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Bundling of Expertise in the area of Sustainable Chemistry: Conceptualization and Establishment of an International Sustainable Chemistry Collaborative Centre

For our Environment

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Bundling of Expertise in the area of Sustainable Chemistry: Conceptualization and Establishment of an International Sustainable Chemistry Collaborative Centre

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Abstract

The objective of the project was to establish an international centre for sustainable chemistry as well as a network for international stakeholders and experts in sustainable chemistry. Having analyzed the status of scientific and political discussion and the stakeholders engaged in this field worldwide, the first step was to propose objectives and tasks for the centre. A concept for the centre was discussed in depth in the framework of talks with the Advisory Council of 35 international experts from academia, industry, NGOs, government bodies and high-ranking representatives of international organisations. From a thematic perspective, the holistic concept of Sustainable Chemistry proved to be a particularly suitable way to link the Sustainable Development Goals (SDGs) with chemical innovations. The concepts for the centre and the network were presented for the first time on 1 October 2015 on the occasion of ICCM4 in Geneva and met with unanimous approval. Because of the importance attached to the concept by the UNEP too, communication activities for the project were broadened considerably and, amongst others, a side event organized at UNEA-2 on 23 May 2016 which was highly successful. The resolution of UNEA-2 to have the Sustainable Chemistry concept examined by the UNEP as an instrument for the Agenda 2030 promptly raised the project's significance. In order to increase transparency about the project and attract potential members for the network, a regular newsletter was published on the project website (isc3.org). Additionally, the project has been presented at numerous international conferences and a professional communication strategy has been developed. The centre and the network were officially established under the names International Sustainable Chemistry Collaborative Centre (ISC_3) and International Sustainable Chemistry Network (ISCnet) in the framework of a conference entitled "Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet" in Berlin on 17-18 May 2017 with participants from 40 countries. To facilitate the centre's start, three studies were conducted with the extensive support of the Advisory Council. Two studies are published in separate reports. The third study was evolved to a policy paper and distributed in the international community. ISC_3 will take care of the network, which should, however, be as autonomous as possible in terms of its organisation. An independent website created within the project – ISCnet.org – is available to this purpose.

Kurzbeschreibung

Ziele des Projekts waren die Errichtung eines internationalen Zentrums für Nachhaltige Chemie sowie eines internationalen Netzwerks für Stakeholder und Experten aus dem Bereich der Nachhaltigen Chemie. Nach einer Analyse des Stands der wissenschaftlichen und fachpolitischen Diskussion sowie der weltweit in diesem Feld agierenden Stakeholder wurden zunächst Ziele und Rollen für das Zentrum erarbeitet. In Gesprächen mit dem international besetzten Projektbeirat mit 35 Fachleuten aus Wissenschaft, Industrie, NGO's, Regierungsstellen sowie hochrangigen Mitarbeitern internationaler Organisationen wurde die Konzeption des Zentrums im Einzelnen diskutiert. Inhaltlich zeigte sich das holistische Konzept Nachhaltiger Chemie als besonders geeignet zur Verbindung der SDGs mit Innovationen aus der Chemie. Die Konzeption von Zentrum und Netzwerk wurde erstmals bei der ICCM4 in Genf am 1.10.2015 vorgestellt und stieß auf einhellige Zustimmung. Auf Grund der Bedeutung, die auch die UNEP der Konzeption zumaß, wurde die Kommunikation für das Projekt erheblich ausgeweitet und u.a. ein Side Event anlässlich der UNEA-2 am 23.05.2016 mit großem Erfolg durchgeführt. Der Beschluss der UNEA-2, das Konzept der Nachhaltigen Chemie als Instrument für die Agenda 2030 von der UNEP prüfen zu lassen, erhöhte schlagartig die Bedeutung des Projekts. Um die Transparenz über das Projekt zu vergrößern und zur Gewinnung von Kontakten für das Netzwerk wurden außerdem zusätzlich ein regelmäßiger Newsletter auf der Projekt-Homepage isc3.org eingeführt, das Projekt auf zahlreichen internationalen Konferenzen vorgestellt und eine professionelle Kommunikationsstrate-

gie erarbeitet. Zentrum und Netzwerk wurden unter der Bezeichnung International Sustainable Chemistry Collaborative Centre (ISC3) bzw. International Sustainable Chemistry Network (ISCnet) im Rahmen einer Fach-konferenz „Mainstreaming Sustainable Chemistry – Launch of ISC3 and ISCnet“ am 17. und 18. Mai 2017 mit Teilnehmern aus 40 Ländern gegründet. Zur Erleichterung des Starts des ISC3 wurden ferner drei vom Beirat intensiv begleitete Studien durchgeführt. Zwei Studien werden in separaten Berichten veröffentlicht. Die dritte Studie wurde zu einem policy paper weiterentwickelt und als solches im internationalen Expertenkreis verteilt. Das Netzwerk soll vom ISC3 betreut werden, sich aber möglichst eigenständig organisieren, wozu eine im Projekt erstellte eigene Homepage - ISCnet.org - zur Verfügung steht.

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AP	Work package
BMBF	Bundesministerium für Bildung und Forschung
BMUB	Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
BRS	Basel, Rotterdam and Stockholm (Conventions)
CEFIC	European Chemical Industry Council
CEN	European Committee for Standardization
CEO	Chief Executive Officer
CPR	Committee of Permanent Representatives
CSR	Corporate Social Responsibility
DJSCI	Dow Jones Sustainability Index
EPIs	Emerging Policy Issues
EU	European Union
G2C2	Global Green Chemistry Centres Network
GC3	Green Chemistry and Commerce Council
GDCh	Gesellschaft Deutscher Chemiker
GEF	Global Environment Facility
gGmbH	Gemeinnützige Gesellschaft mit beschränkter Haftung
GHG	Greenhouse gases
GHS	Globally Harmonized System
GIZ	Gesellschaft für internationale Zusammenarbeit (GIZ) GmbH
GmbH	Gesellschaft mit beschränkter Haftung
GSC II	2nd Green & Sustainable Chemistry Conference
ICCA	International Council of Chemical Associations
ICCM4	4th Session of the International Conference on Chemicals Management
ICCM5	5th Session of the International Conference on Chemicals Management
IKNC	Internationales Kompetenzzentrum für Nachhaltige Chemie
INNC	Internationales Netzwerk für Nachhaltige Chemie
ISC_3	International Sustainable Chemistry Collaborative Centre
ISCnet	International Sustainable Chemistry Network
IUPAC	International Union of Pure and Applied Chemistry
LCA	Life cycle analysis
LIFE	Programme for the Environment and Climate Action
MEA	Multilateral Environment Agreement

MSCI ACWI	Morgan Stanley Capital International All Country World Index
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
OPS	Overarching Policy Strategy
PSC	Parameters for Sustainable Chemistry
R&D	Research and Development
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
SAICM	Strategic Approach to International Chemicals Management
SDGs	Sustainable Development Goals
SEO	Search engine optimization
SMCW	Sound management of chemicals and waste
SME's	Small and medium enterprises
SPIRE	Sustainable Process Industry
SusChem	Sustainable Chemistry Platform
TfS	Together for Sustainability
UBA	Umweltbundesamt
UN	United Nations
UNEA-2	2nd UN Environment Assembly
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
VCI	Verband der Chemischen Industrie
WBSCD	World Business Council for Sustainable Development
WECF	Women Engage for a Common Future

Summary

The Umweltbundesamt commissioned the contractors (under the leadership of N^3 Thinking Ahead, Germany) to lay the foundation for an international centre of Sustainable Chemistry and a global network for scientific exchange. The project focused on bundling the expertise of a large number of stakeholders and regional or specialized networks in sustainable chemistry as well as its further advancement through the foundation of an institution to mainstream it. The basis for the project was the long-lasting work of the Umweltbundesamt as well as experience of other organisations in this topic like the OECD or UNIDO as well as experience collected with multilateral environment agreements and the strategic approach to international chemicals management (SAICM). Sustainable Chemistry is an overarching concept which takes into account the whole life cycle of chemicals, chemical products and services (design, manufacturing, consumption of resources, use, recycling and disposal), social aspects like health and safety at work, economic success as well as scientific research and technical innovation – not only in industrialized nations or the chemical sector alone but in emerging and developing countries and all sectors using chemicals as well.

The contractors analyzed the scientific state and the international political environment of Sustainable Chemistry starting from a large number of publications, which were partially provided by the Umweltbundesamt, and discussions with some experts in the field. In addition, they screened existing networks and the approaches of international organisations in the area of Sustainable Chemistry. On the basis of the above mentioned work, the roles of the centre in the frame of Sustainable Chemistry and a list of tasks were drafted. These potential tasks were discussed with high-ranking officials from international organisations responsible for chemical policy. The analysis of this feedback identified the support of the Agenda 2030 (Sustainable Development Goals - SDGs) through chemical innovations in processes, products and applications as the recommended key task for the centre. In this context, the centre should i.a. address the problems experienced by many countries in establishing sound management of chemicals and waste and it should contribute in developing a vision for SAICM activities post 2020. Other recommendations were the bundling of a number of current networks and initiatives and building on existing ideas and research. Furthermore, the centre should demonstrate the usefulness of the Sustainable Chemistry concept by means of economically successful examples. It was recommended to develop a vision at an early stage to describe the goals for the centre until 2020 and beyond. In addition, the link between the SDGs and sustainable chemistry should be demonstrated in the centre's publications.

The goals and tasks of the future centre were described as follows: A prime objective of the centre will be the continued deployment and improvement of sustainable chemistry worldwide including economically successful business models. The centre will engage in international chemicals' management and help with the effective implementation of relevant international treaties. In this sense, it will identify tools (without intervening in regulatory action by the authorities) to support the implementation and enforcement of these conventions and their objectives. Another aim of the centre is to bundle promising approaches and, if necessary, initiate changes in direction. Additionally, the centre will have an international focus and further develop and strengthen a global network of researchers, enterprises, associations and institutions in this area. It will be a platform for a mutual exchange of information, identifying innovative projects and linking players as well as institutions to the same objectives. The centre will work on further expanding and developing fundamental principles in areas such as the development of safe and benign chemicals ("benign by design") and substitution of environmentally hazardous substances, energy and material-efficient use of resources through better syntheses, resource recovery as well as construction and operation of safe and efficient chemical production plants. It will also aim to create secure jobs with high protection standards as well as develop the supply of consumer products which are preferably inherently safe.

The appointment of an Advisory Council to support the project and create the nucleus of the network was synchronized with the conference "Sustainable Chemistry 2015: the way forward", which was organized by the Umweltbundesamt, as well as with the ICCM4, the UNEP conference on SAICM, both in the autumn of 2015. The Advisory Council members are internationally renowned experts in sustainable chemistry and related areas. In order to cover all relevant stakeholder groups, experts from science, industry, national bodies as well as international and non-governmental organisations were invited to participate in the Advisory Council. 35 persons accepted the invitation to join, of which about two thirds from Europe and one third from other continents or international organisations. At that time a website for the project was created with the aim of making work transparent and of raising awareness towards the centre in the international community.

In this very early stage of the project, the centre was named the "International Sustainable Chemistry Collaborative Centre" with the dynamic abbreviation "ISC_3". Later on, a similar name was chosen for the network: "International Sustainable Chemistry Network", abbreviated as "ISCnet".

In the framework of ICCM4, a special side event with the title "ISC_3 – Moving Sustainable Chemistry Forward!" took place on 1 October 2015. The purpose of the side event was to provide the international public with initial information about the ISC_3 preparing project. The presentations by the German government and the project management team as well as a panel discussion, featuring representatives of various stakeholder groups and countries, resulted in broad consent for the goals of ISC_3. In his closing remarks, Achim Steiner, as Director of UNEP, drew a line from the preceding UN General Assembly (Agenda 2030) to ISC_3 and expressed his firm conviction that this initiative to promote sustainable chemistry is an important component in achieving the UN goals for the period up until 2030.

Following the success of the side event at ICCM4, a further side event was planned for the United Nations Environment Assembly (UNEA-2) in Nairobi. The side event took place on 23 May 2016 with the title "Advancing Sustainable Chemistry in a Sustainable Development Context: Opportunities for Global, Regional and National Chemicals Management". The objective was, in particular, to pave the way for a UNEA-2 resolution, with which UNEP would be mandated to integrate the topic of Sustainable Chemistry into its work. The event therefore concentrated on communicating the principles of sustainable chemistry, the connection between sustainable chemistry and the Sustainable Development Goals (SDGs) and the opportunities for developing and emerging countries which result from the Sustainable Chemistry concept. Though less focus was laid on the ideas for ISC_3, many speakers welcomed the German government's initiative for an International Sustainable Chemistry Collaborative Centre. Insights gained from the event in Nairobi were taken into consideration for the project work and greater attention paid to already identified topics both for the centre and the network.

Following a joint initiative of Germany, the Republic of Ghana, UNEP and the BRS Secretariat, Resolution 2/7 of the UNEA now urges UNEP to investigate the Sustainable Chemistry concept as a tool for chemical policy beyond 2020.

The Advisory Council held three sessions and two additional workshops. The first workshop was dedicated to the discussion of three drafted studies, which were compiled by the contractors. The studies[1] are entitled:

1) "Sustainability initiatives and approaches in the chemical sector": This study created a knowledge base by mapping the most relevant approaches in the field of sustainable chemistry (research and business networks, industry initiatives, work of international organisations, national governments' initiatives and NGO activities).

[1] The studies 1 and 2 have been published separately and are available on the UBA homepage. The third study was evolved to a policy paper and distributed in the international community.

2) "Identification of priority topics in the field of sustainable chemistry": This study focused on innovations in several important areas of production and application of chemicals and aimed to identify sustainable chemistry approaches.
3) "The link between sustainable chemistry and sound management of chemicals throughout their lifecycle, with a view beyond 2020 and for the 2030 Agenda for Sustainable Development": This study proposes suitable policy initiatives and a vision for SAICM beyond 2020.

The purpose of the second workshop was primarily to discuss topical issues in the field of sustainable chemistry in the context of its interfaces with other key topics: These were above all the interface between sustainable chemistry and circular economy, the need for further steps towards safer chemicals with respect to the non-toxic environment programme and the role of sustainable chemistry in transition management.

The Umweltbundesamt and the contractors drew a number of important conclusions from these discussions for the future work of ISC_3 and the network. Other aims of the Advisory Council meetings were to adopt a vision for ISC_3, review the communication strategy and discuss the preliminary programme for the final conference at the end of the project.

Within the project, a number of recommendations for the further work of ISC_3 were formulated. Firstly, goals and indicators for sustainable chemistry should be developed, building on the work that has already been performed by many stakeholders, regional scientific networks and within this project. Secondly, an analysis of interfaces between chemical innovations, climate protection, energy efficiency, conservation of resources, occupational and public health and other issues is needed in order to avoid unilateral solutions which might represent just incremental steps towards sustainability and at the same time neglect drawbacks in other fields of global interest. Thirdly, ISC_3 should screen innovative industrial projects and assess their contribution to reaching the SDGs and to disseminating successful business models with a potential focus on bioeconomy as an opportunity for developing countries. The fourth and final key recommendation was that ISC_3 should endeavour to eliminate the confusion between "Green Chemistry", which offers several useful rules for chemical syntheses, and "Sustainable Chemistry", which integrates green chemistry principles as a basis but also includes the assessment of products, processes and the application of chemicals from a holistic perspective.

Communication on sustainable chemistry issues and ISC_3 was further enhanced by a project newsletter that started in October 2016. The newsletter also served as an invitation to the "Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet" scheduled for 17-18 May 2017. The ideas behind ISC_3 and ISCnet were presented by means of the newsletter and on the occasion of numerous scientific and political conferences. The Umweltbundesamt, the Federal Environment Ministry and the contractors invited interested stakeholders at national and international level to participate in the centre's work and to join the network, the aim of which is to create a common platform to drive progress. Nine newsletters were published from October 2016, until June 2017, in line with a clear communication concept that had also been developed in the frame of the project.

As the final project milestone and event, ISC_3 and ISCnet were officially launched on 17-18 May 2017 in Berlin, on the occasion of the conference "Mainstreaming Sustainable Chemistry". This conference also provided an opportunity to join the ISCnet global network, which is open to all stakeholders involved in sustainable chemistry. The conference addressed the following main topics:

- The concept of Sustainable Chemistry and how it might be further defined, developed, promoted and adopted across all stakeholder communities, including in emerging economies.
- How to ensure that sustainable chemistry is able to fulfil its potential in helping to achieve sustainable development and, specifically, the SDGs.

- The institutional relationships with existing and further "Sustainable" or "Green Chemistry" initiatives, and related UN organisations and programmes (including SAICM), to ensure optimal sharing, cooperation and collaboration, including in emerging economies.
- Securing the necessary resources, financial and non-financial, to ensure the early and full uptake of sustainable chemistry globally and the widest possible expert stakeholder engagement.

These key questions formed the basis on which the conference programme was built. Within a high-level policy session, Barbara Hendricks, German Minister for Environment, Nature Conservation, Building and Nuclear Safety, presented the funding document to a board member of the GIZ as the organisation responsible for hosting ISC_3 and Friedrich Barth, ISC_3 Managing Director. The centre will be established in Bonn with two hubs, one of which will focus on scientific research (Leuphana University of Lüneburg) and the other on innovations (DECHEMA, Frankfurt). 200 participants from 40 countries made the launch of ISC_3 and ISCnet a remarkable event of international importance. The success of the Final Conference, the impressive dedication of the Advisory Council members and the tremendous interest in the project ensured that ISC_3 as well as the network will become important cornerstones in advancing and mainstreaming sustainable chemistry globally.

Zusammenfassung

Das Umweltbundesamt beauftragte das Auftragnehmer-Konsortium (unter Führung von N^3 Nachhaltigkeitsberatung Dr. Friege & Partner) die Grundlagen für ein international ausgerichtetes Zentrum für Nachhaltige Chemie und ein weltweites Netzwerk für den wissenschaftlichen Austausch zu erarbeiten. Das Projekt zielte auf die Bündelung des Expertenwissens vieler Stakeholder und regionaler oder fachlich spezialisierter Netzwerke im Bereich Nachhaltige Chemie und deren weitere Entwicklung durch die Gründung einer Einrichtung zur Förderung und Etablierung Nachhaltiger Chemie ab. Als Grundlage für das Projekt dienten die langjährige Arbeit des Umweltbundesamts wie auch Erfahrungen anderer Organisationen mit diesem Thema wie OECD oder UNIDO, außerdem die mit multilateralen Umweltverträgen und dem „Strategic Approach to International Chemicals Management" (SAICM) gemachten Erfahrungen. Nachhaltige Chemie stellt ein übergreifendes Konzept dar, das den gesamten Lebenszyklus von Chemikalien, Chemieprodukten und Dienstleistungen im Blick hat (Produktdesign, Herstellung, Ressourcenverbrauch, Nutzung, Recycling und Entsorgung), soziale Aspekte wie Gesundheit und Arbeitssicherheit, wirtschaftlichen Erfolg wie auch wissenschaftliche Forschung und technische Innovation – nicht nur in Industrieländern oder dem Chemiesektor alleine, sondern auch in Schwellen- und Entwicklungsländern sowie in allen Bereichen, die Chemikalien einsetzen.

Die Auftragnehmer analysierten den wissenschaftlichen Stand der Nachhaltigen Chemie ausgehend von den Innovationen in einigen ausgewählten Herstellungs- und Anwendungsbereichen von Chemikalien hinsichtlich ihres Beitrags zur Nachhaltigkeit. Ferner wurde das international politische Umfeld in den Bereichen Nachhaltige Chemie und verwandter politischer Themen (z.B. „sound management of chemicals and waste", Umsetzung der Stockholm-, Rotterdam- und Basel-Abkommen) untersucht. Ziel war, vielversprechende Entwicklungen zu identifizieren, die seitens des Zentrums unterstützt werden könnten und Wissenslücken zu finden, die vom Zentrum gefüllt werden könnten. Darüber hinaus untersuchten die Auftragnehmer aktuelle Ansätze und vorhandene Netzwerke im Bereich Nachhaltige Chemie. Nachdem die Rollen, die das Zentrum im Rahmen der Nachhaltigen Chemie spielen soll, festgelegt waren, wurde eine Aufgabenliste erstellt, Diese Liste wurde mit hochrangigen Mitarbeitern internationaler Organisationen diskutiert, in deren Verantwortungsbereich chemiepolitische Fragestellungen fallen. Aus der Analyse der Antworten ergab sich die Empfehlung, die Unterstützung der Ziele der Agenda 2030 (Sustainable Development Goals - SDGs) durch chemische Innovationen bei Prozessen, Produkten und Anwendungen in den Vordergrund der Arbeit des Zentrums zu stellen. In diesem Zusammenhang sollte das Zentrum auch die Probleme vieler Länder mit der Umsetzung des sicheren

Umgangs mit Chemikalien und Abfällen angehen und zur Entwicklung einer Vision für den SAICM-Prozess nach 2020 beitragen. Weitere Empfehlungen gingen dahin, bestehende Netzwerke und Initiativen zu bündeln und auf vorhandenen Ideen und Forschungsarbeiten aufzubauen. Ferner sollte das Zentrum den Nutzen des Konzepts der Nachhaltigen Chemie an wirtschaftlich erfolgreichen Beispielen belegen. Es wurde dazu geraten, frühzeitig eine Vision zu entwickeln, in der die Ziele für das Zentrum bis 2020 und darüber hinaus beschrieben werden. Ferner sollte die Verbindung zwischen den SDGs und Nachhaltiger Chemie in Veröffentlichungen aufgezeigt werden.

Ziele und Aufgaben des zukünftig zu errichtenden Zentrums wurden demnach wie folgt beschrieben: Ein entscheidendes Ziel des Zentrums besteht in der kontinuierlichen, globalen Förderung und Verbesserung nachhaltiger Chemie einschließlich wirtschaftlich erfolgreicher Geschäftsmodelle. Das Zentrum wird sich beim internationalen Management von Chemikalien engagieren und zur wirksamen Umsetzung wichtiger internationaler Verträge beitragen. In diesem Sinne arbeitet das Zentrum auch an Instrumenten, um Implementierung und Vollzug dieser Konventionen und der ihnen zu Grunde liegenden Ziele zu unterstützen, ohne selbst in die Regelsetzung durch zuständige Behörden einzugreifen. Ein weiteres Ziel des Zentrums besteht in der Bündelung geeigneter Ansätze und – falls erforderlich – der Initiierung von Schritten in Richtung Nachhaltige Chemie. Darüber hinaus wird das Zentrum sich international ausrichten und ein weltweites Netzwerk von Forschern, Unternehmen, Verbänden und Institutionen im Bereich der Nachhaltigen Chemie entwickeln und stärken. Es wird als Plattform für den wechselseitigen Austausch von Informationen und für die Identifizierung innovativer Projekte dienen und dabei Akteure wie Institutionen auf gleiche Ziele lenken. Das Zentrum wird an der weiteren Verbreitung und Entwicklung von Grundlagen für sichere Chemikalien ("benign by design") und den Ersatz umweltgefährlicher Substanzen mitwirken, ferner bei dem energie- und materialeffizienten Einsatz von Ressourcen mit Hilfe verbesserter Synthesen, der Rohstoffrückgewinnung sowie dem Bau und Betrieb sicherer und effizienter Produktionsanlagen in der Chemie. Es wird auch die Schaffung sicherer Arbeitsplätze mit hohem Schutzstandard sowie Entwicklung und Versorgung mit Verbraucherprodukten im Auge haben, die bevorzugt inhärent sichere sind.

Die Bestellung eines Beirats, der dafür bestimmt war, das Projekt zu unterstützen und den Kern des später einzurichtenden Netzwerks zu bilden, wurde im Herbst 2015 mit der vom UBA ausgerichteten Konferenz "Sustainable Chemistry 2015: the way forward", wie auch mit der UNEP-Konferenz ICCM4 zu SAICM zeitlich synchronisiert. Als Beiratsmitglieder wurden international bekannte Experten aus der Nachhaltigen Chemie und verwandten Gebieten berufen. Um alle relevanten Akteursgruppen abzudecken, wurden Fachleute aus Wissenschaft, Industrie, nationalen Körperschaften wie auch internationalen und Nicht-Regierungsorganisationen zur Mitarbeit im Beirat eingeladen. Insgesamt nahmen 35 Persönlichkeiten die Einladung zur Mitwirkung im Beirat an, davon etwa zwei Drittel aus Europa und ein Drittel von anderen Kontinenten oder internationalen Organisationen. Bereits zu diesem Zeitpunkt wurde eine eigene Homepage für das Projekt geschaffen, um die dort geleistete Arbeit transparent zu machen und um auf das Zentrum in der internationalen Fachöffentlichkeit aufmerksam zu machen.

In diesem frühen Projektstadium wurde für das Zentrum die Bezeichnung "International Sustainable Chemistry Collaborative Centre" mit der dynamischen Abkürzung "ISC_3" gewählt. Zu einem späteren Zeitpunkt wurde für das Netzwerk mit "International Sustainable Chemistry Network", abgekürzt: "ISCnet", ein ähnlicher Name ausgesucht.

Im Rahmen der ICCM4 fand am 01.10.2015 eine gesonderte Veranstaltung mit dem Titel "ISC_3 – Moving Sustainable Chemistry Forward!" statt. Die Veranstaltung hatte zum Ziel, der internationalen Öffentlichkeit erste Informationen zu dem ISC_3-Projekt zu vermitteln. Die Präsentationen seitens der deutschen Regierung und des Projektmanagements sowie eine Podiumsdiskussion mit Repräsentanten verschiedener Akteursgruppen und Nationen erbrachten eine breite Zustimmung für die mit dem ISC_3 angestrebten Ziele. In seinen abschließenden Bemerkungen zog Achim Steiner, Direktor der UNEP, eine Linie von der zuvor stattgefundenen UN Vollversammlung (Agenda 2030) zum ISC_3 und

gab seiner klaren Überzeugung Ausdruck, dass diese Initiative zur Förderung Nachhaltiger Chemie ein wichtiger Beitrag zu Erreichung der Ziele der UN für die Periode bis 2030 sei.

Aufbauend auf den Erfolg der Veranstaltung anläßlich der ICCM4 wurde ein weiterer „Side Event" für die UN Vollversammlung zu Umweltthemen (United Nations Environmental Assembly – UNEA-2) in Nairobi geplant. Die Veranstaltung wurde am 23.05.2016 unter dem Titel „Advancing Sustainable Chemistry in a Sustainable Development Context: Opportunities for Global, Regional and National Chemicals Management" durchgeführt. Ziel war es insbesondere, den Boden für eine Resolution der UNEA-2 zu bereiten, mit der die UNEP ein Mandat zur Integration des Themas Sustainable Chemistry in ihre Arbeit erhalten würde. Die Veranstaltung wurde daher auf die Vermittlung der Grundlagen von Nachhaltiger Chemie, der Verbindungen von Nachhaltiger Chemie mit den Sustainable Development Goals (SDGs), und den sich aus dem Konzept der Nachhaltigen Chemie ergebenden Möglichkeiten für Entwicklungs- und Schwellenländer konzentriert. Obwohl die vorgelegten Ideen zu Rollen und Aufgaben des ISC_3 nicht ausführlich diskutiert wurden, begrüßten zahlreiche Sprecher diese Initiative der deutschen Regierung. In der weiteren Projektarbeit wurden Erkenntnisse aus der Veranstaltung in Nairobi beachtet bzw. bereits erkannten Themen für Zentrum wie Netzwerk stärker in den Vordergrund gerückt.

Auf Grund einer gemeinsamen Initiative Deutschlands, der Republik Ghana, der UNEP und des Sekretariats der Basel-, Rotterdam- und Stockholm-Konventionen beschloss die UNEA in ihrer Resolution 2/7, dass die UNEP das Konzept der Nachhaltigen Chemie als Instrument zukünftiger Chemiepolitik nach 2020 prüfen solle.

Der Beirat traf sich dreimal zu Sitzungen und führte zwei zusätzliche Workshops durch. Das erste Werkstattgespräch war dazu gedacht, die Entwürfe von drei Studien zu diskutieren, die von den Auftragnehmern erarbeitet worden waren. Titel der (nur in englischer Sprache verfügbaren) Studien[2] waren:

1) "Sustainability initiatives and approaches in the chemical sector" diente der Schaffung einer Wissensbasis zu den wichtigsten Ansätzen im Bereich Nachhaltige Chemie (Forschungs- und Wirtschaftsnetzwerke, Initiativen der Industrie, Arbeit internationaler Organisationen, Initiativen nationaler Regierungen und Aktivitäten von NGOs.
2) "Identification of priority topics in the field of sustainable chemistry" zielte auf Innovationen in einigen wichtigen Bereichen der Herstellung und Nutzung von Chemikalien mit dem Ziel, Ansätze für eine Nachhaltige Chemie zu identifizieren.
3) "The link between sustainable chemistry and sound management of chemicals throughout their life-cycle, with a view beyond 2020 and for the 2030 Agenda for Sustainable Development" zielte auf geeignete politische Initiativen sowie eine Vision für SAICM nach 2020.

Im Hintergrund des zweiten Beirat-Workshops stand primär die Absicht, wichtige Themen der Nachhaltigen Chemie im Zusammenhang ihrer Schnittstellen mit anderen Schlüsselthemen zu diskutieren: Dies waren vor allem die Schnittstelle zwischen Nachhaltiger Chemie und Kreislaufwirtschaft, die Notwendigkeit weiterer Schritte hin zu sicheren chemischen Stoffe unter Berücksichtigung des „non-toxic environment programme" der EU und die Rolle Nachhaltiger Chemie im Transformationsmanagement.

Umweltbundesamt und Auftragnehmer zogen eine Reihe wichtiger Schlussfolgerungen aus diesen Diskussionen zur zukünftigen Arbeit des ISC_3 und des Netzwerks. Weitere Themen bei den Treffen des Beirats waren die Annahme einer Vision für das ISC_3, die Überprüfung der Kommunikationsstrategie und die Diskussion des Programmentwurfs für die Konferenz zum Projektabschluss.

[2] Die Studien 1 und 2 wurden getrennt vom Abschlussbericht publiziert und sind auf der UBA-Homepage abrufbar. Die dritte Studie wurde zu einem *policy paper* weiterentwickelt und als solches im internationalen Expertenkreis verteilt.

Im Rahmen des Projekts wurden zahlreiche Empfehlungen für die spätere Tätigkeit des ISC_3 ausgearbeitet. Zunächst sollten Ziele und Indikatoren für Nachhaltige Chemie entwickelt werden, wobei diese auf den vorhandenen Ansätzen zahlreicher Akteure und regionaler wissenschaftlicher Netzwerke sowie der Arbeit im Rahmen dieses Projekts aufgebaut werden sollte. Zum zweiten sollten Schnittstellen zwischen chemischen Innovationen, Klimaschutz, Energieeffizienz, Ressourcenerhalt, betrieblichem und öffentlichem Gesundheitswesen sowie weiteren Themen analysiert werden, um einseitige Lösungen zu vermeiden, die ggf. nur inkrementelle Schritte in Richtung Nachhaltigkeit darstellen und gleichzeitig Nachteile für andere weltweit wichtige Fragestellungen in Kauf nehmen. Zum dritten sollte das ISC_3 innovative Industrieprojekte aufnehmen und deren Beitrag zur Erreichung der SDGs abschätzen. Darauf aufbauend könnten erfolgreiche Geschäftsmodelle mit einem möglichen Fokus auf Bioökonomie als Chance für Entwicklungsländer öffentlich gemacht werden, Die vierte und letzte wichtige Empfehlung ging dahin, dass sich das ISC_3 bemühen solle, Verwechslungen zwischen „Grüner Chemie", die eine Reihe nützlicher Regeln für die chemische Synthese umfasst, und „Nachhaltiger Chemie" zu eliminieren; letztere integriert die Regeln der Grünen Chemie als eine Grundlage, beinhaltet aber auch die Einschätzung von Produkten, Prozessen und der Anwendung von chemischen Stoffen aus einer ganzheitlichen Perspektive.

Ein Projekt-Rundbrief ("Newsletter"), der ab Oktober 2016 herausgegeben wurde, verstärkte die Kommunikation über Nachhaltige Chemie sowie zum ISC_3. Der Rundbrief diente auch als Medium für die Einladung zur "Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet", die für den 17.-18. Mai 2017 geplant wurde. Im „Newsletters", wie auch bei zahlreichen Konferenzen mit wissenschaftlichem oder politischem Schwerpunkt wurden die Überlegungen hinter ISC_3 und ISCnet vorgestellt. Das Umweltbundesamt, das Bundesumweltministerium und die Auftragnehmer luden zahlreiche interessierte Stakeholder mit nationalem oder internationalem Hintergrund ein, sich an der Arbeit des Zentrum zu beteiligen und dem Netzwerk beizutreten, das auf eine gemeinsame Plattform zur Beschleunigung des Fortschritts abzielt. Neun Rundbriefe wurden bis zur Gründung des ISC_3 auf der Basis eines eindeutigen Kommunikationskonzepts, das ebenfalls im Rahmen des Projekts erarbeitet worden war, veröffentlicht.

Letzter Projektbaustein war die „Eröffnung" von ISC_3 und ISCnet am 17.-18. Mai 2017 in Berlin anlässlich der Konferenz "Mainstreaming Sustainable Chemistry". Diese Konferenz stellte auch eine Gelegenheit zur Teilnahme am weltweiten Netzwerk ISCnet dar, das für alle Akteure, die sich mit Nachhaltiger Chemie beschäftigen, offen steht. Die Konferenz beschäftigte sich mit folgenden Schwerpunkten:

- Mit dem Konzept der Nachhaltigen Chemie und seiner zukünftigen Definition, Entwicklung, Förderung und Anwendung durch alle Stakeholder-Gruppen auch in aufstrebenden Volkswirtschaften
- Wie sichergestellt werden kann, dass Nachhaltige Chemie ihr Potenzial für nachhaltige Entwicklung und speziell zur Erreichung der SDGs ausschöpft.
- Den institutionellen Beziehungen mit bestehenden und zukünftigen Initiativen für "Nachhaltige Chemie" oder "Grüne Chemie" sowie damit zusammenhängenden UN-Organisationen und Programmen (einschließlich SAICM), um die bestmögliche Verbreitung von Wissen, Kooperation und Zusammenarbeit unter Einschluss sich entwickelnder Volkswirtschaften sicher zu stellen.
- Der Sicherung notwendiger finanzieller und nicht-finanzieller Ressourcen, um das Konzept der Nachhaltigen Chemie frühzeitig und vollständig weltweit umzusetzen und das größtmögliche Engagement der Akteure sicher zu stellen.

Das Konferenzprogramm wurde auf der Basis dieser Schlüsselfragen erstellt. In einem Programmblock mit hochrangigen Politikern übergab Barbara Hendricks, Bundesministerin für Umwelt, Naturschutz, Bauen und Reaktorsicherheit, das ISC_3-Gründungsdokument an ein Vorstandsmitglied der GIZ, die als zuständige Organisation das Zentrum beherbergt, und an Friedrich Barth, den geschäftsführenden Direktor des ISC_3. Das Zentrum wird in Bonn errichtet und über zwei Außenstellen verfügen, von denen

sich eine mit der wissenschaftlichen Forschung (Leuphana Universität, Lüneburg) und eine mit Innovationen befasst (DECHEMA, Frankfurt). 200 Teilnehmer aus 40 Ländern trugen dazu bei, den Start von ISC_3 und ISCnet zu einem bemerkenswerten Ereignis von internationaler Bedeutung zu machen. Der Erfolg der Abschlusskonferenz, das beeindruckende Bekenntnis der Mitglieder des Beirats und das breite Interesse an dem Projekt stellen eine Garantie dafür dar, dass das ISC_3 wie auch das Netzwerk wichtige Pfeiler für den weltweiten Fortschritt und die zunehmende Bedeutung Nachhaltiger Chemie werden.

1 Objectives, tasks and structure of ISC_3 and ISCnet

There are numerous approaches in science and business as well as many national and international activities aimed at the advancement of sustainable chemistry. With this project, the Federal Ministry for the Environment, Nature Protection, Building and Nuclear Safety (BMUB) and the Federal Environment Agency (UBA) pursued the goal of bundling this work in an international centre for sustainable chemistry. An international network should further fertilize this centre's work and also support activities outside Germany. The project is thus a continuation of the efforts being made by the UBA and the BMUB to foster the use of "safe chemicals" and substitutions and non-chemical alternatives, to make the handling of chemicals safer both at national and global level, support environmentally compatible substances and reduce the use of renewable as well as non-renewable resources in the sense of sustainable material flow management. The tasks to be solved in the project were partly already defined in 2009 in the UBA's position paper on sustainable chemistry[3] : "Sustainable chemistry reduces the risk of chemicals and pollutants for the environment as well as for human health and in so doing helps to avoid the cost of the damage. Consumption of resources drops. Science and business are encouraged to innovate. In a globalized world, this demands cultivating and shaping international cooperation." However, sustainable chemistry is also an important element of sustainable development and as a consequence – this became particularly clear in the course of the project through the "Sustainable Development Goals" (SDGs) adopted in September 2015 – must be integrated in a macroeconomic and global context.

In order to allow sustainable chemistry to become "mainstream", not only uniform definitions and principles are required but also the bundling and coordination of corresponding development work and in particular the communication of new findings and economically and ecologically successful innovations. The expertise which contributes to sustainable chemistry lies in the hands of many different stakeholders, not just in Germany but in many industrial and emerging countries. Issues are complex and often demand a structured and visionary fusion of individual topics in order to arrive at innovative development approaches or problem solutions. This can most likely be achieved and efficiently further developed if existing expertise is bundled in a network with the help of a central communication and research unit. The project's most important task was therefore to create all the necessary parameters for an international centre as well as an international network for sustainable chemistry. Fulfilling this task has become increasingly urgent in the past years thanks to the establishment and partly also shift in production, processing and use of chemicals from industrialised countries to non-OECD countries. In this respect, the project had particularly to address the social and economic constraints in developing and emerging countries. Current non-sustainable economic activities in chemical, product and production plant management are still leading worldwide to constantly growing problems and damage. The global focus of the centre and its networking with stakeholders throughout the world was therefore a key priority.[4] Initial discussions between the UBA and the project team identified that:

- The reputation and radiance of the centre as a key sustainable chemistry project would be very important for the success of sustainable chemistry ("Mainstreaming"),

[3] „Nachhaltige Chemie – Positionen und Kriterien des Umweltbundesamtes"; March 2009 http://www.umweltdaten.de/publikationen/fpdf-l/3734.pdf

[4] "An international centre of competence for Sustainable Chemistry (IKNC) should network and bring together expertise for the development and advancement of a comprehensive, lifecycle-oriented sustainable management of chemicals, products and production plants for the future… The IKNC should play a major role in shaping the future of international chemicals policy in the sense of Sustainable Chemistry, by contributing to the reduction of harmful impacts, strengthening knowledge and providing information on good governance as well as encouraging sustainable innovation, efficiency and substitution technologies." (Extract from the UBA's Terms of Reference, Dec. 2014)

- The centre's work should concentrate on examining, developing and disseminating good practice examples of economically and ecologically successful approaches instead of focusing on suggestions for "better" laws and regulations

1.1 Analysis of the national and international scenario

This work package was designed as follows:

- Approaches for safe handling of chemicals as well as further development in the direction of sustainable chemistry in the work of international organisations and industry were examined, their significance analyzed with regard to potential tasks for the centre and corresponding activities potentially related to the centre assessed, above all those of:
    - OECD: Sustainable Chemistry Network
    - UNEP: Strategic Approach for International Chemicals Management
    - EU: REACH Regulation
    - SusChem as a research network of the European chemical industry
    - SPIRE (Sustainable Process Industry through Resource and Energy Efficiency) as a network of the chemical industry covering sectors such as mechanical engineering, minerals, ferrous/non-ferrous metals for the development of joint innovations and sustainable technologies
    - Regional or specialized stakeholder networks such as the Green Chemistry & Commerce Council (GC3, North America), the Global Network of Green Chemistry Centres (G2C2) as well as national initiatives (Green Chemistry Network UK, Green & Sustainable Chemistry Network (Japan), GDCh Sustainable Chemistry Expert Group (Germany))
- In addition, objectives, roles and tasks for the centre were developed: An understanding of "Sustainable Chemistry" progresses not only in parallel with the status of scientific findings but also with the development status in the respective region. As a result, there is a need to constantly set new priorities over time. It was agreed with the UBA and the BMUB that progress in the area of sustainable chemistry is likely to depend on the following:
    - Standardized regulation of substances beyond GHS, plant safety etc. at global level,
    - Support for less developed countries in the implementation and professionally sound use of existing policies in the context of SAICM,
    - Close exchange of advanced synthesis strategies, including sustainable material flow management, as well as of sustainable substance and product design between industrial and emerging/developing countries.

Whilst the first task is of a regulatory nature and thus the responsibility of international organisations, the ones mentioned last could be regarded as priorities for the future centre. Not least the integrating perspective of the SDGs was a reason to link sustainable chemistry with numerous other problems, such as resource management, energy sector and product safety, and thus ultimately to develop a way of thinking which could assert itself internationally in teaching, research and business.

- Various possible structures for the centre were examined and evaluated. Criteria for potential operators or "docking stations" for the centre in Germany were developed and the search for suitable hosts commenced.

These tasks were mostly conducted in parallel and repeatedly discussed within the consortium and with the contracting authority in the framework of two meetings at the UBA and in telephone conferences. This analysis of both the discussion at international and European level from a technical and a political perspective as well as the opinions on "Sustainable Chemistry" of stakeholders in the chemical sector were used as a starting point for contemplating the potential tasks and roles of an international

centre of excellence for sustainable chemistry. In addition, the contractors also held talks with important national stakeholders in industry, research and NGOs who are also familiar with the discussion at international level and instrumental in shaping it.

From this the following key tasks for the centre were derived:
1. Monitoring of the discussion on the definition and interpretation of the term "Sustainable Chemistry" on the basis of the concept for Sustainable Chemistry currently being developed by the German Federal Ministry for the Environment and the German Federal Environment Agency
2. Within this context, development of quality criteria for processes, materials and resource demand in order to assess various approaches in the area of Sustainable Chemistry.
3. Assessment of main interfaces to protection of resources, health protection and product and plant safety.
4. Analysis and diffusion of business models which promise successful economic development on the basis of Sustainable Chemistry.
5. Positioning of Sustainable Chemistry as a useful tool to keep within the "planetary guard rails" and thus as a key element of the global agenda for the 21st century.
6. Support for emerging and developing countries in questions concerned with the safe handling of chemicals as well as issues regarding the disposal of waste from hazardous substances produced or used earlier.
7. Guidance for emerging and developing countries in the implementation of existing rules in the context of SAICM.
8. Exchange between industrialized and emerging/developing countries of advanced synthesis strategies including sustainable material flow management as well as sustainable product design.
9. Fostering of the establishment of good technical standards in the manufacture, processing and use of chemicals and their handling, e.g. at European level.
10. Dissemination of latest state of knowledge in schools, technical colleges and universities.

The client and the contractor decided that the centre should not act as an instrument with which to lay the groundwork for regulatory topics since this would endanger its international acceptance, amongst others. The involvement of the chemical industry in the centre was regarded as very important and attention must be paid to the varying approaches to sustainable strategies at social and entrepreneurial level.

In addition, the contractors identified a number of roles which the centre will play for different stakeholders, above all as:

- Analyser / evaluator
- Communicator / platform / multiplier
- Innovation motor / incubator
- Finance procurer / funding expert
- International and national adviser and source of inspiration for institutions in the area of sustainable chemistry

These roles formed the basis for deliberations on the centre's structure and legal form. Ideas on the framework parameters for the centre's concept as well as the suitability of a "docking station" or "host" were developed in a dialogue between the client and the contractor. High priority was placed on six conditions which the centre and the host should fulfil:

- Acceptance amongst international and national stakeholders and the centre's various target groups; international visibility and brand recognition
- Neutrality of host regarding technical questions and target groups
- Independence of the centre from the host
- Safeguarding of national government's influence

- Access to funding (for the host)
- Stability of the host

Under consideration of these criteria, the client and the contractor excluded various types of institution since they were regarded as unsuitable (e.g. interest groups, universities, individual enterprises, public bodies). With regard to the legal form, several options were examined, whereby both legally independent foundations and corporate entities (GmbH, gGmbH) as well as docking the centre onto existing structures (whilst guaranteeing its autonomy – see above) emerged as suitable alternatives.

In addition, a suitable name and a logo (design: CIDCOM, Vienna) were created for the centre in the course of the first work phase and protected (Fig. 1).

1. Figure: ISC_3 logo

The logo features graphics showing dynamic circles of different diameters (blue on a white background), which can be viewed as both a globe with longitudes and latitudes (global link) as well as electrons orbiting an atomic nucleus (link to chemistry). The link to chemistry is shown in the "stirring and mixing motion" of the circles and naturally also in the idea of the hanging "3". To the right of the symbol is the name "ISC_3" where the "3" (for the three "C"s in Chemistry Collaborative Centre) is subscripted in the style of a chemical formula. This formula character is particularly emphasized by the different colours of the letters (black) and the number (blue). The full name "International Sustainable Chemistry Collaborative Centre" (grey) is under the graphics and the abbreviation ISC_3[5]. The logo is also available with white graphics on a blue background. The colour blue was chosen because it is the "colour of the spirit and the mind" and also because the logo should be clearly distinguishable from green chemistry.

1.2 Conclusions from discussions with representatives of international organisations

In order to review the objectives and tasks for ISC_3 derived from first deliberations and to extrapolate more precise tasks from this review, discussions were held with representatives of international organisations which play a role in the areas of chemical safety (sound management of chemicals and waste), international chemical conventions and the development of sustainable chemistry.

[5] This is picked up on the website www.isc3.com (landing page) with the following text: "Welcome! ISC_3 sounds like chemistry, doesn't it? And it is! But ISC_3 is much more besides. ISC_3 stands for International Sustainable Chemistry Collaborative Centre."

Discussion partners were:

- Achim Halpaap (UNEP, Head of Chemicals and Waste Branch)
- Jacob Duer (UNEP, SAICM Secretariat)
- Rolph Payet (Executive Secretary, BRS Conventions)
- Frank Moser (Programme Officer, BRS Conventions)
- Petra Schwager (UNIDO, Industrial Development Officer)
- Björn Hansen (Head of Unit "Chemicals", DG Environment, European Commission)
- Bob Diderich (Head of Division, Environment Directorate, OECD)

Discussions took place in person (mostly on the occasion of ICCM4, see below) or by telephone interview. The following topics and results were particularly important for the next stages of the project:

- Roles and tasks: The centre should act as a think tank and a central knowledge hub for sustainable chemistry and substitution of critical chemicals. ISC_3 should develop visionary projects and case studies to promote sustainable chemistry, including policy setting. ISC_3 could be the unbiased institution through which to introduce a global nomenclature and standardization for sustainable chemistry. ISC_3 should analyze and exchange successful business models ("good practice") for sustainable chemistry. Last not least, dissemination of the latest state of knowledge in schools, technical colleges and universities is regarded as a key task - focus on education is important.
- Development of the Sustainable Chemistry concept and interfaces with other topics: ISC_3 must go beyond the concept of Green Chemistry, but it is necessary to find a clear definition for both, i.e. Green as well as Sustainable Chemistry. In addition to the Green Chemistry rules, it is essential to follow a holistic Sustainable Chemistry concept that covers products from mining to waste. On the basis of the know-how established at the centre, ISC_3 should identify existing shortcomings in sustainable chemistry and propose R&D projects to overcome these shortcomings.
- Link between sustainable chemistry and SDGs: The discussion partners recommended looking for connections to other SDGs besides No. 12.4 and to position sustainable chemistry as a useful tool to keep within the "planetary guard rails".
- What is already in the focus of international organisations? Establishing a close link to the conventions and analyzing the tasks and experience of the UN focal points were recommended (e.g. UNIDO cleaner production centres, Basel Convention regional centres) with a view to using them as platforms for ISC_3. Furthermore, compiling an overview ("landscape analysis") of the activities currently being undertaken by international organisations and Sustainable Chemistry and Green Chemistry centres and networks will be helpful in acquiring an initial sense of needs and gaps.
- Are there national initiatives and programmes which are important for ISC_3? The combination of sound management of chemicals and work on an international basis including emerging and developing countries is seen in the GIZ programme for chemical safety funding for BRS.
- Which international issues could be influenced by the work of ISC_3?

    - Post-2020 SAICM: ISC_3 could assist, in particular, in the knowledge sharing and advisory aspects of this issue. The post-2020 strategy needs a potential sustainable chemistry dimension including elements which are relevant to and interesting for developing countries.
    - In 2018, a strategy for a "non-toxic environment" will be developed within the 7th Environment Action Programme of the European Union. Actions for post 2020 have to be defined and ISC_3 can act as a blueprint for these activities.
- Linking the chemical industry and downstream sectors to sustainable chemistry: Several important connections were mentioned by the discussion partners, which are sorted here in ascending order starting with the use of less hazardous chemicals and ending with economically successful sustainable products and production:

- It must become environmentally and economically relevant for the chemical industry to bring only those chemicals into the market that are inherently safe and need no individual regulation.
- ISC_3 could help to identify policies that allow a faster and easier process for the safety assessment and public acceptance of emerging technologies. ISC_3 should also focus on projects to develop reusable chemical building blocks and degradation of chemical products under controlled conditions.
- ISC_3 should demonstrate that sustainable chemistry is also a successful business model. Fostering the dialogue between start-up companies which are developing new technologies, major players in the chemical industry and public authorities would be a highly appreciated task for ISC_3.
- The aforementioned ideas can only be realized when the upstream and downstream industries are also addressed without directly involving other sectors, unless critical to the centre's work.
- The results of this work will also help to identify products and processes in the chemical industry which are currently called "sustainable" but are obviously not sustainable.

- How can sustainable chemistry help developing countries? How can sustainable production and use of chemicals be accelerated in these countries? The discussion partners thought that support for emerging and developing countries in questions concerned with the safe handling of chemicals and the implementation of the Conventions could be important, but may be difficult to achieve in reality. On the other hand, ISC_3 should also stimulate the discussion on implementing sustainable chemistry in non-OECD countries. Chemistry has often merged as a source of pollution, but sustainable chemistry will act as a solution provider.
- Where are sources for ISC_3 R&D funding? In a top-down approach, the EU can specify R&D topics and anchor them in the relevant funding programmes (e.g. LIFE, Horizon 2020). The Global Environment Facility (GEF) supports many practical projects to clean-up polluted sites as well as programmes based on green chemistry principles.
- How should ISC_3 communicate? It was recommended that a vision should be developed at an early stage to describe the goals for the centre until 2020 and beyond. Moreover, the link between the SDGs and sustainable chemistry should be demonstrated in the centre's publications.

The analysis of the aforementioned results showed that there is a high level of consensus over all amongst the persons interviewed and that their views are very much in line with the proposals previously developed. The results of these discussions were used on the one hand to position more precisely the above-mentioned objectives and roles of ISC_3 and on the other hand – where there was an apparent need for discussion – as topics to be addressed by the Advisory Council (see below).

1.3 Structure and budget

In addition to the discussions mentioned in Chapter 1.1 and 1.2 and following internal concertation at the BMUB, structuring of the ISC_3 was continued. On the basis of the centre's role, tasks and target groups, a first organisational structure for ISC_3 was developed as well as a personnel plan. The latter was also the nucleus of a budget proposal for the establishment of the centre, whereby a grant model as well as the "docking" of the centre onto a host organisation were assumed. The goal was defined as a lean institution which can concentrate on its technical tasks as well as on funded projects in the area of sustainable chemistry whilst the administrative tasks required are to be outsourced as far as possible and performed, for example, at the host's facilities.

In addition, further important aspects of the new centre were taken into consideration, such as the role of a sponsoring association, membership in already existing federations, groups and networks as

well as ways to secure additional sources of finance (public funding programmes, foundations, revenue from conferences).

In the outcome the preparatory work undertaken in the course of this project provided a solid foundation

a) for further implementation by the UBA and the BMUB, which was able to develop detailed justifications from the project results for corresponding budgets (Title 532 02 in Chapter 1601) from 2017 onwards, and

b) for the centre to fulfil all its intended functions from 2018 onwards. In later budget years (2019 and 2020), the centre shall additionally secure third-party finance, including funding from R&D programmes (e.g. EU, GEF, BMZ, BMBF).

1.4 ISCnet

A concept was developed by the contracting parties for the network to be set up and discussed with the Advisory Council as well as with many stakeholders on the occasion of scientific conferences and events (cf. Chapter 4). The aim is to network experts in the area of sustainable chemistry above all from industry, science, administrative bodies, NGOs and international organisations. There is a clear division of roles between ISC_3 and the network, the former being the operational centre, the latter acting as a powerful communication centre to be organized by ISC_3.

The network's tasks were selected in such a way as to make it interesting for players from both industrialized as well as developing countries. In this way, a unique network of stakeholders from all over the world will be created which offers contacts, ideas and collaboration platforms for stakeholders in sustainable chemistry. Partnerships with existing networks will be established and synergies with these networks created. A brokerage platform will be established to connect experts and support the development of new sustainable chemistry projects. The network should aim to integrate and share know-how, experience and best practices in sustainable chemistry. It will also represent a kind of "sounding board" for ISC_3.

An open and interactive network of all stakeholders interested in advancing and sharing knowledge and experience in the area of sustainable chemistry was therefore proposed. In short, the network will:[6]

- ► Provide an open, moderated internet platform
- ► Be free of charge
- ► Provide open discussion and interaction
- ► Share best practices and ideas
- ► Provide learning and training tools
- ► Disseminate success stories from business and science based on sustainable chemistry
- ► Promote sustainable chemistry

In discussions with the Advisory Council, it was decided that the network should function as an umbrella or joint platform for existing regional networks (e.g. GC3) or topic-oriented networks (e.g. G2C2) as well as research networks (e.g. SusChem). Some consolidation will be necessary in the initial phase; that is why the network is communicating in the first instance with experts from different professional backgrounds and not the general public.

[6] According to Friedrich Barth, Managing Director of ISC_3 (presentation of 18.5.2017)

Even if the intention is for ISC_3 to function as a "back office" for the network and make available the necessary resources, the network should nonetheless be independent.

Analogous to the centre's name ISC_3, the network was named ISCnet. The logo was also designed in the style of ISC_3 logo (design: CIDCOM, Wien) (Fig. 2).

2. Figure: ISCnet logo

The logo contains a blue, spherical net in which some of the knots are already highlighted. The logo is explained by the lettering on the right "ISC_{net}" with the sub-line "International Sustainable Chemistry Network". The same colours were chosen as for the ISC_3 logo and the subscripted "net" is in blue, analogous to the "3", to contrast with the black lettering of "ISC".

In order to set up and consolidate the network, it was important to identify and attract partners worldwide. The intention was to establish further contacts alongside the networks already covered by the Advisory Council members. An analysis of existing networks and centres in the area of sustainable chemistry was carried out, which formed a basis for attracting further key partners for ISCnet. The potential partners were characterized by their closeness to topics of relevance to ISC_3, their international importance and their innovativeness. In order to establish the role of ISCnet as a global network of sustainable chemistry experts, regional as well as solely scientific networks needed to be approached and symposia and conferences related to the topic (thematic and/or political) used as a platform to present the project in a suitable way (lecture, participation in panel discussions etc. – cf. Chapter 4.4).

Maintaining contacts and the transparency crucial to the project required ongoing reporting, not least in order to keep interest in the project alive up until the official launch of ISC_3 and the long-term upkeep of the network established by then. To this purpose, a newsletter[7] was created (cf. Chapter 4.3). The first newsletter was sent out to about 100 stakeholders in October 2016. Further newsletters were compiled and distributed at about 4-weekly intervals, not only covering news from the project but also serving as a discussion platform for sustainable chemistry topics. In addition, members of the Advisory Council were presented who each answered some questions regarding their special interests in ISC_3 and ISCnet.

At the "Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet", an interactive session was dedicated to the stakeholders' expectations of the network and its organisation, which showed that the basis for the network outlined above met with broad approval. Further results from this discussion will be adopted by the management of the newly established ISC_3 in the course of its future work.

2 Appointment, work and recommendations of the Advisory Council

The Advisory Council occupied a very important role in the project. According to the Terms of Reference of 10.12.2014, its purpose was firstly to:

- Comment on the studies (see Chapter 3)
- Participate in two workshops at which the studies are presented and the discussion at different stages of development
- Form the core of an international network for sustainable chemistry

Secondly, the project team saw the possibility to clarify numerous questions arising from discussions with stakeholders from international organisations in the framework of a dialogue with the Advisory Council members (see Chapter 1.2) and also to involve the Advisory Council in the development of a work programme and vision for ISC_3.

2.1 Objectives and appointment of members

The appointment of the Advisory Council started in August 2015 and was synchronized with the conference "Sustainable Chemistry 2015: the way forward", which was organized by the Umweltbundesamt, and with ICCM4, the UNEP conference on SAICM, both in the autumn of 2015. Prior to the first meeting, discussions were held either by telephone or at the conferences in Berlin on 24-25 September 2015, which included an "informal meeting" of the members attending this conference, and in Geneva in October 2015, with all Advisory Council members on the topics of work in the project and the role of the Advisory Council.

The Advisory Council members were internationally renowned experts in sustainable chemistry and related areas. In order to cover all relevant stakeholder groups, experts from science, industry, national bodies as well as international and non-governmental organisations were invited to participate in the Advisory Council. A total of 35 persons accepted the invitation to join, of which about two thirds from Europe and one third from other continents or international organisations. A members' list is provided in Table 1.

[7] The publication of a regular newsletter was not part of the original project proposal and was commissioned later, as were additional measures to enhance communication for ISC_3 und ISCnet.

1. Table: List of Advisory Council members

Name	Pre-name	Organisation	Place, Country
Governments / Authorities			
Hansen	Björn	European Commission, Directorate-General for the Environment (DG ENV)	Brussels, Belgium
Jakl	Thomas	Federal Ministry of Agriculture, Forestry, Environment and Water Management of the Republic of Austria	Vienna, Austria
Krist (until 30-11-16) Barth (from 1-12-16)	Helmut Friedrich	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)	Bonn, Germany
Liu	Xiang-mei	Ministry of Environmental Protection of the People's Republic of China	Beijing, China
Schiess	Martin	Bundesamt für Umwelt (BAFU)	Bern, Switzerland
International Organisations			
Diderich	Bob	Organisation for Economic Co-operation and Development (OECD)	Paris, France
Duer	Jacob	Strategic Approach to International Chemicals Management (SAICM)	Geneva, Switzerland
Halpaap	Achim	United Nations Environment Programme (UNEP)	Geneva, Switzerland
Payet	Rolph	Secretariat of the Basel, Rotterdam & Stockholm Conventions (BRS)	Geneva, Switzerland
Schwager	Petra	United Nations Industrial Development Organisation (UNIDO)	Vienna, Austria
Non-Governmental Organisations / Unions			
Azoulay	David	Center for International Environmental Law (CIEL)	Paris, France
Cannon	Amy	beyond benign	Wilmington, MA USA
Constable	David	Green Chemistry Institute of American Chemical Society (ACS)	Washington DC USA
Lauber	Gertraud	Industriegewerkschaft, Bergbau, Chemie, Energie (IG BCE)	Hannover, Germany
Leetz	Anja	Healthcare without Harm Europe	Brussels, Belgium
Lennquist	Anna	International Chemical Secretariat	Gothenburg, Sweden
Nover	Hanny	European Chemical Regions Network (ECRN)	Brussels, Belgium
Roelofs	Elsbeth	MVO Nederland	Utrecht, Netherlands

Name	Pre-name	Organisation	Place, Country
Santos	Tatjana	European Environmental Bureau (EEB)	Brussels, Belgium
University / Research			
Anastas	Paul	Center for Green Chemistry & Green Engineering at Yale	New Haven, CT USA
Bunke	Dirk	Öko-Institut e.V.	Freiburg, Germany
Chebude	Yonas	Addis Ababa University	Addis Ababa, Ethiopia
Clark	James	University of York; Green Chemistry Network	York, UK
Han	Buxing	Chinese Academy of Science	Beijing, China
Kümmerer	Klaus	Leuphana Universität Lüneburg; Fachgruppe Nachhaltige Chemie der Gesellschaft Deutscher Chemiker (GDCh)	Lüneburg, Germany
Oberle	Bruno	EPFL	Lausanne, Switzerland
Osibanjo	Oladele	University of Ibadan	Ibadan, Nigeria
Palkovits	Regina	Rheinisch-Westfälische Technische Hochschule Aachen (RWTH University)	Aachen, Germany
Poliakoff	Sir Martyn	The University of Nottingham	Nottingham, UK
Tarasova	Natalia	D. Mendeleev University of Chemical Technology of Russia, Institute of Chemistry and Problems of Sustainable Development; IUPAC	Moscow, Russia
Tickner	Joel	University of Massachusetts; Green Chemistry and Commerce Council	Lowell MA, USA
Industry / Associations			
Barthélemy	Pierre	European Chemical Industry Council (cefic)	Brussels, Belgium
Broxterman	Rinus	DSM Innovative Synthesis B.V.	Geleen, Netherlands
Dunn	Peter	Pfizer	Sandwich, UK
Kayser	Martin	International Council of Chemical Associations ICCA	Ludwigshafen, Germany
Nimkar	Ullhas	NimkarTek Technical Services	Maharashtra, India
Romanowski	Gerd	Verband der Chemischen Industrie (VCI)	Frankfurt, Germany

As Table 1 shows, it was possible to bring together in the Advisory Council founders of various networks, highly respected personalities from academia, important and dedicated representatives of the

chemical industry and non-governmental organisations as well as decision makers and specialists from international organisations.

The Advisory Council's visions and recommendations proved to be very useful for defining tasks and goals for $ISC_3$and the network. Its work was made transparent to the public as well: summaries of its minutes were published regularly on the ISC_3 website (cf. Chapter 4). Two of the three meetings lasted two days. A telephone and video conference was arranged for those members who were unable to attend in person.

2.2 Main results of the Advisory Council's work

The Advisory Council held its constituting session in December 2015. Professor James Clark (University of York and spokesman of the Green Chemistry Network) was elected as Chairman and Professor Yonas Chebude (University of Addis Ababa) as his deputy. The members of the Advisory Council presented their expectations of ISC_3 and recommended that a vision for ISC_3 be discussed at the next meeting. The project results presented by the project team matched the Advisory Council members' ideas. The contractors presented their concepts for the three studies to be compiled in the frame of the project. (cf. Chapter 3). After deep discussion, several experts from the Advisory Council were in place to assist with the studies as peer reviewers. In addition, rules of procedure were agreed (see Annex). A detailed report of the meeting is available on the ISC_3 website.[8]

The Advisory Council met on 23-24 June 2016 for a workshop, at which the draft versions of those studies which were already available were discussed, as well as for its regular second session. The participants discussed, amongst others, the results of important conferences, including two UNEP workshops in Geneva on the role of chemicals and waste with respect to the SDGs and the UN General Assembly on environmental issues in Nairobi (UNEA-2), and exchanged ideas on the status of EU initiatives in the chemical sector. It was agreed that the resolutions of international organisations which had been passed especially by UNEA-2 would be of great significance for the project and the future work of ISC_3 (cf. Chapter 4). With the adoption of the topic of "Sustainable Chemistry" in UNEA Resolution 2/7, the importance of ISC_3 for international development is growing. The Advisory Council also devoted itself to the development of a vision for ISC_3. A detailed report of the meeting and the workshop is available on the ISC_3 website and was disseminated as part of the first ISC_3 Newsletter.[9]

The second workshop and the third meeting of the Advisory Council took place in Frankfurt in December 2016. The purpose of the workshop was primarily to discuss topical issues in the field of sustainable chemistry in the context of its interfaces with other key topics:

- The interface between sustainable chemistry and circular economy
- The necessity of further steps towards safer chemicals with respect to the EU non-toxic environment programme
- The role of sustainable chemistry in transition management

A detailed report of the discussion can be found on the ISC_3 website (also disseminated via the third ISC_3 Newsletter).[10] Some major questions remaining from the workshop are listed in Chapter 2.2.2.

One of the aims of the third meeting of the Advisory Council was to adopt the vision for ISC_3 partially developed at the second meeting, under consideration of the communication strategy which was then "under construction" (cf. Chapter 4). In addition, the Advisory Council discussed the preliminary programme for the "Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet".

[8] https://isc3.org/2016/02/isc3-advisory-council-holds-successful-first-meeting-in-frankfurt/
[9] https://isc3.org/2016/10/working-vision-isc3-news-2nd-meeting-advisory-council/?lang=en
[10] https://isc3.org/2017/02/sustainable-chemistry-better-understanding-of-challenges-and-opportunities/

The Advisory Council's work ended with its review of the studies.. A detailed report of the meeting and the workshop is available on the ISC_3 website and was disseminated as part of the fifth ISC_3 Newsletter.[11]

The agendas of the Advisory Council's meetings and workshops are included in the Annex.

2.2.1 Recommendations for ISC_3 and ISCnet

The Advisory Council developed a vision for ISC_3, which was presented on the occasion of the "Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet" in May 2017. Through the way it is formulated, the vision also implies the main goals and topics for ISCnet. Under the title **"Vision statement for the International Sustainable Chemistry Collaborative Centre – ISC_3"** the Advisory Council's recommendation is as follows:

"Sustainable chemistry contributes to positive, long-term sustainable development. With new approaches and technologies it stimulates innovations and develops value-creating products and services, thereby using substances, materials and processes with the least possible adverse effects on health and environment. Moreover, substitutes, alternative processes, resource recovery and other resource efficiency concepts contribute to natural resources conservation and avoid damage.

The International Sustainable Chemistry Collaborative Centre – ISC_3 shall become a central and visible international focal point in sustainable chemistry for all relevant stakeholders, i.e. industry, including chemical companies and upstream/downstream sectors in chemical value chains, research organisations and universities, as well as governmental and non-governmental organisations dealing with environmental, economic and societal aspects related to sustainable chemistry.

The ISC_3 will raise broad awareness for sustainable chemistry and act as facilitator, incubator, think tank and information hub for all potential activities foreseen to advance sustainable chemistry, to communicate the concept and lighthouse examples of sustainable chemistry and to foster capacity building and international collaboration in research, innovation, and education.

Specific priorities of ISC_3 shall be:

- to act as a **driver** in sustainable chemistry by initiating and moderating focus groups or thematic clusters on sustainable chemistry priority topics and issue corresponding thematic papers,
- to lead and guide the development of transparent and applicable **metrics and indicators for sustainable chemistry** thereby integrating key elements from the Sustainable Development Goals (SDGs) into the concept of sustainable chemistry, and to show the relation to other goals and metrics such as resource efficiency or circular economy,
- to collect, develop and **disseminate/communicate** case studies as references for sustainable chemistry, educational material for lectures, courses and laboratory experiments, enterprises' market experience and useful tools to foster sustainable chemistry to become mainstream,
- to foster collaboration between industry and academia and in research, innovation, and education, e.g. via matchmaking/brokerage activities, and by providing a platform for open innovation and technology transfer,
- to **engage policy makers** in discussions around sustainable chemistry and SAICM to shape the discussion and help creating favourable framework conditions for driving sustainable chemistry,
- to **establish basic capacity in safe chemicals handling** and therefore contribute to respective workshops and similar activities (also partnering with other organisations and industry)

[11] https://isc3.org/2017/02/minutes-of-the-advisory-council-meeting/

- to actively **involve and support developing countries** by identification of their needs and aspirations, facilitation of technology and know-how transfer, strengthening of sustainable chemistry capacities and policies and establishing collaborations between developing and industrialized countries."

(Bold text = Advisory Council).

2.2.2 Important discussions and findings related to sustainable chemistry

The definition of Sustainable Chemistry and its relationship to green chemistry, the SDGs and other related topics numbered amongst the most important topics of discussion. The debate was triggered by a paper from another project initiated by the Umweltbundesamt which aimed to define Sustainable Chemistry; the final paper has in the meantime been published.[12] According to this publication, Sustainable Chemistry is both a process and an aim. The understanding of Sustainable Chemistry encompasses ecological aspects, economic success together with new business models, avoiding the use of hazardous chemicals, and product longevity. However, some of the goals may be conflicting. During the discussion, it was mentioned that the "holistic approach" presented needs to be explained in detail and should include transition aspects (e.g. barriers, drivers, chemical industry culture, societal, financial issues etc.). The Advisory Council therefore discussed the potential benefits of transition theory in its second workshop. As to the "sound management of chemicals" and whether or not they are hazardous, it was the common view that this is an indispensable basis for sustainable chemistry. The Sustainable Chemistry concept has an umbrella function for the rules of green chemistry (on the molecular level), sound management of chemicals in general, preferred use of renewable feedstock for synthesis and sustainable applications of chemicals, amongst others. Sustainable chemistry thus helps to reach many of the SDGs.

The necessity for "positive lists", i.e. lists of chemicals which are considered to be completely safe in specific applications, remained an open question. On the one hand, small and medium-sized enterprises especially in emerging and developing countries need such lists in order to avoid the use of hazardous compounds for manufacturing everyday products. On the other hand, these lists will hamper innovations, because it will not be easy for better solutions to be included on a closed list. In general, innovation was looked at as a driver for sustainable solutions.

The obstacles to a circular economy and the opportunities provided by sustainable chemistry to overcome some of the obstacles were discussed. Although "circular economy" in the literal sense is an unrealistic vision from a physical point of view, improvements in resource conservation and recovery can be achieved by practicing sustainable chemistry with respect to waste management, i.e. waste minimization as a result of better processes and chemical leasing, design of products which also covers recycling aspects or design of environmentally friendly products for open application, more use of renewable resources or of secondary raw materials, and less hazardous waste from chemical production leading to less risks for occupational health. Other problems, however, cannot be solved, e.g. the entropy dilemma (i.e. mixture of several materials in one product leading to complicated and energy-consuming recovery processes), the dissipation dilemma (i.e. high dissipation of products as an obstacle to collection), the double role of waste and valuables (i.e. contamination through dangerous compounds of used items containing valuable resources) and the time lag between the production of a good and its final fate as waste. It was concluded that it is important to know what a product contains, namely long-lasting products such as houses (e.g. Swedish mandatory logbook for buildings with full declaration of the materials used). In addition, it was common understanding that the design of products should also meet recyclability requirements without focusing on a unique design solution. There was also a call for

[12] Ch. Blum et al.: The concept of sustainable chemistry: Key drivers for the transition towards sustainable development. Sustainable Chemistry and Pharmacy 5, 94-104 (2017); http://dx.doi.org/10.1016/j.scp.2017.01.001

an "entropy policy" alongside energy and climate policy in order to avoid unilateral solutions, which pose new problems elsewhere in the environment.[13]

The European Commission's approach for a "non-toxic environment strategy", which is currently "under construction", was discussed by the Advisory Council following an introduction given by the officer responsible. There was common understanding that a "non-toxic environment" is not a reachable target so this term should not be taken literally. The non-toxic environment strategy will also be developed with respect to the "refit" of REACH and other regulations and can also serve as a blueprint for SAICM post 2020. The strategy resembles the Swedish action plan "For a non-toxic everyday life", which includes the implementation of EU legislation, investigation of national regulation opportunities, a company dialogue on toys, cosmetics, construction and textiles, mapping of hazardous chemicals in consumer products and actions to increase awareness, amongst others. One important and widely accepted goal was to make information on chemicals more easily available for companies which manufacture chemicals, but also for companies which use chemicals and do not have sufficient information to produce sustainable products. Investing in chemical knowledge could be a business model too. In silico tools are available for seeking "benign by design" molecules, which can be used for filling data and knowledge gaps on unknown substances, allowing for the evaluation of fate and effects, de-novo design or optimization of chemicals etc.[14]

The Advisory Council also discussed the ideas behind transition management and potential benefits for Sustainable Chemistry and vice versa. Transition (or transformation) processes can be extremely complex, non-linear processes, difficult to predict and susceptible to non-predictable, non-intended side effects. Transition processes are therefore difficult to manage, but the creation of favourable conditions is possible. It is helpful to understand how transformation processes work as in this way leverage points for change and design strategies can be identified. Focusing on chemistry, three main needs and drivers might be of importance: 1. higher security of feedstock and sustainable raw materials; 2. resource efficiency, flexibility, sustainable production and safer operations, and 3. demand for functionalities, sustainability performance and safer products. What is known as the "carbon lock-in" hampers a number of innovations at present due to several framework parameters which continue to prioritize oil and natural gas-based chemistry. Sustainable chemistry might be looked at as a driver for growth.

3 Summaries of the studies

According to the Terms of Reference of 10.12.2014, the three studies compiled[15] in the framework of the project were to be "presented at the start of the centre and on its website". The purpose of the studies was to prepare the key areas of work of ISC_3. The topics specified were:

- Research and analysis of sustainability certificates, initiatives and approaches in the chemical sector on the basis of a criteria matrix for sustainable chemistry to be developed
- Identification of priority topics in the field of sustainable chemistry…the goal being to develop decision papers for the centre
- Role of sustainable chemistry in international chemicals management post 2020

[13] A paper, which was influenced by this discussion, has been published recently – H. Friege: Sustainable Chemistry – a Concept with Important Links to Waste Management. Current Opinions on Sustainable Chemistry and Pharmacy, in press.

[14] Rücker Ch, Waleed MM, Kümmerer K: REACH und QSAR: Ein Leitfaden für kleine und mittlere Unternehmen. Eds. Meike Winters, Ursula Zipperer. University of Lüneburg, 2015.

[15] In this report, the summaries of the studies are documented. Underscored and bold text have been taken from the original version. The complete studies are provided on www.uba.de

The following titles were initially agreed in discussion with the contracting authority and the Advisory Council:

1) Sustainability certificates, initiatives and approaches in the chemical sector
2) Priority topics in the field of sustainable chemistry
3) Role of sustainable chemistry for SAICM post 2020

Numerous proposals from the Advisory Council regarding the specification of precise topics (December 2015) led to the scale of the studies being considerably expanded. In the first workshop (June 2016), studies No. 2 – "Identification of priority topics in the field of sustainable chemistry" and No. 3 – "The role of sustainable chemistry for SAICM post 2020" were discussed with the Advisory Council. The compilation of Study No. 1 ("Sustainability certificates, initiatives and approaches in the chemical sector") was delayed due to the primary contractor falling ill. In the framework of a project meeting, it was decided that the topic of certificates would not be treated. All studies were reviewed by several members of the Advisory Council and the contracting authority, completed by November 2016 and presented as planned at the Advisory Council's third session. The members had time to comment again until the end of January 2017. The project team then finalized the studies in March 2017. Summaries of the results were published in the ISC_3 Newsletter.

Study No. 3 was modified several times in the course of discussions with the BMUB because interest was expressed in using it to compile guidelines for further work within SAICM. An additional policy paper was compiled outside the project on the basis of the results from Study No. 3 and submitted at the First Meeting of the SAICM Intersessional Process of 7.-9.2.2017 in Brasilia.[16] Since studies No. 1 and No. 2 were not suitable for presentation at the project's Final Conference with its focus on political discussion and establishing ISCnet, it was agreed between the UBA and the project team that parts of these extensive studies would be presented at the "Green & Sustainable Chemistry Conference II", which took place immediately before the "Conference on Mainstreaming Sustainable Chemistry". The three abstracts submitted were accepted. Abstracts, presentations and poster can be found in the Annex.

3.1 No 1: Sustainability initiatives and approaches in the chemical sector

The objective of this study was to create a knowledge base by mapping the most relevant initiatives/approaches in the field of sustainable chemistry. For this purpose, the sectors and players shown in Table 1 were examined.

2. Table: Sectors and players analyzed

Sector	Subsector / Player
Green Chemistry	Green Chemistry Networks: Green Chemistry Network UK (GCN) Green Chemistry Network Center India (GCNC) Green Chemistry Commerce Council (GC3) Green Chemistry Network Brazil G2C2 network
	Green & Sustainable Chemistry Network Japan (GSCN)

[16] Friege H, Zeschmar-Lahl B: Beneficiary contributions of the concept of Sustainable Chemistry to the Strategic Approach to International Chemicals Management beyond 2020. http://www.saicm.org/Portals/12/Documents/meetings/IP1/SustainableChemistry.pdf

Sector	Subsector / Player
	Other Green Chemistry players Green ChemisTree Foundation, India GreenCentre Canada
International organisations	United Nations Industrial Development Organisation (UNIDO) Joint UNIDO UNEP Resource Efficient and Cleaner Production (RECP) Programme UNIDO´s Global Chemical Leasing Programme UNIDO's Responsible Entrepreneurs Achievement Programme (REAP)
	OECD Sustainable Chemistry Platform (SCP)
(Chemical) Industry organisations and initiatives	Responsible Care® / International Council of Chemical Associations (ICCA)
	World Business Council on Sustainable Development (WBCSD)
	Together for Sustainability (TfS)
	Chemie[3]
	European Technology Platform for Sustainable Chemistry (SusChem)
Upstream / downstream value chain	Zero Discharge of Hazardous Chemicals (ZDHC)
	Clean Production Action / BizNGO
	Chemicals Policy Initiative at the Lowell Center for Sustainable Production
Companies	Europe: AkzoNobel, Netherlands Koninklijke DSM NV, Netherlands
	North America: Dow Chemical DuPont
	Asia: PTT Global Chemical PCL, Thailand Sinopec Corp.
Sustainability reporting, sustainability rating and socially responsible investment	Approaches in sustainability reporting: Global Reporting Initiative (GRI) Sustainability Accounting Standards Board (SASB)
	Approaches in sustainability rating and socially responsible investment: Dow Jones Sustainability Index (DJSI) family The MSCI ACWI Sustainable Impact Index
Further non-governmental/non-profit organisations	MVO Nederland, Netherlands
Research approaches	German Environment Agency (customer)

Source: Own compilation

The analysis showed a gap with regard to the definition and understanding of Sustainable Chemistry. In the past, "Green Chemistry" and "Sustainable Chemistry" were regarded as synonyms. Today a much more precise distinction is made between these approaches. With its definition of Sustainable Chemistry as a scientific concept that seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services and also a process that stimulates innovation across all sectors, the OECD has set standards. Industry has no uniform definition of Sustainable

Chemistry. Some refer more or less clearly to the triple bottom line approach, another cites the OECD definition of Sustainable Chemistry, proposes an LCA approach and stresses the need for acceptance by society. UNIDO is following the triple bottom line approach of sustainability.

The evaluation of the approach of six chemical companies – all global players – shows that only one (Dow Chemical) has a clear understanding and definition of Sustainable Chemistry: "Green chemistry is a set of principles to design, but sustainable chemistry looks beyond only a science. It is a catalyst for change, an innovative approach to problem-solving and a long-term solution to global sustainability challenges. … Ultimately, chemistry and collaboration – and people – have the power to bend that straight line to a more positive point in the future, where nature and therefore human prosperity are in balance." Though it does not explicitly address social aspects in detail, this definition is close to the holistic approach of the OECD and the one that Blum et al.[17] proposed with "the challenges in terms of social conditions, the inclusion of research, science and culture, and a successful long-term and sustainable way of management respecting the capacity-limits of our planet."

Indicators and metrics were also analyzed. The development of indicators for measuring progress in the chemical industry is an ongoing process. Current reports on the sustainability progress of companies or sectors focus mainly on economic, ecological and social aspects. WBCSD offers some guiding documents for environmental aspects in the chemical industry, and is frontrunner with its guideline of 2016 on social life cycle metrics (its development was co-chaired by BASF, DSM and Solvay). ICCA periodically reviews its metrics to determine the need for any changes. SusChem will address sustainability more comprehensively across environmental, societal and economic issues along the whole value chain in conjunction with its stakeholders. Chemie^3 has published its catalogue of 40 indicators in late 2016. Since methodological questions and the application of the criteria are still open, this cannot be evaluated. The TfS approach to sustainability or to sustainable supply chains is of interest, but indicators are not available for the public.

Of the six chemical companies selected for analysis, five have published a Sustainability / CSR Report (or integrated report) in accordance with GRI 4 guidelines. The indicator concept, criteria and metrics for reporting is therefore predefined. Companies are however allowed to use additional metrics to control their sustainability goals and four of them did so. These additional metrics include amongst others solutions with downstream benefits, innovations for alleviating global challenges (like energy and climate change, water, food, housing and health), sum of people whose sustainable development challenges have been positively impacted, customer and supplier satisfaction, and position in Dow Jones Sustainability Indices.

The three UNIDO projects selected for evaluation show that their concept covers broad parts of the concept of sustainable chemistry defined by the German Environment Agency, like improvement of resource efficiency, environmentally friendly production and use of chemicals, the inclusion of the entire life cycle of a product.

The concepts of two Sustainability Indices were described, as positioning in the DJSI is an incentive for innovative chemical companies. The indicators of the MSCI ACWI Sustainable Impact Index have probably more potential for application to sustainable chemistry as they – consideration of environmental, social and governance criteria and excellent operational performance provided – focus on the impact of chemical companies with regard to the SDGs.

Recommendations for the future work of ISC$_3$ included initiating a broader discussion on the indicators and metrics of the following aspects: Social conditions, research, science and culture, successful long-term and sustainable management approaches which respect our planet's capacity-limits, and

[17] Ch. Blum et al.: The concept of sustainable chemistry: Key drivers for the transition towards sustainable development. Sustainable Chemistry and Pharmacy 5, 94-104 (2017); http://dx.doi.org/10.1016/j.scp.2017.01.001

observing further how first approaches developed by companies are applied in reality and what results are achieved.

3.2 No 2: Identification of priority topics in the field of sustainable chemistry

The study has been devoted to identifying priority topics in the field of sustainable chemistry. It focuses on innovations in some important areas of production and application of chemicals trying to identify sustainable chemistry approaches. Having this design of the study in mind, it is clear that numerous approaches cited will not be assessed as "sustainable" in a broader perspective, others will turn out as incremental developments towards one or more dimensions or indicators of sustainability. The ISC_3 project group did not attempt to assess sustainability of the huge amount of process and product innovations in the chemical and pharmaceutical industry, but strived to identify developments that contribute to solve grand societal challenges such as health, food security, secure, clean and efficient energy, secure supply of clean water, climate change etc. The Sustainable Development Goals (SDGs) represent the major overarching principle, in which sustainable chemistry is embedded and the definition of Sustainable Chemistry as a concept developed by the German Environment Agency in consultation with national and international stakeholders provides guidance on how to regard sustainable chemistry in a holistic approach. Prioritization of the numerous research and innovation efforts in the various chemical sectors is difficult, but in any case requires careful assessment of sustainability via LCA studies and other holistic assessment methods to investigate impacts of a new process or product. Novel, highly innovative industry fields or sectors provide the opportunity of introducing sustainable thinking early on and in the whole value chain. The SDGs are important criteria for prioritization of actions. Further aspects relevant for a prioritization of activities include the expected effectiveness of measures, technologies and (project and/or R&D) activities in terms of a rapid, efficient and effective implementation of sustainable chemistry and opportunities/possibilities for start-ups and SMEs to participate.

The question has already been raised, which innovations can be subsumed under "sustainable chemistry". With respect to the large number of innovations found at the desktop research, this question can only be answered for a more or less representative example. The approach selected here does not target the actual substance itself, as a substance or a product is never sustainable per se, but instead how a substance or (raw) material is used in a particular application. "Thermal building insulation" was chosen as an example because of its enormous importance for energy efficiency and climate protection on one hand and because of the diversity of chemicals and materials used in this field. The innovations show different ecological goals and refer to various stages in the life cycle. This underlines the difficulty in assessing materials in the context of sustainable chemistry.

To assess the sustainability of innovative solutions in the field of thermal insulation, two approaches have been used:

- a set of quantifiable indicators for sustainable chemistry (Parameters for Sustainable Chemistry - PSC) from a study which has been performed for the Umweltbundesamt
- a number of objectives chosen from the Sustainable Development Goals (SDGs) which are directly connected to sustainable chemistry or to objectives which are considerably influenced by the use of chemicals, e.g. health issues, energy efficiency, waste prevention.

The PSC were primarily developed for enterprises which produce chemical substances or use them in the manufacture of materials. Therefore, most indicators are substance-related in conjunction with the respective production process and producer specific situation as well as his success in the market. Therefore, only some of these indicators could be used for the assessment of insulating materials. In these cases, relative estimates were made, because data were not available or not comparable. As to

the objectives derived from the SDGs, qualitative assessments and/or relative evaluations (solution A is better than solution B…) were carried out. One may conclude from this example

- that a holistic assessment is lacking of "sustainable chemistry indicators" to be defined and – at best – quantified
- that a number of innovative approaches yield more sustainable solutions than materials or processes used up to now with respect to several objectives derived from the SDGs
- that also in this case, their contribution to other objectives cannot be assessed or could also be negative
- that specific conditions related to the building (e.g. local climate, main construction material) influences the results of the assessment.

A second assessment example investigates different production routes for acrylic acid as target product, based on different feedstock again using the PSC. Generally, the biomass routes are advantageous compared to fossil routes in terms of GHG emissions, but also characterized by a substantially higher energy demand due to lower overall process efficiency. Moreover, other impacts have to be taken into account such as land use and a high water footprint of crop cultivation. Sucrose and starch biomass also have the additional critical aspect of potential food and feed competition. Biomass utilisation efficiency for the production of some precursor molecules such as ethylene or propylene can be very low, i.e. several tons of biomass are required to produce a ton of product. In this sense it is advised not only to perform a cradle to gate LCA for one given route, but to also compare different utilisation routes for a given feedstock to identify the best options. This is particularly recommended for feedstock of limited availability, such as biomass.

As for innovation topics, this study document looks at different fields of application and industrial sectors in order to address the often highly divergent requirements of various industrial sectors.

Petrochemicals and base chemical production is based on well-established high volume processes from fossil feedstock, i.e. oil, Naphtha, coal and natural gas. With respect to GHG emissions, a high reduction potential is expected from game changing technologies aiming at novel pathways utilizing alternative (low carbon footprint) feedstock, although the cost-effectiveness of such new technologies is not yet demonstrated. Focus of innovation activities is the use of either biomass or CO_2 as feedstock. For biomass, focus has to be on second generation biomass, e.g. lignocellulosic biomass to avoid food competition. The use of CO_2 as carbon source is emerging, demonstration plants are in operation e.g. for CO_2-based methanol (Carbon Recycling International (CRI) in Iceland) and for synthetic fuels from CO_2 (Sunfire in Germany). These routes require hydrogen, which has to be produced from renewable energy sources to yield a positive process carbon footprint.

The field of polymers has to be divided into large commodity polymers, for which the same approaches and prerequisites are valid as for the petrochemicals, and specialty polymers which are highly diverse and dynamic. For the latter, new functionalities are the main target of innovation activities and sustainability has to be assessed. New bio-based polymers include for instance polyamide 11 derived from castor oil or poly-3-hydroxybutyrate (PHB). An important area is recycling of polymers, which requires stronger attention and will need matching value chain collaboration and logistics to be in place.

In the agrochemicals (pesticides**)** industry, only a few innovative approaches could be identified. This is no doubt due to the fact that this is a very strictly regulated area and in that western industrialized nations industry has considerably reduced its research effort due to a concentration on genetically manipulated seeds. Microencapsulation of the active substance or nanopesticides (active substance is built into a small particle < 100 nanometers) can be regarded as an innovation but currently there are too many questions open, e.g. the risk of further contamination of water and soil due to the improved transport and longer "lifetime" of the active substances. The innovation approaches described in this

chapter refer to biochemical pesticides, e.g. microbial pesticides and natural plant and insect regulators.

It is of critical importance to introduce agricultural practices that allow to build up organic matter in the soil for reducing soil erosion and increasing soil fertility and soil health. With this in mind, new organic fertilisers (e.g. a combination of humic acid and mineral fertiliser) can be regarded as innovation. Further approaches focus on resource recovery, e.g. feedstock change by new or more effective processes for the recovery of nutrients (here above all phosphorus) from wastewater/waste, or increasing the efficiency in the use of the nutrient input (e.g. slow release/controlled release), nitrification and urease inhibitors, or the development of optimized application techniques for slower release and better plant uptake. Optimized production techniques include biomethane as a renewable source of hydrogen for the Haber-Bosch-process or the minimisation of precious metal loss and greenhouse gas emissions in the production of nitric acid using the Ostwald process. But one has to keep in mind that these innovations need further input of materials and energy. Therefore an LCA approach is always necessary to clear the ecological advantageousness. In addition, an examination by independent third parties on the sustainability of these examples is not available.

Coatings, dyes, pigments and adhesives comprise a complex field with many interfaces or overlaps with other sectors addressed by this study, e.g. specialty polymers, construction chemicals etc. Environmental regulations are a driving force behind the adoption of new coating technologies. Waterborne and high-solids coatings, powders, UV curables, and two-component systems appear to have good growth prospects. Additives belong to a broad and diffuse category of key components in a coating formulation. The focus on green technology, sustainability, nanotechnology, lower cost and safer products has led to the introduction of newer additives and chemistries, thereby still demanding the same or better performance than their traditional counterparts. While many new products claim sustainability benefits, those are often reduced to one impact category. All sustainability indicators have therefore to be assessed carefully.

Requirements for the functional properties of detergents, cleaning agents and personal care products differ with their intended use. High performance, low toxicity and high and full biodegradability of the organic components is a prerequisite in many countries. Resource efficiency, resource recovery and use of renewable sources are further important aspects. With regard to the use of renewable sources (palm oil), potential negative impacts like loss of biodiversity due to the necessary cultivation areas with monocultures and intensive agricultural use has to be excluded. Therefore, an LCA approach is always necessary to clear the ecological advantageousness. Currently, detailed criteria (ecological, societal and economic, including life cycle assessment) are developed within a new European norm on Bio-surfactants and Bio-solvents (CEN: mandate M/491 for Bio-surfactants and Bio-solvents). LCA for detergents e.g. showed that in addition to the composition, the product design with regard to simple and economical dosageability is a major influencing factor for the overall consumption. Innovation approaches describes include renewable resources, increased application efficiency, improvement of production processes and of the entire life cycle.

The field of chemical fibres was screened with focus on technical applications. A broad variety of developments already on the market and innovations was found. Incremental steps towards sustainability could be identified especially in the use of – up to now – wasted fibre residues (e.g. as basis for chemicals), in new and better production processes with higher yields and less waste, in the development of applications for nanocellulose and related compounds, in the substitution of steel and other non-renewable compounds by fibres from plants and trees. Fibre re-enforced polymers (FRP) have an increasing importance for light-weight constructions. On the other hand, most current combination of fibres with polymers impedes the recovery of both compounds after use.

The construction chemistry sector is complex and demarcation is difficult. Besides typical chemicals used for building purposes like adhesives, coatings, paints, wood preservers, fillers an enormous number of other chemicals are used as additives for the production of cement, bricks and other materials of high volume. Trends in the production and use of materials follow quite different goals such as low energy consumption, decreased emission of greenhouse gases (GHG), less hazardous properties thus contributing incrementally to one or more SDGs. For the production of cement as the most important construction material, lower energy consumption and use of waste fractions are of high importance. As to the products, many innovations were found in the literature, e.g. (infra-) lightweight concrete recipes, thinner insulating material on the market and under development, wood preservation without chemicals, building materials with self-healing properties, enhanced protection of surfaces. Moreover, many attempts focus on the substitution of traditional by renewable raw materials.

The pharmaceutical industry currently undergoes a transition in manufacturing towards the use of the Green Chemistry principles to develop atom-efficient and more benign synthesis strategies for synthetic steps widely used for synthesis of active pharmaceutical ingredients. Reduction of the environmental impact of pharmaceutical products is based on a rational design of pharmaceutical compounds to improve for instance degradability. Other important areas which contribute to the SDGs entail novel drugs for treatment or rare diseases, affordable drugs, dedicated drugs for children or improved patient treatment using novel drug delivery systems.

The field of nanomaterials enables a large range of applications, from energy storage, air and water purification, surface protection up to catalysis and drug delivery just to mention a few. Most nanomaterials applications aim at superior materials characteristics or improved customer benefit based on enhanced or additional functionalities. The production, use and life-cycle impact of nanomaterials have to be carefully assessed case by case, to identify, which developments and applications are to be flagged as sustainable chemistry. The safety of nanomaterials including potential ecological and health implications of these materials, is subject to many research programmes.

A separate chapter of this study depicts funding programmes and awards related to sustainable chemistry in the EU and the U.S. as examples. Many different funding mechanisms exist including bottom-up programmes for fundamental research via funding programmes with specific calls on defined topics or specific awards.

Finally, another chapter summarises tax instruments, funding and regulatory framework conditions supporting sustainable chemistry in Brazil as an example of a major emerging region with strong chemical industry.

3.3 No 3: The link between sustainable chemistry and sound management of chemicals throughout their life-cycle, with a view beyond 2020 and for the 2030 Agenda for Sustainable Development

This study focuses on the question of how approaches for the management of chemicals throughout their life cycle can be aligned and enhanced with Sustainable Chemistry methods and ideas. The study comprises descriptions and definitions of Sustainable Chemistry and Chemicals Management, based on important selected references. Interfaces between sustainable chemistry approaches and those of sound management of chemicals and waste, or the 2030 Agenda and its SDGs, are analyzed. The most important chapter presents the results of a survey among members of an Advisory Council formed in the context of the preparations for the establishment of the International Sustainable Chemistry Collaborative Centre (ISC_3), in which they were interviewed about their vision for aligning and enhancing chemicals management with sustainable chemistry beyond 2020. The results of the literature study and the survey serve as the basis for recommendations for further developing chemicals management beyond 2020 and the future orientation and function of the ISC_3.

Sound management of chemicals and waste (SMCW) mainly focuses on the safe handling of chemicals in production and use and afterwards on adequate disposal of hazardous chemicals and waste. Green Chemistry is in nuce a set of principles with which to design safer chemicals while minimizing resource consumption. Both approaches have their strengths and undoubted success – and limitations. Sustainable chemistry, however, aims to close the gap between ecologically viable solutions and economic success, taking into account economic and social dimensions as well as thinking in full life cycles. With this in mind, Sustainable Chemistry can best be regarded as an overarching concept, which integrates sound management of chemicals and waste and green chemistry and overlaps with circular economy. It is important to note that sustainable chemistry is not a new sub-discipline of chemistry but guides trans- and interdisciplinary thinking to systematically find solutions for sustainable development. It requires and drives innovations, focusing in so doing on sustainable solutions (e.g. substitution, systemic thinking).

Sustainable chemistry is unthinkable without high standards being anchored and implemented worldwide for the approval and handling of chemicals and hazardous waste. Meeting sound management of chemicals and waste requirements is therefore a prerequisite for sustainable chemistry**.** With regard to SMCW beyond 2020, there are still – on a global scale – deficits in the definition of a long-term common understanding and a vision of how existing management systems should be further developed and made more converging. With a particular view to the Strategic Approach for International Chemicals Management (SAICM) and the perspectives beyond its current mandate until 2020, Sustainable Chemistry appears as an excellent overarching guiding concept for further developing chemicals management beyond 2020. Seen as a holistic approach which takes into account all dimensions of sustainable development, sustainable chemistry has the potential to contribute to achieving numerous Sustainable Development Goals (SDGs).

The International Sustainable Chemistry Collaborative Centre ISC_3 is designed to act as a platform, incubator, think tank and knowledge base. With these functions, the ISC_3 can set impulses for the involvement and support of developing and emerging countries in capacity building ("SMCW baseline"), for fostering collaboration between industry and academia in research, innovation and education, and for mainstreaming sustainable chemistry. Furthermore, the ISC_3 can take a leading role in setting the frame for the Sustainable Chemistry concept and give strong impulses for the further development and implementation of international chemicals management policies beyond 2020.

4 Communication

The project was faced at the outset with tremendous communication challenges. These can be summarized as follows:

- Despite the existence of several relevant journals ("Sustainable Chemistry and Pharmacy", "Current Opinion in Green and Sustainable Chemistry") and valuable preparatory work[18], there is still no binding definition for Sustainable Chemistry in the scientific world. Even in the expert community misconceptions prevail in particular concerning the relationship between Green Chemistry[19], which is defined by a dozen rules, and the holistic Concept of Sustainable Chemistry.
- This meant that an initiative operating at international level in different cultures and industrial societies at different stages of development had first of all to be explained and deemed positive, possibly with the need to overcome a potentially defensive attitude on the part of representatives of existing schools of thought.

[18] Kümmerer K, Clark J: "Green and Sustainable Chemistry. Textbook on Sustainability Science" (Eds.: Michelsen G, Heinrichs H), Springer 2016

[19] Anastas P T, Warner J C (2000): „Green Chemistry: Theory and Practice", ISBN 0-19-850698-8, Oxford Press

- The term "sustainable" was and is subject to many misinterpretations and is popularly used to promote products, processes and services which, upon closer inspection, do not stand up to the claim to sustainable development, for example within the meaning of the UN's goals.
- The Sustainable Chemistry concept is "work in progress". Whilst numerous projects, such as the work being undertaken since the beginning of this century by the OECD and the Federal Environment Agency (UBA)[20] indeed showed the high practicability of the concept, its importance at political level was not yet very high at the beginning of the project.
- The possibility existed that ISC_3 might meet with resistance for political reasons, e.g. due to reservations on the part of developing countries towards initiatives launched in OECD countries.
- Due to the sluggish progress in SAICM many national governments and stakeholders might have the impression that it is too early for such an ambitious project and come to the conclusion that all endeavours should focus on eliminating the deficits in SAICM.

On the other hand, the Sustainable Chemistry concept offers many possibilities and major opportunities for sustainable development in general: it is a trans- and interdisciplinary concept. As a result it can address – beyond the indispensable base of green chemistry with its focus at molecular level – a large number of interfaces, such as protection of resources, waste management, occupational safety, public health systems, power generation, climate mitigation. A large number of interfaces were identified in the framework of the project (see e.g. Chapters 4.1, 4.2) in the Agenda 2030 with its 17 Sustainable Development Goals adopted by the UN General Assembly in 2015 between Sustainable Chemistry and the UN's goals, i.e. where chemistry can help to achieve sustainable development objectives in an environmentally compatible way. For example, using renewable resources and waste not used so far to produce new platform chemicals or for the insulation or synthesis of valuable end products from tropical plants (topic of Study No. 2, Chapter 3.2) makes the concept interesting for developing countries. The chemical industry is backing innovations which lead to new and economically interesting synthesis methods and new products which are far less environmentally hazardous than existing reactions and substances or ones used in the past. Identifying and promoting sustainable chemistry innovations and, if applicable, deriving new business models from them (topic of Study No. 2, Chapter 3.2) ought in turn to be of great interest for the chemical industry but also for sectors which use chemical substances on a large scale in their production.

For the public it is important to communicate that enterprises may only then stake a claim to the sustainability of their business operations in their self-portrayal if they adhere at least to the internationally agreed standards (GHS, Basel, Stockholm, Rotterdam Conventions…) and practise "sound management of chemicals and waste". This makes cooperation easier both for NGOs as well as for those enterprises which act responsibly.

These thoughts were reviewed in the framework of discussions with experts and stakeholders at national and international level (see Chapter 1.1). On the one hand, tasks and roles for ISC_3 were derived from this exchange and on the other hand the decision was reached in agreement with the contracting authority to make the project's communication activities highly transparent and proactive. As a result, it was decided at an early stage that the ISC_3 website should be go live almost a year earlier than originally intended. For the time of the preparing project, the ISC_3 website functioned as the central instrument for external communication for the new ISC_3 and as a protected platform for the Advisory Council. In addition, the opportunity was seized to communicate the possibility for sustainable chemistry to

[20] See e.g. UBA/OECD: "International Workshop on Sustainable Chemistry – Integrated Management of Chemicals, Products and Processes", 27.-29.1.2004, Dessau; Angrick M, Kümmerer K, Meinzer L (2006): Nachhaltige Chemie, ISBN 3-89518-565-5, 71-114, Metropolis-Verlag, Marburg; Umweltbundesamt (2009): „Nachhaltige Chemie – Positionen und Kriterien des Umweltbundesamtes" http://www.umweltdaten.de/publikationen/fpdf-l/3734.pdf; Umweltbundesamt (Publ.): „Leitfaden Nachhaltige Chemikalien. Eine Entscheidungshilfe für Stoffhersteller, Formulierer und Endanwender von Chemikalien", Dessau 2010, http://www.umweltbundesamt.de/uba-info-medien/4168.html

achieve the SDGs and the position of ISC_3 as an important international initiative. In addition, the following objectives and roles of ISC_3 were communicated to the stakeholders:

- ISC_3 has an international focus and would be useful for both OECD and non-OECD countries.
- Priority would lie on networking existing initiatives, closing knowledge gaps and promoting innovations.
- Development of regulatory ideas is not one of the main tasks of ISC_3.
- ISC_3 operates on an interdisciplinary scientific basis.
- Thanks to its transdisciplinary nature, ISC_3 bears firmly in mind the practical and economically successful implementation of scientific results.

In a further step, the communication strategy was expanded and professionalized[21]. Its main aim is to actively involve as many multipliers as possible and it therefore uses methods which are intended to enhance the visibility of ISCnet, for example by use of the ISCnet logo by network members, disseminating information about the work and messages of ISC_3 via multipliers as well as direct approach of potential members. ISCnet members ought, for example, to signal their commitment to sustainable chemistry by displaying the ISCnet logo on their websites. This requires an additional slogan based on a few key messages. These were agreed between the contracting authority and the project team and discussed with the Advisory Council:

- Focusing on sustainable chemistry means focusing on success!
- Helping to shape ISC_3 today helps to shape market leadership for tomorrow!
- Sustainable chemistry contributes to reaching the UN Sustainable Development Goals (SDGs).

A business strategy based on sustainable chemistry also distinguished ISCnet members from their competitors. Such a participatory effect can be enhanced by an annual award for the most successful and effective sustainable chemistry project of the year. ISCnet members ought to be involved in selecting the aforementioned project. In this way, the topic of sustainable chemistry will remain on the agenda throughout the whole year. (The communication strategy's implementation is described in Chapter 4.3).

4.1 ICCM4

An important milestone which the contracting authority had planned for the project was the presentation of the ISC_3 concept at the Fourth Session of the International Conference on Chemicals Management (ICCM4) from 28 September to 2 October 2015 in Geneva. In the framework of ICCM4, a special event with the title "ISC_3 – Moving Sustainable Chemistry Forward!" took place on 1 October 2015 (see Annex). The purpose of the event was to provide the international public with initial information about the ISC_3 project. It was possible to schedule the event immediately prior to the High-level Segment; no other official sessions took place at the same time, which meant that the event attracted greater attention. Dr. Barbara Hendricks, Federal Environment Minister, announced to the international audience the German Federal Government's intention to establish a Centre for Sustainable Chemistry in Germany which will operate on an international scale. The centre will be a platform for cooperation between all stakeholders in this field and make a major contribution to achieving the Sustainable Development Goals (SDGs). Dr. Barbara Hendricks pointed out, amongst others, that sustainable chemistry goes far beyond the topic of chemical safety; it links chemical safety with other ecological challenges, such as resource efficiency and climate protection, as well as social and economic aspects. On behalf of the project team, Prof. Dr. Henning Friege presented the project plan and empha-

[21] Additional contract awarded to O. Fischer Communication (Bonn)

sized the role of ISC_3 in the aggregation, further development and implementation of existing approaches currently to be found within international organisations as well as in science and industry. The discussion, which was chaired by Mr. Paul Hohnen and in which with Prof. Dr. Yonas Chebude, Dr. Véronique Garny, Dr. Achim Halpaap and Dr. Rodney Townsend representatives of various stakeholder groups and countries participated, resulted in broad consent for the goals of the ISC_3. One of the most important aspects is the transparency of the process. As representative of the German Environment Agency, Dr. Petra Greiner, invited everyone present to become involved in the project. In his closing remarks, Achim Steiner, as Director of UNEP, drew a line from the preceding UN General Assembly (Agenda 2030) to ISC_3 and expressed his firm conviction that this initiative to promote sustainable chemistry is an important component in achieving the UN goals for the period until 2030.

In view of the broad support for the project and the considerable political interest at international level in the setting up of ISC_3, the project team recommended, amongst others, that any conflicts which might arise in its establishment, for example for reasons of differing stakeholder or national interests, be tackled in a proactive way, that the website be released for the public as soon as possible and that it also be used as a platform for the discussion on the definition of Sustainable Chemistry, in order to prevent the term from being misused (see above).

4.2 UNEA-2

Following the success of the side event at ICCM4, a further side event was planned for the United Nations Environment Assembly (UNEA-2) in Nairobi. The intention was for UNEA-2 to specify in its concluding documents details of measures and mandates, amongst others for the UNEP, resulting from the Agenda 2030 and other UN resolutions. Therefore, this situation represented an ideal opportunity to bring sustainable chemistry onto the UN's stage. This was also confirmed by observations during discussions of BMUB, UBA and UNEP representatives as well as members of the Advisory Council. The decision to apply at UNEP as a co-organizer of a side event was reached in January 2016 in the framework of an extraordinary project meeting[22]. With the support of the BMUB, it was then possible to secure a time-slot on the programme for a side event. The session was run jointly by the German government, the Republic of Ghana, the UNEP and the Secretariat of the Basel, Rotterdam and Stockholm Conventions (BRS). The project team was responsible for organisation and content. The side event took place on 23 May 2016 with the title "Advancing Sustainable Chemistry in a Sustainable Development Context: Opportunities for Global, Regional and National Chemicals Management" (the programme is included in the Annex). The side event built on the successful event staged at ICCM4 in Geneva. The objective was, in particular, to pave the way for a UNEA-2 resolution, with which UNEP would be mandated to integrate the topic of sustainable chemistry into its work. The event therefore concentrated on communicating the principles of Sustainable Chemistry, the connection between sustainable chemistry and the Sustainable Development Goals (SDGs) and the opportunities for developing and emerging countries which result from the Sustainable Chemistry concept, whilst less focus was laid on the ISC_3 project. After the UN had decided in favour of the side event, a concept was developed for it and two speakers were invited who introduced the topic as well as a group of experts for a panel discussion. Here too, care was taken to create a balanced mix of participants from industrialized nations and developing countries, the BRICS economies as well as international organisations. With Maria Krautzberger, President of the Federal Environment Agency, and Daniel S. Amlalo, Director of the Ghana Environment Protection Agency (EPA Ghana), who together opened the conference, two high-ranking representatives of the relevant authorities were also in attendance. The ISC_3 project was introduced both in a presentation shown during the course of the event as well as in the shape of a flyer

[22] Since this part of the project was not foreseen in the budget, the N^3/DECHEMA/BZL consortium submitted an application – as too for additional measures to enhance communication activities for ISC3 and ISCnet – to extend the project, which was approved in two instalments (first for the side event at UNEA-2, then for further proposed measures).

(see Annex), whereby many participants already predicted that ISC_3 will be a positive element of future activities in the field of sustainable chemistry. (More details can be found in the UBA's press release of 1 June 2016 – see Annex.) The event attracted a large number of visitors and lasted longer than planned. Insights gained from the event in Nairobi were taken into consideration for the project work and greater attention paid to already identified topics both for the centre and the network. These include:

- Technical support for UNEP in the implementation of the topic of Sustainable Chemistry in SAICM, on the basis, amongst others, of the UNEP goal of "sound management of chemicals and waste"
- Continuation of the "clean up" of toxic chemicals and hazardous waste above all in developing and emerging countries as well as support for the implementation of the GHS and other instruments as preconditions for the next step in the direction of sustainable chemistry
- Formulation of Sustainable Chemistry strategies, taking into account regional specificities (both in economic terms as well as with regard to regional availability of raw materials), for the development of business models and possibly of concrete support measures for them
- Definition of indicators and criteria for sustainable chemistry
- The necessity for the chemical industry to play a more active role in the sustainable chemistry discussion

The expectations on future activities in the field of sustainable chemistry voiced by the participants had already been covered to a major extent by the roles and tasks foreseen for ISC_3.

At first, the draft resolution No. 2/7 presented to UNEA-2 contained no reference to sustainable chemistry. At the initiative of the German government and the Republic of Ghana, its wording was changed and expanded: "According to resolution No 2/7 of the UN Environmental Assembly (2016-05-27), Sustainable Chemistry is a great opportunity to reach goals documented in the Agenda 2030. Academia, private sector, national governments, international bodies, and NGOs are requested to hand over documentation of best practice examples based on the Sustainable Chemistry concept until July, 1, 2017. On the basis of these examples, UNEP shall propose how Sustainable Chemistry can be integrated into SAICM." To cite the wording from the final document "Sound Management of Chemicals and Waste" verbatim:

"The United Nations Environmental Assembly…

- invites countries, international organisations and other interested stakeholders, including the private sector, with relevant experience on the issue of sustainable chemistry, to submit to the United Nations Environmental Programme secretariat, by 30 June 2017, best practices, indicating how these may enhance the sound management of chemicals, inter alia through the implementation of the 2030 Agenda for Sustainable Development, as well as SAICM and chemicals and waste related MEAs;
- requests the Executive Director to prepare a report in the first quarter of 2018analysing the information received to assist SAICM in considering the opportunities presented by sustainable chemistry, including linkages to sustainable consumption and production policies, and the possibilities that sustainable chemistry may offer to contribute to the achievement of the 2030 Agenda…"

It is clear that the planned establishment of ISC_3 gained in significance thanks to the adoption of sustainable chemistry in the final resolution of UNEA-2.

4.3 ISC_3 website

The website was designed during the summer of 2015 based on Wordpress used as content management system (CMS). Its development was brought forward in order to:

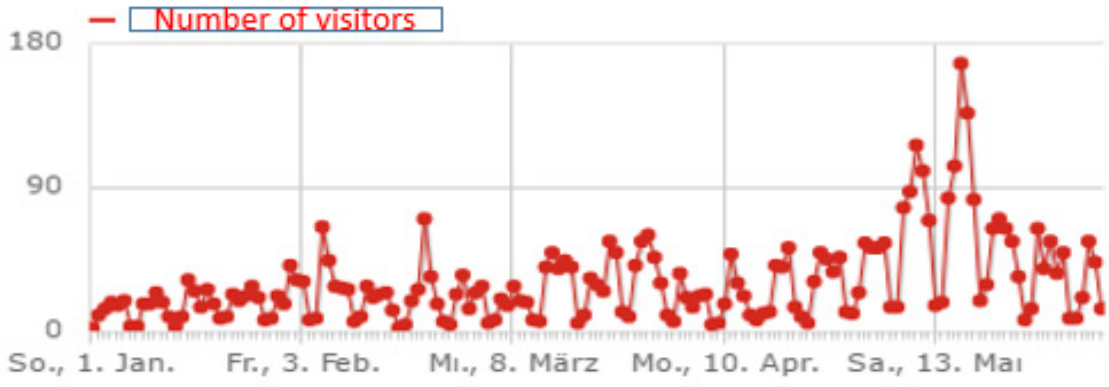
- Offer the Advisory Council a platform from the very start of its work
- Provide continuous and openly available information about the project

Having established the website's structure and its main functions in the framework of a test version, content was created and first uploaded into a version which was only accessible on the web via a code. The finished project website - www.isc3.org – was activated on 11 September 2015 first for the Advisory Council, the contracting authorities and all the members of the project team. The domains isc3.eu and isc3.com were also secured alongside the domain isc3.org.

Due to the topicality of ICCM4, the website was then released to the general public and speeches, pictures and results from the ICCM4 side event were published, amongst others. New content was then added to the website on a regular basis up until the launch of the newsletter (see below), including the publication of the results of the first and second meetings of the Advisory Council and the side event at UNEA-2 (see Chapter 4.2).

Through corresponding activities (SEO) by Consist ITU (the sub-contractor responsible, Hamburg) it was possible to place the website in a good position in search engines relatively quickly. Traffic analyses showed a large number of hits after reports on current topics had appeared (Fig. 3). The diagram shows the daily hits on isc3.org from the beginning of 2017 onwards up until the Final Conference. Peaks in the number of visitors correspond to the dispatch dates of the newsletters and reached a maximum of almost 200 per day immediately prior to the conference.

3. Figure: Traffic analysis of ISC3.org website from January to Mai 2017



The website (basis: Wordpress) was equipped with the functions listed below:

- Multilingualism (so far achieved: English, German)
- Newsletter function with welcome email
- Sitemap
- Statistics and activity streams (hits)
- Comments (blogs)
- Forum
- Protected members' area and possibility to set up groups
- Insertion and attachment of documents
- Profile creation

- Search function within the website (Google Search)
- Video upload option
- Contact form
- Dictionary
- Media tree structure
- SEO
- Calendar of events

However, the uploading of content and changes to the structure and design proved complicated. The calendar of events was updated on a regular basis, at the latest every four weeks. All conferences and congresses were announced which were related to Sustainable Chemistry topics. A small editorial team (see Chapter 7) collected suggestions and decided which announcements to include. In addition, the ISC_3 project website contains a vast range of current materials and publications from the field of sustainable chemistry; deciding which documents should be included was also the editorial team's responsibility.

After ICCM4 and even more intensive after UNEA-2 (cf. Chapter 4.1 and 4.2), the ISC_3 preparing project progressed very dynamically and was characterized by a high level of interest and commitment on the part of the international sustainable chemistry community. Additionally, the ISC_3 preparing project enjoyed an extremely positive reaction from the UNEP, meaning that important milestones had been reached. The encouragement given to the ISC_3 preparing project was a reason to harness this dynamism in order to facilitate an excellent start for ISC_3, also by further expanding certain project activities. In order to keep interest in the project alive up until the official launch of ISC_3 and to provide full transparency about the ongoing project, a regular newsletter was started in October 2016.[23]

The topics published in the newsletter are listed in the following table. The first newsletter was circulated to about 100 subscribers. The ninth and thus last issue in the project was sent to almost 300 experts worldwide. As far as possible, the newsletter focused on the three main messages mentioned above[24]; the questions to the Advisory Council members, for example, were closely linked to the key messages.

3. Table: Topics ISC_3 Newsletter 1-9

Subject	Number of contributions	Remarks
Personal messages by German representatives	3	Including an interview with the President of the UBA
Reports on Advisory Council meetings and workshops	6	
Interviews with members of the Advisory Council	8	Including messages from the co-chairs of the Advisory Council
Publication of the studies from the project	6	

[23] www.isc3.org/newsletter/

[24] Focusing on sustainable chemistry means focusing on success! - Helping to shape ISC3 today helps to shape market leadership for tomorrow! - Sustainable Chemistry contributes to reaching the UN Sustainable Development Goals (SDGs).

Subject	Number of contributions	Remarks
Current opinions in Sustainable Chemistry issues	3	Edited by members of the Advisory Council and of the project team
Reports on UNEP meetings and other conferences	5	
Important studies on Sustainable Chemistry issues (not derived from the project)	4	
Important project news	4	Including UNEP's call for experiences with Sustainable Chemistry
Invitation and programme for the "Conference on Mainstreaming Sustainable Chemistry…"	6	
Editorial remarks	*3*	

4.4 ISCnet website

The additional website for ISCnet, which was identified as important added value in the course of the project, was based on the following considerations:

- There is a clear division of tasks between ISC_3 and ISCnet, the former being the operational centre, the latter acting as a powerful communication centre. ISC_3 acts as host. The fact that it has its own website underlines the network's independence from ISC_3.
- ISCnet is faced with numerous additional and complex tasks, such as a brokerage function for new R&D projects, the formation of a large number of working groups and the interlinking with other networks. This would presumably be too complicated from a technical perspective for the ISC_3 website based on the CMS Wordpress.
- The additional communication strategy developed especially for the network contains "Media Support" as an important additional element (see below), which would not match the character of the existing ISC_3 website.

The ISCnet is intended to function as an aggregator. It relies on new additional multipliers as valuable contacts (leads) - also to stimulated growing of the network over time. Communicators in existing networks and at associations are already supplying existing channels in their networks with information about ISC_3, as these multipliers are familiar with their (partially virtual) networks and can use their tried-and-tested communication methods there. In this context, ISC_3 itself is not the message. Instead, the messages of ISC_3 are transported via success stories with different foci. In this way, the ISCnet stimulates interest to learning more and ideally a desire to become actively involved. The multipliers are provided with comprehensive communication services in the shape of media content such as editorial texts, pictures, diagrams and videos where suitable ("media support"). With the help of this media support, the multipliers can feed their own existing communication channels simply and efficiently with sustainable chemistry content from ISC_3. Media support thus becomes a kind of virtual PR agency. As it has the specialist expertise, ISC_3 must create the content, if necessary in cooperation with external service providers (copywriters, photographers or an agency).

The ISC_3 website as well as presentations by speakers from ISCnet can serve as platforms to generate leads, i.e. addresses and contact details, where an interest in sustainable chemistry can be assumed. These are then contacted or sent information.

SEO ensures that potential multipliers land on the ISC_3 and ISCnet websites when seeking information about sustainable chemistry. Here they have immediate and automatic access to extensive media support and already checked content. All material is based on interesting and verifiable success cases in the field of sustainable chemistry, which are illustrated where possible through lively photographs and perhaps additional videos.

The basis for providing such high-quality content in the form of text and images is a storytelling approach. The description of economic success stories is the foundation for media support. With regard to the text element, headlines and teasers are formulated depending on the type of multiplier, e.g. state, association or researcher. Depending then on the recipient, the news item has an economic, political or scientific focus. In this way, media support creates an impact and is an incentive for the multipliers. A differentiation is made here between the general newsletter (automatic and regular dispatch according to the ISC_3 time schedule) and the media support newsletter (which informs about content which can be called off on demand). The general newsletter reports at regular intervals on ISC_3 and ISCnet activities as well as on events and successful projects. It also highlights personalities and their interests and approaches in the area of sustainable chemistry. By contrast, the purpose of the media support newsletter is to inform multipliers about new content and encourage them to use it in their own communication channels and for their own target groups.

The domains iscnet.org, iscnet.de and iscnet.eu were secured for the ISCnet website, which was built up in TYPO3 as the CMS. The ISCnet website offers, alongside the “normal” website, comfortable download options for the media content made available by the project as well as integrated newsletter functions for the media support and the general newsletter. By choosing TYPO3, it is possible to expand the website flexibly in the medium and long term and link further functions if needed.

4.5 Further communication measures

To attract as many interested parties as possible from around the world for ISCnet, it was necessary to address stakeholders not only via the Advisory Council and the internet but also personally. The best meeting places are generally conferences, whereby due to the interdisciplinary nature of ISC_3 not just congresses focusing on chemistry were selected. Where possible, information about ISC_3 was presented at conference in the shape of presentations as well as flyers (see Annex). In some cases, members of the UBA’s and BMUB’s staff as well as of the project team were assisted by members of the Advisory Council. In general, it was possible to enter into personal contact with a large number of participants. Participants also frequently approached the respective members of the project team on the basis of the information on ISC_3 already available. This made it possible to establish further contacts to networks, enterprises and academic institutions as well as environmental organisations. The conferences are listed in the following Table 4.

4. Table: Information on the ISC_3 preliminary project at national and international conferences

Conference	Date	Location	Participant	Affiliation	Presentation
SUSTAINABLE CHEMISTRY 2015: the way forward	24.-25.9.2015	Berlin	H. Friege / A. Bazzanella	N^3 / Dechema	Yes
Global Network Conference on Resource Efficiency and Cleaner Production	12.-16.10.2015	Davos (Switzerland)	Jutta Emig	BMUB	
Global Business Summit (Chemical Watch)	23.-24.2.2016	Brussels (Belgium)	H.C. Stolzenberg	UBA	Yes
1st Green & Sustainable Chemistry Conference	3.-6.4.2016	Berlin	Chr. Blum	UBA	Yes
Integrated National Implementation of SDGs and International Chemicals and Waste Agreements (UNEP)	11.-13.4.2016	Geneva (Switzerland)	H.C. Stolzenberg, V. Karavezyris, H. Friege	UBA / BMUB / N^3	
Chemistry as an Enabler for Sustainable Societies	11.5.2016	Antwerp (Belgium)	A. Bazzanella	Dechema	Yes
11th Annual GC3 Innovators Roundtable	24.-26.5.2016	Burlington (USA)	Petra Greiner	UBA	Yes (panel discussion)
Woche der Umwelt	7.-8.6.2016	Berlin	P. Wolfmeyer	N^3	No
6th IUPAC Green Chemistry Conference	5.-8.9.2016	Venice (Italy)	Chr. Blum	UBA	Yes
6th EuChemS	10.9.-15.9.2016	Seville (Spain)	H. Friege	N^3	Yes

Conference	Date	Location	Participant	Affiliation	Presentation
ICCA-UNEP Workshop on the Role of Chemistry in Achieving Sustainable Development – Identifying Opportunities, Addressing Challenges (ICCA/UNEP)	11.-13.9.2016	Shanghai (China)	H.C. Stolzenberg, V. Karavezyris	UBA / BMUB	
2nd Summer School on Sustainable Chemistry	12.-16.9.2016	Lüneburg	Chr. Blum	UBA	Yes
ISWA World Congress	18.-22.9.2016	Novi Sad (Serbia)	H. Friege	N³	Yes
3. Green Economy Konferenz	2.11.2016	Berlin	P. Wolfmeyer	N³	No
ESDN Annual Conference 2016	10.-11.11.2016	Bern (Switzerland)	P. Wolfmeyer	N³	No
Transparency and what it means for sustainable chemicals (workshop)	15.12.2016	Utrecht (Netherlands)	P. Wolfmeyer	N³	Yes
Bio-raffiniert IX	13.-14.2.2017	Oberhausen	H. Friege	N³	No
12th Annual GC3 Innovators Roundtable	24.-27.4.2017	Grand Rapids (USA)	H. Friege	N³	Yes (short)
2nd Green & Sustainable Chemistry Conference	14.-17.5.2017	Berlin	Chr. Blum, H. Friege, A. Bazzanella, B. Zeschmar-Lahl	UBA / N³ / Dechema / BZL	Yes (2 oral pres., 1 poster pres.)
16th International Conference on chemistry and the environment	18.-21.5.2017	Oslo (Norway)	Chr. Blum	UBA	Yes

In addition, some articles were published in selected journals where an interested readership could be expected:

C. Blum, H. Friege, H.-C. Stolzenberg: Fostering Sustainable Chemistry. Chemical Watch Global Business Briefing 79, 11-12 (2015)

H. Friege, A. Bazzanella: Launch of the International Sustainable Chemistry Collaborative Centre (ISC_3). Chemistry Today 2/2017, 18-19

5 Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet

Due to the outcomes of UNEA-2, the issue of Sustainable Chemistry had gained momentum. The character of the ISC_3 launch conference was therefore modified in comparison to the original concept, which had targeted a scientific exchange. The aim of the conference now was to foster an international exchange of opinion between politics, business, science and NGOs. The new ISC_3 management was to have an opportunity to present itself to the participants and encourage the audience to participate in the centre's future work and in the network. As far as project results were concerned, political and structural topics should take priority over technical findings. The conference was looked at as the most important opportunity in the current year to meet and inform parties interested in participating in ISCnet and discuss with them network structures and procedures. The conference originally planned for one day was therefore extended by half a day. This made it possible to expand the programme necessary in order to include a high-level policy session and the planning of an evening event to foster networking. Preparatory work for the "ISC_3 Opening Conference" (working title) began at the end of August 2016. It was deemed opportune to stage the conference in direct connection with the international scientific 2nd Green & Sustainable Chemistry Conference (GSC II). The ISC_3 Launch Conference was therefore scheduled for 17-18 May 2017 in Berlin. A first "Save the Date" was sent out in October 2016 (Newsletter No. 1). After agreement had been reached on the exact topics and the speakers, the final programme was published in Newsletter No. 4 in March 2017. "Save the date" invitations had also been dispatched beforehand to a large number of addressees.

The GSC II conference taking place immediately before provided an opportunity to:

- Present the results of the studies compiled in the course of the project
- Raise the interest of this conference's participants for the ISC_3 conference

It was therefore agreed with the organizers of the GSC II conference (Elsevier Publishers) that the two conferences would be advertised on each other's websites and a free bus transfer arranged from the GSC II venue to the BMUB building, where the project's Final Conference took place. Elsevier also offered to publish those contributions from the ISC_3 conference available in written form in a special issue of "Current Opinion in Green and Sustainable Chemistry".[25]

5.1 Planning of conference contents

Paul Hohnen[26], who had already chaired the two side events in the framework of the project, was engaged as facilitator. Further facilitators were Yonas Chebude (Co-chair of the Advisory Council) as well as Andreas Förster and Peter Wolfmeyer (project team). Four main objectives were identified:

[25] DECHEMA is collecting and editing the contributions; publication is planned for the end of the year.

[26] http://www.hohnen.net/

- The formal launch of ISC_3: Handing over its founding document, describing its functions, introducing its first Managing Director and outlining its structure, aims and initial activities. The launch of the ISCnet: Outlining its relationship to ISC_3 and describing how they will work in a complementary manner as well as a discussion about details of the network structure like working groups, special tasks of ISC_3 with respect to the network
- Placing ISC_3 and ISCnet in the context of sustainable chemistry and the Sustainable Development Goals (SDGs)
- Promotion of further stakeholder participation in the above, thereby helping to grow awareness, exchange of information and engagement in the advancement of sustainable chemistry.

In co-operation with the moderator, it was decided to discuss the following key aspects:

- The concept of Sustainable Chemistry and how it might be further defined, developed, promoted and adopted across all stakeholder communities, including emerging economies.
- Foster the potential of sustainable chemistry to contribute significantly to sustainable development and, specifically, the SDGs.
- The institutional relationships with existing and further Sustainable or Green Chemistry initiatives, and related UN organisations and programmes (including SAICM), to ensure optimal sharing, co-operation and collaboration, including emerging economies.
- Securing the necessary resources, financial and non-financial, to ensure the early and full uptake of sustainable chemistry globally and the widest possible expert stakeholder engagement.

The conference programme was built upon these key questions. That is why the conference focused on the following topics: “Sustainable chemistry and the SDGs”, “Opportunities and challenges for ISC_3”, “Sustainable chemistry, investments and economics” and “ISCnet – scope and expectations”.

5.2 Conference proceedings

Federal Minister Barbara Hendricks opened the conference and welcomed 200 participants from 40 countries. In a short presentation she outlined the opportunities which the German government sees for sustainable chemistry and handed over the founding document to the representatives of the GIZ. The headquarters of ISC_3 are in Bonn and it is hosted by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. The intention is to establish a scientific centre, the “ISC_3 Research Hub”, at Leuphana University of Lüneburg, as well as an innovation centre, the “ISC_3 Innovation Hub”, at DECHEMA in Frankfurt. Also in this session Ghanaian minister Kwabena Frimpong-Boateng, CEO of BASF and VCI president Kurt Bock and UNEP Executive Director Erik Solheim (via video conference) spoke on their visions for Sustainable Chemistry. This was followed by a facilitated panel discussion in which stakeholders from industry (Martin Kayser, ICCA), an international organisation (Stephan Sicars, UNIDO), an academic community (Thisbe Lindhorst, GDCh) and an NGO (Susan Wilburn, Health Care without Harm) reacted to the speakers’ remarks and shared their own views on how to develop and mainstream Sustainable Chemistry best into governmental and business policies and practices. It became clear from the contributions in this session that the Sustainable Chemistry concept shifts ideas about industrial production and products in the direction of sustainability, although concrete understanding of the term “Sustainable Chemistry” differs.

The second day of the Conference was opened by Maria Krautzberger, President of the Umweltbundesamt. After the presentation of the “Vision for ISC_3” by James Clark, which had been developed by the Advisory Council (cf. Chapter 2.2.1), Friedrich Barth (Managing Director of ISC_3) responded with his ideas for further work. Achim Halpaap contributed UNEP’s “state of the art” with respect to UNEA Resolution 2/7 and welcomed the work of ISC_3. The panel discussion featured representatives from

science (Pietro Tundo, IUPAC), an NGO (Anja Leetz, Health Care without Harm), a labour union (Gertrud Lauber, IGBCE and Chemie[3]). The panelists supported the widely identical approaches of the Advisory Council (the "Vision", see above, chapter 2.2.1) and did not object the ideas for the tasks and the structure of the ISC_3 presented by the new Managing Director. The discussions showed that the expectations are high and manifold. The panelists pointed out that it will be difficult for ISC_3 to meet all these expectations in the near future.

In the next session, the nexus of sustainable chemistry, sustainable development in general, investment and economics were discussed. It is clear that sustainable development as the overarching policy goal of the world's governments will require a massive shift in investment, with huge opportunities for innovative industries. The economic and commercial dimensions of sustainable chemistry were therefore explored together with experts in economic policy, investment and business. Which approaches (services, technologies, etc.) would be most effective in ensuring that sustainable chemistry is mainstreamed as quickly as possible in order to help achieve sustainable development? Which political environment is suitable for this process? Unfortunately, one speaker and one panelist cancelled their participation shortly before the conference. The presentation by Anne-Sofie Andersson (Executive Director, ChemSec) was therefore moved forward to this session. She drew on ChemSec's work with chemicals companies and investors to identify possible ways ISCnet can promote access to funding or financing for the transition to sustainable chemistry. Dominique Debecker (Solvay) reported on the sustainability approaches of his company as a strategic issue aimed at present and future economic success. Sascha Gabizon (WECF International) derived potential benefits from sustainable chemistry for other issues, mainly hazardous waste and hazardous chemicals still in use somewhere in the world. The following panel discussion featuring the speakers and Joel Tickner (Associate Professor, University of Massachusetts, Lowell, and Director of the Green Chemistry and Commerce Council) highlighted the main economic drivers for sustainable chemistry. Different options from regulations to economic benefits for companies were discussed.

In the third session (after lunch), ISCnet was introduced, its functions and composition described and its relationship with ISC_3 and other Sustainable/Green Chemistry initiatives defined. Friedrich Barth introduced his views on the centre's future work. The centre will initiate innovations, cooperation, business models and a new way of thinking in order to foster the concept of Sustainable Chemistry on a global scale: "Chemistry is facing the biggest challenge in its history: Basically, it has to reinvent itself in order to progress towards the circular economy. This implies new business opportunities, new jobs, and the UN Sustainable Development Goals can be reached everywhere. ISC_3 is set to shape this transformation in cooperation with all stakeholders." He introduced ISCnet as an independent sounding board for the centre and announced several meetings per year with numerous stakeholders to keep ISC_3 on track with the network's opinions and ideas. Joel Tickner gave an overview of the philosophy behind GC3, which organizes stakeholders along value chains including producers of chemicals and manufacturers producing and applying materials, which were assessed "greener" in a discussion of the stakeholders involved. He made some recommendations for ISCnet regarding possible first activities and priorities. James Clark (Professor, University of York, and chair of the Advisory Board) shared some of the lessons learned from his experience with the G2C2 initiative as well as with the global Network of Green Chemistry Centres and provided some recommendations for ISC_3/ISCnet. The following panel discussion, featuring stakeholders from science (Klaus Kümmerer, Leuphana University of Lüneburg), developing countries (Sam Adu-Kumi, Ghana, also acting as Chair of the Stockholm Convention Parties), industry (Pierre Barthélemy, CEFIC), and NGOs (Elsbeth Roelofs, MVO Nederlands) explored how to ensure cooperation and avoid overlap or competition with other Sustainable Chemistry initiatives. It became clear that ISCnet would also function as an umbrella for regional networks and scientific communities. Moreover, the question was how to optimize engagement for ISCnet. The interactive discussion was organized by collecting questions and proposals from the audience sent in via smartphones. Here are some ideas from it:

- ISC_3 – be visible! Important examples and success stories, which are coherent with all of the three pillars of sustainable development, are urgently needed.
- Identify all the relevant players: Broadest involvement globally of users of chemicals (suppliers and consumers)
- Please do not reinvent the wheel: Connect initiatives, stakeholders. Have a broad scope, not only hazardous chemicals and research but also financing, building new product chains, adaptive regulation with room for experiments, look for non-chemical solutions.
- Matchmaking between parties in an interactive and attractive way is an important task!
- Look at developing countries also as a source of solutions and successful experiences, not only as countries that need support - go into operational and practical levels - help companies and society to act in the short term even if results come in the long term
- Enhance collaboration between start-ups and big players as well as investors - provide a marketing space to match demands and solutions - stimulate and help to implement Sustainable Chemistry in developing and emerging countries
- Establish a Younger Chemists Network to promote knowledge and collaboration between young researchers.

In his concluding remarks for this session, Friedrich Barth made clear that ISC_3 will not "re-invent the wheel". This means that ISC_3 will build on existing organisations and networks and seek cooperation and partnerships with all interested stakeholders. It will think and act independently of governments and companies. Establishing a scientific council, an advisory forum and a stakeholder forum (based on ISCnet members) will ensure this.

The Conference was closed by Maria Krautzberger who announced the formal launch of ISCnet. She also expressed her gratitude to all speakers and panelists, the facilitator and the project team.

The conference brochure can be found in the Annex. All presentations as well as the introductions by Federal Minister Barbara Hendricks and Minister Kwabena Frimpong-Boateng and the video message from UNEP Director Erik Solheim can be found on the ISC_3 website[27].

6 Recommendations derived from the project

The following recommendations stem from different work packages and project phases as well as a special policy paper for the BMUB and the strategy workshop undertaken jointly with other projects commissioned by UBA and concerned with Sustainable Chemistry topics, SAICM, implementation of the international conventions etc. The recommendations were therefore attributed to the area in which they can best be put into practice and do not claim to be complete!

6.1 SAICM[28]

With the expiry of the SAICM mandate in 2020, there is a need for international agreement on a successor platform. At the same time, this also opens up an opportunity to take into consideration not just the strengths and weaknesses of the process to date in the framework of a new mandate. The new mandate should rather take into account future challenges, above all the goals of the 2030 Agenda for Sustainable Development. This is the result arrived at by the Committee of Permanent Representatives (CPR) to UNEP 2016.

[27] Published in newsletters No. 8 and No. 9: https://isc3.org/newsletter/?wpmlmethod=newsletter&id=20

[28] This chapter also includes recommendations from a policy paper commissioned by the BMUB in January 2017; First meeting of the intersessional process considering the strategic approach and the sound management of chemicals and waste beyond 2020; http://www.saicm.org/Portals/12/Documents/meetings/IP1/SustainableChemistry.pdf

Sustainable chemistry can make a substantial contribution to achieving the SDGs, as has been proven in several studies performed in the frame of this project. It incorporates ecological viability and social balance but cannot, however, dispense with economic efficiency. The better economic prospects are, the faster it will assert itself. New business models make a contribution here too.

Sound management of chemicals and waste (SMCW) does not, however, become obsolete as a result of sustainable chemistry. On the contrary: sustainable chemistry is unthinkable without high standards being anchored and implemented worldwide for the approval and handling of chemicals and hazardous waste. Meeting SMCW requirements is a prerequisite for sustainable chemistry. It is important to expand further already existing voluntary initiatives by the chemical industry in the direction of SMCW throughout the world and to accelerate their further development and implementation in practice with the help of a dialogue amongst all stakeholders.

The successor platform for SAICM should make use of the possibilities that the concept of Sustainable Chemistry affords (added value) and integrate these into the overarching policy strategy (OPS). This especially concerns the interfaces with the other objectives of the 2030 Agenda and the corresponding SDGs, such as climate action, renewable energies, substitution of hazardous substances by less critical chemicals (viewed over the entire life-cycle), as well as the establishment and implementation of high standards in the approval and handling of chemicals (and hazardous waste). In addition, stakeholders along the value chain must be more actively involved, transparency improved through standardized reporting and suitable indictors developed for measuring progress with regard to the achievement of the SDGs.

A focus on sustainable chemistry in future chemicals management should be formulated in a political declaration and introduced into the OPS and ICCM5. For this it will be necessary to develop a common understanding of Sustainable Chemistry with the many SAICM stakeholders, whereby – as the project showed – it makes no sense to seek fixed and lastingly valid definitions. ISC_3 and das ISCnet will help to ascertain what can be regarded as Sustainable Chemistry and what cannot. That is why good examples of sustainable chemistry are essential, including ones from developing and emerging countries and ones for sustainable chemical products (in the corresponding applications). Examples can come from low-tech as well as high-tech areas. Beyond the discussion on chemicals themselves (Green Chemistry), interdisciplinary and intersectoral discussions are needed in which users of chemicals must be involved; in addition, a linking to SDG topics, such as climate protection, occupational safety or health are very important. ISC_3 can function here as an information broker for concrete projects.

6.2 ISC_3

Whilst at the beginning of the project defining and delimiting the term “Sustainable Chemistry” was seen as an important task for ISC_3,the project work and numerous discussions with experts and stakeholders showed that the portrayal of Sustainable Chemistry as an overarching concept which inter- and transdiciplinary focus is appropriate and open for further development. Through its analysis of concrete projects, processes, services and innovations, ISC_3 can make a rapid contribution to developing a guiding principle and a vision for Sustainable Chemistry. By naming clearly those practices, applications and products which are not sustainable, ISC_3 will prevent misuse of the term so that it cannot be used as an arbitrary label. Even if the role of ISC_3 is primarily to provide information and facilitate discussion, it must nevertheless – especially in view of the information converging and assessed exclusively at the centre – claim for itself the prerogative to interpret sustainable chemistry.

In detail, the following recommendations can be made:

Study No. 2 showed that there is a major need for concrete objectives and indicators which go beyond the simple consideration of chemical substances, since Sustainable Chemistry does not stop at synthesis (Green Chemistry, Green Engineering) but instead must also be usable for users and applications.

In the area of communication, story-telling examples play a key role. These include the following topics (not exclusive):

- New business models, such as chemical leasing
- Sustainable interfaces which are not just tackled unilaterally, e.g. when foregoing critical chemicals for climate action reasons or when clarifying the reusability of "green" chemicals too after the end of product use ("The better is the enemy of the good")

The following supplementary roles – especially following the discussion at the Final Conference – can be documented:

- Contact point for investors
- Analyzer of the applicability of Sustainable Chemistry for the Agenda 2030
- Information broker

Important tasks are:

- Implementation of transdisciplinary projects involving stakeholders from different groups (e.g. industry and NGOs), for example in the health sector, waste management or remediation of contaminated sites
- Occupational safety in the chemical industry and user sectors with the unions as important stakeholders
- Production of (further) training materials
- Organisation of summer schools for Sustainable Chemistry on different continents
- Search for further multipliers outside the area of chemicals
- Cooperation with Regional Centres of the Multilateral Environmental Agreements
- Fostering of partnerships between enterprises and research, mediation of tandem partnerships (e.g. between an industrial and a developing country)
- Support in developing curricula, awareness raising in education and training
- Implementation of the Sustainable Chemistry concept in chemicals management in developing countries

ISC_3 can be a useful contributor to SAICM. What particularly needs to be considered here are the study and provision of solutions on the basis of sustainable chemistry for EPIs such as "lead in paint" or HSLEEP (Hazardous Substances within the Lifecycle of Electrical and Electronic Products). This could be supported, for example, by inviting SAICM stakeholders to summer schools. In addition, ISC_3 and its areas of activity ought to be presented in the framework of the SAICM Intersessional Process. This would correspond to its proposed role as a "science policy interface".

6.3 ISCnet

The first priority for ISCnet is to identify already interested stakeholder groups and attract additional ones. Many contacts were established over the past two years in the framework of different events. In addition, many parties have expressed their interest via the ISC_3 website.

5. Table: Prospective ISCnet members by type of organisation

Governmental organisations	Universities and research institutes
Federal Ministry for Economic Affairs and Energy, Germany	Addis Ababa University, Ethiopia
Federal Office for the Environment (BAFU), Switzerland	Center for Green Chemistry & Green Engineering at Yale, USA
Federal Ministry of Agriculture, Forestry, Environment and Water Management, Austria	Chinese Academy of Sciences, China
Department for Environment, Food & Rural Affairs, UK	Danish Technological Institute
Environment and Climate Change Canada	German Aerospace Center (DLR)
Ghana Environmental Protection Agency	EPFL, Switzerland
European Chemicals Agency (ECHA), Finland	Research Center Jülich, Germany
Organisation for Economic Co-operation and Development, Paris	Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT, Germany
General Secretariat of Research and Technology, Greece	Grand Valley State University, USA
Ministry of the Environment, Land and Sea, Italy	Green Chemistry Network (York), UK
Ministry of Environmental Protection of the People's Republic of China	Green Chemistry Institute of American Chemical Society, USA
Ministry of Infrastructure and the Environment, The Netherlands	IWW Rheinisch-Westfälisches Institut für Wasserforschung gemeinnützige GmbH, Germany
Regional Activity Centre for Sustainable Consumption and Production, Spain	KU Leuven, Belgium
UN Environment Chemicals and Waste Subprogramme Coordination Office, Kenya	Leuphana University of Lüneburg, Germany
United Nations Environment Programme	McGill University, Canada
United Nations Industrial Development Organisation (UNIDO)	Mendeleyev University, Russia
United Nations Institute for Training and Research	National Institute of Metrology, Quality and Technology, Brazil
Washington State Department of Ecology, USA	Öko-Institut e.V., Germany
Zambia Environmental Management Agency	Research Institute of Petroleum Industry, Iran

Governmental organisations	Universities and research institutes
	RWTH Aachen University, Germany
	Thünen Institute, Germany
	TU Berlin, Germany
	Universidad de Concepción, Chile
	Westphalian University of Applied Sciences, Germany
	University of Belgrade, Serbia and Montenegro
	University of Lagos, Nigeria
	University of Nottingham, UK
	University of Oran-1, Algeria
	Wuppertal Institute, Germany
Action Network on Pesticides and Alternatives in Mexico (RAPAM)	BASF SE, Germany
beyond benign, USA	Brightlands Chemelot Campus, The Netherlands
Center for International Environmental Law (CIEL), Switzerland	Braskem SA, Brazil
European Environmental Bureau (EEB), Belgium	DexLeChem, Germany
Greenpeace East Asia, China	DSM Innovative Synthesis B.V., The Netherlands
Health Care without Harm Europe, Belgium	Elekeiroz, Brazil
Industriegewerkschaft, Bergbau, Chemie, Energie (IG BCE), Germany	European Chemicals Industry Council (cefic), Belgium
International Campaign for Responsible Technology, USA	Evonik, Germany
International Chemical Secretariat (ChemSec), Sweden	International Council of Chemical Associations – ICCA, Belgium

Governmental organisations	Universities and research institutes
MVO Nederland	Lufthansa Technik AG, Germany
Pesticide Action Network Tunisia	NimkarTek Technical Services, India
	Outdoor Industry Association, USA
	Pfizer, UK
	SE Tylose GmbH & Co. KG, Germany
	Symrise AG, Germany
	Tarkett, France
	Tchibo GmbH, Germany
	Verband der Chemischen Industrie, Germany
Consultants	**Other**
N³ Thinking ahead, Germany	Kreab, Belgium
adelphi, Germany	Chemical Watch Research Ltd., UK
Dr. Roland F. Schroeder - Wissenschaftliche Beratung, Germany	Elsevier B.V., The Netherlands
NIUB Nachhaltigkeitsberatung, Germany	EURONORM GmbH, Germany
thinkstep AG, Germany	Green Chemistry and Commerce Council, USA
	International Centre for Chemical Safety and Security, Poland
	International Younger Chemists Network

Findings from the studies and discussions in the Advisory Council indicate that sustainability considerations in different geographical regions can lead to varying results, which is shown, for example, in the question of the use of specific renewable raw materials for the synthesis of platform or specialty chemicals. Attention should be paid to this when structuring the network in working groups (or suchlike).

All the main considerations concerning communication with and in the network were already presented in Chapter 4 and 4.4. At this point only a specific danger should be mentioned which accompanies a holistic approach such as that of sustainable chemistry: The vision of Sustainable Chemistry must in itself be so consistent that it is not possible without further ado to limit it to one main aspect

("cherry picking"). The vision must have such a sound scientific foundation that unilateral or ideological interpretations meet with rejection within the network. Examples of successful approaches and their review and assessment by ISC_3 play a significant role here. Scientific integrity, also when dealing with difficult assessments, are conducive to credibility and should take absolute precedence.

6.4 Pursuit of topics outside the project's remit

In the frame of the project work, topics were identified in conjunction with the studies (see Chapter 3), in discussions with the Advisory Council, when attending conferences as well as in the accompanying study of relevant literature which could no longer be treated within the project but could or should play a role in the future work of ISC_3 – this is to be decided by its management.

6.4.1 Communication

There is confusion in many internet sources about the terms "Green Chemistry" and "Sustainable Chemistry", also in the case, for example, of the English-language Wikipedia article[29] on Green Chemistry, in which Sustainable Chemistry is wrongly treated as a synonym. The German-language Wikipedia article[30] on "Grüne Chemie" does not mention Sustainable Chemistry at all; the recently added article on "Nachhaltige Chemie", which is not conclusive.[31]

6.4.2 Assessment issues

Bioeconomy projects currently in the development stage – use of renewable resources and waste of biogenic origin as the basis for organic chemistry – could only be touched on within Study No. 2 (Chapter 3.2). An overview and assessment of these approaches by ISC_3 would seem advantageous, because there are interesting R&D priorities especially in Belgium, the Netherlands and Germany and the simple equation of "natural raw material = sustainable" (example: C1 products from sugar cane) is controversial. In addition, standardization in the area of biobased chemicals has begun and it appears advisable for ISC_3 to be involved or for a corresponding discussion to take place in ISCnet.

3D printing opens up completely new possibilities to make products from masterbatches. Apart from the wide variety of products which can be manufactured with a 3D printer (manufacture on an industrial scale, as it were), new compositions of materials can already result just through small changes to the recipes, which can massively impede the recycling of present mass products. On the other hand, the production of pharmaceuticals on demand for a patient could save large amounts of resources and energy in comparison to the current production and logistics chain. The question arises here too of how and whether the use of 3D printers can be developed in the sense of Sustainable Chemistry.

6.4.3 Advantages/disadvantages of negative/positive lists

The question of the use of positive lists was raised in the Advisory Council on the basis of the example of textile chemicals. For downstream users such lists are very valuable since they can then be sure that the substances do not have any unacceptable and critical properties and which - important in view of the global value chain for textiles - will not be objected to anywhere. On the other hand, positive lists could cement existing solutions and make it difficult for innovative and better solutions.

[29] https://en.wikipedia.org/wiki/Green_chemistry, accessed 9.6.2017
[30] https://de.wikipedia.org/wiki/Gr%C3%BCne_Chemie, accessed 9.6.2017
[31] https://de.wikipedia.org/wiki/Nachhaltigkeit_(Chemie), accessed 13.7.2017

Negative lists as information for chemicals users are popularly compiled from official guidelines. There is a risk here that a substance rightly not approved for specific applications is substituted due to such restrictions by perhaps less sustainable solutions in other applications where it could be used perfectly wisely and safely.

ISC_3 could identify examples for both cases and use them to discuss the question of how such topics should be handled.

6.4.4 Analysis of interfaces

The setting of political priorities for certain fields of sustainable development (e.g. for several years now climate protection at global level, recently the topic of circular economy in the EU) often leads to all measures and innovations aimed at the respective main objective being regarded as "sustainable" and introduced. In many cases, critical side effects are overlooked in the process, such as occur, for example, in innovations for the lightweight construction of vehicles (energy saving, climate protection), which leads to a massive increase in materials diversity and in turn impedes the recycling of such vehicles to a major degree. Fortunately, the SDGs contain a large number of individual objectives in comparison to earlier agendas, which make an overview possible. This accommodates the holistic approach of Sustainable Chemistry, with which such interfaces can be assessed.

7 Project structure and organisational procedures

The project was already divided into "work packages" by the UBA in the Terms of Reference. Each individual company in the consortium - N^3 / Dechema / BZL – assumed responsibility for specific work packages. This structure is presented in Table 6, whereby those tasks and work packages (AP) added in the framework of the later contract are also taken into consideration. In cases where individual work packages were implemented by sub-contractors, a respective member of the consortium took charge of the coordination between the contracting party and the sub-contractor.

6. Table: Responsibilities for individual work packages (AP) and tasks in the project

AP	Description of the work package	Coordinator responsible	Partners responsible
1.	Foundation of ISC_3		
1.1	ISC_3 – Concept and structure	N^3	N^3, DECHEMA
1.2	ISC_3 – Implementation concept	N^3	N^3
2.	Advisory Council	DECHEMA	DECHEMA,N^3,BZL
3.	Foundation of ISCnet		
3.1	ISCnet – Identification and establishment of contacts	DECHEMA	DECHEMA,N^3,BZL
3.1	Communication strategy	DECHEMA	OFischer
3.2	ISC_3 website	N^3	ITU
3.2	ISCnet website	DECHEMA	OFischer
4.	Studies		
4.1	Sustainability initiatives and approaches in the chemical sector	BZL	BZL

AP	Description of the work package	Coordinator responsible	Partners responsible
4.2	Identification of priority topics in the field of Sustainable Chemistry	DECHEMA	DECHEMA,N³,BZL
4.3	The link between sustainable chemistry and sound management of chemicals	BZL	BZL,IFEU
5.	Conferences and communication		
5.1	ICCM4: Side Event	N³	N³,DECHEMA,ADO, BZL
5.2	"Conference on Mainstreaming Sustainable Chemistry"	DECHEMA	DECHEMA,N³,ADO, BZL
5.3	UNEA-2: Side Event	N³	N³,ADO
5.4	Active participation in conferences	N³	N³,DECHEMA
5.5	Strategy workshop	N³	N³,DECHEMA,BZL
0	Project management	N³	N³

Abbreviations: N^3 = N^3 Nachhaltigkeitsberatung Dr. Friege & Partner, DECHEMA = DECHEMA Gesellschaft für Chemische Technik und Biotechnologie e.V., BZL = BZL Kommunikation und Projektsteuerung GmbH, ADO = Akademie Dr. Obladen, ITU = Consist ITU Environmental Software, OFischer = ofischer communication, ifeu = Institut für Energie- und Umweltforschung Heidelberg

The project manager (Henning Friege, with Peter Wolfmeyer as his representative / N^3) was the main contact person constantly at the disposal of the contracting authorities UBA and BMUB. Interim and progress reports, project meetings at the UBA, many telephone conferences and papers produced at short notice formed a basis for the agreement of measures and decisions between the contracting authorities and the contractors. In order to cope with the wealth of materials and documents created in the project from an organisational perspective and to accelerate coordination, a joint internet platform (software: Confluence; technical support during the project: Consist ITU) with two separate areas was set up:

- In the first area, the contractor created and prepared documents which, following approval by the consortium partner responsible for the respective work package or the project manager,
- Were then agreed and finalized in a second area to which both the contracting authorities and the contractors were given access.

The consortium of contractors organized its work amongst others by means of monthly telephone conferences and to-do lists compiled for each work package and continuously updated. Translations into English and the proofreading of most of the documents produced by the consortium and intended for publication (reports, website) were the responsibility of a native speaker (Sharon Oranski, N^3).

In order to agree on publications quickly (website content, inclusion of conferences in the calendar on the website etc.), an editorial team was set up (Christopher Blum (UBA), Barbara Zeschmar-Lahl (BZL), Alexis Bazzanella (Dechema)) as well as an "arbitration board" (Hans-Christian Stolzenberg (UBA), Henning Friege (N^3)) for cases where opinions might differ. The editorial group coordinated its work each month via a telephone conference. This made it possible to publish highly topical announcements on the website. For the newsletter planned from October 2016 onwards, N^3 set up a topic depository which was continuously updated and agreed with the UBA. The newsletters were published promptly by the project assistant (Gisela Buhren-Goch / N^3) after their approval by the UBA.

The project manager took care of the interfaces between the work packages as well as their interdependent deadlines and monitored the time plans and the quality of the documents produced. Enquiries

from parties interested in the network were processed by the project manager with respect to their content and a list of such interested parties compiled in the framework of work package 3.1.

8 Time plan and project implementation

7. Table: Time plan and project implementation

Month	Activities, decisions…	AP
27.2.2015	Award of the contract to the consortium of N³/DECHEMA/BZL	
19.3.2015	1st Project Meeting	0
Mar-May 2015	Concept and roles for the centre / Stakeholder analysis / Assessment of the status quo in the discussion on Sustainable Chemistry / Ideas on the composition of the Advisory Council / Establishment of a joint internet-based work platform	1.1 2 0
22.5.2015	2nd Project Meeting	0
30.5.2015	1st Interim Report	0
June-July 2015	Decision on ISC_3 as the name for the centre / Appointment of Advisory Council members / Decision on accelerating work on the website / Preparation of ICCM4 /	1.1 2, 3.2 5.1
31.7.2015	1st Progress Report	0
31.8.2015	3rd Project Meeting	0
Aug-Oct 2015	Discussions on ISC_3 with representatives of internat. organisations / Draft structure for ISC_3 / ISC_3 logo / Appointment of Advisory Council / Preparation and implementation of side event at ICCM4	1.1, 1.2 2 5.1
31.10.2015	2nd Progress Report (ICCM4)	0
Oct-Nov 2015	Development of budget for ISC_3 / Preparation of 1st Advisory Council meeting, discussions with individual members / ISC_3 website online / Ideas on structure and contents of the studies	1.2 2, 3.2 4.1-4.3
30.11.2015	2nd Interim Report	0
14.12.2015	1st meeting of the Advisory Council: Election of chair and co-chair, formulation of expectation on ISC_3, discussion of topics and structure of the studies, adoption of the Terms of Reference	2
Dec 2015-Mrz 2016	Stakeholder analysis for the network / Structure of the studies / Decision to apply for a side event at UNEA-2 / Ideas on ways to expand communication activities	3.1, 4.1-4.3 5.3
26.1.2016	Extraordinary project meeting	0
23.3.2016	3rd Interim Report	0
Apr-Jun 2016	Preparation of the 2nd meeting of the Advisory Council / Concept and stakeholder analysis in preparation of the network / Further functionalities for ISC_3 website / Compilation of first drafts for the studies	2 3.1, 3.2 4.1-4.3
23.5.2016	Additional contract from the UBA for the side event at UNEA-2	
15.6.2016	3rd Progress Report (UNEA-2)	0

Month	Activities, decisions…	AP
23.-24.6.2016	2nd meeting of the Advisory Council and workshop: Exchange on the results of the conferences (amongst others UNEA-2), ideas for a vision for ISC_3, discussion of the drafts for the studies	2
21.7.2016	4th Project Meeting	0
Jul-Nov 2016	Decision in favour of ISCnet as the name for the network / ISCnet logo / Preparation of the 3rd Advisory Council meeting / Definition of goals and tasks of ISCnet / Start of internet newsletter / Near-completion of the studies / Presentation of ISC_3 at various internat. conferences / Postponement of the Final Conference from Feb 2017 to May 2017	1.1 2 3.1,3.2 4 5.2,5.4
27.9.2016	Additional contract from the UBA, amongst others for additional communication tasks in the project	
1.-2.12.2016	3rd meeting of the Advisory Council and workshop: Discussion of the relationship of Sustainable Chemistry to transition management, the circular economy approach and the EU's Non-toxic Environment Strategy; Approval of the vision for ISC_3; Preparation of the Final Conference; Discussion of the communication strategy; presentation of the final studies	2
Dec 2016-Mar 2017	Completion of the communication strategy for ISC_3 and ISCnet / Three further newsletters / Creation of a website for ISCnet / Submission of the studies / Presentation of ISC_3 at further internat. conferences / Drawing up of the programme for the Final Conference / Prolongation of the project to the end of June	3.1 3.2 4.1-4.3 5.2,5.4 0
28.2.2017	5th Interim Report	0
Apr-June 2017	Five further newsletters / Preparation and implementation of the Final Conference on 17.-18.5.2017 / Transfer of ISC3.org, iscnet.org etc. domains to the contracting authority / Securing of documents stored on the platform /Final Report	3.2 5.2 0
30.6.2017	End of the project	

AP = work package (cf. UBA Terms of Reference)

9 List of Annexes

1. ICCM4 side event programme, 1.10.2015
2. Agenda of the 1st meeting of the Advisory Council, 14.12.2015
3. Terms of reference for the Advisory Council, 14.12.2015
4. UNEA-2 side event programme, 23.05.2016
5. Flyer (for UNEA-2), 23.05.2016
6. Press mailing UNEA-2 (Umweltbundesamt, 01.06.2016)
7. Agenda of the 2nd meeting and the 1st workshop of the Advisory Council (23.-24.06.2016)
8. Flyer (15.09.2016)
9. Agenda of the 3rd meeting and the 2nd workshop of the Advisory Council (01.-02.12.2016)
10. Flyer - invitation to the Final Conference (March, 2017)
11. Abstract and presentation for Study 1 – Reporting of Sustainable Chemistry Approaches (Green & Sustainable Chemistry Conference, 15.-17.05.2017)
12. Abstract and presentation for Study 2 – Indicators for Sustainable Chemistry (Green & Sustainable Chemistry Conference, 15.-17.05.2017)
13. Abstract and presentation for Study 3 – Process Innovations (Green & Sustainable Chemistry Conference, 15.-17.05.2017)
14. Conference on Mainstreaming Sustainable Chemistry – Launch of ISC_3 and ISCnet (programme booklet and final list of participants, 17.-18.05.2017)