Advancing Entrepreneurship and Start-up Initiatives for Sustainable Chemistry: Learning from Case Studies

Organized by UN Environment and the International Sustainable Chemistry Collaborative Center (ISC3), hosted by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in partnership with the United Nations Industrial Development Organization (UNIDO), the German Chemical Society, the Freie Universität Berlin and the United Nations Institute for Training and Research (UNITAR)

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1. Introduction

The concept of sustainable chemistry has recently gained international attention and is increasingly seen as an important element in enhancing the sound management of chemicals and waste, and as a contribution towards the achievement of the Sustainable Development Goals (SDGs). In 2016, the second session of the United Nations Environment Assembly (UNEA) echoed and advanced this development. UNEA-2 Resolution 2/7 on the "Sound Management of Chemicals and Waste" invited countries, international organizations and other interested stakeholders, including the private sector, with relevant experience in sustainable chemistry to submit to the United Nations Environment Programme secretariat best practices in the area of sustainable chemistry.

An important dimension of sustainable chemistry is to scale up research, innovation and entrepreneurship to develop new and safer chemicals and production processes. While chemicals have many benefits and are needed to achieve the SDGs, chemical pollution threatens ecosystems, wildlife, human health and economic growth. It is therefore necessary to re-think how chemicals can be designed, produced, used and disposed in ways that are compatible with all three dimensions of sustainable development (social, economic and environmental). Start-up initiatives and companies can be a strong driver in this transition and help close the gap between science, innovation and business applications. Yet, while certain sectors, such as the IT sector, are known for a thriving start-up scene, start-up initiatives in area of green and sustainable chemistry are less developed. One reason for this, amongst others, may be the need to put in place a laboratory infrastructure, as well as related financing needs.

2. Workshop Overview

On 14 September 2017, some 30 innovators, entrepreneurs and experts from around the world participated in the workshop "Advancing Entrepreneurship and Start-up Initiatives for Sustainable Chemistry: Learning from Case Studies". The workshop was organized by UN Environment and the International Sustainable Chemistry Collaborative Center (ISC3), hosted by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), in partnership with the United Nations Industrial Development Organization (UNIDO), the German Chemical Society, the Freie Universität Berlin and the United Nations Institute for Training and Research (UNITAR). Additional financial support was provided by the Government of Germany. The workshop took place in Berlin, Germany, back to back with other events taking place on 12-13 September 2017 in the context of the 150th Anniversary of the German Chemical Society, including an 'Innovation Marathon'. The overall aim of the workshop was to advance at the international level in scaling up innovation for sustainable chemistry and to identify opportunities for action in this area.

The workshop was attended by 14 entrepreneurs and innovators from universities, start-up companies and other initiatives. Other participants included representatives from Governments, intergovernmental organizations and international institutions, as well as other experts and stakeholders in the field of sustainable chemistry. Participants identified opportunities for sustainable chemistry innovation and start-ups to be a driving force to support implementation of the 2030 Agenda for Sustainable Development, for example in the areas of zero hunger, clean oceans, climate change and sustainable cities, and contribute to the main theme of the upcoming United Nations Environment Assembly in December 2017: "Towards a Pollution-free Planet".

The workshop was opened by Mr. Friedrich Barth, Managing Director of the newly founded International Sustainable Chemistry Collaborative Center (ISC3), who welcomed participants and indicated that the topic of innovation and sustainable chemistry start-ups was of great interest for ISC3. Mr. Achim Halpaap, Chief of UN Environment's Chemicals and Health Branch, pointed out that workshop outcomes will feed into UN Environment's work on the update of the Global Chemicals Outlook (GCO-II) in 2018, and other possible activities at the international level organized by UN Environment, the ISC3, and other partners.

Mr. Hannes Rothe, Freie Universität Berlin, summarized key findings from the Innovation Marathon, which aimed to develop recommendation to foster a new innovation age for green and sustainable chemistry in Germany and beyond. Ms. Petra Schwager, Industrial Development Officer in UNIDO's Industrial Resource Efficiency Division, introduced UNIDO's approach to green chemistry focusing on a project funded by the Global Environment Facility and its anticipated outputs which include the development of guidance.

Through case presentations and interactive sessions, participants:

- explored the momentum around sustainable chemistry and shared insights from the Innovation Marathon;
- gained an understanding of different sustainable chemistry start-up initiatives and elicited determinants of their success and challenges;
- identified key determinants, opportunities and solutions to advance sustainable chemistry start-up initiatives and to strengthen their enabling environment; and
- exchanged ideas for future activities at the global level to advance entrepreneurship and sustainable chemistry start-up initiatives.

3. Case Study Presentations

Entrepreneurs and innovators shared experiences and lessons learned from the following start-up case studies in the field of sustainable chemistry:

- 'Lessons Learned in Green Chemistry from Applied Research in Biotechnology' (Carlos Ocampo Lopez, Universidad Pontificia Bolivariana)
- 'Development of a Cost-effective, Earth-abundant and Non-toxic Photocatalyst' (Prashanth W. Menezes, Technical University of Berlin)
- 'Introducing New Reactions and Technologies in Industrial Synthesis: Challenges and Opportunities for Start-up Initiatives for Sustainable Chemistry' (Irene Erdelmeier, Innoverda)
- 'From Innovation to Corporation: Bridging the Gap between Green Chemistry Research and Business' (Cristina Mottillo, ACSYNAM Inc.)
- 'Building Sustainable Chemistry Laboratories in CEESR' (Edu Inam, University of Uyo)
- 'Crude to Food' (Janet Angel, EcoBioClean®)

- ‘Putting into Action a Low-cost, ESM and Cleaner Production and Sustainable Chemical Way of Recycling Used Lead Acid Batteries’ (Luis Guillermo Marroquin, Acumuladores Iberia)
- ‘Introducing Natural / Organic Pesticides to Vegetable Farmers in Tuba, Ghana’ (Emmanuel Odjam-Akumatey, Ecological Restorations)
- ‘Ghana Blending Project’ (Douglas Cutter, SAFIC)
- ‘Environmentally Friendly Chemicals for the Textile Industry’ (Juergen Jelly, ACTICELL)
- ‘Providing the Means to Achieve a Sustainable Bio-refining Process’ (Leonardo Zambotti Villela, BioativosGroup)
- ‘Use of Landfill Gas as Fuel Interchangeable to Natural Gas’ (Jose Angelo Ohno, Ecometano)
- ‘Better Materials Designed through Biotechnology and Brought-to-Life through Applications Development’ (Charles Dimmler, Checkerspot)
- ‘Toxicity Focus is Essential for Green Chemistry Adoption and Sustainable Product Development’ (Neelam Vaidya, ViridisChem Inc.)

A document summarizing the cases is available on the website of UN Environment.

4. Insights, Challenges and Determinants of Success

Taking the case presentations into account, a panel comprising Ms. Jutta Emig (Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety of Germany), Mr. John Warner (Warner Babcock Institute for Green Chemistry), Monica Becker (Green Chemistry and Commerce Council), Mr. Klaus Kümmerer (Leuphana University Lüneburg), Ms. Sonja Jost (DexLeChem) and Ms. Melissa Lim (Secretariat of the Basel, Rotterdam and Stockholm Conventions) extracted further insights and elaborated on the lessons learned for the wider audience. The panel was moderated by Mr. Paul Hohnen (Sustainability Strategies) and Mr. Hannes Rothe.

The presentations and discussion revealed that sustainable chemistry start-ups:

- can make significant contributions in advancing global chemicals management up to and beyond 2020 and be a strong driving force towards a pollution-free planet;
- can contribute towards implementation of the chemicals and waste multilateral environmental agreements (MEAs) as well as other global environmental priorities identified by Governments through UNEA;
- can provide valuable perspectives and shape international policy discussions;
- hold potential to create sustainable economic growth and employment opportunities;
- need an enabling environment supported by Governments and the international community
- face significant challenges throughout the business lifecycle (access to research infrastructure, intellectual property, finance, marketing, partnerships, commercialization etc.); and
- often face particular challenges in developing countries

Further discussion took place in three working groups, generating the following insights:

<u>(A) From idea to concept</u>

- Innovation culture in universities: few universities provide chemistry students with training in business, marketing etc. and seldom encourage students to create start-ups; cooperation across faculties can foster interdisciplinary thinking; there is also a need for curriculum reform, as sustainability considerations are still not integrated in standard chemistry courses.
- Research infrastructure: more incubators to facilitate sustainable chemistry start-ups are needed; the barriers for spin-offs from universities are too high; there is a need to strengthen partnerships between academia and industry/private sector.

- Intellectual property, patents and licencing: patenting and licensing processes are often lengthy, costly and complicated; where patents are in place, they are often not turned into a product or service; licensing agreements with the universities may sometimes hinder entrepreneurship.

(B) From concept to market

- Business planning and access to finance: sustainable chemistry entrepreneurs often lack business expertise (e.g. development of a business plan); networks and partnerships are crucial to establish a multi-disciplinary team and to gain access to capital.
- Upscaling, marketing and commercialisation: the time until the product/service becomes profitable if often lengthy; a thorough analysis of the market is a prerequisite for success (e.g. innovation should be based on the market demand); the start-ups need realistic milestones and targets.
- Enabling environment / effective regulation: regulations may sometimes pose unnecessary burdens on entrepreneurs; registration processes may be overly costly and lengthy for start-ups with little capital; incentive system can help (e.g. tax reductions).

(C) Developing country issues

- Start-ups in developing countries often face particular challenges, such as a lack of basic laboratory infrastructure and difficult access to capital.
- A lack of efficient regulations may pose problems, for example in terms of the protection of intellectual property.
- In some cases, however, developing countries may also offer particular opportunities, for example given lower market density and the opportunity to leap-frog to advanced technologies.

The discussion of results from the working groups pointed out that some challenges cut across the complete development path, for example the need for strategic planning, access to knowledge, expertise and skills, effective communication, partnerships etc. It also concluded that governments, the international community and other stakeholders (e.g. universities) can empower sustainable chemistry start-up initiatives by:

- creating an enabling environment for sustainable chemistry start-up initiatives (regulatory frameworks, incentive systems etc.);
- putting in place necessary infrastructures (laboratories, incubators etc.);
- providing support, training and guidance to start-up initiatives throughout the business lifecycle (from idea to concept and from concept to market);
- facilitating partnerships and networks; and
- reforming chemistry and other relevant curricula to integrate green chemistry and toxicology.

5. Opportunities for Further Work and Follow-up

During the final session of the workshop, the participants exchanged ideas for future activities at the global level to advance entrepreneurship and sustainable chemistry start-up initiatives. It also provided an opportunity for the organizers and other participants to share specific ideas concerning follow-up in their respective organizations.

Mr. Achim Halpaap noted that UN Environment is ready to:

- explore how the case studies as well as the findings and policy insights generated during the workshop can feed into relevant sections of the upcoming GCO-II and inform future activities;

- work with participants to identify opportunities to raise the visibility of sustainable chemistry start-up initiatives at upcoming international meetings and their side events;
- provide information how entrepreneurs/innovators could actively engage as a group in international meetings and conferences, in particular meetings in 2018 on the intersessional process considering the Strategic Approach and the sound management of chemicals and waste beyond 2020;
- facilitate dissemination of the case studies as well as the lessons learned from the workshop;
- explore a collaboration with ISC3 to provide advisory support and seed capital assistance to advance sustainable chemistry;
- explore collaboration with the Green Chemistry and Commerce Council (GC3), in particular to enhance partnership and network opportunities for sustainable chemistry start-ups.

Mr. Friedrich Barth said that sustainable chemistry start-ups needed support if the international community was to exploit their full potential. He indicated that the ISC3 would be pleased to take, among others, the following next steps:

- explore the possibility to create a dedicated work stream to support sustainable chemistry start-up initiatives within the ISC3;
- facilitate communication between start-up initiatives through ISC3net; and
- organize follow-up meeting and workshops, including at the regional level.

Ms. Petra Schwager emphasised the complexity and challenges faced by entrepreneurs in establishing a successful sustainable chemistry start-up. She noted that the entrepreneurs needed support and guidance and that UNIDO stood ready to provide assistance. She voiced her willingness to continue working with UN Environment and the ISC3 to advance sustainable chemistry. Moreover, she noted that UNIDO was particularly well positioned to:

- facilitate the transfer of know how to developing countries and countries with economies in transition; and
- bring the messages from this workshop to the Ministers of industry and economy.

Mr. Klaus Kümmerer, Director of the Institute for Sustainable and Environmental Chemistry at Leuphana University Lüneburg (which also serves as the research hub of ISC3) listed the following points for follow-up:

- Explore with UN Environment the possibility to publish a special issue of the Journal on Sustainable Chemistry and Pharmacy under the GCO-II process, which could feature the case studies as well as key insights and lessons learned.
- Take up and advance the topic of sustainable chemistry start-ups at relevant conferences, such as the 3rd Green and Sustainable Chemistry Conference.

Ms. Monica Becker, Co-Director of GC3, expressed the interest of GC3 to collaborate with UN Environment and ISC3 regarding potential activities to support sustainable chemistry start-up initiatives in the future.

A number of participants voiced their appreciation for the organization, interactions and workshop outcomes. The statements also underlined partnerships and support from the international community as critical elements. Participants expressed, among others, their readiness to undertake the following:

- initiate a process to give sustainable chemistry start-ups a voice, including at relevant international meetings and conferences;

- engage in side events and/or other modes of participation at relevant international meetings and conferences;
- establish an informal sustainable chemistry start-up network/expand on existing networks (such as the network of the Green Chemistry and Commerce Council); and
- facilitate information exchange and the provision of mutual support among sustainable chemistry entrepreneurs, including via for a mailing lists.