CONNECTING TECHNOLOGICAL INNOVATION TO DECISION MAKING FOR SUSTAINABILITY

G-STIC 2018 Chairperson Summary

1 Introduction

G-STIC 2018 General Info

The second conference in the G-STIC series was convened from 28 to 30th November 2018. Over 1200 participants, representing policymakers, technology researchers, business and industry captains, and civil society attended the meeting. The text below is a summary of the major messages emerging from the meeting from the perspective of the chairperson, Ir. Dirk Fransaer.

Other outcomes include: (1) the background papers, key findings, and other documents from the thematic and topical sessions, available on the G-STIC website, (2) the recording of the presentations, also available on the website, (3) communities of practitioners built around the various sessions, and (4) the outreach material through videos and social media emerging from the conference.

All these materials, as well as the established communities of practitioners, provide an excellent starting point to ensure that the messages of G-STIC 2018 are heard by policymakers and industry leaders alike, and to start preparation of the third G-STIC conference planned for November 2019.

G-STIC 2018 also hosted a number of partner events, including:

- **Expert Group Meeting (EGM) on STI Roadmaps for SDGs,**
- Roundtable on **Energy-Related SDGs,**
- Event on **Flemish Best Practices** regarding the integration of sustainability in higher education,
- **FUTURING H2020 Project Outreach** Event,
- **GeSI event** on the enabling potential of ICT for sustainable development,
- **Planning energy positive solutions**, part of IRENA's CEM Campaign "Long-term Energy Scenarios for the Clean Energy Transition",
- The 4th edition of the **Organic Innovation Days**, TP Organics' annual event,
- **Verifiable Sustainability Goals**: from good intentions to real impact,
- Youth event on **Ensuring a People-and-Planet Centered Technology Strategy**,
- VITO Alumni corner.

G-STIC 2018 Parallel Sessions

G-STIC 2018 focused on integrated technological solutions that potentially have a large impact on the achievement of the SDGs and climate change goals. The G-STIC 2018 activities were organized and structured in **7 thematic clusters**:

- Agroecology for Sustainable Food Systems
- Circular Economy
- Education
- Energy Positive Communities
- Geospatial Data
- Health
- (Waste)Water as a Resource

Parallel sessions for each of these thematic clusters included a mix of (keynote) presentations and interactive panel discussions while providing room for questions by conference participants.

The G-STIC 2018 parallel sessions also addressed aspects that are related to a number of **cross-cutting themes**:

- Climate-smart Technology
- Gender Mainstreaming
- ICT as Enabling Technology
- Sustainable Technology & Development
- Youth Engagement

This Chairperson Summary reports on the Key Findings for each of the thematic clusters, the cross-cutting themes and a number of themes during the G-STIC 2018 Industry Night. More detailed reports include (1) the background papers, key findings, and other documents from the sessions, available on the G-STIC website, (2) the recording of the presentations, also available on the website,

2 Key findings of the thematic clusters

Agroecology for Sustainable Food Systems

The paradigm shift towards diversified agro-ecological systems is increasingly gaining recognition, as the dominant agricultural practices of today that favour industrial monocultures and intensive animal husbandry are unsustainable and have been unable to address the root causes of hunger.

Agroecology can contribute to meeting Targets 2.1 and 2.2 to end hunger and malnutrition, and to ensure universal access to safe, nutritious and sufficient food all year round. Agroecology, if sufficiently supported, can double agricultural productivity, meeting Target 2.3. Its technologies, innovations and practices increase resilience, enhancing the capacity for adaptation to climate change, while improving soil quality, helping to achieve Target 2.4. Because a key pillar of agroecology is agricultural biodiversity, it contributes to Target 2.5. Agroecology also contributes to multiple other SDGs.

G-STIC 2017 concluded that a paradigm shift is needed towards more resilient and diversified agro-ecological practices to achieve SDG2. G-STIC 2017 provided evidence that such diversified agro-ecological systems can work in delivering nutrition and secure livelihoods, in the places where needed most and to people who need these most.

G-STIC 2018 reconfirmed that agroecology comprises an integrated suite of technologies, innovations, practices and knowledge systems that are embedded in a larger framework of respecting farmers' knowledge and ensuring equity, and include those that: (i) diversify in space and time, such as crop rotations and polycultures, which increase nutrient availability and regulate pests and weeds; (ii) reduce erosion and improve soils, such as cover crops and mulching, and green manures; (iii) increase complexity to optimize nutrient cyclings, such as agroforestry systems and crop-livestock mixtures; and (iv) improve water storage and water harvesting. Technologies associated with agroecology achieve several simultaneous goals such as rebuilding soil fertility, controlling pests and weeds, improving nutrient use efficiency, conserving water, reducing erosion, while diversifying production and diets.

Agroecology combines both scientific and traditional knowledge so that they complement and reinforce each other. Examples include the *waru waru* system of raised beds and irrigation channels enabling higher productivity at high elevations in the Andes; the 'push-pull' platform technology for integrated management of pests in sub-Saharan Africa; the *Ifugao* rice terraces that provide micro-watersheds in the Philippines; and the *tabia* rainwater harvesting system in southern Tunisia.

Complementary technologies could help increase the uptake of agroecology, for example, to aid in animal husbandry or address farm labour shortages, particularly in developed countries. These would need to be accessible, affordable, environmentally sound, socially just and empower farmers, and could include appropriate advances in robotics, big data and ICT.

G-STIC 2018 discussed and identified specific actions in the field of policy setting, economic and social areas to upscale the use of agro-ecological techniques.

Three key barriers to the deployment of agroecology technologies at scale are (i) continued policy and resource support to industrial agriculture systems, coupled with the lack of support to agroecology, which are consequences of not accounting for externalities; (ii) research and extension systems focused on a few major species and structured around the needs of large-scale industrial farms; and (iii) current vertical market systems that support large volumes of undifferentiated crop commodities.

Enabling measures include removing incentives that encourage the adoption of unsustainable farming practices such as monocultures and chemical pesticides, and providing incentives for the adoption of specific agro-ecological technologies and requisite training, while helping to buffer farmers, especially family and small-scale producers, in the transition period. There is a need to focus on true cost accounting in food and agriculture, to accurately measure externalities.

Changing agricultural research, education and extension programmes to focus on agroecology needs and co-creation of knowledge and innovations by farmers would be a key step in supporting the transition to agroecology.

Support to local and regional markets for diversified agro-ecological products as well as public procurement programmes are needed. Short supply chains, direct marketing schemes, cooperative marketing and purchasing, and local exchange schemes such as farmers' markets for agro-ecological products need policy and infrastructure support. The relocalisation of food and farming systems brings producers and consumers closer together and reduces food miles, while ensuring that alternative supply chains remain viable, accessible and affordable.

Agroecology focuses on empowering the critical agents of change – family farmers, smallholder producers, indigenous peoples, fishers, rural women and youth. Building new community-led governance structures, for example in cooperative marketing functions, farmer-to-farmer knowledge sharing, community-building activities, and advocacy, can be highly effective.

Circular Economy

G-STIC 2017 concluded that to achieve SDG 9 and SDG 12, a transition to a new societal framework is required, powered by a circular economy approach that is enabled by digital technologies. This will, among others, lead to an optimization of material use per unit of output and reduce waste and pollution. The complete value chain needs to be revisited and customers need to be provided with services rather than throw-away products. Industry 4.0 provides the technological driver for circular innovation, while the circular economy is the driver to transition to a sustainable industrial and societal framework.

G-STIC 2018 saw representatives from the University of Oxford, World Resources Forum (WRF), Regional 3R Forum in Asia and the Pacific, the International Solid Waste Association (ISWA), the European Commission, and G-STIC **expressing their willingness to step up the collaboration in the field of technological innovation needed for the transition to a circular economy**. This increased collaboration will include (1) providing an open exchange platform to stimulate collaboration, (2) learning from each other. An international dialogue is necessary to ensure that a circular economy does not create a group of closed local economies, but becomes a global system of various economies collaborating.

G-STIC 2018 looked in detail at "**closing the material loop**" from a post-consumption perspective, examining advanced sorting systems that combine multiple detection systems with machine learning to allow for characterisation of mixed waste material flows; and the use of robotics in dismantling and separation.
A second major area of focus of G-STIC 2018 was **tracking products across their lifecycle**, involving tagging and identification systems, and digital twinning. Blockchain technology was highlighted to be one useful technology to trace transactions. Mobile money is an enabler for take-back systems, especially in Africa.

And lastly, **the role of urban flows in generating a circular economy at the city level** was discussed. New demonstrated technologies include building information management systems and digital material maps that allow optimisation of urban material flows. Citizens on all continents are involved in the scale-up of circular systems and the optimisation of material flows through the use of mobile apps and collaborative platforms. Circular economy can act as a delivery mechanism for urban innovation, to enable the necessary reductions in resource use in the growing urban areas.

G-STIC 2018 concluded that the contacts between digital and circular economy experts need to be strengthened to develop common approaches, and to showcase the opportunities of blockchain technology, Internet of Things, AI, Big Data, product identification, collaborative platforms,…

Education

Both 'Innovating Education' and 'Education for Innovation' can make strong contributions to the overall SDG implementation. **Scientific knowledge and innovative thinking should, therefore, be organized in the context of global sustainability.**

Education must benefit from an innovative 'industry', developing resources that improve its effectiveness and efficiency. G-STIC 2018 concluded that innovation should offer the education sector the means to new practices, organizations, and technology - improving standards, quality, and access.

G-STIC 2018 confirmed that innovation and technology have an important role to play to expand both access to education and the quality of the education being provided in the developing world. G-STIC 2018, therefore, looked in detail at technological challenges for teacher training, and how technological innovations can support and stimulate a pedagogical transformation in higher education.

The proliferation of digital and other innovative forms of education should be used for increasing the provision of quality education services in developing countries, aiming at **achieving larger access and better quality with lower costs**. Proper application of technology can solve educational issues not only related to access, but also to lack of proper physical infrastructure and lack of trained teachers.

Beyond technology, innovation can take many forms, and indeed it will have to take many forms. Especially in low-income countries, Ministries of Education are not equipped to deal with the massive increase in the cohorts of students completing their primary education and aiming to pursue their education at the secondary level. Current models of service delivery may not be financially sustainable. Partnerships with the private sector can reduce costs, while not

compromising on quality. Even issues related to the core curriculum to be taught in lower secondary schools may need rethinking.

Technology must be tailored to specific populations that may vary by language, usable infrastructure, and end-user adaptations. Context and adaptation are essential for reaching marginalized populations, and thereby reaching the SDGs through improved learning and education.

Technological innovations can help to implement and fasten the realisation of a paradigm shift in pedagogy towards transformational learning, supporting students (1) to solve complex problems in an interdisciplinary setting in connection with real society and ethical reasoning and (2) to activate the networks of knowledge in their brains thanks to discussions, feedback and reflection.

Technological innovations in education should be encouraged by educational institutions, legislators and government at-large by providing an open space for such innovation and not limiting it by restrictive standards and regulations.

Energy Positive Communities

G-STIC 2017 called for an energy access agenda that is driven by decentralized systems that are affordable, appropriate, allow for bottom-up distribution and generate and deliver renewable energy to cover the living and comfort needs of local communities.

The positive impact of such demand-driven energy systems on local communities goes beyond the delivery of energy services and providing universal access to modern, affordable, reliable and sustainable energy (SDG 7). Access to modern energy improves the availability of water and sanitation for local communities (SDG 6). Also, by advancing employment in local communities, it helps promote sustainable economic growth (SDG 8) and industrialisation (SDG 9). Increasing the share of local renewable energy sources will also contribute to combat climate change and its impacts (SDG 13).

G-STIC 2018 identified that to achieve a stable investment climate for energy positive communities, we need to bring together two worlds. On one hand, the world of international and national energy scenarios and planning has a strong focus on the central energy networks. On the other hand, the world of local energy planning and solutions is closely involved with renewable mini- and microgrids. More than ever, we need an equal focus on decentralized and central energy solutions, and we need to monitor the market impact of each solution with real-time data in order to convince private investors.

To bring both worlds together, **we need a coherent portfolio with intelligent decision tools for energy planning on different geographic levels**. These tools can be based on a growing amount of big data available from running initiatives and can be widely applied via open source platforms such as Odyssey, OSeMOSYS, PEAK, etc. These decision tools allow translating the wide opportunity of promising energy solutions to the local conditions (which vary a lot), but can only work if the targets and questions are clearly defined for each community and if there is an active involvement of the (local) stakeholders. In addition, we need to clarify/define how to feed/update these open source service platforms with relevant innovations and practice examples.

To empower a shift from thousands to millions of energy positive communities, **we equally need energy solutions that are based on the principles of modularity, interoperability and reliability**. This is essential if we want to support energy positive communities to grow in feasible steps, and if we want to assure the involvement and acceptance of their inhabitants. In this context, an energy solution is not merely a technology. **An energy solution is a combined solution of "hardware, multi-services and an integrated financing mechanism"**. Energy is no longer a commodity sold per unit, it is a complete service adapted to the local needs of communities and their inhabitants.

G-STIC 2018 clearly identified that entirely new solution, still requiring additional research, **can also have a significant impact before 2030**, especially as digital breakthroughs in the field of artificial intelligence (e.g. deep learning for energy management) have proven to have a much shorter go-to-market than hardware technologies.

Geospatial Data

The Earth is finite. Both its resources and the space available for people, animals, and plants are limited.

Geospatial data can help in managing these finite resources and the limited space that is available. However, as the amount of available geospatial data is growing at an astonishing rate, this holds both opportunities and challenges. Extracting valuable information from a data tsunami for use in a wide range of applications is by no means an easy task, but can be enabled by Big Data Analytics, AI, cloud computing as well as crowdsourcing and open source software development. Sharing data, as well as data processing methods, is a key element to harmonizing all data.

Technical advances are clearly being made, even if not at the same level everywhere. Access to **Earth Observation** data through the internet, for example, is not always easy in many African regions. As technical advances will continue to be made, **the use of Earth Observation data to better manage the Earth's resources can increasingly become a significant help in various applications that matter concretely to people's daily lives.** Examples include:

- SDG 1 - No Poverty: helping farmers to improve food production so they can sustain themselves.
- SDG 2 - Zero hunger: food production and distribution, development of insurance policies against drought and other natural hazards.
- SDG 3 - Good health and well-being: monitoring of air quality and the spread of diseases.
- SDG 4 - Quality education: improving access to schools for all, raising awareness about the environment and sustainable practices.
- SDG 6 - Clean water and sanitation: overlaying population density maps on maps of untreated wastewater leaking into the environment, inland water quality monitoring.
- SDG 11 – Sustainable cities and communities: measuring and modelling air quality in cities and across regions
- SDG 14 – Life below water: marine monitoring of the oceans.
- SDG 15 - Life on land: tracking tree cover and monitor forest loss or gain over time, globally.

Health

Health is an individual and collective right, and it is essential for quality of life. The 2030 Agenda for Sustainable Development calls for "Ensuring healthy lives and promote well-being for all at all ages," (SDG 3) and highlights universal health coverage (UHC) as a paramount goal.

Over the past decades, exogenous factors such as economic development, urbanization, globalization, and technological conversion have transformed the world. The demographic, nutritional, and epidemiological transitions - clear consequences of these changes - create new perspectives and challenges for the future and have direct impacts on the field of health. To overcome these challenges, **Science, Technology and Innovation (STI) gather Information Technology (IT), Artificial Intelligence (AI), big data, biotechnology, and other sources, to come up with a wide range of solutions**. At the same time as they raise expectations for a future with better health and universal health coverage, they also raise concerns about their potential to be disruptive, increase inequalities and challenge the sustainability of healthcare systems.

The holistic approach of the 2030 Agenda reflects, amongst other dimensions, the need to analyse the social determinants of health (for example, climate change, urban life, food safety, and environmental degradation) **and find "one-health" solutions that integrate human, animal and ecosystems.** To achieve a more inclusive and sustainable world, it is extremely important to synchronize the health-related Sustainable Development Goals (SDGs) with technologies that are efficient, applicable, scalable, and affordable. In other words, to better achieve the SDG 3 target on universal health coverage, it is crucial to shrink the gap between STI and health governance.

The G-STIC 2018 Health sessions looked at the problems that health faces today, gathering the technology trends to face them, and the governance systems that can lead toward the SDGs. In particular, it was discussed how technology can improve universal health coverage systems and preparedness for emerging diseases. G-STIC 2018 recommendations include the use of big data and AI for health surveillance systems, the use of OMICS for health predictions, the development of accessible vaccines and the development of off-grid energy technologies to support the vaccine logistics cold chain.

G-STIC 2018 also addressed technologies such as lab-on-a-chip, point-of-care diagnostic tools, and smart vaccines, which can contribute to sustainable healthcare. **Conference participants recommended fighting inequality through inclusive technologies**, fostering open sources in the development of accessible AI for diagnosis, and using IT and AI for health systems management. They also advised using off-grid energy technologies to support the vaccine logistics cold chain.

The cross-cutting nature of health and its synergies with other sectors was also discussed extensively during G-STCI 2018, focusing on inter-sectoral approaches and health technologies with impacts on a broader group of SDGs. It was recommended developing a system analysis to access health-related SDGs and prioritize the implementation of technologies with a broad interactive effect. The use of social networks and social media to engage sustainable policies and to promote inter-sectoral information exchange was identified as a lever to improve health surveillance and regulation. The One-Health approach was mentioned as a sustainable development inter-sectoral strategy, bringing up the need to create consortium funding for basic disease preparedness technologies.

G-STIC 2018 thus brought attention to technologies that are impactful, scalable and affordable, which can confer resilience to universal health coverage and contribute to the main goal of the 2030 Agenda: to promote sustainable development, leaving no one behind. A broader list of

recommendations was developed, including the need to reinforce the aspirational goals of 2030 Agenda and apply the principles and recommendations of the UN's Technological Facilitation Mechanism (TFM) to health. **G-STIC 2018 emphasized the need to build STI National Roadmaps to health-related SDGs and bridge the divide between health and STI Governance.** It also advised fostering national innovation for health systems and building innovative funding mechanisms for health innovation while underlining that such large-scale approach does not exclude the need to build capacity to incorporate health technologies at a local level, reassuring inclusiveness and accessibility for all.

(Waste)Water as a Resource

G-STIC 2017 concluded that "Resource recovery from wastewater is ready to transition to full-scale market applications. The technologies to do so are available, affordable, accepted and applied in cities and industries alike, at large and small scales. Adding the function of resource recovery to a wastewater treatment facility has the potential to create additional sources of income or cost savings, including from the sales of bulk water, bio-energy or fertilisers, or the reduction in energy costs through on-site bio- and renewable energy production."

The "water" discussions at G-STIC 2018 zoomed in on (waste)water as a resource in support of the sub-target of SDG 6.3: " .... **halving the proportion of untreated wastewater and substantively increasing recycling and safe reuse globally**". This sub-target translates in connecting approximately 500,000 citizens per day to some form of wastewater treatment - and do this every day between now and 2030!

G-STIC 2018 identified that the priority actions to make such resource recovery a common practice at the global level and hence contribute to achieving the water treatment and reuse target of the Agenda 2030, were as follows:

- **Act now delivering wastewater treatment solutions, leaving no one behind and learning from doing.** Even if this implies working with less than perfect solutions, celebrating short-term successes will enable to deliver long-term results.
- **Develop, adopt and implement new regulations**, including tariff reforms, that promote (1) higher effluent standards for wastewater treatment and (2) enable the sales of recovered products (energy, nutrients, water, etc);
- **Develop and implement new business models and financial mechanisms** to establish wastewater treatment as a new asset class, mobilising public and private financing for infrastructure & refurbishing of "resource-recovering" wastewater treatment plants;
- **Establish results-oriented public-private-people partnerships** for monitoring, reporting and verification. We need bankable projects but even more importantly, we need projects with tangible results;
- **Clarify and exploit the benefits that water brings to health, energy and agriculture, to establish strong synergistic cases** that combine water technologies with other technologies;
- **Strengthen the empowerment of people to accelerate change.** Strong, local reuse cases start with people recognising the value that water brings to them. Adequate quality monitoring systems and open communication channels need to be established to build trust.

3 Key findings of the cross-cutting themes

Climate-smart Technology

One of the key recommendations emanating from G-STIC 2018 Climate-Smart Technology discussions is the development of a strong entrepreneurial ecosystem, supported by research, knowledge and evaluation protocols, to unlock financing for incubators and accelerators and uptake of climate safe technologies:

- Implementing policies, standards, regulations and financial instruments that build markets and provide incentives for climate technology entrepreneurship;
- Supporting research and knowledge to understand how the Paris Agreement actions and policy changes can feed into modelling platforms so countries can assess the climate impact on its vulnerable communities and regions, on its infrastructure, as well as their progress towards SDG goals;
- Facilitating private sector participation by undertaking business environment regulatory reforms that incentivise businesses to develop and implement climate solutions, while ensuring maximum public safety;
- Utilising government and development financing institutions funding to bridge the financing gap, in particular for climate change adaptation projects that might not be commercially bankable yet.

Other key recommendations relate to

- Crowdfunding in private finance, to help transform ideas into concrete solutions by developing financial instruments that reduce the risk and opportunity cost for local public and private financial institutions to invest in the development and demonstration of technologies that will have multiple benefits - both on climate and SDGs fronts.
- Encouraging the creation of multi-country incubators and accelerators that draw on a larger pool of entrepreneurs, financial providers, supply chains and potential markets, with the participation of public and private financiers;
- Strengthening the adaptive capacity of innovation actors through training and education programmes, including the professionals that manage incubators and accelerators.

Gender Mainstreaming

The achievement of the ambitious Sustainable Development Goals (SDGs), notably gender equality and women's empowerment (SDG 5), requires transformative shifts, integrated approaches, and new solutions. Innovation and technology provide unprecedented opportunities to break trends and reach those who are the most likely to be left behind. This is why UN Women UN Women and its Global Innovation Coalition for Change have developed the Gender Innovation Principles, to set the standard for a gender-responsive approach to innovation.

The principles are a guide to help organizations fulfil the mission of promoting and championing women and girls and to steer an organization both internally, in its innovation process, and externally, in establishing ways to support women and girls.

UN Women engaged G-STIC participants to sign up for the principles to improve their organizational and business practices, committing to:

- Making a high-level corporate commitment to adopt a gender-responsive approach to innovation;
- Designing innovations that include women as end users;
- Adopting an adaptive approach to implementation, ensuring innovations are gender-responsive and meet the needs of women;
- Evaluating gender-responsive impact using a data-driven approach;
- Scaling innovations that provide sustainable solutions to meet the needs of women and girls.

As each organization is unique with different challenges around this subject, UN Women has developed specific tools to help all signatories start their journey and access self-assessment tools, resources and best practices to make innovation and technology work for women.

ICT as Enabling Technology

The discussions related to ICT and digital technology in G-STIC 2018 confirmed the findings of G-STIC 2017: ICT is a key component and key enabler for most, if not all, integrated technological solutions for the SDGs. It is vital that an open and honest conversation continues with all relevant stakeholders on how to address the potential negative impacts of the technology roll-out.

Partnerships and joint investments in connectivity will be indispensable to allow everybody to reap the benefit of the digital revolution. Connecting the unconnected, integrate SDGs considerations in ICT projects from the very start, ensure that solutions empower people, and develop cyber-security measures were some of the key G-STIC 2017 messages that were highlighted again.

The recent report from the Global Enabling Sustainability Initiative (GeSI), *Enabling the Global Goals*, demonstrated positive correlations and early signs of causation between digital access and SDG achievements. The keynote address by the Nobel Prize Laureate Shirin Ebadi during the G-STIC 2018 High-Level Plenary Opening Session highlighted the importance of human rights considerations for sustainable development. The newly-released GeSI report, Enabling Rights, presented at G-STIC 2018, looks at how ICT applications can support the work of human rights defenders, and SDGs 16 and 17.

Sustainable Technology & Development

Technology innovation and its upscaling offer the opportunity to leapfrog the access to basic services such as energy, potable water, etc. for developing countries. From a development and basic access point of view, technology upscaling requires a holistic enabling environment that covers business models and social inclusion.

A large number of innovative technologies that can transform the development scenario from the point of view of the economically deprived are ready for upscaling and urgently need policy, regulatory and financial (particularly de-risking) support. For technology innovation to make a dent in the development scenario, it needs to be coupled with efforts for building human capacities such as technical, entrepreneurial, financial and management skills.

Youth Engagement

Paradigm shifts are needed to enable purposeful transformative technological pathways towards sustainable development. We need to shift to an economic system that views the economy as a subset of the environment, with cleared defined planetary boundaries and biologic carrying capacities, and we need to promote rights-based participation that overcomes power struggles and ensures multi-stakeholder inclusion.

Other key messages that arose from the G-STIC 2018 discussions related to Youth Engagement are that (1) comprehensive anticipatory and lifecycle technology assessment should be integrated into the development of STI Roadmaps for the SDGs, conducting assessments with the participation of diverse stakeholder groups and with foresight on the potential for multidimensional risks, and (2) a more intergenerational approach should be adopted throughout the process of developing, using, and monitoring various STI strategies. Education systems should be transformed in ways that promote both STI skills, as well as an understanding of the complex ethical, legal, and societal dimensions related to STI strategies. Young people should be meaningfully engaged in STI structures at the local, national, regional, and global levels.

UN MGCY commits to continuing its role as a G-STIC partner in facilitating the meaningful engagement of young people in the preparation, execution and outcome of the conference, as well as connecting G-STIC to our participation in the various intergovernmental processes at the UN.

4 Key findings of the Industry Night

Bamboo

G-STIC 2018 highlighted **building construction** and **clean energy production** as two main development areas for bamboo.

While existing construction technology is copied from wood technology, **new construction technology should explore and exploit the specific characteristics and qualities of bamboo**. One key challenge is reducing manufacturing costs, which will happen when production starts at scale. Another key challenge is the lack of bamboo-based standards and certification schemes, which is a work-in-progress with ISO and other organisations.

Energy currently mainly covers **bamboo as a wood energy source** (burning the culm or changing it into charcoal). **Gasification** is a more efficient form of energy production, and this is starting to happen in countries as diverse as India, Indonesia and Kenya. **Energy from pellet production** would be an innovation, possibly to replace wood pellets for the European market so that the EU Member States can reach their target of 20% renewable energy by 2020.

The main challenge for this is planting large areas of bamboo. That should be possible, however, as bamboos are natural vegetation throughout the tropics (source: INBAR), and there is a lot of barren and unproductive land in the tropical belt that could be restored through planting vegetation (source: World Resources Institute). This would create jobs in the global South, provide secondary benefits to local farmers of food and resilience. It would help local governments with carbon capture, especially in the root/rhizome systems, and provide a source of renewable bio-energy for the market, with potential hard currency income for developing countries.

5 G-STIC contribution to international processes dealing with sustainable technology and innovation for the SDG

The G-STIC 2018 Co-host statement confirmed a concrete engagement toward international processes that forward STI for the SDGs. In striving to catalyse a process of better harnessing sustainable technologies and innovation to achieve the SDGs by 2030, and improve human well-being and prosperity broadly, G-STIC pledges its support to the international processes that aim at providing STI support to the SDGs.

In particular, G-STIC promises to support the IATT Expert Group Meeting on STI Roadmaps for the SDGs process under the Technology Facilitation Mechanism and its STI forum, by providing for specific targets of a selected number of SDGs.

This Chairperson Summary includes examples of a potential input that can be provided by G-STIC as an input to the guidelines on selected technologies that can significantly contribute to the achievement of specific SDGs. The examples have been summarized in a series of tables related to individual G-STIC themes.

BAMBOO

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
Bamboo as food	SDG 1	++	Cultural stigma. Lack of awareness	Promotion and publicity	Establishment of SMEs	Limited market	Reluctance to try new products
Bamboo fibres for production of textiles	SDG 12	+++	Use of polluting chemicals for fibre extraction	Improved waste management	Creation of closed loop waste management systems	Limited need for irrigation will be a critical positive argument	Sustainability factor will encourage consumers. If pollution is an issue, however, we have a problem.
				Promote alternative fibre extraction like Lyocell	Implementation of new methods	Is alternative technology cheaper than Rayon?	If we can address the pollution factor, consumers will buy bamboo textiles
Bamboo fibres for composite materials (construction & manufacturing)	SDG 11 SDG 12	++ +++	Use of unsafe glues & adhesives	Encourage research	Availability of new glues on the market	Is it cheaper than plastic?	Sustainability factor will encourage consumers. If safety of glues is an issue, however, we have a problem.
			Limited supply of raw material	Plant more bamboo, as part of climate mitigation actions	Hectares of bamboo increased	5-7 years ROI on financing bamboo plantation	Managing bamboo plantations requires different skills from managing wood plantations

Engineered bamboo for interior design and furniture	SDG 2 SDG 11 SDG 13	+ +++ ++	Limited supply of raw material	Plant more bamboo, as part of climate mitigation actions	Hectares of bamboo increased	5-7 years ROI on financing bamboo plantation	Managing bamboo plantations requires different skills from managing wood plantations
			Wood building codes and production standards do not apply to bamboo	Approve standards and adapt building codes	Adoption of legislative changes	Certification for market access	Consumers want proof of certification
			Lack of encouragement for local industry	Provide financial incentives	Establishment of SMEs	Do SMEs have market access?	Sustainability factor will encourage consumers
Bamboo for renewable energy	SDG 7 SDG 13 SDG 1	+++ ++ +	Limited supply of raw material	Plant more bamboo, as part of climate mitigation actions	Hectares of bamboo increased	5-7 years ROI on financing bamboo plantation	Managing bamboo plantations requires different skills from managing wood plantations
			Bamboo not included in energy policies	Develop new policies	Adoption of legislative changes	Renewable energy is growth sector	Public opinion encourages renewable energy
			Lack of awareness about investment opportunities	Share information	Establishment of businesses	Is bamboo cheaper than other types of renewable energy?	Reluctance to try new products
Bamboo for land and water management	SDG 15 SDG 13	+++ +	Bamboo not included in relevant policies	Promote appropriate amendment of policies	Hectares of bamboo increased	5-7 years ROI on financing bamboo plantation	Managing bamboo plantations requires different skills from managing wood plantations
			Public concerns about invasiveness	Explain that most bamboos are not invasive. Provide management advice for invasive bamboos.	Awareness materials	Potential economic benefits are immense	Overcome perception and “fake news”

Bamboo and rattan for eco-tourism	SDG 15	+	Encouragement for local industry	Provide financial incentives	Establishment of SMEs	Potential economic return is high	Tourists are keen on eco-tourism

CIRCULAR ECONOMY - Closing the material loop - Sorting and dismantling

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
On-the-belt characterization of mixed waste streams	9 12	+	Effort for machine learning Upscaling of equipment to full industrial scale	Binding recycling goals		Upscaling and investment cost	Enabling the replacement of hand-picking labour
Robotized dismantling of waste electronic equipment	9 12	++	Specific design of individual brands and models High CAPEX requires large volume flow – increase collection and logistics Building recycling/refurbishment system around the dismantling	Waste shipment regulation Proximity principle for waste management	Introduction take-back system for used devices Design products for disassembly	Value of recycled materials	Re-use of equipment in developing countries allows low-price access to products, but limits end-of-life recycling

CIRCULAR ECONOMY - Tracking products across their lifecycle

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
Digital twins of buildings	9 11	+	Data needed for a wide variety of products and materials Limited standardization of construction elements	Legislation on selective demolishing and re-use/recycling of construction materials	Introduction of building information management systems in construction projects	Increased material efficiency will lower construction materials sales volumes	Increasing the necessary technical skills level of construction workers
Blockchain and tagging-based virtual product chains	9 12	++	Products not designed for disassembly results in functionality loss upon recycling Lack of willingness with product manufacturers to turn to circular business models	Development of open source data platforms and blockchain protocols	Design products for disassembly Introduction of tagging in product parts Open source sharing of product composition	Development of blockchain technology	Re-use of equipment in developing countries allows low-price access to products, but limits end-of-life recycling

CIRCULAR ECONOMY - Improving urban material flow

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
Digital platforms for product and material reuse	9 12	++	Reliability of platform providers and logistics	Acknowledgment of commercial digital reuse platforms as a contribution to waste prevention targets	Reliable transactions based on guarantee approach	Avoidance of tax by direct peer-to-peer sales	Misuse of platforms for non-market conform sales

ENERGY POSITIVE COMMUNITIES

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
Micro- and mini-grids based on local optimal mix of renewable energy supply	3 4 5 7 9 11	+++	Interaction with the central grid Stable investment climate Tailor-made design Smart metering devices High initial investment	Integration of local energy planning in national energy scenario's Promote "open" decision/design platform for tailor-made local grids consisting of a combination of TSF combinations: technology, (multi) service and financing	Modular, interoperable and quality micro/mini-grid components	Need for new financing schemes: pay-as-you-go, micro-financing, third party	Create community services with the micro-mini-grids, in some cases co-operative initiatives are possible

Swarm technology for decentral integration of energy positive communities	7 11	++	Regulatory conditions on exchange of electricity between prosumers	Create supporting regulatory environment both for energy exchange and business models for e.g. peak shaving, or other grids services	Position as aggregators on the energy market co	Swarm technology alone is low-cost, the application depends on the deployment of interoperable energy components as PV-panels, batteries, etc.	The impact depends on the scale of application; the security of end-user data is important
Local renewable energy supply with services to agro-economy (e.g. soil fertilization) based on local biomass	2 7 11	+	Local integration in agro-economy traditions Biomass availability Biomass fuel diversity	See “micro and mini-grids”	Maximize the fuel flexibility of the technologies Prove the real impact on fertility of the soil and farmers productivity	Low initial investment cost (lower nominal power range), minimal maintenance cost	The impact depends on the social preferences and agricultural practices of the local farmer

Local renewable energy supply for community water supply	6 7 11	++	Local conditions (available water quality) A lot of (renewable) energy is needed High initial investment cost Interaction between water- energy companies required	Develop water demand plans and support the correct choice of the local conditions Support favourable local energy distribution conditions Support the interaction between energy/water companies	See water/materials topics for separation technologies Further lower the cost of renewable energy solutions	The cost of the (desalinated) water is mainly dependent on the (decline of) cost of the supplied renewable energy	The disposal of the brine (waste) can disturb local energy systems

(WASTE)WATER AS A RESOURCE

Innovative market-ready tech solutions	Pertaining to SDG	Contribution to achievement of SDG	Barriers to deployment	Levers/policy changes required for upscaling	Verifiable targets & actions by industry	Critical economic dimension of deployment	Critical social dimension of deployment
Protein recovery from wastewater	SDG 2: We make microbial protein from CO2 from wastewater bio-gas	**+**	Public sentiments and social acceptance	New regulation and policies	Pilot projects and scale-up	Contribution to protein production	Cheap production of protein for animal feed
Wastewater treatment eliminating hazardous chemicals	SDG 3: Contributes to SDG 3.9 reducing the exposure to hazardous chemicals in water	**++**	Lack of awareness	More stringent regulation and enforcement	Effluent Water quality – monitoring, reporting, verification	Additional costs for industry and (local) government with limited budgets	Limited (but growing) citizen awareness and demand
Wastewater treatment and water re-use	SDG 6: Contributes to the entire SDG 6 and 6.3 in particular, reducing pollution and halving the proportion of untreated wastewater an increasing recycling, and 6.4 Water use & Water Scarcity	**+++**	Lack of awareness about investment opportunities	Improved waste management regulation, national policy and strategies for water and sanitation sector	Amount / percentage wastewater collected and safely treated	Sales of energy, bulk water, nutrients, … produced from wastewater, willingness to pay for wastewater services	Demand for clean water, safe and clean environment Demand for more water under water scarcity and population growth

Wastewater treatment with bio-energy recovery	SDG 7: Contributes to 7.2 to increase in share of renewable energy and 7.3 improvement in energy efficiency	**+++**	Wastewater quality insufficient for energy production (too diluted)	Policy and regulation to allow biogas and CHP to produce energy; Attractive feed-in tariffs; allow organic solid waste to be mixed with wastewater	Amount of biogas and energy produced from wastewater treatment facilities	Renewable energy market development, energy prize	Demand for renewable energy and willingness to pay
Sustainable and resilient Infrastructure / Industrial innovation	SDG 9: Contributes to 9.1 to develop sustainable and resilient infrastructure and 9.4 to upgrade infrastructure to make them sustainable	++	Funding for applied research and rapid scale up	Promotion of new partnerships - PPP and Triple Helix on applied research to market	Pilot projects and scale-up	market demand for newly produced products from wastewater	Social acceptance of new products from wastewater (e.g. protein)
Urban drainage and advanced wastewater treatment	SDG 11 Contributes to 11.6 reducing environmental impact of cities, especially through addressing municipal waste management	**+++**	Lack of political will and awareness of opportunity	National and local regulation and enforcement; PPP regulation	% wastewater collected and treated	Solvency local government, wastewater tariffs	Acceptance of private sector involved in water and wastewater services

Wastewater treatment with reduction of GHG emissions	SDG 13 Contributes to 13.a fulfilling commitments made under the UNFCCC and Paris agreement by reducing carbon emissions related to (untreated) wastewater	++	Lack of awareness	Policy and regulation to allow biogas and CHP to produce energy; Attractive feed-in tariffs	Biogas produced, bio-energy produced	Energy prices	Demand for addressing climate change causes
Wastewater treatment to reduce pollution	SDG 14 Contributes to 14.1 reduce marine pollution from land-based activities, incl. nutrient pollution	+++	Lack of encouragement for local industry	Provide financial incentives	Water quality improvements, reduction of nutrients and hazardous chemicals	Business opportunity for energy and water production and re-use, fertilizer production	Demand for improved water quality for downstream use

6 Closing remarks – Word of thanks

Above all, the overall message of G-STIC 2018 is a positive one. Even though the challenge to achieve the SDGs by 2030 has certainly not diminished since G-STIC 2017 took place, we can achieve many of the SDGs by 2030. This will not happen by itself but requires deep technological transitions through the deployment at scale of new, market-ready technological solutions that already exist today.

The resolve and ingenuity of those in the academic, research, NGO, and the private and public sector communities to move jointly to a more sustainable world continues unabated. G-STIC 2018 echoed this resolve and contributed in concrete terms to finding transformative, existing and market-ready technological solutions to the many challenges that civil society and the private and public sectors face in realising the SDGs.

Knowing these technological solutions is not enough, however, to bring them to the market at scale. Societal, policy, legislative, regulatory and institutional changes, as well as changes in the financial and business environments, are needed, along with changes in human perceptions, behaviour and consumer preferences. That's why G-STIC wants to bring the transformative, existing and market-ready technological solutions to the attention of policy and decision makers so that they can take them into consideration when developing new laws and regulations.

To support the higher order, whole-of-government changes that are essential to catalyse a process of better harnessing the contribution of sustainable technologies and innovation for achieving the SDGs by 2030, G-STIC is committed to supporting the international processes that aim at providing STI support to the SDGs.

On behalf of the G-STIC 2018 co-hosts and the G-STIC 2018 thematic leads, I sincerely thank the numerous experts and all conference participants for their active contribution and engagement with G-STIC 2018. I hope to welcome them again at G-STIC 2019, November 27-29, Brussels, Belgium.

The G-STIC 2018 Chairperson,

Dirk Fransaer

Managing Director, VITO

Annexe 1: G-STIC 2017 Key findings

KEY FINDINGS OF G-STIC 2017 CONFERENCE

1. Many technologies needed to achieve many SDG-related targets are readily available. Following the demonstration to show effectiveness under real-life conditions, we need to develop strategies for deployment at scale to a level necessary to achieve the SDGs. For this, suitable policy and institutional environments, models, targeted incentives and partnerships are needed, which themselves are underpinned and strengthened by deep and sustained business, political and citizen engagement.
2. Widely distributed and bottom-up technological solutions that are appropriate for communities' needs and circumstances are to drive the realisation of the energy and food SDGs, two key SDGs for achieving the 2030 Agenda.
3. Circular economy is an essential element of the new narrative, with Industry 4.0 a key enabler to achieve it and resource recovery and use from waste streams, such as wastewater and CO2, the new normal.
4. ICTs are an indispensable tool to enable the achievement of the SDGs.

KEY FINDINGS OF G-STIC 2017 THEMATIC CLUSTERS

AGROECOLOGY FOR SUSTAINABLE FOOD SYSTEMS

A paradigm shift is needed from input-intensive crop monoculture and industrial-scale animal feedlots towards more resilient and diversified agroecological practices. G-STIC 2017 provided evidence that such diversified agroecological systems can work in delivering nutrition and secure livelihoods, in the places where needed most and to people who need these most.

CIRCULAR ECONOMY AND THE ROLE OF INDUSTRY 4.0

Industry 4.0 provides the technological driver for circular innovation, while circular economy is considered a driver for envisioning the industrial framework in 2030. We can't have a circular economy without the 4th industrial revolution, nor can we have socially useful and doable transitions to more sustainable economic development models without advancing the circular economy.

ENERGY POSITIVE COMMUNITIES

G-STIC calls for an energy access agenda that is driven by decentralized systems that are affordable, appropriate, and allow for bottom-up distribution. Ownership of customers in the energy positive communities transition is essential in the energy access debate.

SMART WATER

The digital revolution is providing a huge potential to manage our water resources more efficiently. The Smart Water session illustrated how Instrumentation, Control and Automation (ICA) technologies, combined with information derived from remote sensing, are already revolutionizing how water resources are managed. Three components are required to move from digital technology

to smart solutions: (1) the creation of data platforms, (2) the availability of open data, and (3) citizen participation.

URBAN DESIGN AND SUSTAINABLE BUILDING

A systemic and integrated approach is needed, in which design, construction, operation and use come together, with ICTs and the Internet of Things as major enablers. Much of the needed technology already exists, but moving forward will require new voluntary and mandatory measures and more demonstration projects that will create the required public and political awareness.

ELECTRIC MOBILITY

A mere technological shift without changes in mobility behaviour is insufficient, and the importance of urban planning, fuel efficiency, and prioritising system electrification was underscored. Meanwhile, managing the growth of the global vehicle fleet along with efforts to reduce the carbon intensity of the fleet is a vital intervention.

WASTEWATER AS A RESOURCE

There is a need to not think of wastewater as a burden, but rather as a provider of energy, nutrients and clean water for irrigation and human use. Again, much of the needed technology exists, and there is an immediate need for more demonstration efforts and new business models to ensure economic viability.

BAMBOO

Bamboo fibre and poles are successfully used in an increasing number of applications, from textiles and furniture, wood panels, laminates, biofuels, pulp & paper, up to prosthetics and water pipes. G-STIC 2017 illustrated 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.

CO2 AS A RESOURCE

Feasible solutions to harness CO2 as a resource by transforming CO2 into chemicals, fuels and materials were highlighted at G-STIC 2027. Although further research and innovation efforts are needed in several applications, some of the technologies are ready for the market.

INNOVATIVE BUILDING MATERIALS

Innovations in the production and use of building materials play a key role in the development of a more sustainable built environment around the world. At the same time, there is a growing focus on whether and how building materials may affect the environment and the health of building occupants. G-STIC 2017 showcased feasible innovations in the production and use of building materials.