweight vehicles, electric mobility, genome editing and breeding, personalised medicine, industrial biotechnology and digital farming were only a few of the many examples presented.

- Changes in the chemical industry are driven by a dynamic market demand, which in turn is linked with global megatrends including global economic shifts, technological change, resource competition, demographic changes, urbanisation, and climate change.

- Digitalisation has significant implications for the chemical industry and users of its products, and companies are challenged with incorporating developments such as IoT (Internet of Things), big data analysis, cloud computing, additive manufacturing, augmented reality, artificial intelligence and blockchain technology.

- Three main technologies within digitalisation are highly important for the chemical industry, e.g. intra-company processes like data sharing and collection, as well as data based operation models for the development of business models and decision-making support. Another important implication is the development and maintenance of external networks. The transformation of business activities towards cloud-computing and working requires efficient determining factors.

- The circular economy model (decoupling economic growth from the consumption of finite resources) plays a major part in the industry, as it is gaining more influence on product portfolios, value creation structures and business models. A key challenge here is the use of sustainable chemistry to develop materials which can be circulated more safely and easily, a focus on circularity already at the design stage, and enhancing information provision and sharing across the supply chain.
Annex 1 – Workshop agenda

Regional Expert Workshop – Agenda Day 1

09:30 am
Welcome
Introduction to the Regional Expert Workshop – Europe

10:00 am
Session 1:
Overview of Chemical Sector and Sustainable Chemistry Innovation in Europe
Coffee break

11:15 am
Session 2:
Global Megatrends and Industry Sector Trends in Europe: Risks and Opportunities for Chemicals Management and Sustainable Chemistry Innovation

12:45 pm
Lunch break

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

Regional Expert Workshop – Agenda Day 1 (cont’d)

1:45 pm
Session 2 (cont’d):
Breakout group discussion on trends, risks and opportunities in selected industry sectors
Coffee break

3:45 pm
Session 3 (cont’d):
Sharing of results in plenary, closing

05:20 pm
Closing day 1
07:00 pm
Join dinner

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

Prepared by
Adelphi
Prepared by
IFOK
Regional Expert Workshop – Agenda Day 2

09:30 a.m.  
*Session 3*  
Shaping the Future by Advancing Chemistry Innovation – Future discussions – panellists: Rupi Narang, Klaus, Rams Broersma  
Moderator: Nils Simon

10:45 a.m.  
*Session 3 (cont’d)*  
Breakout group discussions on Innovation  
Each group selects a moderator and a reporter for reporting in plenary

12:15 p.m.  
*Session 3 (cont’d)*  
Reporting back in plenary  
Moderator: Melissa Allen

1:00 p.m.  
Lunch break

Regional Expert Workshop – Agenda Day 2 (cont’d)

02:00 p.m.  
*Session 4*  
Chemicals Management in Europe: Enabling Environment and Key Concerns  
Strategic discussion on the enabling environment (drawing from selected country experiences, with regulation and institutions) to advance both the sound chemicals management and sustainable chemistry innovation in Europe – Moderator: Jost Dörfler

04:30 p.m.  
Summary and conclusions, next steps  
Closing: Agnes Oehlmann, Jost Dörfler

05:00 p.m.  
Closing of the workshop
## Annex 2 – List of participants

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