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G·STIC 2017 GLOBAL SCIENCE TECHNOLOGY & INNOVATION CONFERENCES

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GLOBAL SCIENCE TECHNOLOGY & INNOVATION CONFERENCE 2017: 23-25 OCTOBER 2017

The 2017 Global Science, Technology & Innovation Conference (G-STIC 2017) took place from 23-25 October 2017 in Brussels, Belgium, with the objective of accelerating the development, dissemination and deployment of technological innovations that enable the achievement of the Sustainable Development Goals (SDGs).

The conference was hosted jointly by VITO (The Flemish Institute for Technological Research, Belgium) and its international partners, the African Centre for Technology Studies, the Asian Institute of Technology, the Indian Institute of Technology and The Energy and Resources Institute. It was the first in a series of Global Science, Technology and Innovation Conferences. More than 1,000 participants, representing policymakers, technology researchers, business and industry captains, and civil society, attended the meeting.

During the conference, discussions were organized around thematic clusters on: agroecology for sustainable food systems; circular economy and the role of industry; urban electric mobility; urban design and sustainable building; smart water solutions; waste water as a resource; energy positive communities; and sustainable technology and development. Topical sessions were also held on bamboo, carbon dioxide (CO2) as a resource, and information and communications technology (ICT) as enabling technology.

At the closing of G-STIC 2017, the outcomes were reflected in the draft Chairpersons' summary, available on the G-STIC website: <https://www.gstic.org/>. Participants will have an opportunity to comment on the summary in the two weeks after the conference, following which the final version will be made available. During the closing session, it was also announced that the next G-STIC will take place in Brussels in November 2018.

A BRIEF HISTORY OF G-STIC

In 2015, the international community adopted both the 2030 Agenda for Sustainable Development and the Paris Agreement, thereby setting clear goals to shift the world unto a sustainable development path. This path requires limiting the global average temperature rise to well below 2 degrees Celsius, set by the Paris Agreement, and achieving the ambitious SDGs of the 2030 Agenda. To achieve these two global objectives, a transition is needed to more resilient economic and social development models, and this in turn requires the active participation of all sectors of society to contribute to the worldwide implementation of new technologies, and new ways of producing and consuming.

Within that context, a number of independent and not-for-profit technological research institutes, under the lead of VITO, have teamed up to organize a series of Global Science, Technology and Innovation Conferences.

Bringing together key stakeholders from the science, technology and innovation communities (including the private sector), the aim of the G-STIC series is to help catalyze change, strengthen the means of implementation and revitalize the global partnership for sustainable development. The conference series aims to provide all stakeholders with a forum to review, discuss and identify internationally-relevant technological innovations that can steer the world toward a more sustainable development-oriented course.

One of the objectives of G-STIC is to communicate key findings and messages to decision-makers at local, national and international levels and to industry leaders, to help them set up institutional, regulatory, policy, and business frameworks favorable for realizing a new sustainable development paradigm and achieving the SDGs. The G-STIC also seeks to: contribute to deepening citizen engagement, especially among the youth; and help harness the power of a myriad of individuals across the world to shape the future through directed and mindful technological innovation.

IN THIS ISSUE

The *G-STIC Bulletin* is a publication of the International Institute for Sustainable Development (IISD) <info@iisd.ca>, publishers of the *Earth Negotiations Bulletin* © <enb@iisd.org>. This issue was written and edited by Kati Kulovesi, Ph.D., Aaron Cosbey, and María Gutiérrez, Ph.D. The Digital Editor is Herman Njoroge Chege. The Editor is Tomilola Akanle Eni-ibukun, Ph.D. <tomilola@iisd.org>. The Director of IISD Reporting Services is Langston James "Kimo" Goree VI <kimo@iisd.org>. Specific funding for coverage of G-STIC 2017 has been provided by VITO. IISD can be contacted at 111 Lombard Avenue, Suite 325, Winnipeg, Manitoba R3B 0T4, Canada; tel: +1-204-958-7700; fax: +1-204-958-7710. The opinions expressed in the *Bulletin* are those of the authors and do not necessarily reflect the views of IISD. Excerpts from the *Bulletin* may be used in other publications with appropriate academic citation. Electronic versions of the *Bulletin* are sent to e-mail distribution lists (in HTML format) and can be found at http://enb.iisd.org/. For information on the *Bulletin*, including requests to provide reporting services, contact the Director of IISD Reporting Services at <kimo@iisd.org>, +1-646-536-7556 or 300 East 56th St., 11D, New York, New York 10022, USA.

(L-R) **Dirk Fransaer**, VITO (Flemish Institute for Technological Research); **Ajay Mathur**, Director General, TERI; **Ambuj Sagar**, Indian Institute of Technology Delhi; **Surendra Shrestha**, AIT; and **Kennedy Orwa**, African Centre for Technology Studies

G-STIC is guided by an International Advisory Committee composed of more than 30 senior representatives from United Nations (UN) agencies and participating expert institutes in the G-STIC thematic clusters or more cross-cutting themes. The Committee is responsible for advising the co-hosts on the strategy and preparation of the conference as a whole.

REPORT OF G-STIC 2017

HIGH-LEVEL PLENARY OPENING SESSION

G-STIC 2017 opened on Monday morning, 23 October 2017. Dirk Fransaer, Managing Director, VITO, emphasized the G-STIC's focus on how technology can contribute to achieving the SDGs and highlighted the importance of integrated technologies that contribute to solving more than one problem at once. Calling for a paradigm shift, he said discussions at G-STIC should culminate in position papers that will be communicated, *inter alia*, to the UN General Assembly.

Ajay Mathur, Director General, The Energy and Resources Institute (TERI), argued that "the future cannot simply be more of the past," noting that G-STIC is about finding a different path along the lines encapsulated in the SDGs. He stressed the importance of dialogue wherein the technology and innovation communities can speak with policymakers and civil society. He expressed hope that the results of G-STIC would complement and feed into similar events, such as the World Summit for Sustainable Development organized by TERI.

Noting the "immense and complex" challenges ahead, Ambuj Sagar, Indian Institute of Technology, highlighted the global and annual nature of G-STIC and the formation of a community of individuals across disciplines and countries working to advance technological innovation and implementation.

Surendra Shresta, Asian Institute of Technology, expressed hope that G-STIC would help bring together the public and private sectors with innovative technologies serving as "the glue" to enable achievement of the SDGs.

Kennedy Orwa, African Centre for Technology Studies, said G-STIC 2017 comes at a critical and timely moment, as it aims to highlight ways to scale up technological innovations and also take up the challenge of linking with policymakers who can facilitate the fast adoption of these technologies.

Elioda Tumwesigya, Minister of Science, Technology and Innovation, Uganda, identified science, technology and innovation as drivers of growth and transformation. On expectations, Tumwesigya highlighted G-STIC 2017 as a networking opportunity and called for a new or strengthened multilateral task force, organization or institutional framework to focus on issues related to the development, deployment and dissemination of technology.

Her Royal Highness Mona Al-Said, Sultan Qaboos University, Oman, noted that her university has recently created a Sustainable Energy Research Centre, a multi-disciplinary effort to help Oman address its energy challenges. She stressed that the fundamental challenge of sustainable development compels an equally fundamental change in the nature of higher education.

Her Royal Highness **Mona Al-Said**, Sultan Qaboos University, Oman

U.P. Singh, Ministry of Water Resources, River Development and Ganga Rejuvenation, India

U.P. Singh, Ministry of Water Resources, River Development and Ganga Rejuvenation, India, spoke on challenges facing the Ganges River, known in India as "a divinity in flow." He noted impacts related to the intense and varied uses of the river, where more than two million people "take dips" every day, and the difficulties not only of installing but also maintaining infrastructure. Singh said he looked forward to linking with technology providers at this conference.

Li Yong, Director General, UN Industrial Development Organization (UNIDO), welcomed G-STIC as a platform for exchange. He discussed UNIDO's relevant activities, including the Sustainable Cities programme and the Global Cleantech Innovation Programme.

G-STIC moderator Jan Staman, Staman Consultancy, stressed that G-STIC is not a "normal talk-based conference," but rather is an effort to create impact and change, including by creating communities of practice, an enterprise aimed at putting science, technology and innovation in the service of the SDGs. He urged participants to "get out of their comfort zones" and engage in a process the organizers have centered on the principles of participation and effectiveness.

CEO PANEL ON OCEANS

On Tuesday morning, a CEO panel on oceans took place, chaired by Christine Valentin, World Ocean Council. She stressed the vital importance of oceans, the negative impacts they sustain as a result of climate change and human activities, and how relatively little we know about them.

Mikael Thinghuus, Royal Greenland A/S, emphasized that while innovative technology exists, what is missing for the sustainable management of oceans is strong rules and governance.

Pål Bakken, Seaweed Energy Solutions, described the ocean's great potential in unconventional activities such as aquaculture and seaweed farming. He highlighted that unlike land masses, the ocean is in constant rapid motion and fundamentally inter-connected, so it calls for different kinds of policy responses. He questioned whether state-based policy making and the 200-mile Exclusive Economic Zone limits make sense in that context.

Eric Antoons, Parwind, described his group's ventures in offshore windfarms, in which they have invested over €2 billion. He viewed the industry's dependence on subsidies as a challenge given the pressure to reduce government support, but said that pressure is beneficial since it forces a focus on cost reduction and efficiency.

Bert Groenendaal, ATSEA Technologies, said that while the seaweed cultivation and processing sector is already big business, it is still growing fast and its scope is broadening to include textiles, bioplastics and bioremediation. He emphasized the need for upscaling and for offshore ventures, and underlined the importance of cross-sectoral collaboration.

Bert Groenendaal, ATSEA Technologies

Daan Schalck, Port of Ghent, spoke on the role that ports can play in the creation of added value, and stressed that ports need to shift their strategic goals from a focus on volume to focusing on sustainability, energy and climate. He drew attention to new forms of energy and called for collaboration between government and the science, technology and innovation communities.

Chris Coyle, Exocetus Autonomous Systems, described his company's work in designing, manufacturing and servicing underwater drones, largely used for mapping. He noted that in the early stage of his company's work, he focused on impact investors, making a corporate social responsibility case for investment, but that it became increasingly obvious that this work had critical economic value, underpinning renewable energy and other ocean-related investments.

Alain Bernard, Demed Group, noted that Demed is the first builder of hybrid dredgers, capable of operating on clean natural gas. He argued that global solutions will derive from what he called the "blue cluster" – inter-sectoral collaboration in ocean-related sectors such as chemicals, agri-food, fisheries, energy and others.

During the subsequent discussion, panelists elaborated on synergies and impacts. They noted the positive growth of sea-life around offshore windfarms and seaweed farms. They underscored cross-sectoral collaboration and reiterated the need for strong government and controls, particularly at high seas. Panelists also noted that money is available but legislation is much too slow.

Participants' questions addressed governmental cooperation on ocean-related challenges. It was noted that there are existing forums in which the government, industry and academic actors gather separately, but that there is a need for more integrated collaboration. Several participants bemoaned the lack of global governance related to oceans, pointing out that no country

can tackle ocean problems unilaterally. A private sector representative noted that even costly regulations are preferable to no regulations, because they give certainty to investors.

Bernard noted different types of plastic pollution in the ocean, requiring different approaches. He emphasized the importance and urgency of the problem, and expressed confidence that solutions will eventually be found. Panelists also noted the potential for synergies between desalination and clean energy in places like the Middle East. Bakken expressed serious concern with acidification and seaweed production, and called for creating a forest in the sea as an efficient way of sequestering carbon while improving sea life.

Alain Bernard, Demed Group

THEMATIC CLUSTERS AND TOPICAL SESSIONS

From Monday afternoon to Tuesday evening, breakout sessions were held on the following thematic clusters:

- agroecology for sustainable food systems;
- circular economy and the role of Industry 4.0;
- energy positive communities;
- sustainable technology and development;
- urban electric mobility;
- urban design and sustainable building;
- smart water solutions; and
- waste water as a resource.

Topical sessions took place on the following themes:

- ICT as enabling technology;
- carbon dioxide (CO2) as a resource;
- bamboo; and
- innovative building materials.

IISD Reporting Services covered a selection of these thematic clusters and topical sessions. This report contains below, a full summary of the thematic clusters and topical sessions covered by *IISD Reporting Services,* as well as a short summary of the findings of the other sessions not covered.

AGROECOLOGY FOR SUSTAINABLE FOOD SYSTEMS: The thematic cluster on agroecology for sustainable food systems was considered on Monday and Tuesday, chaired by Lim Li Ching, Third World Network – The South Centre.

Opening the discussion on Monday, Li explained that while industrial agriculture has produced large volumes of food, it has done so at great cost to the environment, human health and animal welfare, while doing little to address the root causes of poverty and hunger. She said agroecology can increase productivity, renew soil fertility and sustain yields over time, while diversifying farms and landscape, building complexity and resilience, and mitigating climate change.

In a keynote presentation, Emile Frison, International Panel of Experts on Sustainable Food Systems (IPES-Food), and International Scientific Committee on Sustainable Food Systems of the Daniel and Nina Carasso Foundation, called for a paradigm shift from industrial agriculture to diversified agroecological systems. He identified lock-ins hindering this shift, including: concentration of power; export orientation; short-term and compartmentalized thinking; expectation of cheap food; and success measured in tons per hectare. He called for new indicators for sustainable food systems, such as nutrient content per hectare, total biomass, resource efficiency, ecosystem services, and resilience of farmers' livelihood.

Participants of the session on Agroecology for Sustainable Food Systems

Clara Nicholls, University of California, Berkeley, and Latin American Scientific Society of Agroecology (SOCLA), addressed the impacts of climate change and extreme weather events on agricultural yields. She noted the resilience shown by agroecological systems traditionally employed by small farmers in various parts of Latin America and Africa, saying these avoid loss of biodiversity and decrease vulnerability.

Million Belay, Alliance for Food Sovereignty in Africa, presented case studies from Africa proving that agroecology contributes to the achievement of the SDGs. He underscored the need for farmer-managed seed systems and the critical role of farmer groups in spreading agroecological practices.

Zoraida Calle, Centre for Research on Sustainable Agriculture, Colombia, presented on silvopastoral systems as an agroecological approach to sustainable livestock production. Noting that complex problems demand complex approaches, she stressed the importance of pilot farms and farmer-to-farmer training, and of "silvopastoral heirs" to ensure cross-generational continuity.

Vibha Dhawan, TERI, presented on integrated nutrient and pest management for ecosystem sustainability. She highlighted various pest control technologies developed by TERI, including microbial pesticides, biofertilizers and biopesticide extracted from eucalyptus leaves. She stressed the importance of pest control as opposed to pest eradication, drawing attention to strict monitoring and responsible use of chemicals.

Discussions addressed, *inter alia*: social resistance in the face of the concentrated power in the agriculture and food production industries; translating lessons from agroecology into policy recommendations; and the critical role of subsidies.

Underlining diversity as the basis for sustainable development, Parviz Koohafkan, World Agricultural Heritage Foundation, presented on the dynamic conservation of Globally Important Agricultural Heritage Systems, which include the Ifugao rice terraces in the Philippines, oases in the Maghreb, or the Satoyama system in Japan. He highlighted the positive effect of product labeling and ICT tools such as geo-referencing and geo-tagging.

Parviz Koohafkan, World Agricultural Heritage Foundation

Eugenio Tisselli, Swiss Federal Institute of Technology, presented on ICT for agroecology among smallholder farmers. He elaborated on the Sauti ya wakulima project in Tanzania where farmers actively participate and conduct research on the effectiveness of agroecological practices, building a live, open-source, publically accessible repository of evidence and a platform for advocacy.

Bart Deronde, VITO, spoke on the use of remote sensing for index-based insurance. He drew attention to the benefits of insuring yields to secure income and reduce financial loss in the face of climate change, and noted that remote sensing and geo-ICT applications are powerful tools to expand and improve index-based insurance in times of uncertainty.

In the ensuing discussion, participants addressed, *inter alia*: intellectual property rights and the ownership of data resulting from ICT; the potential risks of de-skilling among farmers as a result of ICTs; and the lack of impact studies. They also discussed the implications of scaling up agroecological systems, and the importance of the context in which agroecological practices take place.

Summarizing, Caterina Batello, FAO, highlighted bottom-up approaches and integrated, multiple solutions. She noted that agroecological principles apply universally but that practices are locally specific, to be shared through farmer-to-farmer networks, and stressed the need to reconnect producers and consumers. She also identified gaps, including the limited number of economic analyses, and links to the energy sector.

Discussions on this thematic cluster continued throughout the day on Tuesday.

Findings: The draft Chairpersons' summary indicates that agroecology applies ecological principles to the design, technology and management of agriculture and food systems. Its technologies and practices adapt to local conditions, diversify farms and farming landscapes, increase biodiversity and nurture soil health, such that farms can provide their own soil organic matter, pest regulation or weed control without resorting to extensive use of external chemical inputs. The solutions identified to overcome the barriers to a shift towards agroecological practices include:

- reorienting agricultural policies and significantly increasing funding to support agroecology;
- dismantling incentives and subsidies for industrial and high-emissions agriculture;
- refocusing research and development to bottom-up approaches that recognize farmers' knowledge; and
- strengthening existing farmer knowledge and innovation.

WASTE WATER AS A RESOURCE: This thematic cluster was considered on Monday and Tuesday, chaired by Ger Bergkamp, ARCOWA. Opening the session on Monday, Bergkamp underlined the challenges and potential of science and innovation in contributing to water-related SDGs.

Glenn Daigger, University of Michigan, stressed that the world is in the midst of the most significant transition in the history of the water profession. He underlined that: adopting a

new technology is not a linear process; the technology s-curve involves an exponential change powered by "learning by doing"; and such processes typically take 20 years to run their course.

Ludo Diels, VITO, presented on the Andicos™ process, which involves enriching sewage flows with household organic waste, using the result to produce biogas. Hypothetically applied to treat effluent in Kanpur, India, the system would generate its own power and €53,000 worth of surplus energy annually, avoid greenhouse gas (GHG) emissions similar to those of a coal-fired electricity generating plant, and discharge clean water.

Gang Liu, Delft University of Technology, noted that China has the world's second-highest processing capacity for sewage. He described a new era of wastewater treatment in China, aimed at reducing costs, while also reducing GHG emissions and recovering valuable resources such as water and nutrients.

Peter De Smet, Clean Energy Invest, talked about an urban development project in Ghent, Belgium, that will separate black- and grey-water effluent, with the latter contributing to district heating and the former producing biogas for energy, with treated water going to a nearby industrial consumer. He explained that the project had been several years in development, with patient investors, and has provided "critically important learning."

Tineke Hooijmans, UNESCO-IHE Delft, described a Dutch-Indian cooperation effort that will see a pilot wastewater treatment plant installed on one of the biggest drains in New Delhi. Providing a model that could be adopted in other Indian mega-cities, it will recover energy and nutrients from urban wastewater, and will yield clean pathogen-free water.

On Monday afternoon, a multi-stakeholder panel with Andre Dzikus, UN-Habitat, Durk Krol, WSSTP, and Janet Molina Maturano, Ghent University, commented on the presentations.

During the discussion, it was suggested that the learning curve does not take place in a lab, but rather on the field. Others observed that demonstration projects are important for allowing investors to confidently support innovative technologies; only those interested in social impact tend to invest at early stages of adoption. It was stressed that there is plenty of money for research and development but not enough for commercialization.

Discussions continued throughout the day on Tuesday.

Findings: The draft Chairpersons' summary indicates that wastewater treatment does not have to be a major cost to local governments. By recovering energy from waste streams, governments can lower sewage treatment costs. If water, energy, nutrients and other useful materials are recovered from the waste stream, they can even build the wastewater treatment process into a cost-neutral or cost-positive one. This demands, however, a new approach to wastewater treatment, involving different government departments (including water, energy and agriculture), adapting laws and regulations (to allow spiking wastewater with organic waste, for example), and changing waste collection infrastructure (to concentrate waste streams, for example).

CIRCULAR ECONOMY AND THE ROLE OF INDUSTRY 4.0: The thematic cluster was considered on Monday and Tuesday. Chairing the session on Tuesday, Karen

Antonis Mavropoulos, International Solid Waste Association

Hanghøj, European Institute of Innovation and Technology (EIT) Raw Materials, explained that EIT brings together business, education and research, and aims to develop raw materials into a major strength for Europe.

During a keynote address, Antonis Mavropoulos, International Solid Waste Association, emphasized the ongoing transition to the fourth industrial revolution (Industry 4.0) that will transform the planet, ecosystems and business. He drew attention, *inter alia*, to robotic recycling as an efficient waste sorting solution, including for e-waste. Mavropoulos gave the example of Apple, the technology company, noting that the company will now become a closed-loop industry due to Liam, a recycling robot that can disassemble devices fast and at 0.2% of the cost of human labor. He highlighted, however, that there are important choices to be made regarding the sustainable character of Industry 4.0 and that many barriers are social rather than technical, for example, related to changing ownership patterns. He noted that the circular economy can provide the framework for developing a sustainable Industry 4.0.

Marcin Kulik, Aravato, presented on his company's business model that helps other companies transform into circular economy actors such as through the use of big data, artificial intelligence, blockchain and predictive analysis.

Leen Osterloh, Tomra Sorting Solutions, emphasized that there is "value in waste" and highlighted technical opportunities to significantly increase recycling quotas. He explained that using many different kinds of sensors will sort all types of waste into useful fractions for recycling and noted that smart data enables several new opportunities.

Bhargavi Nagendra, Public Affairs Centre, Bangalore, presented on a mobile application that helps collect real-time data concerning waste collection from citizens, providing a platform for dialogue and helping to address problems related, *inter alia*, to data and communication.

Jef Peeters, KU Leuven, discussed technical considerations related to the circular economy, highlighting: ecodesign and policy support; increasing electrification; and product identification and sorting, including with robots.

During the ensuing discussion, participants addressed, among other things, the job implications of the circular economy, drawing attention on one hand to gradual labor shifts between sectors and loss of jobs from automatization and, on the other hand, to job creation associated with financial benefits for companies from switching to a circular economy.

On Tuesday afternoon, Keith Alverson, UN Environment, emphasized unintended consequences of technology and technological innovation. On past examples, he mentioned the combustion engine, which created many benefits but is driving climate change. He stressed the need to consider the waste consequences of new technologies, such as used electric vehicle batteries or old solar panels. He also highlighted that transformations can happen very quickly, recalling that New York shifted from horses to cars, and Beijing from bicycles to cars, both in less than 20 years.

Presenting on the Asia Pacific region, Choudhury Rudra Charan Mohanty, UN Centre for Regional Development, highlighted the Adelaide 3R (Reduce, Reuse, Recycle) Declaration on the Promotion of Circular Economy adopted in 2016, explaining that implementation of the circular economy in the South Pacific is happening at different levels.

Carlos Montalvo, TNO/INNO4SD, explained that small and medium-sized enterprises (SMEs) have a "high birth and death rate" with a life horizon of 3-5 years and noted that it is difficult to upscale new processes. He stressed that innovative SMEs need specific attention and financial support.

Jiska Verhulst, The Flanders Public Waste, Materials & Soil Agency, presented on successful stakeholder involvement experiences from Circular Flanders, stressing: shared ambition; a single focal point acting as a flywheel; and engagement and willingness to act on all levels.

Mohammed Sulaiman Al-Harthy, Oman Environmental Services Holding Company "be'ah," discussed the challenges of the circular economy in the Middle East and North Africa region, noting for instance, that the region is a net importer of goods, foods, fuel and natural resources, and has weak environmental laws and regulations. He outlined how Oman has taken a pro-active approach to tackle challenges and develop solutions related to waste management and the circular economy, including strong investment in infrastructure development.

Thomas Wagner, Collaborating Centre on Sustainable Production and Consumption, discussed how the younger generation can adopt both the sharing and circular economy, noting that it is important to understand the Millennials, as they will be the professors and leaders in 2050.

During the subsequent dialogue, participants discussed: illegal workers; artificial intelligence; resource efficiency; and compensation for "short-term losers."

In closing, Karl Vrancken, VITO, highlighted that many technologies already exist but need to be made available to the field of circular economy. He reflected on specific promising technologies such as "digital twins" and stressed the need to exchange regional experiences. He stressed the importance of a vision, including a 2030 perspective, and noted the role of the SDGs in guiding the way.

Karl Vrancken, VITO

Findings: The draft Chairpersons' summary indicates, among other things, that the circular economy represents a fundamental alternative to the currently predominant linear "take-make-consume-dispose" model. A new model is needed to ensure that material usage per unit of functionality can be minimized, and to manage materials to reduce waste and avoid pollution. The value chain needs to be revisited based on principles of the circular economy, and customers need to be provided with services rather than throw-away products. From an industry viewpoint, the circular economy generates the need for advanced sorting and recycling solutions, efficient materials-processing solutions and manufacturing methods that are designed for circularity, and platform technologies that allow connectivity and interoperability.

The summary also outlines that "Industry 4.0" refers to a broad set of smart manufacturing and automation processes enabled by technologies such as the internet of things (IoT), big data & analytics, rapid prototyping (3D printing), augmented reality and blockchain technology. The various technologies covered by the concept of Industry 4.0 are crucial to facilitating a transition from a linear to a circular economy. To further the transition, a closer cooperation between the technology and business communities is needed, along with enabling policies and appropriate institutional, business and financial environments.

Turning waste into "new" raw materials in increasingly smarter and automated ways, Industry 4.0 facilitates a shift from waste thinking to materials management for circularity.

ENERGY POSITIVE COMMUNITIES: This thematic cluster was considered on Monday morning and afternoon through a joint session with the thematic cluster on sustainable technology and development, and individually throughout the day on Tuesday.

Chairing the session on Tuesday afternoon, Dolf Gielen, International Renewable Energy Agency, invited a panel of speakers to relate their success stories in innovation for

Dolf Gielen, International Renewable Energy Agency

community power. The session heard interventions from Sonia Dunlop, Policy Adviser, SolarPower Europe; Paul Kreutzkamp, co-founder and co-manager, Next Kraftwerke Belgium; Dr. Christian Chudoba, Founder and CEO, Lumenaza GmbH, Berlin; Frédéric Crampé, Founder, co-CEO & CFO, BeeBryte, Lyon; and Maarten Hommelberg, Innovation Manager, BredeStroomversnelling, Amsterdam.

In the discussion that followed, participants and panelists stressed the need for a new electricity market pricing model that adequately compensates conventional baseload providers. They noted that these providers are needed as backup for intermittent renewable energy supplies, but are facing pressure on profitability as renewable energy captures ever more of their peak pricing market.

Gielen then delivered a keynote address focused on grid-connected mini-grids. He explained that these are not an alternative to centralized grids, but a useful complement, with potential environmental and economic benefits. Their increasing use is being driven by innovations in energy and information technology, which is driving the development of new business models that allow consumers of electricity to be producers as well, selling to utilities and directly to other consumers.

Guy Vekemans, Energyville, moderated the remainder of the session, noting the focus on urban energy systems.

Peter Van Den Heede, Asea Brown Beveri (ABB), described connected micro-grids as a key component of distributed energy solutions. He expressed optimism that common standards would eventually replace proprietary standards for many system components, and noted that artificial intelligence, deep learning and new software will be instrumental in managing how those components interact. He noted examples of ABB micro-grids in Kenya, Australia and South Africa.

Dorothée Coucharrière, Blue Solutions, described the company's electric car-sharing project in Singapore. Starting as battery technology innovators, the firm evolved to become a producer of electric cars and buses, and from there to a turnkey provider of large-scale municipal systems that include charging points, software, vehicles and user interface. She said an initial contract to supply Paris was instrumental in fostering early-stage learning by doing.

Alessandro Medici, Power-Blox, described their scalable modular residential systems. Analogous to the laptop and internet in their evolution from early information technology, these products are distributed, connected and user-friendly, and capable of managing solar photovoltaic (PV), wind, e-mobile charging, peer-to-peer sales and other energy technologies in a grid-connected micro-grid setting.

Marisca Zweistra, Alliander, described City Zero (carbon) ENergy ("City-zen") demonstration projects in Grenoble and Amsterdam, running since 2014 and featuring a broad array of innovative energy solutions. These include: home-based inter-connected "virtual power plants" that regulate grid purchases and sales of solar-based power; vehicle-to-grid systems that can charge electric vehicles and also use them as power storage; and smart grid systems. She stressed the importance of such projects for identifying challenges.

Daisuke Takeda, Toshiba, described the advantages of battery storage in a renewable energy micro-grid setting, including smoothing out fluctuations in power flow and improving load factor; effects that had been proven in Toshiba's New Mexico demonstration project.

Vekemans then moderated a debate on priorities for grid-connected communities, featuring opening statements by Diego Pavia, InnoEnergy; Karin Widegren, International Smart Grid Action Network; Bert Gysen, VITO-Energy Ville; and Dolf Gielen. In subsequent discussions, the importance of consumers as agents was stressed. Participants noted that consumers' readiness to accept new technologies is critical, and that they can also act as operators, investors and learners. Participants also debated whether distribution service operators may have to eventually accept less grid reliability as new modes of energy production, consumption and storage disrupt their conventional systems.

In closing, Vekemans noted that the work of G-STIC in this area is ongoing, assuring participants that the rich discussion would feed into the continuing process.

Findings: The draft Chairpersons' summary indicates that energy-positive communities operate on a local, modular structured, sustainable energy system that generates and delivers renewable energy to meet the living and comfort needs within local communities. The positive impact of such demand-driven energy systems on local communities goes beyond the delivery of energy services. They also help reduce poverty, increase employment and improve quality of life through advancements in health, water supply, education and mobility, and have a positive impact on global climate targets as well. A clear outcome of G-STIC is that demand-driven, energy-positive community approaches are as important as, if not more important than, supply-driven centralized systems for achieving the energy-related SDGs. A paradigm shift is needed to ensure that: local, regional, national and international energy planning and provision give at least the same amount of attention to energy-positive community approaches as to centralized energy systems, and that the technologies used to deliver energy to end users reflect both a decentralized, bottom-up and a centralized, top-down approach.

Sophie Wilmet, European Chemical Industry Council

CO2 AS A RESOURCE: On Monday, the topical session on CO2 as a resource took place, chaired by Heleen De Wever, VITO.

Sophie Wilmet, European Chemical Industry Council, discussed CO2 valorization, stressing links with several SDGs and policy. On possible applications, she identified, *inter alia*, renewable energy storage, alternative fuels for transport and chemicals materials.

Louis Fradette, CO2 Solutions, presented on the "Valorisation Carbone Québec" project that uses CO2 capture technology (taking advantage of the enzyme carbonic anhydrase) to demonstrate commercially-viable solutions for transforming CO2 into value-added products.

Dirk Van Mechelen, Orbix, presented on the carbstone process, a proven technology to sequester CO2 in high-quality construction materials by recycling steel slags.

Brent Constantz, Blue Planet, focused on utilizing CO2 for production of limestone aggregate. He described a technology to capture and mineralize CO2, converting it into carbonate rocks for use in roadways and buildings.

Nils Aldag, Sunifire, highlighted the production of e-Fuels obtained by converting electricity from renewable sources into hydrogen or syngas. He emphasized that: the technology is ready for deployment; there is immediate CO2 reduction potential if used in the existing vehicle fleet; and this could be a long-term mandatory solution for aviation, ships and heavy duty vehicles.

Stressing the importance of rapid solutions in the road transport sector, Benedit Stefanssons, Carbon Recycling International (CRI), described CRI's process for direct hydrogenation of CO2-to-methanol and highlighted methanol's potential in the transport sector given that only a fraction of the sector can be fully operated by electric power. On policy, he stressed the importance of transparent lifecycle assessment frameworks.

Christophe Mihalcea, Lanza-Tech, described Lanza-Tech's proprietary microorganisms and gas fermentation technology to transform carbon from industrial waste gas, biogas, solid waste and biomass, into fuels and chemicals. He highlighted that up to 50-80% GHG emission reduction over petroleum products can be obtained.

Willy Verstraete, Avecom - Ghent University - KWR, highlighted microbial fermentation routes to produce biomass from CO2 for two purposes. He noted that protein-rich biomass can be used as an alternative protein supply for food and feed, but that several challenges exist, such as acceptance of the protein by the public and regulators. He said microbial biomass can be used as a means to increase the organic C content in soils, and that such biomass-based storage thus constitutes carbon capture and storage.

Achim Raschka, Nova-institut Gmbh, highlighted many opportunities involving the use of CO2, addressing the many sources, conversion routes and end products that can be targeted. Outlining examples, he identified potential benefits, compared alternative routes towards the same products and presented life cycle assessment data.

Findings: The draft Chairpersons' summary indicates that technological innovation can be used to turn CO2 from a nuisance into a resource. GSTIC 2017 showcased feasible solutions to transform CO2 into chemicals, fuels and materials. Although further research and innovation efforts are needed, some of the technologies are ready for the market. What is mostly missing to enable these technologies to penetrate the market at scale is the legislative and regulatory environment, a sufficient number of incentives and a fair carbon price.

BAMBOO: On Tuesday morning and afternoon, the topical session on bamboo took place, chaired by Hans Friederich, International Bamboo and Rattan Organisation (INBAR).

Dina Nath Tewari, Centre for Sustainable Development and Poverty Alleviation, spoke on bamboo for landscape restoration, noting that re-greening with bamboo in an integrated crop system project in India had led to the improvement of thousands of livelihoods devastated by land degradation.

Tingting Mei, Zhejiang A&F University, Hangzhou, China, presented on bamboo for climate change mitigation, pointing to the development of Verified Carbon Standards for bamboo forests and the use of carbon credits from bamboo projects as part of China's national carbon market.

Bernice Dapaah, Ghana Bamboo Bikes Initiative, described a project that manufactures bamboo bicycles in Ghana. She noted current work on the development of a toothpick factory,

Bernice Dapaah, Ghana Bamboo Bikes Initiative

a bamboo-based filtration system and a prototype for a bamboo wheelchair, and stressed the technical advantages of bamboo and its potential for climate change adaptation and poverty reduction in rural areas.

Hector Achila, Amphibia, presented on building with bamboo, elaborating on its technical advantages, including high strength, low weight, low energy consumption, low carbon footprint, low cost, good thermal capacity, and high seismic and wind resistance.

Ye Ling, State Forestry Administration Engineering Research Centre for Bamboo Winding Composites, China, spoke on the development of bamboo winding composite as a new bio-based construction material replacing steel, cement, metal and plastic at a much lower cost. He highlighted winding composite pipes and utility tunnels that are made from bamboo and are already in use, and a high-speed train compartment and modular houses, soon to be on the market.

Juha Anttila, Chempolis, described the first bamboo biorefinery for the production of second generation ethanol in Guwahati, India. He pointed to several advantages, including its profitability, the use of traditional technology, full recovery of chemicals, replacement of imported oil and oil products, and reduction of air pollution from straw burning.

Vladimir Ratsimandresy, Support Programme for the Rural Microenterprise Poles and Regional Economies, addressed bamboo for energy in Madagascar, elaborating on a charcoal production project for sustainable household energy which reduces deforestation and contributes to improved rural livelihoods.

The subsequent discussion centered on, *inter alia*: bamboo's technical performance; its global availability; multiple uses and different species; replicability of the projects; ISO standards; and the importance of government support.

In the afternoon, participants engaged in a policy-focused panel discussion on bamboo.

Wang Yan, Chinese Mission to the European Union, commended INBAR for facilitating cooperation on bamboo as a means towards achieving the SDGs, and elaborated on the creation of a bamboo culture in China, where it is now "a huge industry."

Mark Draeck, UNIDO, spoke on UNIDO's work with governments everywhere to bring innovation for industrial and economic development that addresses environmental sustainability and social inclusion.

Jan E.G van Dam, Wageningen Food & Biobased Research, stressed the importance of public awareness of bamboo's potential and its contribution to sustainability.

Mark Halle, International Institute for Sustainable Development, suggested that bamboo is now at a stage typical of a transitioning industry: awaiting agreed standards and the development of markets and trade opportunities. He called for thinking of it as a universal challenge, with all working towards eliminating obstacles so that bamboo's positive value can be fully realized by 2030. He expressed hope that "we are now in the cusp of a positive change of attitude towards bamboo."

Peter Wehrheim, European Commission, proposed enshrining bamboo more firmly under the UN Framework Convention on Climate Change (UNFCCC) and including it in countries'

Participants during the thematic clusters and topical sessions

nationally determined contributions (NDCs). He also drew attention to the bio-economy and the need for monitoring and accounting systems that show additionality from bamboo production and consumption.

Luc Bas, IUCN, spoke on bamboo's role in nature-based solutions and the need to address questions of sustainability, volume and land pressure. He pointed to hidden subsidies for fossil fuels as an obstacle for bamboo and drew attention to the Bonn Challenge on Forest Landscape Restoration.

During the ensuing discussion, Draeck highlighted South-South cooperation, while van Dam stressed the importance of public awareness and transparency in marketing bamboo. Bas suggested looking at trade agreements and import tariffs, and considering how accounting for emissions for imported products would positively affect bamboo's consideration. Drawing attention to the increased use of aluminum in construction, a participant stressed the use of bamboo as a matter of urgency. Halle said that while we would not want a "bamboo bubble," the bigger risk now is that the potential for bamboo will remain undervalued, meaning a missed opportunity to benefit livelihoods and landscapes.

Findings: The draft Chairpersons' summary indicates that bamboo grows abundantly and easily in the tropics and subtropics, even on the poorest soils in harsh weather conditions. Bamboo fiber and poles are successfully used in an increasing number of applications, from textiles and furniture, wood panels, laminates, biofuels, pulp & paper, prosthetics and water pipes. G-STIC illustrates how bamboo can also be an alternative resource in many commercial applications, supporting the creation of new jobs and extra income for local people, and acting as a significant carbon sink.

ICT AS ENABLING TECHNOLOGY: This was one of three cross-cutting themes, and participants met on Monday and Tuesday to consider the best ways ICT can help in the achievement of the SDGs, and in creating opportunities for strengthening sustainable lifestyles and production processes.

***Findings*:** The draft Chairpersons' summary recommends, *inter alia*: connecting the 3.9 billion citizens unconnected worldwide; ensuring that innovation and implementation are done in partnership with all relevant stakeholders, creating multi-stakeholder platforms (Living Labs); ensuring that solutions empower people to change consumption behavior; and providing cyber-security measures to ensure that people and their data are protected.

SMART WATER SOLUTIONS: Participants considered smart water solutions on Monday and Tuesday, and convened a joint session with ICT as enabling technology. They highlighted that ICT is revolutionizing the ability to manage water resources efficiently, providing near-real time data, and instrument, control and automation technologies that vastly improve decision-making and control systems.

***Findings*:** According to the draft Chairpersons' summary, the session produced a proposal for a "water watch" to improve the availability of data, address the issue of data ownership and help monitor the achievement of the water-related SDGs. Participants identified three components that are required to move from ICT technology to smart water solutions: the creation of data platforms, the availability of open data, and citizen participation.

URBAN ELECTRIC MOBILITY: Thematic cluster sessions on urban electric mobility took place on Monday and Tuesday, with participants noting trends in electric vehicles and parallel trends in renewable energy, car sharing, autonomous vehicles and enabling ICT platforms.

***Findings*:** According to the draft Chairpersons' summary, the coming transportation revolution will require policy actions by governments if it is to deliver its full transformative potential. Policies on fuel taxation and vehicle regulation are basic components of the needed package, but also important will be local policy measures in areas such as urban planning, and investments in public transport, and pedestrian and cycling infrastructure.

URBAN DESIGN AND SUSTAINABLE BUILDINGS: Sessions on this cluster took place on Monday and Tuesday.

***Findings*:** According to the draft Chairpersons' summary, in this area as much as any, integrated technological solutions are needed, covering sustainable building materials, renewable energy, lighting, and IoT-related automation for building energy management. Policy changes are also needed to drive changes

Christine Leurquin, SES S.A., speaks during the Smart Water and ICT as Enabling Technologies joint sessions

Quentin de Hults, BASF Group, presents during the Urban Design and Sustainable Building session

in this sector, including comprehensive and mandatory building codes for new buildings, retrofits and new housing developments. Innovative financing models will also be needed to allow rapid uptake, and solutions need to be developed to address split incentive issues.

CHAIRPERSONS' SUMMARIES AND KEY FINDINGS OF G-STIC 2017

At the closing of G-STIC 2017, the outcomes were reflected in the draft Chairpersons' summary, available on the G-STIC website: <https://www.gstic.org/>. Participants will have an opportunity to comment on the summary in the two weeks following the conference, before the final version is made available.

Monday: On Monday evening, the first interactive discussion took place on the Chairpersons' summary and key findings of G-STIC 2017, highlighting the youth perspective. Using a mobile phone app, G-STIC 2017 participants were given the opportunity to express their opinions on three cross-cutting themes: gender, youth, and climate-smart technology.

During the discussions, several participants noted the importance of including youth voices in decision-making processes up to the highest levels. One participant noted that youth and marginalized populations are often not taken seriously, even if they are allowed in the room. Another participant highlighted the importance of diversity and advised that the minority of dissenting views during the interactive voting should still be taken into consideration.

Participants also commented on: the importance of effective communication and public awareness of the SDGs; the limited presence of farmers; the problems of capacity building and financial resources; the problematic assumption of perpetual economic growth; and the contribution of non-technological tools for addressing the SDGs. One participant argued that governments need to decide what technologies are a priority and then help to ensure that innovators and businesses focus on these.

Wednesday: On Wednesday morning, Robby Berloznik, VITO, presented the key findings of the eight thematic clusters, which will be annexed to the Chairpersons' summary.

Robby Berloznik, VITO

On agroecology for sustainable food systems, he indicated that agriculture systems need to be integrated, affordable, socially acceptable, environmentally sound and gender sensitive. He emphasized that "we now have evidence that such systems can work." On circular economy, he noted the need for both political will and finance, and highlighted the importance of ICT in many applications. He cautioned that regional differences are important, and reminded participants that the youth will be the implementers of this agenda.

On energy positive communities, Berloznik called for decentralized systems that are affordable, appropriate, and allow for bottom-up distribution. On urban electric mobility, he noted that a pure technological shift without changes to mobility behavior is not sufficient, and underscored the importance of urban planning, fuel efficiency, and prioritizing system electrification. On smart water, Berloznik defined "smart" as meaning integrated and cutting across sectors. He highlighted the need to incorporate ICTs into existing technologies that model the usage of water.

On urban design and sustainable building, he stressed the need for an integrated approach in which design, construction, operation and use all need to change, with ICT and the internet of things as important enablers. He said much of the needed technology exists, and moving forward, will require new voluntary and mandatory measures, and more demonstration projects. On waste water as a resource, Berloznik noted the need to think of waste water not as a burden, but rather, as a provider of energy, nutrients and clean water for irrigation and human use. He stressed that much of the needed technology exists, and that the need now is for more demonstration efforts, and new business models to ensure economic viability.

Jukka Uosukainen, Climate Technology Centre and Network (CTCN), spoke on climate-smart technology from the viewpoint of the CTCN as the operative arm of the UNFCCC's Technology Mechanism. He highlighted, among other things: technology action plans and technology mapping to support key climate actions in countries' NDCs under the Paris Agreement; long-term carbon policies; private sector involvement; revolutionizing business models affecting both consumers and producers; and technology integrated in a circular economy.

Jukka Uosukainen, CTCN

Donovan Guttieres, UN Major Group for Children and Youth, spoke on youth engagement, cautioning against reinforcing inequalities through technology. He called for risk-based assessments of technology and accountability frameworks. On process, he encouraged more communication across thematic issues, and trans-disciplinary and intergenerational discussion.

Yannick Glemarec, UN Women, highlighted that innovation and technology are not gender-neutral and identified five key conclusions: ensuring a gender-responsive approach to the technological innovation cycle; promoting technological education and innovation and literacy of women; encouraging innovation and entrepreneurship among women and girls; developing technological innovation and markets in such a way that they advance gender equality and empowerment of women and girls; and focusing on high-impact innovation that benefits marginalized women.

Luis Neves, Global e-Sustainability Initiative, stressed that the first priority is to connect the four billion people who currently have no internet access. He identified the need to think about the implications of new technology for democracy, human rights, privacy, financing, and other important social institutions, and proposed a set of guiding principles that would help innovators and businesses to push technological progress.

Presenting on the draft Chairperson's summary, which contains the co-hosts' statement, Veerle Vandeweerd, G-STIC, summarized progress made. She highlighted the creation of communities of practice and underscored consensus on the need for paradigmatic change. She drew attention to four key findings, namely that: many of the needed technologies already exist; technology needs to be widely distributed and bottom-up; the circular economy is a key concept, with Industry 4.0 as a driver; and ICT is a key enabling tool. She emphasized G-STIC as a process aimed at putting technology into practice in ways that contribute significantly to achieving the SDGs.

In ensuing discussions, a participant urged thinking about ways to identify those innovations that are ethical and human. Another called for G-STIC to work more closely with the UN's Technology Facilitation Mechanism and avoid duplication of efforts. Participants also drew attention to energy access in every one of the SDGs and bemoaned the lack of forums to address it in an integrated manner.

Topics for Future Editions of G-STIC: On topics for the next G-STIC, Vandeweerd highlighted health, new materials and chemicals, as possibilities. She also suggested addressing energy as a cross-cutting issue for all SDGs, and called for youth to help in finding ways to better integrate topics.

Aisa Kirabo Kacyira, UN Habitat, suggested focusing on cities as the place to integrate smart technology, and on urban mobility and public transport, green housing, and the effects on social inequalities and job creation.

Al Hammond, Allen L. Hammond & Associates, identified three developments with "immense potential" to revolutionize access by those people currently not benefitting from the global economy: algorithm-based platform businesses; blockchains allowing for internet financial transactions; and artificial intelligence, providing smarter services to the poor over mobile devices and at low cost.

Malcolm Johnson, ITU, proposed three principles for ensuring that technology helps to achieve the SDGs: collaboration, inclusivity and dialogue.

Professor Nebosja Nakicenovic, International Institute for Applied Systems Analysis, stressed the need to see the SDGs in an integrated manner, focusing not only on the trade-offs among the silos, but more importantly on the synergies. He noted that systemic change results "as a mesh of different technologies interact, and it is that sort of fundamental change that we are seeking."

During final discussions, participants highlighted that technology needs to respond to end-users, noting the need to look beyond high technology in agroecology, in particular in light of negative impacts of the green revolution. One participant called for greater focus at the next G-STIC on employment and the social impacts of automation. Bernice Dapaah presented her bamboo bike to Louise De Tremerie, a PhD student from Ghent.

Veerle Vandeweerd, G-STIC

Bernice Dapaah, Ghana, presents her bamboo bike to **Louise De Tremerie**, a PhD student from Ghent

Dirk Fransaer, VITO, closes G-STIC 2017

Dirk Fransaer thanked G-STIC 2017 participants and partners. He suggested that the next G-STIC event might include finance as a cross-cutting theme, and that the organizers might broaden the group of co-hosts to include a more global mix. Bringing the conference to a close, he invited participants to gather at G-STIC 2018 in Brussels in November.

UPCOMING MEETINGS

UNFCCC COP 23: The 23rd session of the Conference of the Parties (COP 23) to UNFCCC will be organized by Fiji and hosted at the headquarters of the UNFCCC Secretariat in Bonn, Germany. **dates:** 6-17 November 2017 **location:** Bonn, Germany **contact:** UNFCCC Secretariat **phone:** +49-228-815-1000 **fax:** +49-228-815-1999 **email:** secretariat@unfccc.int **www:** http://unfccc.int/meetings/bonn_nov_2017/meeting/10084.php

Sustainable Innovation Forum 2017: This business-focused event will be held during COP 23. Debate and discussions will be held on: renewable energy; circular economy; sustainable land and water management; carbon markets; climate finance; and climate innovation in emerging regions. The Forum is being organized by Climate Action, in partnership with UN Environment. **dates:** 13-14 November 2017 **location:** Bonn, Germany **contact:** Climate Action **phone:** +44-20-7871-0173 **fax:** +44-20-7871-0101 **email:** info@climateactionprogramme.org **www:** http://www.cop-23.org/

International Technical Conference on Climate Change, Agriculture, Trade and Food Security: The conference will explore the linkages between climate change, agricultural trade and food security. **dates:** 15-17 November 2017 **location:** FAO Headquarters, Rome, Italy **contact:** FAO **phone:** +39 06 57051 **email:** CCT-Conference@fao.org **www:** http://www.fao.org/economic/est/est-events-new/climatetrade/en/

World Toilet Day: The 4th World Toilet Day will take place on 19 November 2017, and will focus on the theme of wastewater. **date:** 19 November 2017 **contact:** UN-Water **phone:** +41 22 730 8636 41 01 **e-mail:** unwater@un.org **www:** http://wtd.unwater.org/2017/

4th Global Science Conference on Climate Smart Agriculture (CSA): The 4th Global Science conference on Climate Smart Agriculture will be organized around the theme "Catalysing local innovations and action to accelerate scaling up of CSA." The Conference is hosted by the New Partnership for Africa's Development (NEPAD). **dates:** 28-30 November 2017 **location:** Johannesburg, South Africa **contact:** Conference Organizers **email:** csa2015.montpellier@agropolis.fr **www:** http://csa2017.nepad.org/en/

UN Environment Assembly (UNEA): The third meeting of the Assembly, with the overarching theme of pollution, aims to deliver a number of tangible commitments to end the pollution of air, land, waterways, and oceans, and to safely manage chemicals and waste. Four events will take place in Nairobi in conjunction with the Assembly, including the Global Major Groups and Stakeholders Forum (27-28 November), the Open-ended Meeting of the Committee of Permanent Representatives (29 November to 1 December), the Science, Policy and Business Forum (2-3 December), and the Sustainable Innovation Expo (4-6 December). **dates:** 4-6 December 2017 **location:** Nairobi, Kenya **contact:** UN Environment Secretariat **phone:** +254-20-762-1234 **email:** beatpollution@unenvironment.org **www:** www.unep.org/environmentassembly/assembly

World Ocean Council's Sustainable Ocean Summit (SOS): The Summit will focus on: ocean business community leadership in achieving SDG14; and business growth and investment opportunities for ocean sustainable development. **dates:** 29 November to 1 December 2017 **location:** Halifax, Nova Scotia, Canada **contact:** World Ocean Council **email:** https://sustainableoceansummit.org/contact/ **www:** https://sustainableoceansummit.org/

3rd International Conference on Global Food Security: This conference will feature five core themes reflecting an integrated approach to food security, including: food creation; food safety and bio security; food loss and waste; food in a changing society; and food utilization. **dates:** 3-6 December 2017 **location:** Cape Town, South Africa **contact:** Elsevier **www:** http://www.globalfoodsecurityconference.com/

28th UN-Water Meeting: The 28th UN-Water Meeting will be hosted by the International Fund for Agricultural Development (IFAD) in Rome, Italy. **dates:** 1-2 February 2018 **contact:** UN-Water **phone:** +41 22 730 8636 **e-mail:** unwater@un.org **www:** http://www.unwater.org

Ninth World Urban Forum (WUF9): This Forum, convened by the UN Human Settlements Programme (UN-Habitat), will bring together thousands of stakeholders to share practices and knowledge on how cities are built, planned and managed. WUF9 will be the first Forum to meet after the post-2015 development agenda process and the UN Conference on Housing and Sustainable Urban Development – Habitat III in 2016. **date:** 7-13 February 2018 **location:** Kuala Lumpur, Malaysia **contact:** UN-Habitat **phone:** +254 20 7621234 **e-mail:** infohabitat@unhabitat.org **www:** http://wuf9.org

Cities & Climate Change Science Conference: The aim of the conference is to: identify key research and knowledge gaps related to cities and climate change; inspire global and regional research that will lead to peer-reviewed publications and scientific reports; and stimulate research on cities and climate change throughout the AR6 cycle. Its outcomes are anticipated to inform the upcoming reports of the Intergovernmental Panel on Climate Change, and support cities and citizens in building low-carbon, climate-resilient and sustainable cities towards the implementation of the Paris Agreement on climate change, the New Urban Agenda, and the SDGs. **dates:** 5-7 March 2018 **location:** Edmonton, Alberta, Canada **contact:** Conference organizers **email:** https://www.citiesipcc.org/en/contact **www:** http://www.citiesipcc.org/

World Water Forum: The 8th World Water Forum will take place in Brasilia from 18-23 March 2018, gathering experts, managers and organizations involved with water issues all over the world. It will coincide with World Water Day, which is on 22 March. **dates:** 18-23 March 2018 **location:** Brasilia, Brazil **contact:** World Water Council **phone:** +33 4 91 99 41 00 **fax:** +33 4 91 99 41 01 **e-mail:** contact@worldwaterforum8.org **www:** http://www.worldwaterforum8.org

13th International Conference on Waste Management and Technology: The 13th International Conference on Waste Management and Technology (ICWMT) will provide a platform for specialists and officials to discuss scientific problems related to solid waste management, exchange experiences, and to look for innovative solutions. With the theme of "Overall Control of Environmental Risks," national and international participation is expected from government, research institutions, academia, and industry and business interests. **dates:** 21-24 March 2018 **location:** Beijing, China **contact:** Shi Xiong and Zhang Tianjiao, Basel Convention Regional Centre for Asia and the Pacific, Tsinghua University **phone:** +86-10-82686410 **fax:**+86-10-82686451 **email:** icwmt@tsinghua.edu.cn **www:** http://2017.icwmt.org/ICWMT2017/indexen.asp

Ninth Clean Energy Ministerial (CEM9): CEM9 will be jointly hosted by the European Commission, Denmark, Finland, Norway, and Sweden, and will focus on promoting the green transition. The CEM consists of 24 nations and the EU, who together account for 90% of all investment in clean energy in the world and 75% of global GHG emissions. CEM focuses on practical co-operation, the exchange of good ideas and experiences within green solutions and the involvement of the private sector. **dates:** *TBD* 2018 **location:** to be determined **www:** http://www.cleanenergyministerial.org/Our-Work/Ministerial-Meetings

First Global Bamboo and Rattan Congress 2018: This meeting will bring together ministers, government officials, scientists, conservationists, educators, and business leaders to address the role of bamboo and rattan in achieving the SDGs, providing a platform for South-South and North-South-South cooperation to shape future policies, new partnerships and initiatives. **dates:** 25-27 June 2018 **location:** Beijing, China **contact:** Pan Huining **phone:** +86-10-64706113 **email:** hnpan@inbar.int **www:** http://www.barc2018.org/en/index.html

High-level Political Forum on Sustainable Development (HLPF) 2018: HLPF 2018 will convene under the auspices of the UN Economic and Social Council (ECOSOC) and undertake an in-depth review of: SDG 6 (clean water and sanitation), SDG 7 (affordable and clean energy), SDG 11 (sustainable cities and communities), SDG 12 (responsible consumption and production), and SDG 15 (life on land). Goal 17 (Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development) is also considered each year. In addition, 48 countries are expected to present their Voluntary National Reviews. **dates:** 9-18 July 2018 **location:** New York City, US **contact:** UN DESA **www:** https://sustainabledevelopment.un.org/hlpf/2018

Second World Circular Economy Forum: This meeting will be held in 2018, organized by the Finnish Innovation Fund Sitra and partners, with dates and location to be determined. **dates:** to be determined **location:** to be determined **e-mail:** sitra@sitra.fi **phone:** +358 294 618 991 **www:** www.sitra.fi

Global Science, Technology and Innovation Conference (G-STIC) 2018: The objective of G-STIC is accelerating the development, dissemination and deployment of technological innovations that enable the achievement of the SDGs. The second G-STIC will take place in Brussels in November 2018. **dates:** 28-30 November 2018 **location:** Brussels, Belgium **contact:** VITO NV **phone:** +32 (0)3 2867458 **e-mail:** info@gstic.org **www:** https://www.gstic.org

GLOSSARY

CO2	carbon dioxide
GHG	greenhouse gas
G-STIC	Global Science, Technology and Innovation Conference
ICT	information and communication technology
INBAR	International Bamboo and Rattan Organisation
NDCs	nationally determined contributions
IoT	internet of things
SDGs	Sustainable Development Goals
SMEs	small and medium-sized enterprises
TERI	The Energy Research Institute
UNIDO	United Nations Industrial Development Organization