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Interim report

The International Sustainable Chemistry Collaborative Centre (ISC3)

1 May 2019 – 30 April 2020

by:

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Abstract: Advancing the transformation to Sustainable Chemistry – ISC_3 annual report May 2019 – April 2020

The International Sustainable Chemistry Collaborative Centre (ISC_3) promotes and develops Sustainable Chemistry Solutions worldwide. The international centre thus addresses a major challenge facing the chemical sector and promotes sustainability, circular economy and a new system thinking in this field. With a sustainable and circular approach, the chemical sector can make significant contributions to achieving the UN's Sustainable Development Goals (SDGs). In a forward-looking perspective, sustainable chemistry offers many opportunities for the development of new business models and the creation of new jobs.

The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the Federal Environment Agency (UBA) commissioned the "Gesellschaft für Internationale Zusammenarbeit (GIZ) with the foundation of the ISC_3 in 2017. Further partners are DECHEMA (Gesellschaft für Chemische Technik und Biotechnologie e.V.) as Innovation Hub and the Leuphana University as Research & Education Hub. ISC_3 is a globally operating institution and a multi-stakeholder platform. It works in five main activity fields: cooperation, innovation, education, research and information. This report describes the ISC_3 activities in the third year after its foundation from May 2019 to April 2020. During this period, the ISC_3 carried out its first Innovation Challenge for start-ups in the field of sustainable chemistry, launched the world's first Master's program in sustainable chemistry at Leuphana University and established its Global Start-up Service, which was joined by over 80 start-ups from all over the world by April 2020.

Kurzbeschreibung: Förderung der Transformation zu einer nachhaltigen Chemie - ISC_3 Jahresbericht Mai 2019 – April 2020

Das International Sustainable Chemistry Collaborative Centre (ISC_3) fördert weltweit nachhaltige Lösungen in der Chemie. Das internationale Kompetenzzentrum adressiert damit eine wesentliche Herausforderung, vor der der chemische Sektor derzeit steht und fördert Nachhaltigkeit, Kreislaufwirtschaft und ein neues zirkuläres Systemdenken in diesem Bereich. Mit einem nachhaltigen und zirkulären Ansatz kann der Chemiesektor bedeutende Beiträge zur Erreichung der UN-Ziele für eine nachhaltige Entwicklung (Sustainable Development Goals, SDGs) leisten. Perspektivisch betrachtet bietet die nachhaltige Chemie viele Chancen für die Entwicklung neuer Geschäftsmodelle und die Schaffung neuer Arbeitsplätze.

Das Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (BMU) und das Umweltbundesamt (UBA) haben 2017 die GIZ mit dem Aufbau des ISC_3 beauftragt. Weitere Partner sind die DECHEMA (Gesellschaft für Chemische Technik und Biotechnologie e.V.) als Innovation Hub sowie die Leuphana Universität als Research & Education Hub. Das ISC_3 ist eine global agierende Institution und eine Multi-Stakeholder-Plattform. Es arbeitet in den fünf zentralen Handlungsfeldern: Zusammenarbeit, Innovation, Bildung, Forschung und Information. Der hier vorliegende Bericht beschreibt die Tätigkeiten des ISC_3 im dritten Jahr nach seiner Gründung von Mai 2019 bis einschließlich April 2020. In diesem Zeitraum führte das ISC_3 seine erste Innovation Challenge für Start-ups aus dem Bereich der nachhaltigen Chemie durch, startete den weltweit ersten Masterstudiengang „Nachhaltige Chemie“ an der Leuphana Universität und etablierte seinen Globalen Start-up Service, dem sich bis April 2020 über 80 Start-ups aus aller Welt angeschlossen haben.

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AI	Artificial Intelligence
ANII	Agencia Nacional de Investigación e Innovación
ASIIN	Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik
BCIC	Brightlands Chemelot Innovation Center
BMU	The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
BMZ	German Federal Ministry of Economic Cooperation and Development
CBO	Community-Based Organization
CEO	Chief Executive Officer
COVID-19	Corona Virus Disease
CRM	Customer-Relationship-Management
ECTN	European Chemistry Transfer Network
EU	European Union
GC3	Green Chemistry & Commerce Council
GCO	Global Chemicals Outlook
GHG	Green House Gas
GIZ	Gesellschaft für Internationale Zusammenarbeit
GIZ (InS)	Gesellschaft für Internationale Zusammenarbeit (International Services)
GIZ FMB	GIZ Fach- und Methodenbereich
GSCC	Green and Sustainable Chemistry Conference
GSS	Global Start-Up Service
ICCM5	Fifth Session of the International Conference for Chemicals Management
IGCW	Industrial Green Chemistry World Conference
IH	Innovation Hub
IIT	Indian Institute of Technology
IKI	International Climate Initiative

INSEAD	Institut Européen d'Administration des Affaires
IP3	3rd Meeting of the Intersessional Process Considering the Strategic Approach and the Sound Management of Chemicals and Waste Beyond 2020
ISC_3	International Sustainable Chemistry Collaborative Centre
ISI	International Scientific Indexing
ISO	International Organization for Standardization
KGaA	Kommanditgesellschaft auf Aktien
KPI	Key Performance Indicator
LATAM	Latin American
LATU	Technological Laboratory of Uruguay
LCA	Life Cycle Assessment
M.Sc.	Master of Science
MBA	Master fo Business Administration
MFA	Material Flow Accounting
MoU	Memorandum of Understanding
NGO	Non-Governmental Organisation
NY	New York
OECD	Organization for Economic Corporation and Development
OEWG	Open-Ended Working Group
OPCW	Organisation for the Prohibition of Chemical Weapons
PAGE	Partnership of Action on Green Economy
PBT	Polybutylenterephthalat
PPP	Public Private Partnership
PR	Public Relations
QSAR	Quantitative Structure Activity Relationship
RECP	Regional Comprehensive Economic Partnership
REH	Research & Education Hub
SAICM	Strategic Approach to International Chemicals Management

SBE19	Sustainable Built Environment Conference 2019
SCP	Sustainable Chemistry and Pharmacy
SDGs	Sustainable Development Goals
SENAI	Serviço Nacional de Aprendizagem Industrial
SEYP	South East Youth Partnership
SMCW	Sound Management of Chemicals and Waste
SoM	Start-up of the Month
SusChem	European Technology Platform for Sustainable Chemistry
UBA	German Environment Agency
UN	United Nations
UNEA	United Nations Environment Assembly of the UNEP
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
VCI	Verband der Chemischen Industrie e.V.
W2C	Waste to Chemicals
WEF	World Economic Forum
WIPO	World Intelectual Property Organisation

Summary

The International Sustainable Chemistry Collaborative Centre (ISC_3) has the assignment to promote sustainable chemistry worldwide. In 2017, the BMU and UBA commissioned the Gesellschaft für Internationale Zusammenarbeit (GIZ) to establish the centre together with the two partners DECHEMA (Gesellschaft für Chemische Technik und Biotechnologie e.V.) and the University of Leuphana, which are acting as hubs. As a multi-stakeholder organization, ISC_3 has the mission to build a global network to promote sustainable chemistry within academia, the public and the private sector as well as through innovation and entrepreneurship.

Activities of the International Sustainable Chemistry Collaborative Centre

This report covers the third year of the ISC_3, the period from May 2019 to April 2020, during which the centre was active in the five activity fields defined since 2018: Collaboration, Innovation, Research, Education and Information.

In the activity field **Collaboration**, the ISC_3 has the mission to connect the stakeholders relevant to this field - including experts from industry, academia, politics and civil society. The most important formats of stakeholder participation in the ISC_3 are the Advisory Board, the Scientific Board and a Stakeholder Forum that takes place regularly. All three boards met in June 2019 in Königswinter (Germany). The members of the boards confirmed the existing approach of the ISC_3 and advised the centre on current professional topics and trends. The Stakeholder Forum was held as a dialogue event and involved the participants in the advancement of its strategic program. At its first Stakeholder Forum, the ISC_3 was able to welcome more than 110 participants from Africa, Asian, North and South America and Europe.

At an international level, ISC_3 was involved in the SAICM Beyond 2020 process, the Science Policy Business Forum in the lead-up to UNEA 4, the "Platform for Mainstreaming Sustainable Chemistry Innovation" of the Word Economic Forum and High-Level Conference on "EU Chemicals Policy 2030: building on the past, moving to the future".

For its first "Workstream", the ISC_3 2019 surveyed experts worldwide on the topic of "Plastics in Sustainable Building and Living". A total of four workshops with 58 experts were held at international conferences and trade fairs (AchemAsia (Shanghai), Nairobi Innovation Week, Sustainable Built Environment (Graz) and Green Build 2019 (Atlanta)). The insights and expert opinions gained from these workshops will be compiled and published as the first expert report of the centre.

The Innovation Hub, which is located at DECHEMA in Frankfurt (Germany), is responsible for the activity field "**Innovation**". In the period under review, ISC_3 has further expanded its Global Start-up Service, the world's first program to support young entrepreneurs in the field of sustainable chemistry and provided a "Sustainable Chemistry Toolbox" to all 82 onboarded start-ups. Also, the ISC_3 Innovation Hub provided individual advice to start-ups, networked them with potential partners and examined the feasibility of business ideas.

In May 2019, the centre launched its “Innovation Challenge”, inviting start-ups in the field of "Sustainable Building and Living" to participate. A total of 47 companies from 26 different countries applied. The five selected finalists received customized advice from the ISC_3 Global Start-up Service and were able to participate in expert workshops. The

winner is be announced at the ISC3 Investor Forum in October 2020 and will receive prize money of 25,000 Euros.

The ISC3 is establishing a worldwide network of partners to jointly promote sustainable chemistry in all parts of the world. The ISC3 Spiderweb Network promotes innovators, educational programs and the exchange of knowledge. Between May 2019 and April 2020, five organizations joined the network: The National Agency for Research and Innovation of Uruguay (ANII), Brightlands Chemelot Campus; the Green ChemisTree Foundation, Start-Up Chile and youthinkgreen Egypt.

The Research & Education Hub, which is hosted by Leuphana University in Luneburg (Germany), is responsible for the activity fields **Research** and Education. The hub examines new emerging academic research ideas, materials and processes and analyses potential and pitfalls. So far, four main research directions are being worked on: 1. Electrochemical Synthesis of Chemicals; 2. Metals as non-renewable, critical Resources; 3. Entropy Change as a Measure of Chemical Sustainability; 4. Chemo-Informatics as a versatile tool in green and Sustainable Chemistry.

In the activity field **Education**, the first master program (MSc) in sustainable chemistry started in March 2020 at Leuphana University. The four-semester course has already been awarded the label of the German Accreditation Council and the label of the European Chemistry Transfer Network (ECTN). Currently, the Hub is developing a curriculum for an MBA program in Sustainable Chemistry which is scheduled to start in the summer semester 2022. Another educational event was the fifth Summer School "Sustainable Chemistry for Sustainable Development", which was attended by 50 participants from 25 different countries in September 2019. The focus of the Summer School 2019 was on the topic: "Sustainable Chemistry and the Myths of Renewables".

The activity field **Information** evolves around the exchange of knowledge and the dissemination of information on sustainable chemistry and is thus an essential cross-sectional task of the ISC3. The centre communicates via its own website, a newsletter and the social media channels Twitter, LinkedIn, Facebook and YouTube. Since September 2019, the ISC3 has been presenting a "Start-up of the Month" on its website and social media channels.

Zusammenfassung

Das International Sustainable Chemistry Collaborative Centre (ISC_3) hat den Auftrag, nachhaltige Chemie weltweit zu fördern. 2017 beauftragten das BMU und UBA die Gesellschaft für Internationale Zusammenarbeit (GIZ) mit der Gründung des Zentrums, als Partner wurden die DECHEMA e.V. (Gesellschaft für Chemische Technik und Biotechnologie e.V.) und die Universität Leuphana, die als Hubs fungieren, eingebunden. Als Multi-Stakeholder Plattform arbeitet das ISC_3 mit Akteuren aus Wissenschaft, öffentlicher und privater Hand sowie aus dem Bereich Innovation und Gründertum zusammen, um ein globales Netzwerk zur Förderung der nachhaltigen Chemie aufzubauen.

Aktivitäten des International Sustainable Chemistry Collaborative Centre

Der hier vorliegende Bericht deckt das dritte Jahr des ISC_3 ab, den Zeitraum von Mai 2019 bis April 2020. In diesem Zeitraum konnte das Zentrum seine Arbeit in den seit 2018 festgelegten Handlungsfeldern: Collaboration, Innovation, Research, Education und Information weiter etablieren und ausbauen.

Im Handlungsfeld **Collaboration** hat das ISC_3 den Auftrag, die für diesen Themenbereich relevanten Stakeholder – dazu gehören Experten aus Industrie, Forschung, Politik sowie Zivilgesellschaft - miteinander zu vernetzen. Die wichtigsten Formate der Stakeholder-Beteiligung im ISC_3 sind das Advisory Board, das Scientific Board sowie ein regelmäßig stattfindendes Stakeholder Forum. Alle drei Gremien tagten im Juni 2019 in Königswinter. Die Board-Mitglieder bestätigten dabei die bisherige Vorgehensweise des ISC_3 und berieten das Zentrum zu aktuellen fachlichen Themen und Trends. Das Stakeholder Forum fand in Form eines Dialog-Events statt und involvierte die Teilnehmenden bei der Weiterentwicklung seines strategischen Programmes. Das ISC_3 konnte bei seinem ersten Stakeholder Forum mehr als 110 Teilnehmer aus Afrika, Asian, Nord und Süd Amerika sowie Europa verzeichnen.

Auf internationaler Ebene engagierte sich das ISC_3 im Berichtszeitraum unter anderem im SAICM Beyond 2020 Prozess, beim Science-Policy-Business Forum im Vorfeld der UNEA 4, bei der „Platform for Mainstreaming Sustainable Chemistry Innovation" des Word Economic Forums sowie bei der High-Level Conference on "EU Chemicals Policy 2030: building on the past, moving to the future".

Für seinen ersten „Workstream" befragte das ISC_3 2019 weltweit Expert*innen zum Thema „Plastics in Sustainable Building and Living". Insgesamt wurden auf internationalen Fachkonferenzen und Messen (AchemAsia (Shanghai), Nairobi Innovation Week, Sustainable Built Environment (Graz) and Green Build 2019(Atlanta)) vier Workshops mit insgesamt 58 Experten durchgeführt. Die dabei gewonnenen Erkenntnisse und Expertenmeinungen werden in einem Bericht eingeordnet und veröffentlicht.

Das Themenfeld „**Innovation**“ wird vom Innovation Hub durchgeführt, der bei der DECHEMA in Frankfurt angesiedelt ist. Hier hat das ISC_3 im Berichtszeitraum seinen Global Start-up Service, das weltweit erste Programm zur Unterstützung von jungen Unternehmen im Bereich nachhaltige Chemie weiter ausgebaut und allen 82 aufgenommenen Start-ups eine „Sustainable Chemistry Toolbox“ zur Verfügung gestellt. Darüber hinaus hat der ISC_3 Innovation Hub Start-ups individuell beraten, sie mit potenziellen Partnern vernetzt und die Machbarkeitschancen von Geschäftsideen überprüft. Das Innovation Hub unterstützte Start-ups auch bei der richtigen Standortwahl und identifizierte die besten Messen und Veranstaltungen zur Vermarktung von Produkten.

Im Mai 2019 hat das Zentrum seine erste Innovation Challenge gestartet, die Start-ups im Bereich „Nachhaltiges Bauen und Wohnen“ zur Teilnahme aufrief. Insgesamt haben sich 47 Unternehmen aus 26 verschiedenen Ländern beworben. Die fünf ausgewählten Finalisten erhielten maßgeschneiderte Beratung durch den ISC_3 Global Start-up Service und konnten an Experten-Workshops teilnehmen. Der Gewinner wird beim Investor Forum im Oktober 2020 bekanntgegeben und erhält ein Preisgeld in Höhe von 25.000 Euro.

Das ISC_3 baut im Handlungsfeld Innovation zudem ein weltweites Netz an Partner auf, um nachhaltige Chemie in allen Teilen der Welt voranzutreiben. Das ISC_3 Spiderweb-Network fördert Innovatoren, Bildungsangebote und den Austausch von Wissen. Von Mai 2019 bis April 2020 sind fünf Organisationen dem Netzwerk beigetreten: the National Agency for Research and Innovation of Uruguay (ANII), Brightlands Chemelot Campus; the Green ChemisTree Foundation, Start-Up Chile und youthinkgreen Egypt.

Für das Handlungsfeld **Forschung** ist der Research & Education Hub, der bei der Leuphana Universität angesiedelt ist, zuständig. Der Hub prüft neue aufkommende akademische Forschungsideen, Materialien und Verfahren und analysiert Potenziale und Schattenseiten. Bislang werden vier Hauptforschungsrichtungen bearbeitet. 1. Elektrochemische Synthese von Chemikalien; 2. Metalle als nicht-erneuerbare, kritische Ressourcen; 3. Entropieänderung als Maß für chemische Nachhaltigkeit; 4. Chemo-Informatik als vielseitiges Werkzeug in der grünen und nachhaltigen Chemie.

Im Handlungsfeld **Bildung**, ebenfalls beim Research & Education Hub angesiedelt, startete im März 2020 der erste Masterstudiengang in Nachhaltiger Chemie an der Leuphana Universität. Der viersemestrige Studiengang wurde bereits mit dem Label des deutschen Akkreditierungsrates und mit dem Label des European Chemistry Transfer Networks (ECTN) ausgezeichnet. Derzeit erarbeitet der Hub ein Curriculum für einen MBA Studiengang in Nachhaltiger Chemie, der zum Sommersemester 2022 starten soll. Eine weitere Bildungsveranstaltung war die fünfte Summer School „Nachhaltige Chemie für eine nachhaltige Entwicklung“, bei der im September 2019 50 Teilnehmer aus 25 verschiedenen Ländern teilnahmen. Die Summer School 2019 fokussierte sich auf das Thema: “Sustainable Chemistry and the Myths of Renewables”.

Im Handlungsfeld **Information** geht es um den Austausch von Wissen und die Verbreitung von Informationen und Wissen über nachhaltige Chemie, es ist damit eine wesentliche Querschnittsaufgaben des ISC3. Das Zentrum kommuniziert über eine eigene Website, einen Newsletter sowie die Social-Media-Kanäle Twitter, LinkedIn, Facebook sowie YouTube. Seit September 2019 präsentiert das Zentrum ein „Start-up of the Month“ auf seiner Webseite und den Social-Media-Kanälen

1 About the ISC$_3$

1.1 The ISC$_3$ from May 2019 to April 2020

The ISC$_3$ is an international centre with the mission to promote and develop sustainable chemistry solutions worldwide. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) and the German Environment Agency (UBA) have commissioned the GIZ to establish the ISC$_3$ as an international centre that engages with civil society, politics, and the private sector to contribute to international chemicals policies and build up a global network on sustainable chemistry. The centre was founded in 2017 on the initiative of BMU and UBA.

In the operation of the ISC$_3$, the GIZ works closely with DECHEMA[1] and Leuphana University, which host two so-called "Hubs" of the ISC$_3$. The head office of the ISC$_3$ is managed through GIZ in Bonn while the "Research & Education Hub" (ISC$_3$ REH) is hosted by Leuphana University, and the "Innovation Hub" (ISC$_3$ IH) is hosted by DECHEMA. By managing the ISC$_3$ headquarter, the GIZ is responsible for the overall operation of the collaborative centre. This structure with a headquarter and two hubs has created three strong pillars that combine the strengths of the three partners.

The ISC$_3$ engages in the international political dialogue on the contributions of sustainable chemistry to the sound management of chemicals and waste, especially in the Strategic Approach to International Chemicals Management (SAICM)[2] and Sound Management of Chemicals and Waste (SMCW)[3] beyond 2020 process. As a multi-stakeholder platform, the ISC$_3$ serves as an interface between the public and the private sector. By connecting different stakeholders, the centre supports transformative collaboration and policies in the field of chemicals management, the Sustainable Development Goals[4] (SDGs) and the 2030 Agenda for Sustainable Development [5].

Acting as an innovation promoter and start-up supporter for sustainable development, the ISC$_3$ carries out innovation scouting to discover new sustainable chemical solutions and business ideas, with a focus to explore or establish them in developing countries. Through its Global Start-Up Service, operated through the Innovation Hub at DECHEMA, the centre offers start-ups, entrepreneurs, and innovators in the field of sustainable chemistry mentoring, training, and other supporting services to bring innovative products and services to market.

Furthermore, the ISC$_3$ initiates collaborative and foresight projects to explore opportunities and challenges of sustainable chemistry innovation. It also discusses transformative pathways towards achieving the 2030 Agenda. Through its collaborative projects, the centre engages with partners from the public and private sector to explore and support new practical approaches, projects, and services.

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[1] DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V.

[2] **S**trategic **A**pproach to **I**nternational **C**hemicals **M**anagement (**SAICM**) http://www.saicm.org

[3] For SMCW, see e.g. the IOMC-Website (https://www.who.int/iomc/en/) or The sound management of chemicals and wastes in the context of the Sustainable Development Goals: links between the Basel, Rotterdam and Stockholm conventions and the 2030 Agenda for Sustainable Development: https://wedocs.unep.org/bitstream/handle/20.500.11822/22694/Chemicals_%20wastes_SDGs.pdf?sequence=1&isAllowed=y (accessed 30/08/2020)

[4] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

[5] Resolution adopted by the General Assembly on 25 September 2015: Transforming our world: the 2030 Agenda for Sustainable Development

Through its educational activities, implemented by the Research & Education Hub at Leuphana University, the offers an annual Summer School on Sustainable Chemistry and the recently started first Sustainable Chemistry Master Programme. The ISC3 thereby sets up sustainable chemistry as a new field in the curricula for chemists, international students, and professionals.

The ISC3 further engages in the international scientific dialogue on sustainable chemistry. As a knowledge-hub and dialogue forum for sustainable chemistry, the ISC3 organizes events, conferences, workshops, and exhibitions to engage with stakeholders, gather and exchange knowledge, raise awareness, and disseminate information.

1.2 From an idea to reality – The establishment of the ISC3

The establishment of the centre followed a stepwise approach (the so-called "Phasenkonzept"), defining number of phases for setting up the ISC3 from May 2017 until November 2020[6]. The development of the ISC3 until 2020 was described in five phases or steps. The major part of the reporting period covered by this report lies in phase 4 (2019). The first three development phases are therefore presented as part of the overview of achievements according to the phase concept in the Appendix General Remarks 1.

This phase concept provided guidance for the establishment of the ISC3 with its infrastructure, personnel, organisational and cooperation structure that formed the main objective in the early stages of the project. With growing progress, when the centre as such was successfully established, its functions and services came into the focus. Therefore, at the end of phase 3, in close coordination with the contracting authorities five strategic activity fields of the ISC3 were identified, thus providing a conceptual framework for the further development and activities of the centre. As far as already defined, respective KPIs and milestones for each activity field are presented in the following chapters.

A detailed table with the implementation and achievements of the ISC3 in the respective phases is attached in Appendix 1 General Remarks). A short summary describes the development of the ISC3 in the defined phases since 2017:

In Phase 1 (until September 2017), the first steps for the development of ISC3 were made, with the following essential milestones: setting up the ISC3, including renting and equipping the building, personnel recruiting, development of an organization and stakeholder concept. All milestones targeted for in this phase were achieved. It should be mentioned, however, that some adjustments with regard to the predefined milestones had to be made during the process. One example is the recruitment phase, which was completed with the onboarding of all personnel in 2019.

Phase 2 involved an implementation strategy for the central functions of the ISC3 and a concept for a global scenario process for sustainable chemistry. For the implementation of the central functions, in close cooperation with the contracting authorities, the ISC3 developed a strategy based on five activity fields (Collaboration, Innovation, Education, Research and Information) incorporating the key functions of the

[6] See tender to the UBA: Internationales Kompetenzzentrum für Nachhaltige Chemie, Aktenzeichen: 42002-1_21

ISC_3 in an overall strategic concept. The development of a scenario process on sustainable chemistry, as

mentioned in the offer to UBA provided an opportunity for a prestigious cooperation with UNEP, enabling the ISC_3 to contribute to the leading international publication in the field of chemicals management, the second edition of the Global Chemicals Outlook (GCO II). The ISC_3 provided successfully aspects of sustainable chemistry innovation to the report (see GCO II "From Legacies to Innovative Solution, UNEP 2019). This important step allowed the ISC_3 to get involved in the get involved in the professional international debate on chemicals management and sustainable development at a very early stage, thus gaining international visibility.

Deriving the intended overall business plan, which was scheduled for this phase, the ISC_3 delivered annual planning of activities and operations, in close coordination with the contracting authorities and its scientific and advisory board.

Though originally planned, a complete planning matrix with outputs, indicators, and milestones has not been established by the end of phase 3. Instead, the above-described conceptual framework with five activity fields was developed and served as a basis for project management and steering with the BMU and UBA (see also fig. 1 below). The following indicators and milestones were already achieved during this period: planning of the first Stakeholder Forum, organising a Summer School, the start of research activities and, to some extent, the acquisition of co-finance projects.

The period covered by this report corresponds to phase 4. In this phase, the ISC_3 was supposed to address the topics of investor relations, alternative business models and lighthouse projects. The centre started to build investor relations with its first Investor Forum, which took place at DECHEMA in Frankfurt in December 2018. A follow-up event is planned for November 2020 (postponed from May due to the Covid-19 crisis). With the proposal for a Sustainable Chemistry Investor Fund, ISC_3 has also taken the first steps towards alternative business models. Two initial lighthouse projects have been launched with BASF and a sizeable industrial consortium as well as with Merck.

1.3 Evolution and state of the conceptual framework of the ISC_3

In the original tender four central functions were offered as the main activity areas of focus of the expert work of ISC_3:

- Platform for the international community
- International Knowledge Platform
- Globally active Think-Tank
- Engine and multiplier of innovations

In close consultation with the BMU und UBA, these central functions were developed into five ISC_3 activity fields, thus forming an overall strategic approach for the ISC_3. The activity fields were designed to deliver a holistic approach for the transformational work of the ISC_3 in promoting the concept of Sustainable Chemistry. They mirror the key competencies of the ISC_3 Headquarters and the two Hubs at DECHEMA (IH) and Leuphana University (REH) whilst providing an integrated approach with

"collaboration" as an overarching element at the very heart of the strategy. Each one of the five activity fields addresses an important element of transformation: "innovation" as a diver of new ideas and business models, "information" as a key element of communication and awareness-raising, "research" to provide new insights and much needed knowledge on the upcoming concept of Sustainable Chemistry, and "education" as the key to change the mindset and forming a new generation of experts. Last but not least, "collaboration" as the interconnecting element of the ISC3 strategic approach capitalizes stakeholder involvement and dialogue to gain substantial sustainable chemistry input to policy related processes.

Figure 1: The five key activity fields of the ISC3

Source: own illustration, International Sustainable Chemistry Collaborative Centre (ISC3)

With this approach, the ISC3 can fulfil its mission to promote and further evolve the concept of Sustainable Chemistry as orientation for the sound management of chemicals and waste contributing to the 2030 agenda for sustainable development. Through stakeholder involvement and dialogue, the centre aims to bring substantial sustainable chemistry input to policy related processes, including the SAICM process.

The function "Platform for the International Community" was transferred to the activity field "Collaboration" as an interlinking key element of the strategic approach. In this activity field, the ISC3 engages in international political events and processes, for example the UN Climate Conferences (UNFCCC COPs) and the SAICM Beyond 2020 process, to inform the political audience on sustainable chemistry. Furthermore, the centre invites Stakeholders to ISC3 events and provides expert advice in international expert dialogues, for example on the development of the "Green and Sustainable Chemistry Manuals" by UNEP. Collaborative Foresight and Collaborative Projects are to provide further develop and implement the new concept of Sustainable Chemistry.

The key driver for the implementation of an "International Knowledge Platform" is the Research and Education Hub at Leuphana University working academically and which is responsible for the research agenda. Furthermore, the area involves dialogue, implementation and dissemination of knowledge, thus working towards a knowledge platform that involves all relevant stakeholder groups. The activity field "Education", which is at the Leuphana University, is directly interlinked with the "knowledge platform function" of the ISC3 and crucial to disseminate knowledge to professionals, academics and students.

The establishment of a Globally active Think Tank is addressed through the research work of the ISC3 as well as through expert dialogues and studies conducted as a part of the "collaborative foresight workstreams" (see Collaboration) of the centre. Specific topics, such as the use of plastics in construction materials as well as the challenges and opportunities of digitalisation and AI for the implementation in sustainable chemistry are addressed in this field. The further specification of the concept of sustainable chemistry through the identification of relevant research topics as well as the publication and monitoring of scientific findings.

The central function "Engine and multiplier of innovations" is mainly driven in the area of "Innovation" and is, therefore, addressed through the establishment of the ISC3 Global Start-up Service. In this activity field support programmes for start-ups and young companies are implemented as well as tools for a competent assessment of the sustainability approaches. For the promotion of the start-ups and the matching between entrepreneurs and investors, external communication and thus, the area of information, also plays an essential role to implement the central function.

Strategic further development and measurable targets and KPIs were drawn up and defined for these activity fields based on annual planning and are described in the respective chapters.

1.4 Changes in the framework conditions

The UN 2030 Agenda for Sustainable Development with its 17 SDGs and 169 targets, as well as the broader field of Green Technologies, have received continuously growing acknowledgement, awareness and action by political decision makers, corporates and civil society during the reporting period. In particular, the issue of plastic contamination and consumption was increasingly discussed in the public, by politicians and industry representatives. In this context, the chemical industry was subject to criticism but also acknowledged as a key solution provider leading to the establishment of several initiatives to address the pressing issue, for example the "Alliance to End Plastic Waste".

The period covered by the report also shows that the chemical sector is increasingly taking a role as solution provider for sustainable development. One example is the study: "Roadmap Chemie 2050 - Auf dem Weg zu einer treibhausgasneutralen chemischen Industrie in Deutschland[7]", published by DECHEMA and FutureCamp on behalf of the VCI. In the survey, experts analyse the development of the chemical sector until 2050 and discuss the potentials and prerequisites for achieving greenhouse gas neutrality. In November 2019 UBA presented its report on the results of the research project "Transformation process towards a greenhouse gas neutral and resource-saving Germany". The summery Report: "Resource-Efficient Pathways towards Greenhouse-Gas-Neutrality – RESCUE[8]" describes in six scenarios possible development paths towards a resource-efficient and greenhouse-gas (GHG) neutral Germany until 2050.

[7] Roadmap Chemie 2050 - Auf dem Weg zu einer treibhausgasneutralen chemischen Industrie in Deutschland https://www.vci.de/vci/downloads-vci/publikation/2019-10-09-studie-roadmap-chemie-2050-treibhausgasneutralitaet.pdf

[8] Resource-Efficient Pathways towards Greenhouse-Gas- Neutrality – RESCUE: Summary Report: https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/rescue_kurzfassung_eng.pdf

During the reporting period the ISC3 has been acting within a network of international organisations, for example with SusChem which published its Strategic Innovation and Research Agenda "Sustainable Chemistry to solve global challenges: the new SusChem Strategic Research and Innovation Agenda[9]" in November 2019.

At the international level, the SAICM beyond 2020 process discusses a future framework on the sound management of chemicals and waste. With the upcoming ICCM5 and the ongoing negotiations under the Presidency of Ms Gertrud Sahler, BMU, the debate on chemicals management will gain broader attention in Germany in 2021, the EU, and globally. The ongoing negotiations provide not only an opportunity to strengthen the international cooperation and chemicals management but provide a window of opportunity to integrate the concept, approaches, and solutions of Sustainable Chemistry into the future framework for sound management of chemicals and waste. With the ICCM5 due to take place in Bonn, Germany, in July 2021 (postponed from October 2020, due to the Covid-19 pandemic), the ISC3 engages in the accompanying and informing dialogues on sustainable chemistry at the interface for policy, thus supporting the process towards an ambitious framework beyond 2020.

Companies - in all industries and sectors - are increasingly aware of the UN Sustainable Development Goals (SDGs) and are taking further steps to mainstream sustainability measures in their products and supply chains, while net progress towards sustainable development remains still challenging to measure. The 2019 United Nations study: "The decade to deliver – A call to business action - Global Compact Accenture Strategy CEO Study on Sustainability[10]" confirms that sustainable development continues to move higher in the agenda of international companies with growing commitment, belief and action from CEOs. The sustainable development and redesign of products have proven to be a driver of innovation and companies with a profound sustainability strategy succeed better in attracting and retaining talent and young professionals. Research and development, in the academic sector as well as in the development departments of companies, are providing more and more solutions for sustainable production and disposal. Via start-ups and companies, innovations are gradually being successfully implemented in production processes.

The Covid-19 pandemic, which has been ongoing since February/March 2020, and its global impacts have resulted in significant changes in the timing of the work of ISC3 and partner organisations. The events planned for May 2020, the Innovations Days and Stakeholder Forum as well as the 5th Green and Sustainable Chemistry Conference, organized by Elsevier in cooperation with the ISC3 Research and Education Hub and Leuphana University, have been postponed to the fourth quarter of 2020.

The extent to which the Covid-19 pandemic and its global consequences will affect the multiple approaches to promoting sustainable chemistry (investments in the chemical industry, public funding, guidelines for environmental protection) can currently not be

[9] "Sustainable Chemistry to solve global challenges: the new SusChem Strategic Research and Innovation Agenda http://www.suschem.org/newsroom/suschem-identifies-key-technology-priorities-to-address-eu-and-global-challenges-in-its-new-strategic-research-and-innovation-agenda

[10] United Nations Global Compact: The decade to deliver – A call to business action - Global Compact Accenture Strategy CEO Study on Sustainability https://www.accenture.com/_acnmedia/pdf-109/accenture-ungc-ceo-study.pdf#zoom=50

assessed. In mid-April 2020 the European Green Recovery Alliance[11] was founded by 180 CEOs, politicians, trade unions, NGOs and think-tanks.

[11] GREENRECOVERY: REBOOT & REBOOST our economies for a sustainable future https://drive.google.com/file/d/1j54QxE-QjhrEHjGb5LrKsHuDAKvv8LUq/view

2 Collaboration as a key activity field

2.1 Developments in the collaborative environment during the reporting period

Table 1: Milestones and achievements in the activity field "Collaboration"

Central Field	Milestones	Achievements (facts and figures)
International Dialogue	Successful stakeholder engagement and establishment of an international "Sustainable Chemistry Community"	Successful establishment of an Advisory and Scientific Board Successful Stakeholder Forum with high international participation and over 100 participants from five continents
International Dialogue	Common Understanding of Sustainable Chemistry	Intensive dialogue and feedback at the Stakeholder Forum and dialogue with the SAICM stakeholder at IP3 in Bangkok
Promoting sustainable chemistry in the international community	Partnerships with organisations from different sectors	5 Signings of MoUs with international Partners (see chapter 3. Innovation)
Promoting sustainable chemistry in the international community	Contributions to the UNEP activities	Contribution to the UNEP Policy-Science-Business Forum at UNEA IV in Nairobi Contribution to the development of the Green & Sustainable Chemistry Manuals (Expert Workshop in Geneva)
Promoting sustainable chemistry in the international community	Active participation in the negotiations on the SAICM beyond 2020 framework	Promotion of the topic "Sustainable Chemistry" at the OEWG in Montevideo and the IP3 in Bangkok (Information documents docs and workshop with about 70 participants)
Promoting sustainable chemistry in the international community	Participation in the Technical Workshop on Indicators for the SAICM beyond 2020 framework	Contribution to the discussion on indicators for the beyond 2020 framework
Promoting sustainable chemistry in the international community	Co-Hosted session at the WEF Impact Summit at the margins of the SDG Summit in NY and Presentation at the WEF Annual Meeting in Davos as elements of the joint initiative on mainstreaming sustainable chemistry innovation	Promoting Sustainable Chemistry innovation in the industry sector at high-level meetings
Foresight Workstream	Implementation of the first ISC$_3$ Workstream	4 workshops with a total of about 50 international experts

Central Field	Milestones	Achievements (facts and figures)
		Carrying out of an online survey with currently 100 additional participants Contributions of 15 experts to the final report
Foresight Workstream	Expert workshop on Digital Transformation and Artificial Intelligence	Consultations and discussions with 20 experts
Flagship projects	International Climate Initiative (IKI) Project	Successful submission of a project outline
Flagship projects	"Nigeria Plastic Waste Project"	Preparation of a project with BASF in Nigeria
Flagship projects	Project Airbnb4Labs	Preliminary studies on South Africa and Brazil completed (see chapter 3-2-4- Innovative Projects)

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

The ISC_3 connects relevant stakeholders from all sectors enabling them to discuss and promote sustainable chemistry in a transparent und collaborative way. As a dialogue platform the ISC_3 brings together experts from industry, academia, politics and government agencies as well as from the civil society to share ideas, voice expectations and raise concerns on the emerging concept of sustainable chemistry.

The collaborative work of the ISC_3 in the reporting period was focused on three areas: international political and conceptual dialogue on sustainable chemistry with the contributions to the SAICM beyond 2020 process as well as activities of UNEP, technical and expert collaboration with first ISC_3 foresight workstream and, last but not least, preparation of flagship projects to showcase sustainable chemistry.

2.2 Activities and results

2.2.1 International Dialogue: Stakeholder Engagement in the reporting period

As a globally acting institution and think tank, the ISC_3 is committed to the transformation of chemistry towards sustainability in cooperation with all relevant stakeholders. Key elements of the ISC_3 stakeholder engagement are the Advisory Board and the Scientific Board, as well as the ISC_3 Stakeholder Forum, three complementary fora allowing the ISC_3 to share experiences, discuss the working programme of the ISC_3 as well as share ideas and activities between experts and activists, thus building up an "international sustainable chemistry community". All three annual meetings were held in June 2019 in Königswinter, Germany.

The second meeting of the Advisory Board at the margins of the ISC3 Stakeholder Forum brought new impulses for the ISC3 working program and contributed to the further development of the concept of Sustainable Chemistry. The board members discussed ongoing trends in research and innovation and gave advice on the implementation of communication activities and events.

The Scientific Board provided advice on the research activities as well as the education programme with the new Master of Sustainable Chemistry in preparation. Several board members also supported the ISC3 as jury members in both ISC3 Awards (Entrepreneurial Spirit Award and the ISC3 Innovation Challenge).

As a dialogue event, the Stakeholder Forum is dedicated to involving the ISC3 stakeholders in the work programme of the centre and engaging them in a cross-sectoral dialogue on the emerging concept of Sustainable Chemistry. The first ISC3 Stakeholder Forum provided an open platform to interlink representatives from policy, industry, academia, and civil society, and discussed how sustainable chemistry could contribute to achieving the SDGs and become a solution provider for a circular, climate-resilient society. More than 110 experts from Africa, Asia, Europe, and North and South America participated in the new dialogue event. During the two-day conference, participants engaged in an intense interactive programme. The international experts reflected on the ISC3 working programme, shared experiences, and offered guidance for the further work of the Centre:

The first day of the Stakeholder Forum opened with a directors' dialogue under the motto "Sustainable Chemistry – Our Mission at the ISC3". This was followed by a discussion about the ISC3 thought-starter "Towards a Common Understanding of Sustainable Chemistry" on the base of the paper which the ISC3 submitted to the Open-Ended Working Group III (OEWG) in Montevideo in the context of the negotiations for a new SAICM framework beyond 2020.

The lively and partly controversial discussions on the key elements of Sustainable Chemistry gave all stakeholders the opportunity to share their perspectives, experiences and ideas. To mirror back the multiplicity and complexity of the interaction among the participants the dialogue was held in the format of round table discussions and facilitated by the ISC3 team as round table moderators in cooperation with a professional lead facilitator.

The second day focused on the ISC3 working programme and the broad reflection on the activities of the centre. The participants were given the opportunity to interact with each other in mini-workshop sessions in order to share views on topics of interest related to the ISC3 five activity fields. The ISC3 invited all participants to develop recommendations and ideas for the ISC3 work programme as well as to engage in the further implementation of the activities.

2.2.2 Promoting sustainable chemistry in the international community

One of the main objectives of the ISC3 was to promote sustainable chemistry in the international community of experts and international organisations working in the field of the sound management of chemicals and waste and the interlinkages of sustainable chemistry and the SDGs. Within the reporting period, the ISC3 was engaged in the following international conventions and processes:

- Within the international SAICM beyond 2020 process, the ISC3 promoted the consideration of sustainable chemistry as an element of the future framework on SMCW, hereby supporting the position of the German Government as a new stakeholder. The ISC3 provided information on the emerging concept of sustainable chemistry by submitting two INF doc to the OEWG in Montevideo highlighting the contributions of sustainable chemistry to the SAICM process and the beyond 2020 framework as well as innovation in the field. With the documents the ISC3 invited the SAICM stakeholders to the collaborative development of a "Common Understanding of Sustainable Chemistry" as an important stepping-stone to establishing the new holistic approach.
- In the lead-up to the 3rd Meeting of the Intersessional Process in Bangkok the ISC3 hosted a workshop to discuss the key elements of the first draft for a "Common Understanding of Sustainable Chemistry" and the possible contributions of the emerging concept to the SDGs. Experts from 17 countries exchanged their views on the ISC3 thought starter "Reaping the full potential of sustainable chemistry for SAICM, the Sound Management of Chemicals and Waste beyond 2020 and the 2030 Agenda" , as well as the ongoing dialogue and current expectations surrounding the emerging concept of sustainable chemistry.
- To bring the emerging concept to the expert discussions at UNEA IV the ISC3 contributed to the Science-Policy-Business Forum in the lead up the Assembly. The ISC3 hosted a Session on Sustainable Chemistry and the Global Chemicals Outlook II, which was to be presented at UNEA IV. The event welcomed more than 70 experts to a multi-stakeholder panel discussion, featuring a representative form UNEP and female experts from NGOs and academia as well as a female entrepreneur from Nairobi.
- The UN Resolution adopted at the UNEA 4 on the development of Manuals on Green and Sustainable Chemistry provided an opportunity for the ISC3 to further engage with UNEP in the international dialogue on Sustainable Chemistry. To support UNEP in the development of the manuals, ISC3 offered to host an international expert workshop at the margins of the annual Stakeholder Forum. Following the official invitation to UNEP at a Side Event at the SAICM IP3 in Bangkok the ISC3 participated in the first expert workshop on developing the manuals. The workshop was conducted by UNEP in Geneva and brought together about 30 experts from different sectors with the goal to discuss the first outline for the manuals. Following up the discussion the ISC3 provided further contributions, while the hosting of the international workshop had to be postponed due to the Covid-19 pandemic.
- Based on the mutual interest in promoting Sustainable Chemistry Innovation as a contribution to the SDGs and a new strategy for the chemicals industry, the ISC3 joined forces with the World Economic Forum to set up a new initiative for the WEF members and industry stakeholders, the "Platform for Mainstreaming Sustainable Chemistry Innovation". This strived to engage corporates form the chemicals sector to invest in sustainable chemistry innovation, entrepreneurship centres and collaborative innovation challenges.
- In September 2019 the joint initiative was presented with a session at the WEF Impact Summit at the margins of the UN SDG Summit in New York. The session was moderated by the ISC3 and set a starting point to build up commitment by the

corporates. In follow up, a high-level session at the Annual Meeting of the WEF in Davos was prepared with the goal to create CEO-commitment for the implementation of the initiative. Despite the successful session in Davos, the further development of the initiative had to be stopped due to the Corona pandemic.

- The ISC_3 has contributed to the High-Level Conference on "EU Chemicals Policy 2030: building on the past, moving to the future" 27-28 June 2019 in Brussels to the thematic session on "Promoting green and sustainable chemistry through innovation, alternative technologies and processes and right skills".

2.2.3 The implementation of the first ISC_3 workstream

The ISC_3 Workstream initiates a dialogue with all interested parties. The topics for workstreams led by ISC_3 should be SDG-oriented and linked to the megatrends with a focus on sustainable chemistry. The workstreams involve international experts from different fields in a series of dialogues. The final reports will be prepared by expert groups and contain recommendations on the above topic. The focus of the first workstream 2019/2020 was placed on the specialist topic "Plastics in Sustainable building and living", whereby the method for the workstream was tested, iteratively improved and established. The aim was to prepare a final paper with experts from relevant fields and regions:

Method development

In terms of methodology, the workstream focused on a qualitative stakeholder dialogue. The chosen approach comprises three steps: a preliminary study, a stakeholder dialogue and a final report. The preliminary study and the preparatory workshop served to identify priorities and contact persons or groups. The workstream was presented at the international specialist events Healthy Building London, SBE19 Scilla, Regulatory Summit Brussels and at conferences to which the thematic workshops were linked: AchemAsia (Shanghai), Nairobi Innovation Week, Sustainable Built Environment (Graz) and Green Build 2019(Atlanta). The conferences served to establish a stakeholder network and to present ISC_3 to experts. In four thematic workshops, the selected topics were elaborated in stakeholder rounds with international experts on four different continents. In addition to the workshops, an online survey was designed for each topic and distributed to the stakeholders. The survey was also conducted at the conference "Resilient Cities" were the ISC_3 had a booth.

Implementation

As of February 2020, all dialogues have been carried out: Three stakeholder workshops at conferences in China, Kenya and Austria on the topics of urbanisation & resilience, demography & affordable housing and health & environmental protection have been successfully completed. The last workshop on energy demand in the building life cycle was held in Atlanta. The workshops were attended by altogether 58 local and international experts from various sectors: chemical producers, engineers, construction companies and associations, recycling and waste management companies, ministries and agencies (construction, environment), financial sector, NGOs and large international organizations. In the online surveys more than 100 respondents from all continents took part. So far, the dialogue with the experts has highlighted major regional differences in

terms of environmental perception, material evaluation, affordability, policy and innovation drivers.

Results presentation

Selected workshop participants from different regions and disciplines work on individual contributions based on the input of the workshops. These contributions, together with the documented stakeholder discussions and the online surveys, will be compiled into the final report under the direction of ISC3. The report aims to position ISC3 as an expert and knowledge carrier and distributor on the respective topic and will serve as a guide to the current issues in the field of plastics in construction. The report will also discuss possible solutions to improve the sustainability of the construction sector and exemplary construction chemicals in accordance with the SDGs. Based on exemplary start-ups, the question of relevant fields of innovation for sustainable chemistry will be raised.

2.2.4 Expert workshop on Digital Transformation and Artificial Intelligence

The idea of "digital transformation" describes the change which is triggered by using digital technologies to create new processes and business models. Industry 4.0, Blockchain, Big Data, Artificial Intelligence (AI. and Quantum Computing are buzz words that continue to raise hopes and give impulses to transformed industries and economies. During the workshop on 25 - 26 February 2020 in Frankfurt the ISC3 gathered essential experts from academia, NGOs and industry together with entrepreneurs to discuss opportunities and risks that arise from the combination of sustainable chemistry and digitalization.

The goal of the 2-day expert workshop was to identify stakeholders and prioritize current major problems, develop visions and identify trends, methods and tools that can contribute to more sustainable chemistry. Leading questions during the workshop were "What are opportunities and synergies to move towards sustainable chemistry and materials, and what are imaginable rebound effects and threats?" Finally, possible technologies were allocated to the problems and necessary needs were identified to overcome currently existing weaknesses. Three focus topics were identified that needed to be addressed in expert groups:

1. Prediction of chemicals reactivity, toxicity & degradability against the background of SDG complexity

2. Sustainable development & assessment of chemicals

3. Sustainable chemistry innovation identification sharing

Overall, it became clear that all three focus topics can be fostered by digital technologies. There will be a follow up in the form of a UNEP in-kind contribution for the SAICM community, a scientific paper and the evaluation of a possible pilot project for applying for Public-Private-Partnership e.g. in the application for EU funding.

2.2.5 Flagship Projects

2.2.5.1 Flagship Project "Plastic Waste"

The Flagship Project "Plastic Waste" was initiated by the BASF at the beginning of 2019 as the W2C Project in Lagos, Nigeria. Shortly after that, ISC3 became involved in the project following an invitation from BASF. The Plastic Waste Project is aimed at

developing and implementing solutions to address the problematic of plastic waste littering the environment. In Lagos, plastic waste is clogging rivers and lakes, polluting the ocean, being burned at open-air, which is posing health and sanitation risks, disrupting land-based and marine life, and emitting GHG, among others.

ISC$_3$ is working with BASF, to develop sustainable and circular solutions following a holistic approach, as a contribution to solving the plastic waste problematic in Lagos Nigeria. These solutions are to be deployed to other geographical areas in the world. In addition, the project implementation shall contribute to job creation and to improving social and environmental conditions.

In May 2019, ISC$_3$ and BASF decided on the strategic and technological direction of the project. The concept contemplated involvement of various stakeholders and activities as W2C (pyrolysis), waste management systems, capacity building, policy and innovation. Foreseen stakeholders should be from research and education, industry, local authorities, NGOs, CBOs and civil society. According to the agreed activity plan, ISC$_3$ elaborated a comprehensive mapping of Lagos stakeholders and realized an expert workshop on "Plastic Waste Project – Lagos, Nigeria" with participants from Nigeria as a side event of the ISC$_3$ Stakeholder Forum in June 2019.

Meanwhile, BASF, together with an overseas partner, resumed the testing of Lagos plastic waste streams overseas and the planning of the future installation and commissioning of a pilot-scale pyrolysis plant in Lagos. The plant should process certain streams of plastic waste available locally. Adequate plastic waste streams should be supplied by two local social entrepreneurs who are already working with BASF. BASF further co-sponsored the workshop "Plastic Waste Management Policy" in Lagos, with participation of the ISC$_3$. While in Lagos, the ISC$_3$ conducted a short assessment of the problematic of plastic waste in Lagos and discuss further activities with BASF. A MoU between the partners to govern the cooperation in the project is planned.

2.2.5.2 ISC$_3$-InS Interface Work

Following discussions between ISC$_3$, International Services der GIZ (InS), and FMB, it was agreed that ISC$_3$-InS interface work should be carried out. This cooperation aims to the acquisition of financing and contracts for the development and implementation of sustainable and circular projects in the chemical industry and related areas. Potential sources of financing are private financial institutions and companies, Funds, national authorities, national, regional and international organizations. In this context, ISC$_3$ elaborated a Concept Outline for the acquisition of new contracts/projects and finance from the private sector. ISC$_3$ also initiated contacts with potential project financiers and clients. Promising contacts with a European Bank and an Asian company were established and are being further pursued.

2.2.5.3 Climate Protection Programme for the chemical industry in developing and emerging countries as part of the International Climate Initiative (IKI)

The chemical and petrochemical industry accounts for around 10% of the world's final energy demand and 7% of global greenhouse gas emissions. However, the impact of the chemical industry sector on climate change, the environment and health goes far beyond energy- and material-intensive production processes. More than 90% of all industrial production processes use products from the chemical industry. The design and product life cycle of chemical products play an important role in the greenhouse gas generation. Although the chemical sector in the EU has continued to grow at market growth rates, a

significant reduction in CO2 emissions of 61% has been achieved since 1990. Given the challenges, a sector-specific climate protection programme for the chemical industry in developing and emerging countries is urgently needed in order to contribute to the achievement of their Nationally Determined Contributions.

To address these challenges, the ISC3 has initiated the process of raising funds within the framework of the International Climate Initiative (IKI) 3rd Category for project financial support. The project proposal aims to know-how transfer from Europe to developing and transition countries through a dedicated training program for capacity building with the main focus on climate mitigation and chemicals management for the chemical industry. This will be the basis for a later in-depth implementation and upscaling of the project. During the reporting period, the ISC3 was invited by BMU to submit a project proposal.

3 Innovation as a key activity field

3.1 Development during the reporting period

Table 2: Milestones and achievements in the activity field "Innovation"

Central Field	Highlights	Achievements (facts and figures)
Global Start-up Service (GSS)	Continuous on-boarding of start-ups to the GSS	82 start-ups from 5 continents and covering over 15 thematic categories have been on-boarded to the Global Start-up Service
Global Start-up Service (GSS)	Development of the GSS services	All on-boarded start-ups have received the first stage "General Support" Over 20 start-ups have received support within second stage "General Support Plus"
Global Start-up Service (GSS)	Stage 1 "General Support"	Launch of the Sustainable Chemistry Toolbox Launch of the peer-to-peer networking LinkedIn group
Global Start-up Service (GSS)	Stage 2 "General Support Plus"	Conceptualization of the "Mentors and Experts" service Organization of workshops in China, Germany and India supporting local innovators and exploring local start-up ecosystems Participation in several international events to raise awareness about the GSS Launch of the "Start-up of the Month" series
Global Start-up Service (GSS)	Stage 3 "Customized Support"	Kick-off of a series of non-specific customized services for the on-boarded innovators
Global Start-up Service (GSS)	Development of the GSS Spiderweb Network	Conduct of Fact-Finding Missions to India, Chile, Uruguay, South Africa and Brazil to identify strategic local partners Participation at the GC3 Innovators Roundtable, and conduct of a side

Central Field	Highlights	Achievements (facts and figures)
		event focused on sustainable chemistry innovation in Latin America Initiation of a partnership with ANII to jointly support entrepreneurs in Sustainable Chemistry in Latin America 5 Memoranda of Understanding (MoU) signed with partners from 5 continents; additionally, one institutional partnership with Start-up Chile has been established. Follow-up missions to Egypt and India conducted to organize/ speak at regional events organized by MoU partners
Innovation Challenge	Successful launch of the first ISC3 Innovation Challenge 2019/20 in Sustainable Building and Living	1st application phase of the Challenge resulted in 47 proposals from 26 countries
Innovation Challenge	Selection of the finalists of the Innovation Challenge	8 finalists from three continents and six different countries were selected Honorable mention for the best 3 female founders, and an impactful, out-of-the-box solution were granted
Innovation Projects	Development of projects with individuals or organizations complementing or directly financing the action of the GSS	1 on-going innovation project: "Better access to infrastructure for sustainable (chemistry) innovation in Brazil and South Africa" advanced as a public-private-partnership

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC3)

Key activity of the ISC3 Innovation Hub is the set-up and implementation of the ISC3 Global Start-up Service (GSS), the world's first programme supporting sustainable chemistry-related entrepreneurs. The service is implemented using a Stage-Gate approach, meaning that start-ups can benefit from three different levels of support: General Support, General Support Plus and Customized Support as soon as they have successfully completed the relating application forms for each support level. Main deliverables related to the GSS in the past year have been the first ISC3 Innovation Challenge as well as the development and implementation/conduct of a growing portfolio of services and events. Fact-finding missions had the purpose to extend the

network of partners supporting the GSS in the different world regions. The preparation of dedicated innovation projects complemented the work on the GSS in last period from May 2019 – May 2020. The ambitions and KPIs for the ISC3 Innovation Hub in relation to the GSS as well as the current status are listed in Appendix Innovation 2 (GSS ambitions and KPIs and status as of April 2020).

3.2 Activities and results

3.2.1 ISC3 Global Start-up Service

From Mai 2019 to April 2020, the ISC3 Innovation Hub continued on-boarding promising innovators to the GSS. In order to benefit from the service, innovators need to fill in the On-boarding Questionnaire available on the ISC3 website, which is after completion evaluated by the ISC3 Innovation Hub team. As of April 2020, 82 entrepreneurs were on-boarded and became eligible for the first support stage "General Support" of the GSS. Out of the on-boarded innovators, 23 come from Africa, 11 from Asia, 28 from Europe, 12 from Latin America, and 8 from North America (see Appendix Innovation 2: Geographical distribution of GSS start-ups). The innovations developed by the entrepreneurs span a wide range of categories including, among others, agriculture, bioeconomy, new materials, waste management and construction (the exact number of start-ups in respective categories is available in Appendix Innovation 3: Thematic categories of GSS start-ups).

Subsequently, the team of the Innovation Hub started to systematically evaluate the eligibility of start-ups for the second stage "General Support Plus" based on completed Innovation Fact Sheets, which consist of open-ended questions on innovation, sustainability and market potential. If completed successfully, entrepreneurs are eligible for accessing a range of extended services, such as invitations to pitching and matchmaking events and promotion through the ISC3 communication channels. In the past years, 21 start-ups have already received such second stage support even without going through this formal process.

For the third stage "Customised Support", a similar formalised process will be set up by the Innovation Hub team. So far, it was decided that the past and future Entrepreneurial Spirit Award winners as well as the finalists of the ISC3 Innovation Challenges will directly become eligible for this third support level.

3.2.1.1 Update on GSS services offered

a. Stage "General Support"

Sustainable Chemistry Toolbox for Innovators

The ISC3 team and partner Think Beyond™ Innovation Accelerator have set up an online portal that shall serve as a living gateway to a curated set of information to support innovators and entrepreneurs exploring opportunities in the sustainable chemistry space. The toolbox is structured according to the terminologies "Discover, Create and Expand" (which refer to the three different development stages of start-ups that the ISC3 GSS aims to cover) and is constantly updated with the most relevant and useful tools and resources to help start-ups on their journey towards market success. It is available in a restricted area at the ISC3 website.

Peer-to-peer networking LinkedIn group

The ISC3 IH has set up a LinkedIn group for on-boarded start-ups, and uses this channel to post topical news, articles, investment opportunities, competition announcements, etc., and thus continuously inform the community on current events and sustainable chemistry-relevant topics. Within the "ISC3 Global Start-up Service Changemaker Group", the team also encourages members to connect with each other, engage in discussions, and share interesting information themselves. As of April 2020, the ISC3 counts 44 start-ups in this group, continuously adding newly on-boarded members [status 19/03/2020].

b. Stage "General Support Plus"

Mentoring programme

The GSS includes an excellent network of experts and partner organisations, both in the EU and worldwide. To leverage this network into a new service for the GSS start-ups, a concept to provide mentoring services has been developed. This new service, called "Mentors and Experts" will consolidate isolated efforts of the GSS into a more structured initiative, where professionals with great knowledge and experience are recruited from all over the world to offer their expertise and guidance to innovators and entrepreneurs. The initiative has a programme character with defined goals, communication activities and the objective of recruiting between 10-20 mentors for the first phase of implementation. Furthermore, it distinguishes between "mentors" and "experts" depending on the kind and time of support they offer to our target group and depending on the relationship they establish with entrepreneurs. This new service will be launched after on-going adaptations to the ISC3 webpage which are necessary to guarantee compliance with the EU General Data Protection Regulation.

3.2.1.2 Events promoting Sustainable Chemistry Innovation

The ISC3 Innovation Hub has organised different formats of interaction with interested stakeholders throughout the past year for implementing the GSS and promoting sustainable chemistry innovation at different conferences, meetings and other events, including:

Session at Elsevier 4th Green and Sustainable Chemistry Conference, Dresden, Germany, 7 May 2019

In the frame of this conference, the ISC3 organised a session which zoomed into the topic of how researchers can become Sustainable Chemistry Changemakers. During this half-day event, founders and experienced start-up coaches shared their experiences on how to innovate in sustainable chemistry and how to manage best the different opportunities and challenges along the innovation journey. The event was joined by about 40 participants and included a lecture on the ISC3 GSS, story-telling presentations as well as a discussion panel using an interactive online tool for direct engagement with the audience in a live format.

AchemAsia, Shanghai, PR China, May 2019

AchemAsia, the international exhibition and innovation forum for sustainable chemical production for the Asian market, organized by DECHEMA, took place in Shanghai, PR China, on 21-23 May 2019. During the event, the ISC3 hosted a booth showcasing local innovators developing sustainable chemistry solutions and conducted a congress session targeted at sustainable chemistry entrepreneurs and potential partners from the

Asian region. Moreover, the ISC$_3$ organised an expert workshop on Resilience & Urbanisation within the workstream "Plastics in Sustainable Building & Living".

Industrial Green Chemistry World Conference (IGCW), Mumbay, India, October 2019

In cooperation with our partner Green ChemisTree Foundation, the ISC$_3$ Innovation Hub organised a workshop on "Green & Sustainable Chemistry based entrepreneurship" for about 40 students and other stakeholders from the Indian Institute of Technology (IIT) Bombay as a side event of the IGCW2019 on 18 October in Mumbay, India. Besides presentations on the ISC$_3$ and its conceptual approach relating to Sustainable Chemistry and the GSS, the workshop hosted showcase presentations of local entrepreneurs developing sustainable chemistry solutions as well as a panel discussion on the question "How can we build a more supportive innovation ecosystem for Green and Sustainable Chemistry in India?". In addition, the ISC$_3$ was represented in another panel discussion organised under the umbrella of the conference and hosted a booth.

Participation in other events

In addition to above-mentioned events, the ISC$_3$ Innovation Hub team also joined several external conferences and meetings to share information and spread the word on the GSS. Presentations were held at e.g. bi-annual meetings of the German "Forum Start-Up Chemie", the 3rd Summer School on Sustainable Chemistry for Sustainable Development at Leuphana University Lüneburg, the ii2030 Forum organised by Endeva, the SEYP '19 Closing Ceremony organised by our partner youthinkgreen in Cairo, the 4th European Chemistry Partnering Event 2020 (with a dedicated session hosted by the ISC$_3$ Innovation Hub) and the 2nd Advisory Scientific Committee meeting of the Brazilian ISI Green Chemistry (listed in chronological order).

Upcoming: Start-up Days, October 2020

Due to the on-going 2019/20 Coronavirus pandemic, the ISC$_3$ Start-Up Days 2020 were recently postponed from May to October 2020. The event will host a series of start-up related activities that include the following events: The second ISC$_3$ Investor Forum 2020 and the ISC$_3$ Innovation Challenge Award Ceremony on October 22nd, and an Expert Workshop Session on October 23rd 2020.

The second edition of the Investor Forum, organized by the ISC$_3$ Innovation Hub and Think Beyond™ Innovation Accelerator, will explore how sustainable chemistry can support innovations in achieving the 17 SDGs, and how these innovations can be adequately financed. The Forum will bring together founders, investors, scientists as well as decision-makers from industry and politics. The event will host panel discussions, pitches and innovation showcases of cutting-edge entrepreneurs, as well as speed dating and networking sessions with international investors.

The Award Ceremony for the ISC$_3$ Innovation Challenge in Sustainable Building and Living will be part of the Investor Forum. The Expert Workshop Session is thought for ideators and more advanced entrepreneurs from the Global Start-up Service pool.

Communication promoting GSS innovators: The new "Start-up of the Month" series

In September 2019, the ISC$_3$ launched the "Start-up of the Month" series (SoM), which aims to promote outstanding start-ups from our pool at the ISC$_3$ website and via the ISC$_3$ social media channels. (see Chapter 6. Information as a key activity field)

c. Stage "Customised Support"

In addition to the services described above, the ISC3 Innovation Hub has started a series of non-specific customised services, mostly on request. As mentioned earlier, it is intended that these customised services will in the future be implemented based on a formalised on-boarding process for the third support level. A few examples of ad-hoc 1-1 support services provided in the past year are listed in the following:

- Entrepreneur X sent a new business idea to sell its products as part of a decarbonization initiative by the private sector. The GSS team provided advise on the feasibility of the idea as well as suggestions for improvement and potential partners;
- Entrepreneur Y requested support to identify possible partners for an application for a governmental support programme. The GSS team contacted around 15 experts in the network in different countries and could help in finding the right partner;
- Entrepreneur Z asked for advice on selecting a country in the EU to register, as well as fairs in their sector to promote its products. The Innovation Hub sent some facts and figures to help the decision-making process and connected with peer start-ups in related sectors to identify the best fairs/ events to promote products.

3.2.2 ISC3 Innovation Challenge in Sustainable Building and Living

The first edition of the ISC3 Innovation Challenge was launched in May 2019 during the international exhibition and conference AchemAsia in Shanghai, China. The Challenge invited ideators and more advanced entrepreneurs to submit solutions in the area of Sustainable Building and Living. The first application phase resulted in 47 proposals from 26 countries (see Appendix Innovation 4: Geographical distribution of Innovation Challenge applicants, Phase 1) for the geographical distribution of the applicants). Based on a pre-screening of the ISC3 team, 30 selected applicants were asked to submit extended application forms, which were then reviewed by a panel of 16 international judges from different ISC3 partner organisations, including members from the ISC3 Advisory Board, and external experts assigned by the ISC3.

Out of the large number of top-notch ideas, eight finalists from three continents and six different countries were selected. Their innovative solutions span a broad range of topics such as design of construction materials facilitating recycling, low cost solutions for affordable housing, as well as sustainable performance materials and technologies (see Appendix Innovation 5: Summary of the Innovation Challenge finalists' ideas). All eight finalists will receive ongoing customised support within the GSS and will participate in the expert workshops and the Investor Forum 2020. In preparation for the Forum, the finalists will take part in an online start-up training provided by the partner organization of the ISC3, Think Beyond™ Innovation Accelerator. On the basis of this training sessions, which include a final rehearsal pitch, five finalists will be shortlisted and given the chance to pitch during the Investor Forum and compete to win 25,000 Euro.

In addition to this, the ISC3 Innovation Hub decided to encourage and recognize efforts of female entrepreneurs and grant honourable mentions for the best three female founders, as well as an additional special mention to a start-up providing a particularly impactful, out-of-the-box solution (see Appendix Innovation 6: Key Facts Innovation Challenge 2019/20).

3.2.3 Update on the GSS Spiderweb Network/ Partnering

The ISC3 has been setting up a global "ISC3 Spiderweb Network" of multipliers for promoting Sustainable Chemistry and implementing the GSS. The Spiderweb represents the vision of a growing network of organisations and individuals with a shared vision on the role of Sustainable Chemistry and the achievement of the UN Sustainable Development Agenda 2030. The development of the Spiderweb has started in 2018 and the network will continuously grow over time. Its actors shall foster the support of innovators in their regions, mobilise resources and knowledge towards Sustainable Chemistry and empower other players to join the community. In the past year, several fact-finding missions have been conducted and existing and new partnerships have been advanced, as described in the following:

3.2.3.1 Fact-Finding Missions

Mission to India, May 2019

Based on an Ecosystem Mapping for India , the ISC3 Innovation Hub organised and conducted a Fact-Finding Mission to India from 1 - 10 May 2019. The mission aimed at meeting different stakeholders and identifying potential Spiderweb Network Partners, who would promote the idea of Sustainable Chemistry in India and to introduce the ISC3 Global Start-up Service to the relevant players. This mission focused on four regions: Mumbay, Pune, Hyderabad and Delhi, where chemical industry and supporting infrastructure (universities, incubators, accelerators, governmental organisations) can be found. Meetings with 13 Incubators, 4 Aggregators / Multipliers, 2 Corporates, 1 Industry organisation and 1 Service Provider were conducted. The potential partners covered a wide range of chemistry- related sectors and all visited stakeholders were open for cooperation. A follow-up with all potential partners is resource-intense, and the success is dependent on available resources and actively engaged local partners. Therefore, the development of a regional contact point via GIZ or the Green ChemisTree Foundation was suggested. A meeting during the mission with the Green ChemisTree Foundation emerged into a partnership which was agreed upon in an MoU signed in June 2019.

Participation at the Innovators Roundtable of the Green Chemistry Commerce Council, Cincinnati, US, May 2019

From 7 - 9 May 2019, the Innovation Hub prepared and coordinated a delegation of three South American institutions to participate in the Innovators Roundtable of the Green Chemistry and Commerce Council (GC3) in Cincinnati. In collaboration with GIZ, the following institutions were selected to participate: the Technological Laboratory of Uruguay (LATU), the Uruguayan Agency for Research and Innovation (ANII) and the Peruvian environmental NGO "Grupo GEA", which is also hosting the Peruvian National Cleaner Production Centre set up under the frame of the joint UNIDO/UNEP RECP Programme). The German Federal Ministry of Economic Cooperation and Development (BMZ), through its programme "Green Economy Transformation", supported this activity by financing travel grants for two of the five participants of the Latin American delegation. Jointly with the GC3, a roundtable on "Sustainable Chemistry Innovation in Latin America" was co-organised and attended by several experts and decision-makers from private sector companies and non-for-profit organisations. The session and the event kicked-off as a successful collaboration with ANII as later that year, ANII entered the Spiderweb Network of GSS via signing an MoU with the ISC3.

Mission to Chile and Uruguay, July 2019

The mission combined meetings with already identified partners to advance joint work as well as prospection activities to identify new strategic partners. Both countries were chosen to implement a mission based on:

- Comparison of innovation and business indicators within the region and sub-region (World Bank´s Ease of Doing Business Index and WIPO/Cornell/INSEAD´s Global Innovation Index);
- Assessment on professional organisations for entrepreneurship support with sustainability or sustainable chemistry aspects (own research and expert opinion of GIZ);
- Potential role as regional leader in innovation, entrepreneurship or sustainable chemistry support with the capacity of multiplying/transporting contents to neighbouring countries in the region/sub-region.
- In total, 25 institutions were visited in both countries. Selected results include:
- Kick-off conversations with a consortium of Chilean universities, the "Millennium Nucleus towards Sustainable Chemistry". As a result, the ISC3 R&E Hub has been invited to be part of a new project for a new research institute with funding of Chilean Government;
- Specification of cooperation with the biggest LATAM accelerator "Start Up Chile". It defines recommendations of start-ups to be nominated for either the accelerator programme or any initiative of the GSS. Both institutions promote activities in their PR and social media channels;
- Collaboration with three further accelerators/incubators started, two of them could be implementers in initiatives to support Sustainable Chemistry in the region;
- Positive reception in both countries for our topic and centre. Great interest of the Uruguayan chapter of the UN Partnership of Action on Green Economy (PAGE) to partner with ISC3 and act as local focal point for the sub-region South America.

3.2.3.2 Joint "Sectorial Call" on Sustainable Chemistry LATAM (ANII - ISC$_3$)

After signing of an MoU with ANII during the 1st ISC$_3$ Stakeholder Forum, ANII and ISC$_3$ committed to initiate a public-public partnership to jointly support entrepreneurs in the field of Sustainable Chemistry in Latin America. The initiative entailed a joint investment of approx. 200.000 Euro (50 % ANII and 50% ISC$_3$). Main focus shall be ideation and early stage support, with promotional activities in universities and research institutes in all Latin America. After joint selection, two previously identified incubators in Uruguay would have supported around 6-8 entrepreneurs to advance their idea with customised capacity building and some funding. The concept and legal documents have been drafted and discussed and upon some last details are ready to be used for launching. The implementation of this call was postponed to a later stage due to budget constraints at ISC$_3$.

3.2.3.3 Update on existing and new MoU-based partnerships

It is at the core of the ISC$_3$´s innovation-related work to collaborate with like-minded partners, so that sustainable chemistry innovation is spread worldwide, and that

entrepreneurs receive local and regional support. As of April 2020, the ISC3 has partnered up with 6 organisations in order to advance the internationalisation and regionalisation of the GSS. Follow-up work of the signed MoUs with our partners from Egypt, India, Uruguay and USA included different activities such as the co-organisation of joint events (e.g. side event at the IGCW2019 in Mumbai, India, co-organised with the Green ChemisTree Foundation), contributions of ISC3 staff in events organised by the partners (e.g. participation and presentation given at the "SEYP 19" Closing Ceremony in Cairo, Egypt, organised by our partner youthinkgreen Egypt) as well as different structured collaboration for further promoting and implementing the GSS. The partnering approach has proven to be especially successful in the sense that all our partners recommended several start-ups of their world regions to join our GSS pool. Synergies were also created in terms of facilitating participations and contributions of our partners to ISC3 events, such as the 1st ISC3 Stakeholder Forum 2019, and other activities, including the work related to our Innovation Challenge and other activity fields, such as research and education.

In addition to the already established partnership of 2019, the ISC3 Innovation Hub signed in February 2020 another MoU with the Brightlands Chemelot Innovation Center (BCIC). BCIC is the entrepreneurial heart of the Brightlands Chemelot Campus, which is part of one of Europe's largest industrial chemical sites in the Netherlands, and a rather new organisation in which large and small companies, start-ups, students, and scientific institutions collaborate to build innovations and sustainable solutions around chemistry, the circular economy and digitisation. As a part of their cooperation, the partners intend to expand each other's networks, strengthening efforts in finding the most promising sustainable chemistry start-ups globally and providing joint support to these companies.

Lastly, it is notable that several partnerships with other institutions and organisations exist in a number of countries worldwide. Amongst others, the partnership with the SENAI Green Chemistry Institute Brazil has already resulted in a nomination of the ISC3 Innovation Hub Director to join the institute´s newly formed advisory council.

3.2.4 Innovation Projects

Better access to infrastructure for sustainable (chemistry) innovation in Brazil and South Africa ("Airbnb4Labs")

The objective of the project is to pilot an online system for the management and sharing of labs spaces, equipment and services that resembles the business idea of "Airbnb". The system step-by-step democratizes the access to labs as well as increases open innovation and collaboration between science, research and industry institutions. The project was initiated by ISC3 and is now being advanced as a public-private-partnership with Merck KGaA as main private partner, as well as with the support of the London-based start-up "Clustermarket". The Brazilian chemical company Braskem and further companies are considering their participation. Given its light-house character and potential contribution to SDG 9: "Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation", the German Federal Ministry of Economic Cooperation and Development (BMZ) granted the GIZ/ ISC3 with approx. 50.000 Euro to support preparatory activities in pilot countries. With this funding, local ecosystems in Brazil and South Africa were mapped and the team gained support of around 15 public institutions that would like to use the project to share labs, equipment or services. In order to support these institutions in a structured project of 2,5 - 3 years, ISC3 plans to submit an application for the programme "develoPPP.de". This application

is nevertheless only possible if the involved private sector companies contribute with at least 50% of overall project costs. Currently, the commitment of Merck Brazil, Braskem and further interested partners is being discussed to assess the possibility and the amount of public funding to be provided by develoPPP.de, and consequently to determine the scope of the project.

3.2.5 Communication strategy and implementation

During the past year, the ISC_3 used multiple communication channels to promote its events and activities. In order to raise awareness about the launch of the ISC_3 Innovation Challenge, the ISC_3 developed a social media strategy as well as a number of printed communication materials such as flyers, postcards and banners. Moreover, the Innovation Hub compiled a list of over 130 potential multipliers, comprising of ISC_3 partner organisations and relevant regional players, who could additionally announce the launch of the Challenge among their own contacts. The ISC_3 website as well as social media (Twitter, Facebook and LinkedIn), were continuously used to promote activities organized by the ISC_3 Innovation Hub, as well as its GSS.

4 Research as a key activity field

4.1 Development during the reporting period

Table 3: Milestones and achievements in the activity field "Research"

Central Field	Highlights	Achievements (facts and figures)
Preparation and realization of the GSC**C**	Preparation and realisation of the 4th GSCC	250 international participants from 50 countries from all over the globe The final of the Elsevier Foundation-ISC$_3$ Green & Sustainable Challenge and the award ceremony took place during the conference
Preparation and realization of the GSC**C**	Preparation and realization of the 5th GSCC	Program is almost completed Despite the postponement of the conference because of the corona crisis a vast majority of the keynote and invited speakers confirmed their participation in November 2020
Continuation of international networking	Working with Cooperation Partners	Around 25 national and international cooperation partners
Conducting and publication of studies, workshops	Publications	Five publications were prepared
Conducting and publication of studies, workshops	Workshops	Contribution to four workshops
Presentation of ISC$_3$/Research Hub and activities at international conferences and other events	Conference Green China in	Prof. Dr. Klaus Kümmerer served as a co-chair and held the opening lecture
Presentation of ISC$_3$/Research Hub and activities at international conferences and other events	Presentations	about 20 invited presentations and lectures given throughout the reporting period on different context (see Appendix Research 1) interviews in different national and international media

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

Since the formation of the ISC_3, the Research and Education Hub (R&EH) is constantly developing the concept of Sustainable Chemistry serving as a base for the ISC_3 common understanding process. The recent insights of the role of sustainable chemistry in a circular economy were published in the high quality, renowned magazine "Science" (Kümmerer K, Clark JH, Zuin VG. Rethinking chemistry for a circular economy) as a perspective paper. On top of that, R&EH conducts research in the cutting-edge chemistry-related topics relevant for sustainable development in agreement with the ISC_3 project plan. Possible pitfalls, bottlenecks, rebound effects of the new scientific ideas and technologies, sustainability assessment methods, as well as applicability and development of in silico approaches are addressed by R&EH research activities. In the reporting period, the activities in the four research fields (a brief description of topics background can be found in the previous reports) were continued. The developments and activities from May 2019 to April 2020 in each field are described in the following.

4.2 Activities and results

4.2.1 Four main research streams at the Research and Education Hub

4.2.1.1 Electrochemical synthesis of chemicals

Chemicals synthesis based on renewable electricity is a recent trend in academic research, which is increasingly discussed within industries. However, there are many competing sectors, such as digitization (including industry 4.0), electromobility, and communication. Therefore, it is crucial to understand whether there will be bottlenecks in the future as for the availability of renewable electricity on the one hand and the materials needed (e.g. metals, see below) as there are also many competitive sectors. The limitations, pitfalls and neglected problems in this field have been identified and understood. A brief report is in preparation. The findings, open questions as well as possible solutions will be addressed in the scientific publications. Based on the work done, currently, there are two publications under development and results will be presented at the scientific conferences (a first presentation was planned for the Green and Sustainable Chemistry Conference initially scheduled in May 2020 and postponed to November 2020 due to the COVID-19 pandemic).

4.2.1.2 Metals as non-renewable, critical resources

As metals are critical for low carbon technologies, including electrochemical synthesis of chemicals, the findings on this topic will be included in the publications mentioned above. In addition, recycling and dissipation of metals can be used as an example for the entropy change based sustainability assessment approach. The R&EH co-organized two very successful workshops dedicated to the discussion of metals related problems. Both workshops brought together diverse stakeholders groups including academia, industry, NGOs and authorities, among others. The multidisciplinary exchange was beneficial for

all participants and resulted in creating several further cooperation of the actors from different fields and environments.

Workshop "Metall des Jahres" (Metal of the year), Goslar, Germany, July 4-5, 2019

The R&EH contributed to the Metal of the year workshop. Participants of the workshop aimed to raise social awareness about metals as non-renewable resources crucial for numerous aspects of human life (e.g. mobility, digitalization, renewable energy) by creating long term, multidisciplinary cooperation of different stakeholders. The meeting was dedicated to identifying possible strategies of highlighting the increasing metals demand, possible supply bottlenecks, problems related to recycling and gaps in a circular economy, sound and sustainable metal resources management on the political, scientific, industrial, economic and social level. The workshop was jointly organised by „"Die Transformateure – Akteure der Großen Transformation", Deutsche Bundesstiftung Umwelt, Weltkulturerbe Rammelsberg, Museum & Besucherbergwerk, TU Clausthal, Materials Resource Management, Universität Augsburg, Leuphana Universität Lüneburg, ISC_3 Research & Education Hub.

Workshop Metals - a prerequisite for digital transformation, Tutzing, November 8-10, 2019

In November 2019 ISC_3 R&EH, Leuphana Universität Lüneburg, German Federal Environmental Foundation, Entwicklungsfonds Seltene Metalle (ESM Foundation), Materials Resource Management (Institute of Materials Resource Management University Augsburg), "Die Transformateure – Akteure der Großen Transformation held a workshop Metals" - a prerequisite for digital transformation addressing the increasing use of metals needed for digital transformation and seeking solutions for their use in a wise and sustainable manner.

4.2.1.3 Entropy change as a measure for chemical sustainability

The first ideas developed by the R&EH related to the applicability of entropy change as a measure of sustainability were discussed and compared with ideas of the invited experts during the workshop in Vienna in June 2019. The workshop resulted in establishing several partnerships and mini-research groups investigating selected aspects discussed during the workshop.

Workshop "Entropy change - a suitable measure for (chemical) sustainability?", Vienna, Austria, June 25, 2019

The meeting was jointly organized by the R&EH, the Austrian Federal Ministry for Sustainability and Tourism, and the Institute of Sustainable and Environmental Chemistry at the Leuphana University of Lüneburg, Germany. The workshop explored the appropriateness of entropy change as a measure of sustainability. As an interactive scientific format, the workshop brought together leading experts from the fields of material flow management, resource and waste management, statistical entropy

analysis, and sustainability, amongst others. The multidisciplinary approach provided an opportunity to look at entropy change from different perspectives and investigate its links to sustainability. It was concluded that the entropy change can be a promising measure of sustainability. In this context, entropy change can complement existing approaches by addressing thermodynamic aspects beyond energy, e.g. products complexity, dissipation of resources and limits of recycling among others neglected in commonly applied approaches like e.g. Life Cycle Assessment (LCA) and Material Flow Accounting (MFA). Participants identified numerous possible fields of applications and case studies, e.g. Plastic & recycling, Steel industry & down cycling, Copper & renewable energy, Utilization of batteries (prominent example in the context of electromobility), Microplastic & Nanoplastic in water treatment. It was also agreed that addressing quality and function assessment, toxicity and climate change, among others by the entropy change based approaches would be challenging and needs to be further investigated.

4.2.1.4 Chemo-Informatics as a versatile tool in Green and Sustainable Chemistry - Study on the biotic and abiotic degradation of ionic liquids as an example

Based on the substance class of ionic liquids, this research topic disseminates the potential and limitations of chemoinformatic tools with the focus on quantitative-structure–activity-relationship models (QSAR) and their contribution to the implementation of sustainable chemistry. Ionic liquids are seen as promising solvents in green chemistry (e.g. extraction of cellulose) because of their low vapour pressure and are called green solvents. They are offering many tunable properties and can be synthesized easily. Further applications that are under discussion will release ionic liquids to the environment, e.g. applications as active pharmaceutical ingredients, herbicidal ionic liquid or electrolyte in solar cells and batteries. These are the examples where chemicals cannot be circulated in a circular economy. However, often ionic liquids are persistent in the environment. Such chemicals and products have to be designed form the scratch to be completely mineralized after their introduction to the environment. Regarding the concept Benign by Design, QSAR facilitates to decide which chemical structure is a promising candidate for further experimental testing. However, on the one hand, more success stories are needed to demonstrate the feasibility and raise industry interest to avoid PBT problems of future chemicals. The research here will serve as such an example and will also, on the other hand, show the needs to be met to transfer it into practice. Currently available QSAR models for biodegradability need more and better data of ionic liquids for generating reliable predictions in order to allow for benign design. Against this background, the main aim during the reporting period was to review which biodegradability data is available for ionic liquids to better understand the possible role of Chemo-Informatics in such a context. Therefore, a literature research was conducted to screen biodegradation studies, which followed national and international standards (e.g. OECD, ISO). These findings will be addressed in a scientific paper, which is currently under development. Within the scope of this research topic a talk was given on “advantages and challenges of in silico tools and their

contribution to sustainable chemistry with the focus on (Q)SAR" at the ISC$_3$ expert workshop "Digitalization and Artificial Intelligence: chances and challenges for sustainable chemistry" in Frankfurt a. M. in February 2020.

4.2.2 Events and Outreach

For outreach and spreading the understanding of Sustainable Chemistry as well as its opportunities, events are an important tool. In the following the most important activities in this context are highlighted. Beyond these there have been about 20 presentations given throughout the reporting period on different context (i.e. internal meetings and trainings of companies such as Merck; industry events, academic events including universities and the JungChemikerForum (JCF) (German division of the Younger Chemists Network) ras well as the general public) and future cooperation partners (ANII Uruguay, U Sao Carlos Brazil, Workshop U Sousse, Tunisia), interviews in different national and international media etc. (see Appendix Research 1: Selected presentations and lectures apart the above-mentioned conferences workshops etc.; see Appendix Research 3: Selected cooperation partners; see Appendix Research 4: Events and Conferences of the R&EH with contributions of Prof. Dr. Klaus Kümmerer). Klaus Kümmerer also served as Editor-in-Chief of the scientific journal Sustainable Chemistry and Pharmacy (SCP) (IF 2.4 in 2018, 3-3.5 expected for 2019), including being editor of a special issue on the 4th Green and Sustainable Chemistry Conference; both roles he had also with the review journal Current Opinion in Green and Sustainable Chemistry, together with Zhimin Liu (China). A special issue on Green and Sustainable Chemistry Education was initiated in SCP; first manuscripts have already been submitted (Guest editors: Glenn Hurst and James Clark, U York).

Whenever possible press releases were prepared and published e.g. publication in science, summer school, study programme (See Chapter Information)

4th Green and Sustainable Chemistry Conference, Dresden May 5-8, 2019

Previously organized by Elsevier and Leuphana University, nowadays the GSCC is a well-established event in cooperation with the Leuphana University Lüneburg and the ISC$_3$ illustrating a milestone of the R&EH activities. The conference chaired Prof. Klaus Kümmerer, again brought together about 250 international participants from 50 countries from all over the globe, representing academia as well as the private and public sector, to share the latest developments in the fields of green and sustainable chemistry. Participants benefited from the transdisciplinary character and the high-level scientific attendance as well as knowledge exchange and networking opportunities. The final of the Elsevier Foundation-ISC$_3$ Green & Sustainable Challenge and the award ceremony took place during the conference. The challenge seeks to stimulate innovative chemistry research that helps the environment and low-resource communities, while tackling some of the developing world's most significant sustainability challenges. Another unique feature of the conference was a session dedicated to Sustainable Chemistry in Society to which Dr. Elschami (Coordinator Education ISC$_3$ Research &

Education Hub) contributed by holding a lecture: Towards an International School for Sustainable Chemistry. Prof. Dr. Klaus Kümmerer gave a presentation on sustainable chemistry within textile industries. Contributions of keynote speakers and some of the regular oral speakers were published in the scientific journals "Sustainable Chemistry and Pharmacy" and "Current Opinion in Green and Sustainable Chemistry".

Preparation of the 5th Green and Sustainable Chemistry Conference, Dresden, November 8-11, 2020

Two months after the well-received and successful 4th Green and Sustainable Chemistry Conference in May 2019, R&EH has started preparation to the 5th edition in May 2020. However, due to the corona crisis, the event has been postponed for November 2020. Despite the date change, a vast majority of the keynote and invited speakers confirmed their participation.

Green China, November 2019

Together with the Chinese Chemical Society and Elsevier the First International Conference on Green and Sustainable Chemistry was organized and held in November 2019 in Beijing. It was very well attended (800 participants) and well received. Elsevier and Chinese Chemical Society plan to hold this conference together with ISC_3 biannually. Prof. Dr. Klaus Kümmerer served as a co-chair together with Buxing Han and held the opening lecture.

Publications

1. Bartkowiak D., Kümmerer K., Contribution of chemical leasing to sustainable chemistry, (article submitted to the Chemical Leasing book, UNIDO, book to be published about September 2020).

2. El-Khawad L., Bartkowiak D., Kümmerer K., “Closing the loop” in the German silicon solar panel industry". Publication in preparation

3. Elschami M., Bazzanella A., The 3rd Green and Sustainable Chemistry Conference successfully brings together scientists and innovators from all over the world to discuss sustainable chemistry. Curr Opin Green Sustain Chem. 2019; 15:115–7.

4. Elschami M., Kümmerer K., Design of a Master of Science Sustainable Chemistry. In: Special issue on Green and Sustainable Chemistry, under revision, (Guest editors: Glenn Hurst and James Clark, U York).

5. Kümmerer K., Clark JH., Zuin VG., Rethinking chemistry for a circular economy.

5 Education as a key activity field

5.1 Developments during the reporting period

Table 4: Milestones and achievements in the activity field "Education"

Central Field	Highlights	Achievements (facts and figures)
Development of an online-based professional degree M.Sc. Sustainable Chemistry	Accreditation of the degree	The detailed content of the course including syllabi were developed Label from the German accreditation council (Akkreditierungsrat) and the European Label Euromasters, from the European Chemistry Transfer Network (ECTN)
Development of an online-based professional degree M.Sc. Sustainable Chemistry	The implementation of marketing measures	Generation of a short video for the programme website, a programme flyer and information leaflets, an online information webinar, as well as announcing the programme on several German and international portals for higher education degrees
Development of an online-based professional degree M.Sc. Sustainable Chemistry	The application process	27 applications were submitted, 24 received admittance
Development of an online-based professional degree M.Sc. Sustainable Chemistry	Admission of applicants to the programme	11 applicants from 5 different countries and different professional sectors enrolled in the programme
Development of an online-based professional degree M.Sc. Sustainable Chemistry	The actual launch of the degree in March 2020	Study course is ongoing internal as well as external international teaching staff (academia, industry, authorities) were contracted for the first and in part the second semester already.
Development of an online-based professional degree MBA Sustainable Chemistry	Submitting a draft curriculum to the decision body (Ministry for Science and Culture Lower Saxony)	In progress

Central Field	Highlights	Achievements (facts and figures)
Development of an online-based professional degree MBA Sustainable Chemistry	Setting up a collaboration for streamlining and sharing educational content with a related degree at Leuphana Professional School.	In progress
Preparation and realization of the Summer School	Preparation and realization of the 5th Summer School in September 2019	The 50 participants, representing 25 nationalities, were selected from almost 80 applicants. The international participants accounted for 70%. Six travel grants from a 3rd party (OPCW) were acquired with the total amount approx. 10,000 €. An evaluation by questionnaires showed that the summer school was well received by the participants. the lectures were "good" up to "very good"
Preparation and realization of the Summer School	Preparation of the 6th Summer School in September 2020	In progress
Preparation and realization of the Summer School	Compiling the Programme	Programme is almost completed
Preparation and realization of the Summer School	Application for funding for travel grants	Funding for travel grants from R&EH budget has been secured, acquisition of additional from external institutions is in progress. 26 applications for travel grants from 10 different countries were received by the application deadline in March 2020

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

The activities of the R&EH in the field of "Education" include the development of international study programs for sustainable chemistry in cooperation with the Professional School of the Leuphana University of Lüneburg to gradually integrate the topic of sustainable chemistry into the higher education sector. Furthermore, the activities include the planning and implementation of the annual "Summer School on

Sustainable Chemistry for Sustainable Development" at the Leuphana University of Lüneburg. The Summer School not only contributes to scientific exchange, but also increases the visibility of ISC_3 in an international context.

5.2 Activities and results

5.2.1 Development of an online-based professional degree M.Sc. Sustainable Chemistry

Key milestones achieved in the development of the M.Sc. Sustainable Chemistry in the reporting period were the accreditation of the degree, the implementation of marketing measures and the application process, the admission of applicants to the programme, as well as the actual launch of the degree in March 2020. The detailed content of the course including syllabi were developed and internal as well as external international teaching staff (academia, industry, authorities) were identified and contracted as for the first and in part the second semester already.

The programme is already awarded the label from the German accreditation council (Akkeditierungsrat) and the European Label Euromasters, from the European Chemistry Transfer Network (ECTN). For the application of the accreditation labels, an accreditation report was developed from May 2019 to August 2019 and handed in to the accreditation agency ASIIN in September 2019. This report was based on essential steps of a programme development that took place in parallel such as acquiring lecturers for the modules of the programme, assembling a module handbook containing learning aims, examination methods and didactic structures of the individual modules, as well as detailed descriptions of Leuphana University facilities (e.g. Laboratories for practical work, E-Learning platform, Quality Assurance procedures) and their suitability for implementing the M.Sc. Sustainable Chemistry. The accreditation audit took place in December 2019. After minor adjustments to programme implementation requested by the agency ASIIN, the German accreditation was awarded in February 2020, and the European label in March 2020.

In parallel to preparing the accreditation, marketing measures were set up, including the generation of a short video for the programme website, a programme flyer and information leaflets, an online information webinar, as well as announcing the programme on several German and international portals for higher education degrees.

The application procedure was initiated with the publication of the programme website (March 2019), with an initial deadline set for 10 December 2019, as well as two extensions (31 January 2020 and 29 February 2020). Altogether 27 applications were submitted, 24 received admittance, and 11 applicants from 5 different countries and different professional sectors enrolled in the programme.

The programme was launched on 16 March 2020. A classroom session that was planned for March 16 to March 20, 2020 on the campus of Leuphana University was shifted to online teaching on short notice due to the shutdown of Leuphana University in the context of the Corona crisis. The programme launched successfully with a very positive feedback round from the participants at the end of the first classroom session. By the end of April 2020, the participants will have completed the first module ("Concepts of Sustainable Chemistry") of the programme.

Additional funding was provided by Leuphana University: 75% position for administrative support.

5.2.2 Development of an online-based professional degree MBA Sustainable Chemistry

The professional degree MBA Sustainable Chemistry is to be launched two years after the M.Sc. Sustainable Chemistry, in the summer semester of 2022. Important steps in programme development were initiated such as submitting a draft curriculum to the decision body (Ministry for Science and Culture Lower Saxony) as well as setting up a collaboration for streamlining and sharing educational content with a related degree at Leuphana Professional School. After approval of the draft curriculum by the Ministry Lower Saxony, programme development will proceed in analogy to the development of the M.Sc. Sustainable Chemistry. Identifying and modifying, and possible application of experiments affordable on a allow cost basis, as well as internet-based material, was done.

5.2.3 5th Summer School on Sustainable Chemistry for Sustainable Development, – Lüneburg, Germany

Another milestone of the work at the R&EH is the implementation of the "Summer School on Sustainable Chemistry for Sustainable Development". Since 2017 the summer school is a well-established yearly event jointly organized by R&EH and Leuphana University of Lüneburg taking place at the Campus of the Leuphana University. In the reporting period the 5th Summer School took place from 16th to 20th September 2019 following the focus topic "Sustainable Chemistry and the Myths of Renewables". The summer school provided the participants with an understanding of the latest developments in concepts of sustainable chemistry and chemicals management. In addition, during the interactive lectures and workshops, the participants had the opportunity to discuss opportunities and benefits of renewable resources and energies. The trainers' team consisted of scientists and practitioners as well as of individuals who actively operate in different fields of sustainable chemistry and international co-operations. The 50 participants, representing 25 nationalities, were selected from almost 80 applicants. The international participants accounted for 70%. An evaluation by questionnaires showed that the summer school was well received by the participants. The evaluation confirms that the lectures were "good" up to "very good" as well as networking and potential new collaborations will enrich the future work of most of the participants.

Six travel grants from a 3rd party (OPCW) were acquired with the total amount approx. 10,000 €. Elsevier Foundation facilitated the participation of the 5 finalists of the Green and Sustainable Chemistry Challenge. The GIZ Programme "Green Economy Transformation in cooperation with the Partnership for Action on Green Economy" (PAGE) financed the participation of one participant. In addition, ISC_3 R&EH supported seven participants, and ISC_3 IH supported three participants with travel grants.

5.2.4 Preparation on the 6th Summer School on Sustainable Chemistry for Sustainable Development – Lüneburg, Germany

Preparation of the next edition of the annual summer has begun in November 2019. Funding for travel grants from R&EH budget has been secured, acquisition of additional from external institutions is in progress. 26 applications for travel grants from 10 different countries were received by the application deadline in March 2020 (number

slightly lower than last year, probably caused by COVID-19 crisis). An almost completed programme is available online.

6 Information as a key activity field

6.1 Development in the field of information during the reporting period

Table 5: Milestones and achievements in the activity field "Information"

Central Field	Milestones	Achievements (Facts and Figures)
Events	Stakeholder Forum	110 Experts from five continents attended
Events	Meeting of the Scientific and Advisory Board	The board meeting took place with a participation of 85% of the board members
Website	Interactive Website with the functions of a knowledge and a dialogue platform Customer Relationship Management	Concept for a new website and CRM has been developed Two tenders have been prepared
Website	New Content on the Website	9 news articles have been published 8 videos have been published on the Website within the series "Sustainable Voices" 9 portraits of start-ups have been published within the series "Start-ups of the Month" 7 Subsites (Innovation Challenge, Global Start-up Service, etc.) published
Social Media	Building up visibility and outreach on the major social platforms (YouTube, LinkedIn, Twitter, Facebook)	20 videos have been published on the ISC_3 YouTube channel More than 400 followers on LinkedIn More than 470 followers on Twitter
Media Relations	press distribution list	Reaching 70 expert journalists

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

Sharing knowledge and disseminating information on sustainable chemistry innovation, policies and research are essential cross-sectional tasks of the ISC3. The ISC3 aims to promote a better understanding of sustainable chemistry and aims to inspire a profound discussion about the benefits of the emerging concept. Therefore, an important long-term goal of the centre is to establish a knowledge and dialogue platform. According to the original tender, a website of the centre, news tools, Social Media, events, conferences, exhibitions and print products are the key elements of the ISC3 communication strategy to inform and invite all stakeholder groups to join forces or cooperate with the ISC3.

6.2 Activities and results

During the reporting period, communication on all ISC3 activity fields has been developed further. News on the activities and progress of the centre have been published on the website and distributed via the ISC3 Social Media Channels (Twitter, Facebook, LinkedIn, and YouTube). The centre has published nine news articles on its website informing about new partnerships and collaborations, events, the two ISC3 awards, the new Master's degree programme and scientific publications. The ISC3 has further published articles in the following newspapers and magazines: Sächsische Zeitung, Biospektrum and in the Umweltmagazin.

To interact with stakeholders on all activity fields and engage them in the ongoing work of the centre, the ISC3 has been developing the concept for a new website with an interconnected Customer Relationship Management (CRM) System. The new website will allow all stakeholders to share knowledge on sustainable chemistry and inform themselves about innovations, news, scenarios, discussions, training courses and events about sustainable chemistry. With both digital tools, the new website and the CRM-System, the ISC3 can act as a reliable network partner, build up a network and knowledge platform and initiate networks and collaborative activities between different stakeholders, for example, between start-ups and investors. The call for tender for the new concept was stopped in the second half of 2019 due to budgetary constraints.

During the reporting period, the communication team also elaborated a concept for a "Global Week on Sustainable Chemistry". Given the foreseeable high costs of such an event the concept has been re-designed as a bi-annual umbrella event starting in 2021.

The original concept was to showcase the diversity of sustainable chemistry by heading each day with a focus topic. Starting with a daily panel discussion on the respective topic, several workshops, exhibitions and other smaller events were planned.

The concept also envisaged integrating the Investor Forum organised by the ISC3 IH and Think BeyondTM Innovation Accelerator, which provides start-ups with necessary knowledge and networking opportunities to promote their business, while at the same time connecting potential investors and start-ups The Green and Sustainable Chemistry Conference co-organised by the Research and Education Hub with Elsevier and Leuphana University would have provided the scientific view on sustainable chemistry, addressing foremost the academic stakeholders. The annual Stakeholder Forum was also to be taking place during the week to provide a networking platform and discuss the common understanding. Furthermore, a youth parliament discussing the needs and

expectations of the younger generation towards sustainable chemistry, resulting in a resolution that was to be officially handed over to political representatives, was planned.

Additionally, a more in-depth look into women in sustainable chemistry, Africa and sustainable chemistry, and many more topics were to be addressed. The ISC3 intends to re-activate all these events and partners in the new concept of the Global Week on Sustainable Chemistry in summer 2021.

6.2.1 Information about the activity field Collaboration

The ISC3 Thought Starter: "Reaping the full potential of sustainable chemistry for SAICM, the Sound Management of Chemicals and Waste beyond 2020" – first presented at the SAICM OEWG in Montevideo, 2-4 April 2019 – has been published on the website inviting stakeholders to contribute their comments.

This thought starter was also discussed during the ISC3 Stakeholder forum which was held in 21 – 22 June 2019 in Königswinter 110 participants from Africa, Asia, Europe and North and South America joined the dialogue on Green and Sustainable Chemistry and its role on the way towards achieving the 2030 Agenda.

Three news articles were published informing about the activity field collaboration:

- New Partners in Africa, Asia and Latin America join the ISC3 Spiderweb Network (https://www.ISC3.org/en/news/article/article/new-partners-in-africa-asia-and-latin-america-join-the-ISC3-spiderweb-network.html)
- Building up the International Sustainable Chemistry Community – first ISC3 Stakeholder Forum connects experts worldwide (https://www.ISC3.org/en/news/article/article/building-up-the-international-sustainable-chemistry-community-first-ISC3-stakeholder-forum-conne.html)
- In the lead-up to the SAICM meeting in Bangkok: ISC3 hosted successful workshop on Sustainable Chemistry (https://www.ISC3.org/en/news/article/article/in-the-lead-up-to-the-saicm-meeting-in-bangkok-ISC3-hosted-successful-workshop-on-sustainable-chemi.html)

The communication team supported the ISC3 workstream on Sustainable Building and Living which was carried out with a series of workshops and stakeholder dialogues in 2019. The workstream and events were announced on the ISC3 website, the workshops were further accompanied by the ISC3 communications channels (Website, information flyer and Social Media Channels).

A video series (eight videos) was implemented on the website with statements from ISC3 stakeholders (members of the scientific and the advisory board as well as cooperation partners). The statements emphasise the broad approach of sustainable chemistry and the manifold benefits of the concept. The videos were also promoted on the ISC3 Social Media Channels.

6.2.2 Information about the activity field Innovation

The communication team has developed a strategy to reach out to the relevant target groups with information about the Global Start-up Service and the launch of the onboarding tool. The Global Start-up Service was promoted with a subsite on the ISC3 website, an information flyer, information banners and social media posts.

The communications team also developed a concept for the promotion of information on the ISC3 Innovation Challenge. News articles, a subsite on the ISC3 website, information flyers, postcards and banners, social media posts and a joint press release with the partner DECHEMA about the launch of the challenge as well as the announcement of the finalists were published. The ISC3 IH contacted over 130 relevant stakeholders and provided them with promotional emails and attachments to further spread a word about the launch of the challenge within local communities. The measures resulted in 47 applications from all parts of the world.

The ISC3 is further promotes the Start-up Days and the Investor Forum in Frankfurt, postponed to October 2020 with an announcement of the event on the website and in social media posts and the development of an information flyer.

In September 2019 the "Start-up of the Month" series (SoM), was launched in cooperation with the ISC3 Innovation Hub. The series promotes outstanding start-ups from our pool of the Global Start-up Service at the ISC3 website and via the ISC3 social media channels. Up to now, eight start-ups have been selected as SoM [status 30/4/2020]. The featured start-ups were picked by the GSS team due to their outstanding innovation and sustainability efforts, as well as based on regional, gender and topical criteria. The SoM series is produced basing on interviews and the received On-Boarding Questionnaires (see Appendix Information 1: Key Facts Start-up of the Month series).

Image Video Sustainable Innovation: A 3-minute image video was produced in cooperation with the ISC3 Innovation Hub, highlighting the contributions of the Global Start-up Service to initiate innovation and transformation towards sustainability and circular economy (https://www.youtube.com/watch?v=YIZW8582u_M).

6.2.3 Information about the activity field Research

The 4th Green and Sustainable Chemistry Conference organized by Elsevier in cooperation with the Leuphana University and ISC3 R&EH in Mai 2019 in Dresden was promoted on the ISC3 Homepage and social media channels.

The first "Entrepreneurial Spirit in Sustainable Chemistry Award" was promoted on the website and a joint press release together with the Elsevier Foundation has been published. An interview with the award winner Mario Heredia was published on the ISC3 Social Media Channels.

Through its communication channels, ISC3 informed about the second call for entries of the "Entrepreneurial Spirit in Sustainable Chemistry Award" which resulted in a total of 51 applicants. The seven finalists were announced on the ISC3 website.

A joint press release with the Leuphana University was published highlighting the scientific publication "Rethinking chemistry for a circular economy" of Prof. Klaus Kümmerer, Director of the ISC3 Research and Education Hub in the renowned journal Science. The article defined guidelines on how to rethink chemistry for a circular

economy. The co-authors, Prof. John Clark, University of York, and Prof. Vânia Zuin, University of São Carlos, are also members of the ISC_3 Scientific Board.

6.2.4 Information about the activity field Education

The ISC_3 promoted the first Master Programme in Sustainable Chemistry at Leuphana University: Together with Leuphana University a joint press release about the start of the degree programme has been published. During the registration phase, the ISC_3 drew attention to the new programme on its website and through social media posts.

The ISC_3 promoted the Summer School 2019 via the ISC_3 homepage and the social media channels. The communication team further produced four videos with statements of the participants on the benefits and significance of the content taught during the summer school. The videos where published on the ISC_3 YouTube Channel and shared in all social media channels.

A Appendix

A.1 Appendix General Remarks

A.1.1 Appendix General Remarks 1. ISC_3 Phasenkonzept

Table 6: Das ISC_3 Phasenkonzept

Milestones	Indikatoren	Status	Rahmenbedingungen und Maßnahmen
Phase 1 bis September 2017			
Einrichtung des Gebäudes	Seit Juni 2017 hat das ISC_3 Räume in der Simrockstraße angemietet, offizielle Einweihung erfolgte gemeinsam mit dem 1st Year Anniversary Event https://www.ISC_3.org/en/news/article/article/1st-year-anniversary-event-ISC_3-celebrates-successful-first-year-with-international-guests.html	erfolgt	Mit der Anmietung und Einrichtung des Gebäudes in der Simrockstraße, ist das ISC_3 seinem Auftrag nachgekommen, Räumlichkeiten für das Zentrum zu schaffen und diese nach bauökologischen und nachhaltigen Gesichtspunkten einzurichten, dabei wurden Nachhaltigkeitsaspekte bei der Herstellung wie auch bei der späteren Entsorgung überprüft.
Ein Teil des Personals ist rekrutiert	Die Personalrekrutierung mit der Besetzung nahezu aller Planstellen war Anfang 2019 abgeschlossen https://www.ISC_3.org/en/about-ISC_3/our-team.html	erfolgt	Die Besetzung der Stellen wurde stetig vorangetrieben. Bereits 2018 war das ISC_3 mit einem Teil des Personals sowohl in den Hubs als auch in Bonn arbeitsfähig, weiteres hochqualifiziertes Personal konnte im Laufe des Jahres 2018 gewonnen werden und startete Anfang 2019.
ISCnet übernommen	Internetseite und Netzwerk wurden 2017 aus dem Vorgängerprojekt ISCnet übernommen	erfolgt	Die ISC_3.org Internetseite (hervorgegangen aus der ISCnet-Seite) konnte bereits Ende 2017 zur Klimakonferenz in Bonn online gehen. Das unter dem Vorgängerprojekt aufgebaute Netzwerk wurde in das ISC_3 Stakeholdernetzwerk integriert.
Organisations-konzept	Ein strategischer Gesamtansatz wurde ab Ende 2017 mit BMU und UBA abgestimmt, ISC_3 legt sich auf fünf Aktivitätsfelder fest, die auch die Zusammenarbeit mit den Hubs strukturieren und	erfolgt	

Milestones	Indikatoren	Status	Rahmenbedingungen und Maßnahmen
	abgrenzen (Collaboration, Innovation, Research, Education und Information).		
Stakeholder-konzept	Die Arbeit des ISC$_3$ wird von einem Advisory Board, einem Scientific Board sowie einem jährlich stattfindenden Stakeholder Forum strategisch ausgerichtet und überprüft.	erfolgt	Protokolle Jour fix UBA, PPP hinterlegt?
Arbeitsprogramm	Das Arbeitsprogramm, abgeleitet aus dem Organisationskonzept des ISC$_3$, wurde jeweils auf der Basis von Jahresplanungen eng mit dem BMU/UBA abgestimmt.	erfolgt	Jahresplanungen hier hinterlegen?
Kommunikations-strategie	Die Kommunikationsstrategie wurde – in enger Abstimmung mit dem BMU erarbeitet	erfolgt	Betrieb der Webseite Neukonzeption der Website in enger Verzahnung mit einem Customer Relationship-Management-System (in Vorbereitung) CD (Logo, Signet, Key Visuals, PPT) Social Media Kanäle Video-Content Eventplanung
Summer School	Seit 2017 veranstaltet das ISC$_3$ in Kooperation mit der Leuphana Universität jeweils im September eine einwöchige Summer School zu einem ausgewählten Thema aus der Sustainable Chemistry in Lüneburg.	erfolgt	https://www.ISC$_3$.org/en/activities/education.html und https://www.leuphana.de/en/institutes/isec/summer-school-sustainable-chemistry/summer-school-2017.html Topics seit 2015: Renewable Energy" (2019) "Sustainable Building and Living" (2018) "Sustainable Chemistry and e-Waste" (2017) "Sustainable Textiles" (2016)

Milestones	Indikatoren	Status	Rahmenbedingungen und Maßnahmen
			"Sustainable Chemistry in International Cooperation" (2015)
Phase 2 bis Dezember 2017			
Geschäftsplan	Vorbereitung und Durchführung der ersten Scientific- und Advisory Board-Sitzungen	abgewan-delt	Das ISC$_3$ lieferte in enger Abstimmung mit UBA/BMU und seinen Boards eine jährliche Planung der Aktivitäten.
Implementierungs strategie für die zentralen Funktionen liegt vor (Think Tank, Wissensplattform, Innovationsraum)	Implementierungsstrategien wurden mit dem BMU entwickelt und abgestimmt.	erfolgt	Innovationsraum: Beim ISC$_3$ Innovationhub wurde der Global Startup-Service konzipiert und seit 2018 aufgebaut Seit 2019 lobt das ISC$_3$ den Innovationspreis „Innovation Challenge“ aus Think Tank und Wissensplattform: das Research und Education Hub hat einen Studiengang „Sustainable Chemistry“ konzipiert, Beginn erstes Studienjahr: März 2020 Wissenschaftliche Veranstaltungen: Die Green and Sustainable Chemistry Conference findet seit 2018 in Kooperation mit der Elsevier Foundation statt, seit 2019 wird dort durch das ISC$_3$ der Preis „Entrepreneurial Spirit“ vergeben. ISC$_3$ ist Mitveranstalter des jährlich stattfindenden Entropie-Workshops.
Konzept Szenario Prozess	In Abstimmung mit dem BMU wurde die Erstellung eines Szenario Konzeptes in die Erstellung eines Foundational Papers umgewandelt.	Änder-ung des ursprüng-lichen Konzepts	Durch die Erstellung eines Foundational Papers konnte das ISC$_3$ aktiv beim Global Chemistry Outlook II mitwirken und dort die Aspekte der nachhaltigen Chemie erfolgreich einbringen. Dadurch wurde das Zentrum bereits in einer sehr frühen Phase in internationale Konventionen (SAICM, UN) eingebunden und erlangte internationale Sichtbarkeit (Auftrag ging an

Milestones	Indikatoren	Status	Rahmenbedingungen und Maßnahmen
			Adelphi, Bericht publiziert bei der UN)
	Ein Kurzpapier für einen Szenario Prozess wurde 2018 auf der Board-Sitzung präsentiert		Vorstellung und Diskussion des Kurzpapiers im entsprechenden Boardmeeting.
Implementierung Phase 1			
Phase 3 bis Dezember 2018			
Jahreskonferenz	Die Jahreskonferenz (erstes ISC$_3$ Stakeholder Forum) wurde 2018 konzipiert und organisiert und im Juni 2019 durchgeführt.	erfolgt	2018 konnte das ISC$_3$ noch nicht mit seiner vollen Personalstärke agieren. Die Planung des Stakeholder Forums wurde vorangetrieben, konnte aber erst 2019 durchgeführt werden.
Summer Schools	Die Summer School on Sustainable Chemistry for Sustainable Development "Construction Materials and Habitation" des ISC$_3$ in Kooperation mit der Leuphana Universität von vom 24. - 28. September 2018 statt.	erfolgt	https://www.leuphana.de/en/institutes/isec/summer-school-sustainable-chemistry/summer-school-2018.html
Forschungs-aktivitäten	Vier Forschungsthemen werden vom Research and Education Hub gescreent	erfolgt	1. Electrochemical synthesis of chemicals 2. Metals as non-renewable, critical resources 3. Entropy change as a measure for chemical sustainability 4. Chemo-informatics as a versatile tool in Green and Sustainable Chemistry-Study
Akquisition Kofinanzierungen	Antrag für das IKI-Projekt Air BnB Projekt mit Partnern	erfolgt	Antrag und Projektbeschreibung hier hinterlegen
UN-Collaborative Centre	Nicht weiter verfolgt	Änder-ung des ursprüng-lichen Konzepts	Aufgrund der Rechtsform des ISC$_3$ (keine Eigenständigkeit) konnte dieses Ziel nicht weiterverfolgt werden.

Milestones	Indikatoren	Status	Rahmenbedingungen und Maßnahmen
Implementierung Phase 2			

Phase 4 bis April 2019

Investor Relations	Investor Forum	erfolgt	Bereits im Dezember 2018 veranstaltete das ISC_3 – mit Kooperationspartnern – ein Investor Forum, ein weiteres Investor Forum ist für Oktober 2020 (verschoben vom Mai) geplant.
Alternative Geschäftsmodelle	Antrag für einen Bioökonomie-Fond wurde 2019 beim BMWi gestellt	erfolgt	
Leuchtturm-projekte	Projekt mit BASF, einem großen industriellen wurde Anfang 2019 gestartet Air BnB, Pilotphase Ende 2019	erfolgt	

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

A.2 Appendix Innovation

Appendix Innovation 1: GSS ambitions and KPIs and status as of April 2020

Table 7: Support innovators along the entire technology innovation chain and hereby contribute to the global breakthrough of Sustainable Chemistry, Ambitions and KPIs

Number	Defined in June 2019	Status as of April 2020
1	At least 5 projects with individuals or organizations complementing or directly financing the action of the GSS KPIs: number of projects and financial support generated via projects	1 on-going innovation project: "Better access to infrastructure for sustainable (chemistry) innovation in Brazil and South Africa" advanced as a public-private-partnership with Merck KGaA (further companies are considering their participation).
2	At least 200 start-ups/entrepreneurs (stage-gate 1 and higher) with a good mix from different world regions and thematic backgrounds are registered in the pool KPIs: number of start-ups in database, geographical distribution and number of covered innovation fields	82 start-ups from 5 continents on-boarded to the Global Start-up Service (stage-gate 1 and higher). The start-ups' innovations cover over 15 topics and sectors.
3	>90% of the start-ups participating in the customised support the GSS pool confirm that they have received positive support from GSS KPI: Customer satisfaction rate via queries	
4	At least 20 letters for cooperation/of agreement (Memorandum of Understandings) with Key Partners signed in 5 continents KPIs: number of collaborations with Key Partners, number of concrete services/ support and number of entrepreneurs supported by these services	5 Memoranda of Understanding (MoU) signed with partners from 5 continents (The National Agency for Research and Innovation of Uruguay (ANII), Uruguay; Brightlands Chemelot Innovation Center, the Netherlands; Green ChemisTree Foundation, India; Think Beyond Plastic™ Foundation, USA; youthinkgreen, Egypt). Additionally, one institutional partnership with Start-up Chile has been established.

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

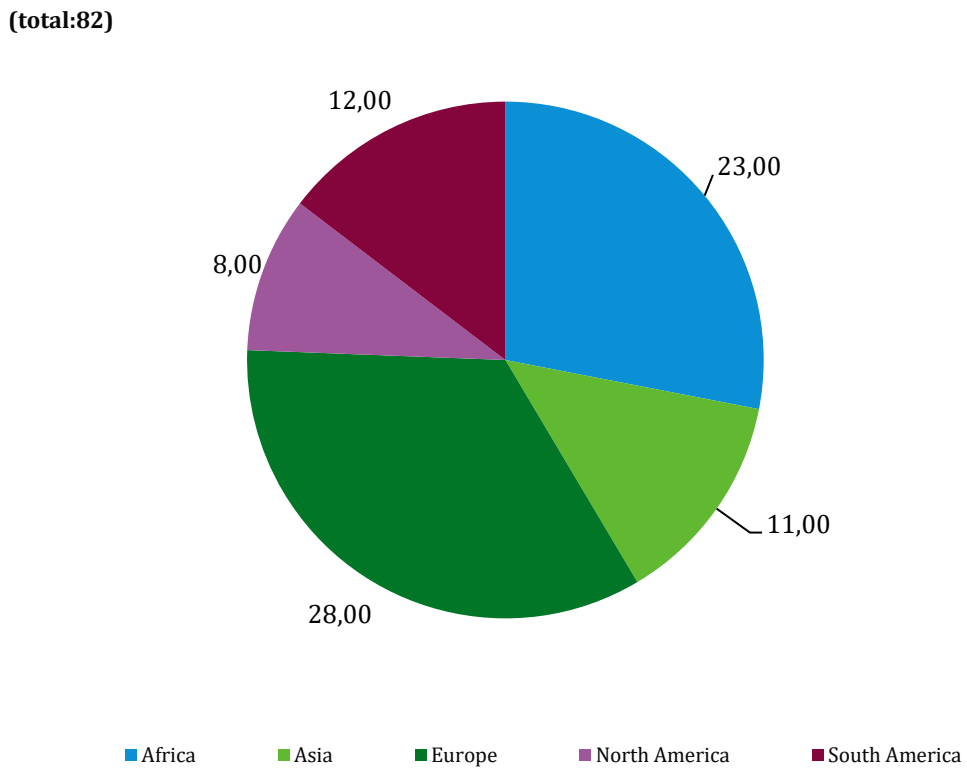
Appendix Innovation 2: Geographical distribution of GSS start-ups

Table 8: Geographical distribution of GSS start-ups

Continent	Number of start-ups
Africa	23
Asia	11
Europe	28
North America	8
South America	12
TOTAL	**82**

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

Figure 2: Geographical distribution of GSS start-ups



Source: own illustration, International Sustainable Chemistry Collaborative Centre (ISC_3)

Appendix Innovation 3: Thematic categories of GSS start-ups

Appendix Innovation 3: Thematic categories of GSS start-ups

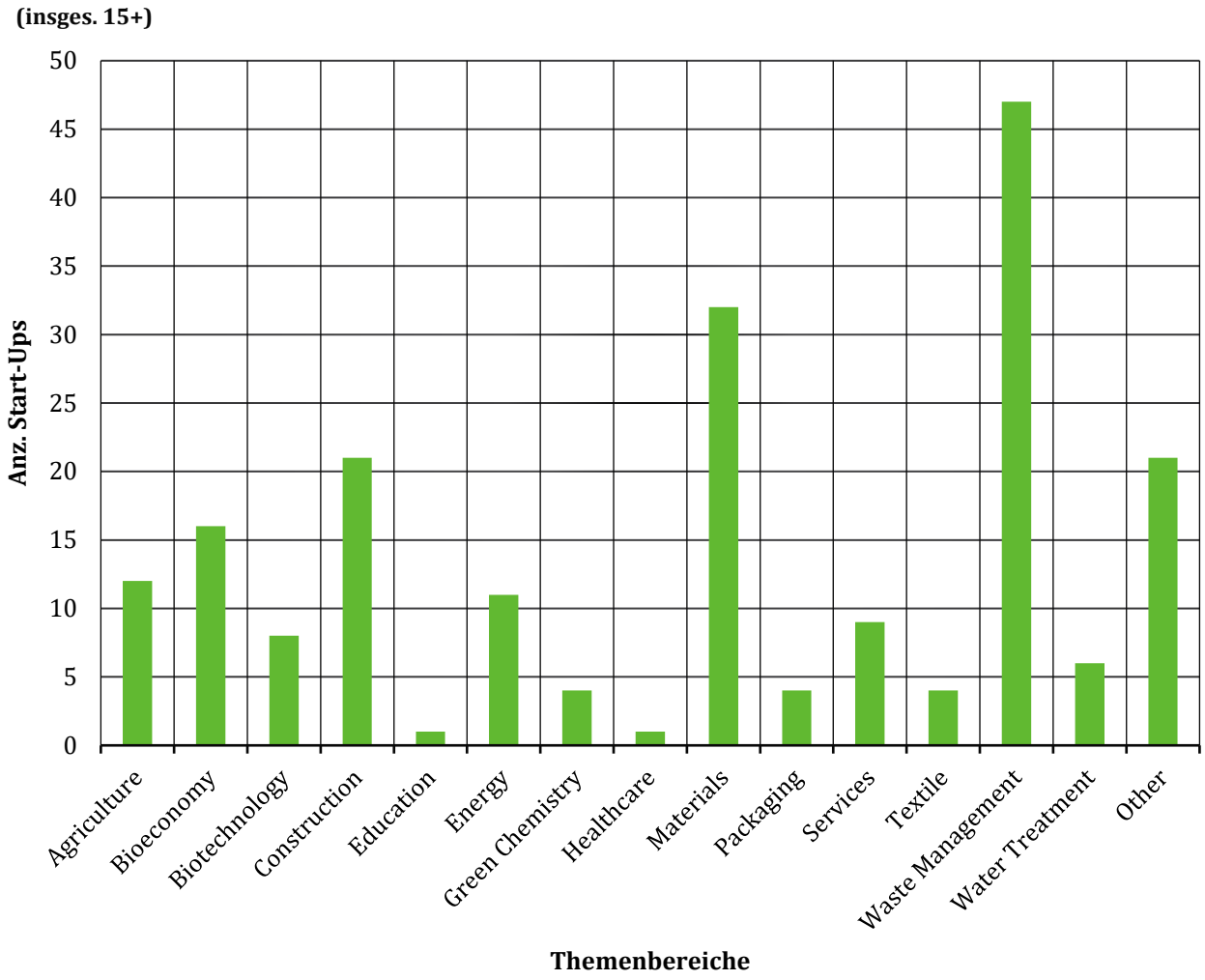
Table 9: Thematic categories of GSS start-ups

Category[12]	Number of start-ups
Agriculture	12
Bioeconomy	16
Biotechnology	8
Construction	21
Education	1
Energy	11
Green chemistry	4
Healthcare	1
Materials	32
Packaging	4
Services	9
Textile	4
Waste management	47
Water treatment	6
Other	21

Source: own compilation, International Sustainable Chemistry Collaborative Centre (ISC_3)

[12] A start-up can be classified into more than one category.

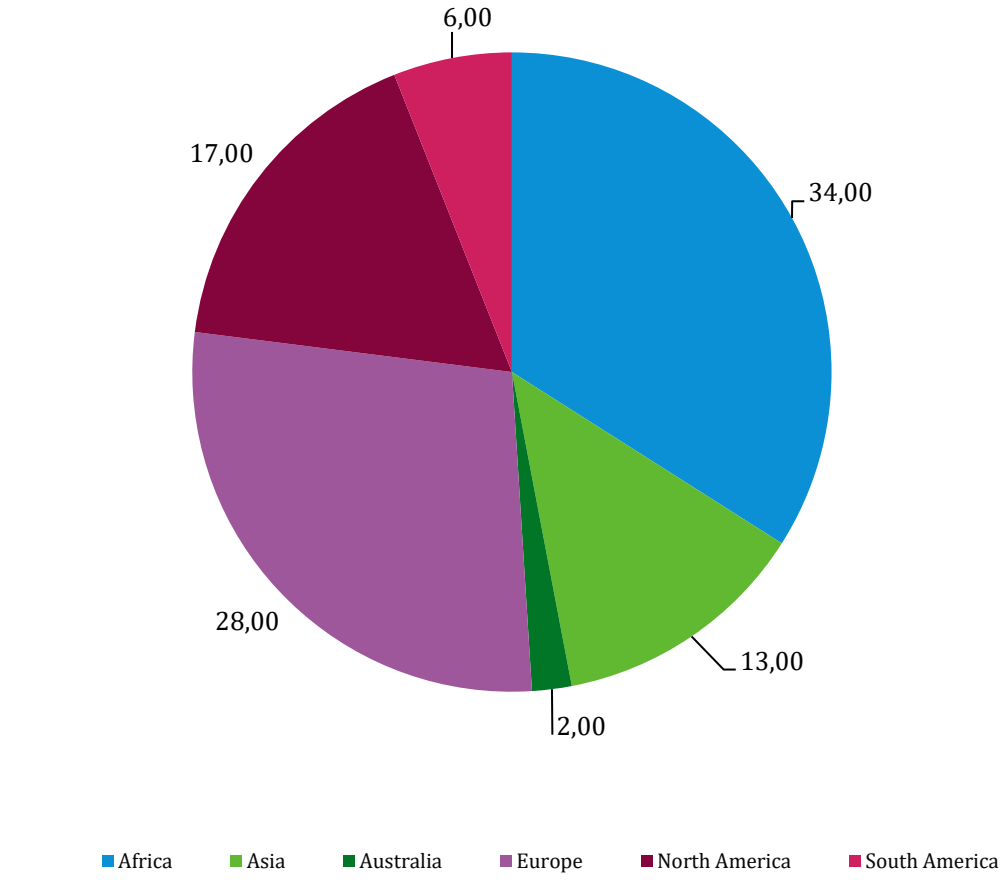
Figure 3: Thematic categories of GSS start-ups



Source: own illustration, International Sustainable Chemistry Collaborative Centre (ISC_3)

Appendix Innovation 4: Geographical distribution of Innovation Challenge applicants

Figure 4: Geographical distribution of Innovation Challenge applicants



Source: own illustration, International Sustainable Chemistry Collaborative Centre (ISC_3)

Appendix Innovation 5: Summary of the Innovation Challenge finalists' ideas (in alphabetical order)

1. **Block Solutions, Finland:** Lightweight building blocks produced through injection moulding from environmentally friendly wood fibre-based biocomposite. The strength of the blocks originates from the wood fibre and the encapsulation by recycled or virgin Polypropylen ensures the flexibility, lifespan, and resistance to external abrasion. The innovation offers a promising, affordable "Do It Yourself" housing solution, as the product is modular, can be expanded according to the needs of the user, and can be built very easily.

2. **Ecoact, Tanzania**: Energy conserving plastic extrusion technology, which recycles and transforms post-consumer plastic garbage and packaging materials into durable and long-lasting plastic timbers. The technology uses natural profiled waxy inversion in the plastic extrusion process and helps plastic materials of different polymers reach their melting point quickly, while retaining their original stability and strength, hence lowering energy consumption and production costs.

3**. Ecovon, Ghana:** Sustainably sourced, newly-engineered wood made from coconut husk and sugar cane bagasse, supplying the global market with a formaldehyde-free bio-based renewable wood alternative. The product is naturally flame retardant and anti-fungal without added binders (glues). Moreover, the innovation of Ecovon allows for the reduction of CO2 footprint and deforestation as compared to the commercial wood and has a positive social and economic impact in coconut and sugarcane producing developing countries, such as Ghana.

4. **Glassolina, Egypt**: Sheets of wood-plastic composite made out of recycled plastic and wood wastes with superior properties that can be used as an alternative for other virgin plastic-based materials, such as acrylic and polycarbonate. The solution is an up-cycled material with numerous applications that can be customizable (transparent, translucent, opaque, and coloured for further uses). The panels can fit as a replacement of glass in net-zero energy buildings and can also be used in photovoltaic solar panels.

5. **Mesocarpe, Germany:** The 1- 4 mm flexible "Salt Crystal Wall" is an active biodegradable membrane made from renewable resources and minerals, which regulates indoor air quality by filtering pollutants and bacteria. "Salt Crystal Wall" is self-adhesive, attenuates noise, and can reduce electromagnetic radiation. In addition, the translucent salt wall can neutralize electromagnetic fields.

6. **Reuse Design Laboratory, USA**: Lightweight, insulative masonry block system Drywall Waste Block (DWB), containing up to 90% recycled drywall waste. DWB mixtures utilize drywall demolition and construction waste, replacing a high percentage of Portland cement with a waste-derived binder. DWB can offer new opportunities for waste recyclers and building materials manufacturers and superior results at lower costs to builders, encompassing a range of structural and non-structural applications.

7. **SUMTEQ, Germany**: Affordable high-performance insulation material SUMFOAM® on the basis of polymer nanofoams. SUMFOAM® achieves a significant reduction in thermal conductivity of up to 50% compared to common insulating materials. Thus, the energy requirement from heat losses is greatly reduced with unchanged insulation thickness. In this way, SUMFOAM® particularly contributes to the sustainable conservation of valuable resources. Based on the scalability and the costs-efficient processes, SUMFOAM® can be offered with an attractive price-performance ratio.

8. **Zila Works, USA**: 100% BPA-free epoxy resin made from industrial hemp - a plant that is easy to grow and has strong, durable fibres – which produces benefits for farmers, reduces health risks for manufacturing workers, and decreases toxins to consumers. This technology is an innovative bio epoxy resin based on the fatty acids (FA) of hemp seed oil for use in composites and other industrial applications, such as coatings.

Appendix Innovation 6: Key Facts Innovation Challenge 2019/20

8 finalists represent 3 continents: Africa (3: Egypt, Ghana, Tanzania), Europe (3: Germany and Finland), and North America (2: USA);

The innovations span the topics of performance materials (5), Design of construction elements and materials facilitating reuse and recycling (1), low cost/tech solutions (1), and renewables and recycling (1);

3 female founders selected for the honourable mention represent Chile, Germany and South Africa;

A Jordanian start-up selected for the honourable mention for particularly impactful, out-of-the-box solution.

A.3 Appendix Research

Appendix Research 1: Selected presentations and lectures apart the above-mentioned conferences workshops etc.

- IUPAC Conference Paris, 8-12 July 2019
- Max Planck Institute Mühlheim, 10 July 2019
- National University Singapore, 27-29 August 2019[13]
- Institute of Chemical and Engineering Sciences, A*STAR, Singapore, 27-29 August 2019[14]
- Dialog-Veranstaltung Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall e.V. (DWA), Berlin, 23-24 September 2019
- Gemeinsamer Umweltausschuss der Grünen und der SPD im Deutschen Bundestag: Berlin, 23 September 2019
- SCEX (Industrietagung), Frankfurt, 9 October 2019
- U Sao Carlos, Sao Carlos, Brazil, 23-24 November 2019
- U Sao Paulo, Sao Paulo, 25-26 November 2019
- ANII, Montevideo, Uruguay, 28-29 November 2019[15]
- Universität Hamburg, 6 December 2019

Due to the Covid-19 pandemic numerous invited, opening or key-note lectures were cancelled (e.g. Industrietagung Chemical Manufacturing, Frankfurt, Jungchemiker Österreich Jahrestagung Innsbruck, Austria, McGill University Montreal Canada, European Association of Chemical Distributors (FEEC), Annual Congress Milan).

[13] Several lectures and giving classes for students and staff: introducing ISC_3, sustainable chemistry, Benign by design, Chemistry in a circular economy, Metal as a scarce resource, Dissipation
[14] Several lectures and giving classes for students and staff: introducing ISC_3, sustainable chemistry, Benign by design, Chemistry in a circular economy, Metal as a scarce resource, Dissipation
[15] Several lectures and giving classes for students and staff: introducing ISC_3, sustainable chemistry, Benign by design, Chemistry in a circular economy, Metal as a scarce resource, Dissipation

Appendix Research 2: Bachelor and Master Theses

Alina Rading. 2019. On the Way to Greener Ionic Liquids: Biodegradation and Photodegradation Studies of Selected Ionic Liquids in Aqueous Matrix. Bachelor thesis (June 2019).

Livia El-Khawad. "Closing the loop" in the German silicon solar panel industry. Bachelor thesis (January 2020).

Appendix Research 3: Selected cooperation partners

International

- Austrian Federal Ministry for Sustainability and Tourism
- Green Chemistry Centre of Excellence, University of York, York, United Kingdom
- Department of Chemistry, Federal University of São Carlos, São Paulo, Brazil
- MultiCASE Inc., Beachwood, USA
- Leadscope, Inc., Columbus, USA
- Chinese Chemical Society
- Elsevier Publisher
- Elsevier Foundation[16]
- International Union of Pure and Applied Chemistry (IUPAC)[17]
- European Chemical Society (EUChemS)
- Chinese Chemical Society
- Organization for the Prohibition of Chemical Weapons (OPCW)
- University of Sousse, Sousse, Tunisia
- United Nations Environment Programme
- Strategic Approach to International Chemicals Management
- Institute of Chemical and Engineering Sciences, A*STAR, Singapore[18]
- ANII, Uruguay[19]

[16] Klaus Kümmerer Chair of Award Selection Committee
[17] Among other activities: Klaus Kümmerer member of boards
[18] MoU in preparation
[19] MoU in preparation

- SusChemEurope[20,21]

National

- Leuphana Universität Lüneburg
- German Federal Environmental Foundation
- Entwicklungsfonds Seltene Metalle (ESM Foundation)
- Materials Resource Management (Institute of Materials Resource Management University Augsburg)
- Die Transformateure – Akteure der Großen Transformation
- Deutsche Bundesstiftung Umwelt
- TU Clausthal
- Gesellschaft Deutscher Chemiker

Appendix Research 4: Events and Conferences of the R&EH with contributions of Prof. Dr. Klaus Kümmerer

National:

21.02.2019	SAICM Meeting Berlin
01.03.2019	CHT Germany GmbH Tübingen
22.05.2019	Merck Darmstadt
08.07.2019	Workshop "Metall des Jahres", Goslar vom 4.07.19 - 5.07.19
10.07.2019	Max Planck Institut Mühlheim
23.09.2019	Meeting Plastics Strategy
24.09.2019	Gemeinsamer Umweltausschuss Grüne und SPD im Deutschen Bundestag
09.10.2019	Industrietagung Chemical Innovation Exchange, Frankfurt
10.11.2019	Vortrag und Organisation Tagung Tutzing
04.12.2019	Chemisches Kolloquium Universität Hamburg
06.12.2019	Symrise Holzminden

[20] M Elschami, K. Kümmerer: Significant input for the chapter "Education" of the latest SusChem Europe strategy paper
[21] Among other activities: Klaus Kümmerer member of boards

15.01.2020 Fraunhofer Institut Würzburg

Cancelled due to Corona:

Industrietagung Chemical Manufacturing, Frankfurt

Hafencity Universität Hamburg

Hochschule für Angewandte Wissenschaften Hamburg

International

20.02.2019	EuChems, Lissabon
08.07.2019	IUPAC Paris
24.08.2019	Kooperationsmöglichkeiten und Vorstellung ISC_3 bei A*-Star Instituten Institute of Chemical & Engineering Sciences (ICES und ISES, National University of Singapore auch in der Lehre beteiligt) Singapur
15.10.2019	Green China Conference, Peking (Mitorganisator, Eröffnungsvortrag),
18.11.2019	U Sao Carlos, U Sao Paulo (Brasilien) und Uruguay (ANII), Vorträge und Podiumsdiskussionen, Kontakte zu lokalen Universitäten
24.10.2019	Tagung Micropol Seoul, 24.10.-27.10.

Cancelnd due to Corona:

Green Chemistry Center McGill University Canada

Jungchemiker Österreich Jahrestagung Innsbruck

European Association of Chemical Distributors (Fecc) Annual Congress in Milan

Biorenewables Gent

A.4 Appendix Information

Appendix Information 1: Key Facts Start-up of the Month series

Eight start-ups promoted since September 2019; Innovators represented so far stem from 5 continents: Africa (1), Asia (1), Europe (2), North America (2), South America (2); Start-ups promoted cover the sectors of waste management, energy, materials, green chemistry, bioeconomy, textile and construction; 2 of the promoted start-ups were founded by female entrepreneurs.