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High-level political forum on sustainable development
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Multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

Note by the Secretariat

The President of the Economic and Social Council has the honour to transmit to the high-level political forum on sustainable development the Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals, held in New York on 14 and 15 May 2019. The Co-Chairs of the forum, the Permanent Representative of Barbados to the United Nations, H. Elizabeth Thompson, and the Permanent Representative of the Czech Republic to the United Nations, Marie Chatardová, were appointed by the President of the Council. The summary is being circulated pursuant to paragraph 123 of the Addis Ababa Action Agenda (General Assembly resolution 69/313) and paragraph 70 of the 2030 Agenda for Sustainable Development (Assembly resolution 70/1).

Co-Chairs' summary of the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

I. Introduction

1. The present summary represents a reflection of the broad discussions that took place during the multi-stakeholder forum on science, technology and innovation for the sustainable development goals (STI Forum). The summary brings together a diverse set of views articulated through both formal and informal statements provided by stakeholders. The views presented do not necessarily represent opinions held or endorsed by the Co-Chairs or the Governments that they represent.

2. Pursuant to General Assembly resolution 70/1, on 14 and 15 May 2019, the President of the Economic and Social Council, Inga Rhonda King, convened the fourth annual STI Forum. As a component of the Technology Facilitation Mechanism (TFM), the forum is a venue to discuss cooperation in science, technology and innovation (STI) around thematic areas pertaining to the implementation of the Sustainable Development Goals (SDGs), bringing together all relevant stakeholders to actively contribute in their areas of expertise. The forum provides a venue for facilitating interaction, matchmaking and the establishment of networks between relevant stakeholders and multi-stakeholder partnerships in order to identify and examine technology needs and gaps, including with respect to scientific cooperation, innovation and capacity-building, and to help to facilitate the development, transfer and dissemination of relevant technologies for the Goals and targets.

3. The Permanent Representative of Barbados to the United Nations, H. Elizabeth Thompson, and the Permanent Representative of the Czech Republic to the United Nations, Marie Chatardová, co-chaired the forum. The forum was prepared by the UN Inter-agency Task Team on Science, Technology and Innovation for the Sustainable Development Goals (IATT), with the support of the 10-Member Group of representatives from civil society, the private sector and the scientific community (10-Member Group).

4. The opening of the forum featured statements by the President of the Economic and Social Council, Inga Rhonda King, and the Under-Secretary-General for Economic and Social Affairs, Liu Zhenmin.

5. Two keynote speakers set the scene for the forum: Romain Murenzi, Executive Director of the World Academy of Sciences for the advancement of science in the developing world, and Claudette McGowan, Chief Information Officer of the Bank of Montreal, Canada.

The forum also watched a video message from the Chair of the Commission on Science and Technology for Development, A Min Tjoa, who presented an overview of the Commission's deliberations at its twenty-second session, held in Geneva from 13 to 17 May 2019, including a response to General Assembly resolution 73/17, which are presented in detail in the report of the Commission.

6. The forum was well attended, with an estimated 700 participants, representing Governments and scientists, innovators, technology specialists, entrepreneurs and civil society representatives. The forum comprised interactive sessions that engaged all stakeholders in the deliberations. In line with its mandate, the forum promoted networking and "matchmaking", including through innovator's presentations; exhibitions of innovative solutions for the SDGs and on gender and STI that featured prominent women scientists from around the world; special events to launch the exhibitions; a special roundtable on STI roadmaps for the SDGs; and 29 side events.

It was convened back to back with the Global Solutions Summit (GSS), a special event of the Global Sustainable Technology and Innovation Conference (GSTIC), and several other events during the week. This year's forum also included a Ministerial segment on strengthening capacity and policy for the development of STI roadmaps.

II. Highlights of the discussions at the forum

7. The forum deliberated on the challenges and technology solutions with transformative impact on each of the SDGs that are up for review at the high-level political forum (HLPF) in 2019: Goals 4, 8, 10, 13, and 16. The following, in particular, were discussed: the status of existing and new technologies; the potential for how science, technology and innovation could support the achievement of Goal 4 on quality education and lifelong learning; the ways in which STI impact economic growth and perspectives for full and productive employment and decent work for all (Goal 8); the interrelations between technology change and inequality within and among countries (Goal 10); the main challenges for developing, adopting, disseminating or scaling clean technologies for mitigating and adapting to climate change (Goal 13); and the ways in which STI can promote peaceful and inclusive societies, access to justice for all and build effective, accountable and inclusive institutions (Goal 16). Good practices and policy recommendations, as well as challenges, were identified, with a view to facilitating the development, scaling up the adoption and dissemination of relevant technologies for sustainable development.

8. The forum also addressed global trends and cross-cutting issues, including with on emerging technology clusters and the impact of rapid technological change on the achievement of the SDGs, pursuant to General Assembly resolutions 73/17 and 72/242; strengthening capacity and policy for the development of STI roadmaps; gender and STI for the SDGs; youth, innovation ecosystems, and development; linking STI of indigenous peoples, cultures and traditional knowledge, and the achievement of the SDGs; and on next steps for the TFM. The 10-Member Group which had been appointed by the Secretary-General for the period 2018–2019, moderated the sessions and provided their vision on the TFM.

9. Selected messages and highlights of the forum are presented in the remainder of the present summary. Statements and presentations in the opening session laid out "big-picture" views of key issues, principles and policy responses, many of which were further elaborated on in later sessions.

Impact of rapid technological change on the achievement of the Sustainable Development Goals

10. Pursuant to General Assembly resolution 73/17, Alexander Trepelkov, Officer-in-Charge of the Division for Sustainable Development Goals in the Department of Economic and Social Affairs (DESA), presented and update on the findings of the TFM on the impact of rapid technological change on the achievement of the SDGs.[1] These findings documented by the inter-agency task team, represented a collaborative, multi-stakeholder effort with well over 100 expert contributors. Key contributions to this process were also made by staff of UNCTAD, DESA, UNU, ECLAC, ESCAP, ESCWA, ITU, ILO, WIPO, and World Bank, and by the International Council for Science and the UN Major Group on Children and Youth. They synthesize the evidence and conclusions from eight meetings and sessions under

[1] Available from https://sustainabledevelopment.un.org/content/documents/28145AT_IATT_presentation_14_May_2019.pdf

the umbrella of the TFM;[2] 10 recent United Nations system reports and publications; written inputs from the 10-Member Group and from the IATT; and 50 science-policy briefs:

11. Digital technologies, robotics, artificial intelligence (AI) and automation, biotechnology and nanotechnology all have far-reaching impacts and present opportunities and challenges, in respect of the economy, society and environment and can already be felt in all countries. They require us to engage actively with the issues identified by TFM experts:

12. *Great potential:* The potential benefits of new and rapidly changing technology clusters are so great for the SDGs and beyond that we cannot afford not to make wise use of them.

13. *Technology risks and gaps:* Technology change has never been neutral, creating winners and losers, involving risks, and potentially exacerbating gaps and inequalities. The UN has an important role in promoting action on these issues.

14. *Development impacts of cheap automation and AI:* Rapidly declining costs of new technologies can broaden access to the benefits of technology and enable much more rapid development, but they also present extraordinary policy challenges that call for an extraordinary level of international cooperation. Many countries may need to find new development pathways that incorporate these technologies and to rethink employment and income distribution issues.

5. *Employment impacts:* The overall employment effects will depend on the specific circumstances within sectors and various local contexts. Computers and robots could replace as many as half of all human jobs in the coming decades - essentially precluding traditional routes to achieve economic development in some countries, but they could also create many new jobs. It is unclear how jobs losses and job creation will compare and how they will be distributed, however, we need to be prepared for different scenarios to unfold.

16. *Preparing for the impacts:* Governments will need to re-think and re-organize how they match the supply of skills to the rapidly evolving job market needs in formal and informal education systems. Some TFM experts call for testing proposals for technological unemployment insurance, guaranteed income policies, and a range of other compensatory social policies.

17. *Natural environment:* New materials, digital, bio-, and nanotechnologies, and AI all hold great promise for a range of high-efficiency water and renewable energy systems that could be deployed in all countries and catalyse the global move towards sustainability. However, despite efficiency increases, AI and all the other emerging technologies clusters will require ever-increasing electricity with its associated pollution and wastes (e.g., e-waste, nano-waste, and chemical wastes), which calls for incorporating environmental considerations into the design of these technology systems from the start.

18. *Strengthening the science-policy interface:* Our knowledge and understanding of new technology trends – especially in developing countries - need to be expanded as the basis for well-founded actions and policies. TFM experts proposed building

[2] See in particular, the DESA/ECLAC/UNCTAD expert group meeting on rapid technological change, artificial intelligence, automation and their policy implications for sustainable development targets (Mexico City, 26-27 April 2018), see https://sustainabledevelopment.un.org/index.php?page=view&type=13&nr=2857&menu=1634 . and the first such meeting in December 2016, see https://sustainabledevelopment.un.org/unsystem/index.php?page=view&type=13&nr=2042&menu=23

partnerships and interfaces with universities, labs, innovation incubators, and private sector entities that are at the forefront of this technological change, potentially in the form of a discovery lab or a network of interfaces between the policy makers and technologists at the frontier, facilitating the exchange of real-time information, engagement, and policy insights.

19. *Norms and ethics:* Calls for a more responsible and ethical deployment of new technologies have to be balanced against concerns that excessive restraints on innovations may deprive humanity of many benefits. Ethical and normative considerations that should guide our thinking on these issues have to spring from our shared vision - the values contained in the UN Charter, the Universal Declaration of Human Rights, the Rio+20 outcome "The Future We Want", and most recently the 2030 Agenda on Sustainable Development.

20. *Multi-sectoral and multi-stakeholder engagement:* Fostering policy coherence and multi-stakeholder dialogue is more important than ever - coherence across policies for macro-economy, science and technology, industrial development, human development and sustainability; and multi-stakeholder dialogue to present different perspectives, arrive at shared understanding and establish trust.

21. By design, the aforementioned identified issues are complemented by those contained in the recent report of the Secretary General on the impact of rapid technological change on sustainable development (E/CN.16/2019/2).

22. In the discussions that followed the presentation, private sector representatives offered their support to work with Governments to keep pace with technological breakthroughs and how to leverage them towards the common SDG aspirations. Many case studies of private sector and partnerships are available in this regard. An idea of common table was presented. The TFM online platform was highlighted as an important tool that should be engaging and interactive, allowing participants to learn and partner with others.

23. Notably, antibiotics resistance was identified as an emerging global health crisis. Commensurate support is urgently needed for academic and business efforts towards reducing, or even eliminating antibiotics resistance.

24. The forum was briefed on progress and consultation processes undertaken by the Secretary General's High-level Panel on Digital Cooperation. The Panel's work has focused on the issues of digital commons for the SDGs, metrics for digital inclusion, economic policy coordination and regulation. It indicated the importance of values and principles, workable mechanisms, and illustrative actions. It was found that high-tech solutions can be used to tackle low-tech challenges, and low-tech solutions can be delivered through high-tech mechanisms, hence both are intricately linked with each other. Governments should thus build partnerships with universities, innovations incubators, private sectors, linking frontier stakeholders to policy makers.

25. The discussions on new and emerging technologies have been ongoing at the forum since 2016 and are likely to continue at the STI forum, the CSTD and other forums at the regional and national levels. Not all policymakers are aware of the far-reaching potential effects of accelerated technology change and how to strategically respond to these trends. Against this background, the IATT was encouraged to identify and facilitate the implementation of good practices and public policy responses related to the SDGs, including through a repository of good practices and salient empirical data.

Strengthening capacity and policy for the development of STI roadmaps (Ministerial segment and Technical Roundtable)

26. The challenge is to design STI policies and instruments for the SDGs that translate the Goals' universality principle into actions, while respecting national science, technology and innovation priorities and realities. STI roadmaps for the SDGs - together with measures for tracking progress - can be important strategic tools for ensuring policy coherence and for linking the development challenges with solutions.

27. In the Ministerial segment, the following countries and/or political groups shared their experiences emphasizing the role of STI as a central element of national development strategies, policies, and programmes: G77 and China; European Union; Barbados; Ecuador; Egypt; Ethiopia; Hungary; Japan; the Philippines; and Serbia. Their submitted statements are available on the TFM Website at https://sustainabledevelopment.un.org/index.php?page=view&type=20000&nr=5519&menu=2993

28. Speakers suggested to establish an international funding mechanism to support start up tech-SMEs and bright and creative youth, as well to support human skills development through new fabrication labs and technological learning centres where innovators can pilot and commercialize their products and services.

29. Speakers encouraged addressing the needs of Small Island Developing States and other small developing countries and encouraged working on solutions on how these countries could better leverage technologies for development and to themselves become technology creators.

30. A number of lessons have been learned from such national plans, policies and road maps, many of which were already discussed at last year's forum. Based on these findings and further expert consultations, the IATT has produced a technical guide book on STI roadmaps for the SDGs. This year's forum also included a technical round table was also dedicated to the STI roadmaps.

31. The cross-cutting nature of the SDGs requires holistic approaches and strategies that are multidisciplinary and take into account different sources of knowledge. Global partnerships are essential. Science ecosystems and advisory systems need to be improved and stakeholders involved in STI policy design, adaptation and application. Collaboration should be fostered among scientists, engineers, companies, public research and government institutions and the end users of technological products.

32. The roundtable explored how to integrate the range of issues related to frontier technologies into STI roadmaps. Market-ready, integrated frontier technology solutions exist to support developing countries to achieve specific SDGs. The Government's role is to build the infrastructure and education systems. To identify appropriate technology solutions, the entire value chain, business models and potential impacts need to be considered.

33. It is important to balance policy coherence across sectors, including through deep dive analysis of goal-specific roadmaps. People's needs, affordability, economics and technical efficiencies deserve consideration. Close collaboration between Government and private sector is essential for the development and implementation of STI roadmaps. Different groups of countries will have different needs

34. The roundtable also assessed the various partnership models for STI roadmaps. It found certain types of public-private partnerships promising but acknowledged great regional and national differences. Globally, ODA for STI amounts to about US$20 billion per year, but it is highly fragmented, and it should respond to the prioritized needs of countries. It is important to note that even simple replication of successful existing technology in other countries is risky with local human talent as a critical factor.

35. STI roadmaps for SDGs need to be customized to fit countries' circumstances and at the same time be harmonized worldwide to structure the necessary knowledge and match problems with solutions. They need to consider national innovation system, governance, regulatory environment and ultimately the precise value proposition. Attention should paid to market-ready technology solutions, to build strong linkages with stakeholders and outline the potential wider impacts of proposed STI policies.

36. Main elements of STI roadmap implementation include localizing, mobilizing, prioritizing, and customizing. The IATT's guidebook on STI roadmaps can also serve as communication tool with stakeholders and citizens. Raising social awareness and increasing inclusion is essential. In view of the complexity, capacity building is critical to bring everyone to a minimum knowledge level before engaging in roadmap development. Such capacity building has been the focus of the IATT subgroup on capacity building.

37. The STI roadmaps process needs to consider socio-cultural sensitivities, include institutional issues and fully involve science and technology communities. It should clearly predict and monitor the positive and negative impacts of the roadmap implementation. The sustainability of infrastructure construction is key. Governments should stimulate cross-sector cooperation and carefully examine the social, economic and environmental impacts of frontier technology and react to the findings with fine-tuned policies.

38. Further international support, Member State engagement, and partnerships with donors and the private sector will be needed to fill the critical gaps in data, finance and effective implementation. The UN system, through IATT, is encouraged to design an international roadmap of STI for SDGs as a communication tool, based on expert inputs and the contents of national or local STI roadmaps. International organizations need to mobilize funding to support roadmap implementation, enable policy-learning, improve capacity for monitoring and analysis and to inform international efforts.

39. National STI for SDGs road maps can be a significant output of the TFM. They can help decision makers in Government and civil society, as well as members of the public — from Heads of State and finance ministers to citizens at the local level — to evaluate how the nation's policies, investments and actions are achieving the intended outcomes efficiently and effectively. UN experts in the IATT, the 10-Member Group and TFM partners constitute an important source of expertise and financial support, which should be effectively mobilized. The IATT subgroup on STI roadmaps, most notably the World Bank, are currently exploring national pilot applications.

STI for education and decent work for the future (SDG4 and SDG8)

40. STI have strongly shaped and changed the worlds of work and education, which is expected to accelerate in the next ten to twenty years. Digitalization continues to create new types of jobs, even as its disruptive nature continues to be a matter of great concern. New and emerging technologies will continue to increase efficiencies and may benefit workers (e.g., by promoting part-time work and online learning). The OECD's recommendations on artificial intelligence and its policy toolkit were highlighted as useful guidance in this regard.

41. STI can support SDG4 and SDG8 through proactive, life-long learning and skills-development of workers. At the same time, high quality university education in science and engineering remains key.

42. A paradigm shift in action and practice of education is needed to prepare for a rapidly changing future of work. In the context of national development processes,

the formal and informal education systems need to be continuously adapted to prepare students, researchers and workers for disruptive technologies. Concerted efforts are needed for a greatly expanded and interconnected, world-wide STEM education system that is open to and accessible for talent from everywhere. Comprehensive learning strategies should also look at learning in families, social networks, and enterprise networks. And engineering education need to be geared to address the SDG challenges and human-centred design. Similarly, policy makers need to negotiate a delicate balance so that jobs are not lost due to technology change in a way which causes social dislocations in societies where the unemployed are not easily reabsorbed into the job market.

43. There are strong links between access to capital and education as enablers of ST-driven development. Financial resources are dedicated to achieving higher education levels, and higher education levels help attracting investment – in a virtuous cycle driving development. Hence, adequate public and private investment into education is paramount for sustainable development.

44. National innovation systems should be geared to support new employment opportunities and inclusive growth, reflecting innovation goals, technology direction and capacity. Basic research and its close connection with applied research are important. A global system of infrastructures needs to be built to allow all countries to benefit from frontier technologies. Stakeholders should jointly develop international standards for frontier technologies. The population share of STI researchers need to be increased significantly in many countries, and STEM elements expanded in school curricula (including global educational qualifications). In this regard, the leading scientific nations should provide capacity support and tools to other countries, including transfer of educational technology through ODA.

Gender and STI for the SDGs

45. Globally women spend twice as much time on unpaid work than men. According to ILO, women's unpaid work amounts to 12 billion hours per day, which equals about 2.1 billion jobs. These vital unpaid contributions are typically ignored in official statistics, GDP estimates, and in economic policies in general. It is important to recognize these economic contributions and to address the significant data gap.

46. Technology access of women in lower social strata remains varied. However, mobile technologies have proven particularly useful enablers of financial transactions in the informal sector. Political leadership can address the existing divide and ensure including women's issues in the STI and labour policies. In particular, Governments could showcase the usefulness of technology in women's daily activities.

47. Continued efforts are needed to improve women's representation in technical fields. However, approaches to gender and STI have dramatically changed in the last few years. It is now recognized that it is not simply a matter of increasing the number of women, but of promoting structural change in STI institutions. In particular, girls should be engaged in technology early on during schooling and top talents could be identified, in order to mentor, provide role models, connect and inspire them Ultimately, increased women's representation will improve science, innovation and problem-solving. Hence, women and girls are essential as both beneficiaries and creators of STI.

48. Some countries face a shortage of STI workers. Yet, excellent minds can be found anywhere - they simply have to be matched with opportunities. Boot camps can be cost-effective tools to provide technology training to women. Government policies and flexible, culturally sensitive arrangements in corporations can improve the recruitment and retainment of women in technology industries. Direct support for

placements in companies can also be useful. International science organizations should continue advocating for gender equality in science.

49. Software coding could be taught in different ways, in order to make it accessible to everyone. Excellent minds can be found everywhere, but not excellent opportunities. For example, coding when taught more like a language rather than a complex set of algorithms, can make it more attractive to some girls and women.

50. Following the session, a special exhibition on gender and STI prepared by IATT was launched. It celebrated prominent women scientists from around the world and their contributions.

A Brighter Future – Youth, Innovation Ecosystems, and Development

51. Young people are a force for development. They tend to be pioneers and first adopters of new ideas and technologies. Most importantly, young people are the leaders of tomorrow. Decisions made today will have long term implications, often with consequences that will only be realized in hindsight.

52. The STI Forum heard views of the younger generations on what kind of STI policies and solutions they would like to see. A large number of side events were organized by younger people, many of the initiatives spearheaded by the UN major group on children and youth.

53. Intergenerational equity is a core principle of the Rio process. It is essential to ensure that STI policies and solutions designed today do not jeopardize the capabilities of future generations to deal with their challenges due to technology lock-in and path dependence. This can be achieved in numerous ways, for example, by providing spaces for young scientists in science advisory systems, community-based technology assessment, simulations to forecast short-and-long term consequences of STI policies/solutions, and spaces for peer-learning and mentorship.

54. Young scientists, engineers and entrepreneurs should be fully involved in STI decision-making, especially with regard to the impacts of rapid technological change. Science literacy and modern science education for youth is important. Early career scientists, engineers and innovators need to be systematically supported, also to retain top talent in areas to address STI challenges for the SDGs. Similarly, providing young people with access to seed funding and continued resources for their STI ventures is worthwhile.

55. In LDCs, science literacy levels need to be raised. Universal access to affordable education is to be achieved through whatever technological means. This is especially important given the comparatively large share of young populations in poorer countries.

56. STI policies should be continuously and critically assessed, advised and inspired by younger people to shape the visions for the future. Such discourses are essential to elicit multiple perspectives, to allow for comparisons and co-designing with communities to ensure relevance.

57. Similarly, effective science communication is important to bridge the gap between science and society and to make sure science addresses societal needs and concerns. This includes ethical considerations.

STI for inclusive and equitable societies (SDG 10 and SDG 16)

58. In the past, STI has both been a cause of and a solution to the issue of inequalities within and among countries. There is no technology determinism that necessarily leads to extreme forms of technology divides. Instead, institutions are

decisive in determining the ultimate direction of STI effects. International STI cooperation is essential in this regard.

59. Partnerships between Governments and private sector can be useful for leveraging technology to deliver social protection programmes and enhance digital opportunities for citizens.

60. Persons living with disabilities should be involved in all stages of the technology development cycle. Ethical considerations and the Principle of Universal Design can support ensuring technology availability, affordability and accessibility. This is important for persons with disabilities, since they have typically been excluded from the technology development process, despite being key users of artificial intelligence and robotics.

61. Various international programmes are important supporters of STI for SDG10 and SDG16. For example, the European Union's Horizon Europe is a €100 billion R&DD programme which will also support the SDGs through co-creation and citizen dialogues. The World Bank's approach to mitigating the technology risks combines building the infrastructure for technology, boosting the users' capacities, and brokering infrastructure access particularly for poorer countries.

62. Digitalization can play an important role in improving private sector productivity and governance. It can enhance citizen participation, improve access to healthcare and financial transparency. Examples showcased included the WFP's use of blockchain technology to deliver aid to refugees and Armenia and Georgia's e-governance portals.

63. Even as technology application become ever more useful and ubiquitous, or precisely because of these trends, it is important not to lose sight of the potential risks of technology becoming all-consuming to the point that they erode rather than improve quality of life.

64. There are a number of STI solutions that have demonstrably supported reducing corruption. Online platforms limit interactions between civil servants and contractors/service providers. It is especially important to eliminate corruption from the construction sector, which can be supported by innovative technology solutions.

65. The STI sector, and especially financial technologies, require better regulation, which is only possible if Governments and society at large have a minimum understanding of the technology issues. At the same time, Governments should invest in data systems, following best practices in data privacy, transparency, openness, and accountability. It was also suggested for the UN to lead the creation of standardized national addressing systems in developing countries.

STI for taking action to combat climate change and its impacts (SDG 13)

66. There are several technological pathways to achieving net zero GHG emissions into the atmosphere and to limiting global warming to less than 1.5 degrees Celsius in this century. Effective technology solutions are available in principle and political commitment has increased in many parts of the world. However, trade-offs between other policy objectives and the large-scale deployment of GHG mitigation and climate-altering technologies need to be better understood and quantified at various levels. Good governance, participatory approaches, business partnerships, and international cooperation will be essential in this regard.

67. More than 9,000 cities world-wide are already addressing climate change. Most infrastructure and 80 per cent of world GDP is concentrated in urban areas, many of which face the double challenges of urbanization and early climate change impacts. Recently, the Global Covenant of Mayors established the Innovate4cities initiative to

create partnerships between the scientific and academic community and cities, and to use science as a base for their decisions. Thousands of cities have signed the Edmonton Declaration which calls for science-based decisions and climate action in line with the Paris Climate Agreement.

68. More investments in STI are needed in almost all countries. International collaboration on STI for climate change mitigation and adaptation is needed. International partnerships could promote increasing R&DD investments into climate technologies and demonstration projects. Ultimately, regional adaptation plans will be needed, which may need to include relocating climate refugees and protecting their human rights.

69. Globally, an estimated 10 million new students are now engaged in multi-disciplinary studies that are in one or another way related to climate change. Yet, no unified applied climate science and technology studies exists as an academic discipline.

Linking STI of indigenous peoples, culture and traditional knowledge, and the achievement of the SDGs

70. The international community should not underestimate the practical knowledge of indigenous people. Development of STI at all levels could help driving the bottom-up transformation and encourage STI roadmaps to fully respond to their needs.

71. Local and indigenous knowledge has an important role in addressing complex global issues, such as biodiversity loss, weather risks, climate change, and desertification. However, conducive conditions and partnerships are needed to mobilize such knowledge.

72. Important synergies can be realized between traditional, local and indigenous knowledge and grassroots technologies on the one hand and modern scientific knowledge on the other, leading to accelerated progress towards the SDGs. To this end, policy makers and development practitioners should acknowledge the traditional knowledge systems and take into account the specific socio-cultural contexts. This is especially important when new technologies, such as AI, are introduced at community level.

73. Governments should support dialogue among different knowledge systems to facilitate the innovation process on national level. Funding is needed also for traditional knowledge systems, in order to ensure knowledge is passed on to the next generation.

74. International organizations should find new ways to reach out to indigenous communities through online platforms or similar forums focused on these communities. The aforementioned IATT's guidebook on STI roadmaps should consider indigenous knowledge and communities.

Supporting the implementation of the TFM – the way forward for joint action

75. At the end of the four-yearly cycle, it is an opportune time to look back on what has been achieved, but also to look forward to ever greater engagement of scientists, engineers and innovators, forging new partnership for action. The forum has matured and firmly established STI discussions at UN headquarters in New York. It is the premier UN entry points for scientists, innovators and researchers. In the words of a former co-chair of the forum, "there are great opportunities where great impact can be seen".

76. Panellists and speakers did not only reflect on lessons-learnt from the start-up phase of the TFM since 2015, but also discussed means and ways for the TFM to work

closely with the Internet Governance Forum and the Technology Bank for Least Developed Countries.

77. As in previous years, interest in and demand for the TFM has continued to increase over the past year. Thus, renewed efforts should be made to involve a wider range of global science communities and civil society in the planning and follow-up of the forum, building on existing mechanisms and intersessional dialogue in online and offline formats.

78. The forum commended recent progress in the work of the IATT and the 10-Member Group. The Mechanism's intersessional work should build links to important STI- -related events and initiatives, in order to amplify the scope of the forum and draw on diverse stakeholder communities. Examples include the GSS, GSTIC, CSTD, IGF, ITU's Artificial Intelligence for Good Global Summit, UNESCO and ICSU's World Science Forum, OECD forums, Conferences of development banks, among others.

79. It was requested to strengthen and systematize the substantive work of IATT work streams, by fully engaging the 10-Member Group, science and engineering stakeholders, donors and interested Governments as political champions.

80. Science and technology are most needed in countries and places where they don't exist. Hence, capacities need to be built, not only for R&D and for specific technology solutions, but, most crucially, for practical deployment of technology solutions on a large scale. Similarly, technology management capacities are essential for identifying economically affordable, environmentally sound and socially acceptable new technologies. The forum welcomed the IATT joint capacity-building initiative which had pooled training materials and staff expertise to organize a second training workshop in Panama, from 5 to 8 May 2019 - with several more workshops planned in the coming months.

81. Political commitment and scientific leadership continue to be of paramount importance. The forum encouraged technical and financial support for the full operationalisation of the TFM online platform. The prototype platform continues to be improved with an increasing number of partnerships for the platform's further development, maintenance and operation.

Exhibition hub and winners of a global call for innovations

82. As in previous years, an integral part of the forum was an exhibition hub which featured winners of a global call for innovations for the SDGs, as well as a showcase of selected corporate solutions. These innovations, selected from around the world, had to be transferable, inspiring and impactful.

83. The exhibition was launched through a special event. The innovations addressed technologies to improve education delivery (Goal 4), support skill building for work (Goal 8), promote cleaner cooking fuels (Goal 7), reduce GHG emissions (Goal 13), and reduce waste (Goal 12), and improve transparency and accountability (Goal 16), inter alia. The following are short descriptions of the winners of the global call for innovations who presented their solutions to the forum.

84. "A roof, a skill and a market for women" provides a roof, a skill and a market to end housing poverty in Africa and takes a slice of Uganda's urban $4.9 billion housing market.

85. "BioLite HomeStove" is an innovative, fan-assisted biomass stove that burns wood like gas, turns fire into electricity, and reduces smoke emissions by 90 percent and fuel consumption by 50 per cent compared to traditional open-fire cooking.

86. “Coliba Recycling” has been referred to as the "The Uber of waste management service". Coliba makes us of mobile technology to creating solution to the huge plastic waste problem in West Africa.

87. “No Food Waste” is a youth and technology-driven surplus food recovery network that collects surplus food from weddings, restaurants, food industries in India and feeds the people in India there by combating both Hunger and Food Waste together.

88. The “It's our forest too” app is a forest monitoring smartphone application used to monitor and report on illegal logging and biodiversity loss by indigenous communities.

89. “We Love Reading” is a grassroots community-based program to encourage children to read for fun.

90. “DIYlaw” is a one-stop hub for all things legal in Africa. It creates access to legal and business support services, service providers & information for African entrepreneurs.

91. “Broad Class - Listen to Learn” is an Interactive Radio Instruction program that provides lessons and teacher training. It reaches the poorest and remotest schools with interactive basic skills and English. Measurable gains have been gained in quality, equity and inclusiveness.

92. “Using UAVs to Map, Monitor and Protect Indigenous Territories”. UAVs are a low-cost, powerful and effective tool for indigenous communities to map, monitor, and protect their territories. UAVs help collect important data and are an alternative to satellite images for precise photogrammetry and 2D and 3D mapping.

93. “Can't Wait to Learn” is custom-made digital game-based learning to bridge the education gap for conflict-affected children.

94. “Zelij Invent” is a greentech solution that transform plastic waste into sustainable construction materials.

III. Key messages and general recommendations

95. The forum highlighted many practical examples and proposed recommendations for action by the UN system, Governments, businesses, scientists, academia, civil society and others. The necessity of a multi-stakeholder approach was repeatedly underscored. The following issues may be considered by decision makers, in addition to the wider range of recommendations on how to address the challenges in SDGs 4, 8, 10, 13 and 16 and a number of cross-cutting issues (see sect. II above).

96. The TFM constitutes a new one-UN way of working for the UN system which is entirely new, especially in terms of engaging many STI communities and individual experts that are not typically engaged with the UN.

STI for the SDGs

97. Many insights have been gathered towards SDG-specific technology solutions, including those that help to manage trade-offs and realize synergies. Attention should now move to identify and assess high impact, integrated technology solutions across SDGs, their socio-technical feasibility and potential impact. These should be discussed at the 2020 forum.

98. Similarly, hundreds of innovators participated in the call for technology innovations for the SDGs every year since 2016. It is time to follow-up, support and create partnerships for supporting the scaling up these and similar other innovations.

99. The TFM has become the premier multi-stakeholder mechanism in the UN system for advancing STI applications for the SDGs. Existing conferences and events within and outside the United Nations may be associated with and consider presenting their STI findings to the forum. The online platform, as mandated by the 2030 Agenda, is close to operationalisation, but requires further support from donors, the private sector, international organizations and others to reach this stage.

New and emerging technologies, frontier technologies, and rapid technological change

100. While the TFM has made progress in documenting and analysing the wider societal impacts of new technologies, much better knowledge and also quantitative insights are needed — in both developed and developing countries — in order to prepare for the different scenarios of how these impacts might unfold in the coming years. Supporting the capacities of developing countries to assess and prepare for these impacts and exchange of experiences on public policies and good practices will be needed and should be systematically supported by the UN.

101. Responsible and ethical deployment of technologies has to be balanced against concerns that “excessive” restraints on innovations might otherwise deprive humanity of many benefits. This requires pragmatic, evidence-based ethical assessments that must derive from the values contained in the UN Charter, the Universal Declaration of Human Rights, the Rio+20 outcome, and the 2030 Agenda. The report of the High-level Panel on Digital Cooperation is expected to provide guidance in this direction.

102. Holistic, integrated approaches and strategies are needed. They should be conducive to a wide range of forms of knowledge and perspectives, including those of young people, as well as local, traditional and indigenous forms of knowledge, and also supported by new and emerging technologies.

103. Extraordinary levels of international cooperation on research, infrastructure, access, and capacities are needed, in order to overcome the technology gaps between and within countries, between men and women, and across social groups — ultimately to avoid long-run, low-technology traps. This requires multi-stakeholder approaches and UN system support.

104. A forward-looking perspective is needed to understand the potential opportunities and challenges associated with the impact of rapid technological change on the achievement of the SDGs.

105. In this regard, key emerging issues need to be systematically identified by the TFM. One such example was the call of this year’s forum to fully supporting academic and business efforts towards reducing, or even eliminating antibiotics resistance.

STI for the SDGs road maps and action plans

106. STI roadmaps for the SDGs and related action plans need to be developed at the national and subnational levels, ideally with measures for tracking progress and in line with national and global development strategies. They are strategic tools for ensuring policy coherence, linking public and private actions, and optimizing investments. They are also powerful communication tools.

107. The IATT guidebook provides an outline of the scope and nature of the road mapping process. It was suggested that a group of Member States could lead the way by undertaking serious efforts over the coming year to develop their own versions of STI roadmaps for the SDGs and reporting on their experiences at future STI Forums and the HLPF.

108. Participation of science communities, funders, academia and the private sector need to be further expanded and deepened, and partnerships are essential. Regardless of the model of involvement, a business case should be made for private sector investments in innovation for the Goals. Member States were also called upon to support the TFM, both politically and financially.

IV. Recommendations for the multi-stakeholder forum on science, technology and innovation for the Sustainable Development Goals

109. Going forward, the forum will continue to strengthen its convening power for dialogues between stakeholders and governments and for sharing ideas and catalysing new initiatives and partnerships. It will continue to help to identify practical means and solutions to foster science, technology and innovation in all countries.

110. Continued real demand for the multi-stakeholder STI Forum and its science-policy interface function in support of the SDGs is apparent. Given the high expectations for the TFM, Member States and stakeholders should consider strengthening their political and financial support for the Mechanism.

111. The multi-stakeholder TFM should continue to improve inclusion of stakeholders and associated related events and improve coordination with UN system and other international organizations. Support is needed for even greater participation in the forum by government representatives and innovators from developing countries. Significant support is needed to fully operationalise and expand the TFM online platform into a veritable partnership portal on STI for the SDGs. And support is needed for the expert work at the working level in the various IATT subgroups streams, to better integrate the work streams themselves, and to disseminate and communicate its work.

112. The IATT subgroup on new and emerging technologies, frontier technologies and rapid technology change should make a special effort to disseminate salient information on and support the knowledge and understanding of STI trends, impacts, good practices, initiatives and public policies for the SDGs. A forward-looking perspective, coherent and plausible scenarios and more robust quantitative approaches could help in this effort.

113. The TFM should build partnerships and interfaces with universities, innovation incubators and private sector entities that are at the forefront of technological change. In particular, it may want to further pursue the idea of a discovery lab or a network of STI centres to serve as an interface between the policy makers and technology pioneers, facilitating a two-way exchange of real-time information, engagement and policy insights.

114. The work of the IATT subgroup on STI roadmaps for the SDGs should continue supporting the development of multi-stakeholder roadmaps in interested countries, based on the conceptual approaches outline in the recent IATT guidebook on STI roadmaps. International support, Member State engagement and partnerships with civil society and the private sector will be needed to develop capacities and fill critical gaps in data, finance and effective implementation. UN experts in the IATT, in the 10-Member Group and among TFM stakeholders constitute an important source of technical expertise in this respect.

115. Similarly, the IATT subgroups on capacity building and on gender and STI need full support and engagement.

116. In view of the demand for further work streams, the IATT and 10-Member Group is encouraged to take stock of the start-up phase of the TFM from 2015 to 2019, and optimize its focus and working structures, based on the lessons-learnt.

117. Over the coming 11 years, future forums should learn from and advance the achievements of previous ones. The forum might become the outcome of an annual programme of results-oriented activities in the IATT subgroups in close cooperation with the 10-Member Group.