G7 Science and Technology Ministers' Meeting Communiqué

(Bologna and Forlì, July 9-11, 2024)

We, the G7 Science and Technology Ministers, have come together in Bologna and Forlì, Italy, from 9 to 11 July 2024, to discuss the pivotal role that science, technology, innovation, and higher education and advanced training play in contributing to a sustainable future that benefits all people, based on our common values of democracy, respect of international law, and promotion of human rights, fairness, and freedom.

The overarching intent of the G7 Science and Technology Ministers' Meeting under the Italian Presidency is to foster stronger collaboration among its members and reaffirm our shared commitment to promote progress in research for the benefit of the whole world, aligned with the view that openness is fundamental, security is essential, and freedom and integrity are crucial.

We continue to condemn Russia's ongoing war of aggression against Ukraine in the strongest terms and reaffirm our unwavering support for Ukraine's fight for freedom, independence, sovereignty, and territorial integrity. Ukraine's research and innovation ecosystem has been devastated by Russia's war, particularly affecting Ukraine's research infrastructures and human capital. We re-emphasise the crucial role science, technology, and innovation will play in rebuilding Ukraine as a thriving, modern, and sustainable economy.

We, the G7 Science and Technology Ministers:

1. Stand ready to deliver coordinated and concrete support for and with Ukraine's research and innovation ecosystem. We welcome the high-level discussions on science, technology, and innovation held at the recent Ukraine Recovery Conference in Germany. We express our continued commitment to science, technology, and innovation in the context of Ukraine's recovery and confirm our support for the inclusion of this issue as an integral part of the agenda of the Ukraine Recovery Conference 2025 in Italy. In the lead up to the Conference, we welcome Italy's efforts to coordinate, in collaboration with the European Union, regular, enhanced engagements between the G7 members, Ukraine, and relevant international stakeholders for sharing expertise, best practices, and solutions on leveraging science, technology, and innovation for sustainable reconstruction;
2. Emphasise the role of science and technology in achieving the objectives of the 2030 Agenda of the United Nations and its Sustainable Development Goals, and the goals of the Paris Agreement and the Kunming-Montreal Global Biodiversity Framework;
3. Welcome the Declaration on Transformative Science, Technology and Innovation Policies for a Sustainable and Inclusive Future, adopted at the Ministerial-level meeting of the OECD Committee for Scientific and Technological Policy. New and emerging technologies are crucial to urgently tackle global crises, such as climate change, biodiversity loss and pollution, and emerging diseases or pandemics. These technologies can also pose governance challenges that are best addressed with international cooperation based on shared values;

4. Encourage the engagement of civil society in scientific research processes by promoting and supporting mutual learning initiatives between researchers and the public. As such, we acknowledge the value of initiatives to fully realize the potential of participation and engagement in science through partnerships across research domains and geographies;

5. Affirm the need for enhancing diversity, equity, inclusion, and accessibility in science and technology to improve the quality of the scientific process, fostering a closer alignment between research and societal needs, identifying and addressing gaps in research, and facilitating the uptake of scientific research results within society. We continue to appreciate the work of the G7 Gender Equality Advisory Council, which promotes the above-mentioned shared values within the practice of science and research.

The discussion among G7 members focused on the following priority areas:

1. Research Security and Integrity, Open Science, and Science Communication

1.1 Research Security and Integrity

We emphasise the increasing importance of promoting research security and integrity in international collaborations. Research integrity is an essential element in ensuring the quality and reliability of the scientific process, scientific conduct, and the results of research. In addition to the protocols and practices for ensuring research integrity in general, it is important to address the mutually reinforcing interplay between security, integrity, and openness, recognized as being fundamental to international collaborative science. Furthermore, we highlight that greater awareness should be sought about the potential risks of foreign interference in research and innovation (R&I). To this end, G7 members are united in the implementation and enhancement of effective, proportionate, and appropriate risk mitigation measures within our domestic systems to promote trusted research collaboration.

In this context, we consider the G7 a crucial forum for discussion, promotion, and dissemination of common values, principles, and best practices for global research security and integrity. We highly value the achievements of the G7 Security and Integrity of the Global Research Ecosystem (SIGRE) Working Group. This encompasses the publication of the "G7 Common Values and Principles on Research Security and Integrity" and the "G7 Best Practices for Secure and Open Research" documents, alongside the establishment of the Virtual Academy. We welcome the efforts of the G7 Virtual Academy Oversight Board in advancing and implementing the outcomes of the SIGRE Working Group and in widening the international outlook of the Virtual Academy by extending access, by the end of 2024, to countries beyond the G7 that share our common values and approach to research security and integrity.

Given that the SIGRE Working Group has concluded its mandate, we acknowledge the need for the G7 Virtual Academy Oversight Board to continue the dialogue among all G7 members regarding current policy approaches on research security and integrity.

We welcome the organization by the Italian Presidency, in close collaboration with the G7 Virtual Academy Oversight Board, of a G7 Conference on Security and Integrity of the Global Research Ecosystem aimed at raising awareness and exchanging experiences on these topics among the

research communities of G7 members and beyond. We aspire for it to serve as a valuable resource in maintaining a continuous and concrete dialogue among all G7 members and beyond on these matters, which could evolve into a recurring conference within the G7 Science and Technology track.

1.2 Freedom and Inclusiveness in Scientific Research and Open Science

We highly value and promote scientific research for its innovation and problem-solving results in addition to its public value in pushing the frontiers of knowledge and developing strong human capital, including international talent mobility and circulation. Researchers, in the practice of science, should have the ability to independently define questions, choose and develop theories, gather empirical evidence, employ research methods, and bring forward new or innovative ideas. Society, as a whole, should be able to enjoy the benefits of scientific progress and its applications.

Open science facilitates the creation of new knowledge within the global scientific community, and enhances efficiency and innovation in research, fostering and permitting appropriate access to curated and trusted data, source codes, and knowledge. Open science promotes equitable and secure scientific collaboration; respects intellectual property, privacy, and the protection of personal data; and is enhanced by diversity, equity, inclusion, and accessibility.

We promote collaboration, both among the G7 members and across the global scientific community, to expand open science with equitable and responsible dissemination of scientific knowledge and appropriate research outputs, including open and public access to publicly funded scholarly publications and scientific data. We continue to promote the Findable, Accessible, Interoperable, and Reusable (FAIR) data principles as a best practice in publicly funded research activities.

We affirm our continued support for the ongoing work and achievements of the Open Science Working Group, including the need for increasing the productivity and quality of FAIR research outputs and ensuring equity and trust.

1.3 Science Communication

Responsible science communication that advances the dissemination of scientific knowledge and emphasizes dialogue and relationship-building between the science ecosystem and the public enhances public trust and enables the design of better-informed evidence-based policies resulting in greater positive societal impact.

We therefore welcome the progress of the G7 Working Group on Science Communication. The Working Group aims to improve the quality and effectiveness of science communication in research and practice to enhance responsible and evidence-based science-policy-society interactions. We underline the importance and value of science communication in addressing the grand challenges and pressing issues of our time.

2. Large Research Infrastructures

Large research infrastructures leverage research investments and advancements while serving broad and diverse user communities, often with interdisciplinary contributors. They play a strategic role in generating, storing, sharing, and evaluating scientific data in line with the FAIR principles, allowing the scale-up and validation of new knowledge and innovation.

We intend to continue strengthening large research infrastructure collaborations and exploring new opportunities between G7 members in fields of common interest, including natural and social sciences and the humanities, leveraging existing international multilateral research initiatives that can help advance our collective efforts. We acknowledge the importance of identifying opportunities for scientists and innovators that could be achieved through cutting-edge joint research infrastructure projects by G7 members.

We express our unified support to the Group of Senior Officials (GSO) on Global Research Infrastructures (GRIs) in advancing and broadening the dialogue on GRIs, also through the identification of innovative practices and the sharing of experiences to further strengthen, renew, and connect GRIs.

We welcome the organization, by the Italian Presidency, of a G7 Conference on Large Research Infrastructures aimed at discussing the scientific, socio-economic, environmental, and geopolitical impact of these facilities, introduced by a dedicated report commissioned by the Italian Presidency. Additionally, the conference is expected to discuss emerging opportunities and potential collaborations among G7 members in large research infrastructures.

We highlight the role of research infrastructures as exceptional venues for facilitating talent (e.g., graduate, post-doctoral, and early-career researchers) and knowledge exchange to build new skills at the scientific, technological, and managerial levels. Given the high complexity of managing large research infrastructures, we acknowledge the value of facilitating the pooling of experiences and sharing of best practices, while also fostering networking and relationship-building among G7 research infrastructure managers. In light of this, we propose to pilot an initiative aimed at facilitating a dialogue among managers of large research infrastructures across G7 members. This pilot would be set up and implemented in close cooperation and consultation with the GSO G7 representatives, through a dedicated workshop during the G7 Conference on Large Research Infrastructures later in 2024, with the potential prospect of expanding this dialogue to other countries beyond the G7 that share our values. This initiative has the potential to enhance the effectiveness, efficiency, and collaboration capabilities of large research infrastructures, thereby contributing to advancements in scientific research.

We recognise the importance of using research infrastructures to facilitate cooperative science, particularly in polar regions, the ocean, and outer space. This should enable the development of solutions for better managing and preserving these spaces for the benefit of all.

3. Research on New and Emerging Technologies, Nuclear Fission and Fusion Energy, and Space

3.1 Research on New and Emerging Technologies

To accelerate productivity and confront pressing societal challenges, such as the green and digital transitions, there is a need to foster advancements in new and emerging technologies. This necessitates an enhanced focus in relevant research areas such as artificial intelligence (AI), high-performance computing, quantum technology, advanced materials, synthetic biology and other biotechnologies, nanotechnologies, and robotics. We acknowledge the importance of creating inclusive, transparent, and accountable collaborative research ecosystems, sharing best practices and guidelines for reliable testing, and benchmarking such technologies and their responsible design and development.

We consider it is essential to support responsible research and scale-up of novel innovations in science, technology, and engineering and the related voluntary technology transfer on mutually agreed terms, from academia to industries and businesses. Such an approach helps ground-breaking ideas and research solutions not only to emerge but also to find practical applications, bridging the gap between theoretical advancements and real-world solutions. This can be achieved with a diverse range of individuals equipped with the skills needed to leverage the opportunities these technologies offer safely, securely, ethically, and responsibly.

Enhancing cooperation in advanced research on AI, quantum, and other emerging technologies should lead to faster progress, greater efficiencies, better outcomes for society, and improved commercialization opportunities. AI and quantum domestic strategies are crucial for all G7 members to improve technological capabilities and enhance international cooperation.

We welcome the organization by the Italian Presidency of a G7 workshop on quantum technologies organised by the G7 Science and Technology track and the G7 Industry, Tech and Digital track.

We have witnessed enormous progress in the field of AI in the last decade, and it remains a relevant research area today. To facilitate continued progress on safe, secure, and trustworthy AI, a strategic and sustained focus on basic AI research should be maintained and complemented by the exchange of best practices and collaborative efforts among G7 members, including on the impact of AI on science itself.

AI, quantum, and other technologies are also enabled by the development of semiconductor technologies. We welcome the establishment of a semiconductors Point of Contact Group dedicated to facilitating information exchange and sharing best practices among G7 members in the G7 Industry, Tech and Digital track.

A rapidly advancing global bioeconomy propelled by advances in biotechnology, including synthetic biology, presents both opportunities and challenges. Enhanced cooperation on topics of mutual interest, such as data standardization and interoperability, will help G7 members collectively leverage the potential of these technologies to accelerate innovation, in alignment with shared values, and manage potential security risks.

Similarly, the integration of AI with other technologies, like synthetic biology, is expected to accelerate innovation, while also presenting new potential risks. We encourage G7 members to work together to promote biosecurity risk-reduction throughout the research, development, and innovation pipeline.

We promote international talent mobility and circulation in emerging technologies especially among G7 members and with other partners sharing our values. We recognize the importance of higher education and advanced training in advancing the responsible development and adoption of new and emerging technologies, especially in AI. We encourage an approach that could recognize the convergence of educational needs in these fields, encompassing and linking the entire workforce development, from sparking interest in science, technology, engineering, and mathematics (STEM) to enhancing training and research opportunities for under-graduate, graduate, and post-doctoral researchers and other trainees. This could enable increasing the capacity of policymakers to make informed decisions and addressing the challenges of digital divides and uneven technological uptake. This approach would also showcase how STEM advancements contribute to solving global challenges.

We welcome further efforts to strengthen the cooperation between G7 members on research related to new and emerging technologies. Furthermore, we advocate for the sharing of best practices in scientific data management, including organizing and curating research data according to the FAIR principles, the promotion of research ethics assessment practices, and the encouragement of further discussions on the safe, secure, and trustworthy deployment and use of AI applications in scientific research. Through these concerted efforts, we seek to foster a collaborative and forward-thinking environment conducive to technological advancement and responsible innovation.

We encourage collaboration to facilitate the co-development of AI applications that help address the most pressing global challenges. We also encourage G7 members to employ their respective computational and data capabilities to promote the uptake of safe, secure, and trustworthy AI applications for the good of all.

AI technologies supported by supercomputing centers play an increasingly significant role in helping tackle global societal challenges, including by predicting, mitigating, and effectively managing natural disasters (e.g., earthquakes, tsunamis, wildfires) and pandemics. We acknowledge the value of the existing initiatives and institutes that advance and encourage international collaboration among like-minded countries in these areas, such as the EU-U.S. Research Alliance in AI for the Public Good and the European High Performance Computing Joint Undertaking.

We welcome Italy's initiative to explore the possibility of increased coordination among G7 members, on a voluntary basis, to facilitate the development of AI solutions to the benefit of all by leveraging computational and data capabilities.

We also acknowledge the importance of making the benefits of AI and advanced computing available to low- and middle-income countries, to advance science and sustainable development.

3.2 Nuclear Fission and Fusion Energy

We are committed to the highest standards of nuclear safety, security, and safeguards, and therefore recommend additional research and human resource development in these fields.

For those countries that opt to use them, fission and fusion energy are among a suite of technologies that can help to rapidly reduce emissions, as well as promote energy security and economic development.

Further research and development on **fission energy** is crucial, also in view of advancing this and other related advanced or emerging technologies. The design of advanced reactors, small modular reactors, and microreactors needs additional research to lower capital costs, improve safety features, achieve a high level of safety in waste management, and provide reliable power for generating dependable electricity, as well as producing high temperature heat and hydrogen. In this regard we also acknowledge the contribution of the International Atomic Energy Agency in terms of science and research capacity building in Africa for peaceful uses of nuclear technologies.

We recognise that "**fusion energy** technology has the potential to provide a lasting solution to the global challenges of climate change and energy security" (2024 Apulia G7 Leaders' Communiqué). Furthermore, "the successful delivery of fusion energy production could offer major social, environmental, and economic benefits, being a source of potentially zero-emission, safe, secure, virtually unlimited clean energy" (2024 G7 Climate, Energy and Environment Ministers' Communiqué). We promote collaboration among G7 members in fusion energy research and the sharing of research and development as well as higher education best practices and regulatory initiatives.

3.3 Space

The G7 represents an opportunity to promote collaboration in space, including fostering the sustainable use of outer space, and is united in a commitment to advance multilateral efforts in this regard.

We reiterate the commitments within the 2023 Sendai G7 Science and Technology Ministers' Communiqué and the 2024 Apulia G7 Leaders' Communiqué, including the promotion of safe and sustainable use of outer space, the importance of addressing the challenge of orbital debris, and the need for continued discussions in the appropriate forums regarding the impact of large constellations of satellites on astronomy for the protection of the dark and quiet sky.

We reiterate our shared view that the implementation of international guidelines adopted at the United Nations Committee on the Peaceful Uses of Outer Space is urgent and necessary.

We strongly encourage further efforts to research and develop technologies and solutions on orbital debris mitigation and remediation and to improve global coordination on space situational awareness.

4. Research and Innovation Cooperation with Africa

We recognize the importance of tackling the issue of inequitable access to, and structural capacity to use, knowledge and skills development, research opportunities and results, innovations, and advanced technologies. This disparity transcends borders and affects the global community with a disproportionate impact on women, children, and persons with disabilities. Therefore, the G7 recognises the importance of cooperating with low- and middle-income countries, allowing for joint approaches to address significant needs and challenges. Cooperation in research and innovation with partners in low- and middle-income countries should aim at both mutual learning and an inclusive dialogue involving relevant institutions and actors.

A particular focus, in this context, will be given this year to the African continent, acknowledging the Mattei Plan for Africa launched by Italy. We welcome inputs and insights from the African Union (AU) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) on how to support meaningful G7-Africa collaborations in science and technology. We intend to align our efforts with the needs of African countries, also in view of the AU Science, Technology and Innovation Strategy for Africa 2034 to be adopted in 2025.

To foster talent mobility in science and research for the mutual benefit of G7 and African countries, we welcome and promote the establishment, expansion, or continuation of merit-based researchers' mobility initiatives suitable for graduate, post-doctoral, and early-career researchers at universities, research centers, and research infrastructures. This should be done with a focus on promoting, in African communities, opportunities to support higher education graduates, retention of top-tier research talent, specialized and technical jobs, and economic development. Furthermore, we welcome efforts to strengthen intra-African mobility in these areas.

An important priority of the G7, to be accomplished in close cooperation with the AU and UNESCO, is to strengthen relations with African countries by connecting and sharing best practices and existing concrete cooperation initiatives, including joint R&I projects, transnational higher education and advanced training initiatives, and networking opportunities to co-create more effective solutions for a sustainable common future. This includes the AU-EU Innovation Agenda, the Partnership for Research & Innovation in the Mediterranean Area, the Global Health European and Developing Countries Clinical Trials Partnership Joint Undertaking, and the Vision Statement for the U.S.-Africa Partnership. Furthermore, we welcome and promote initiatives that increase the quality, relevance, and attractiveness of African higher education systems for enhancing the skills of researchers. We intend to jointly strengthen the development of research infrastructures in Africa.

In this context, we encourage collaboration with higher education institutions and research centers in African countries and support valuable AU and UNESCO initiatives in the field of higher education and research, such as the 2024 AU Year of Education and the UNESCO Campus Africa. Furthermore, we welcome the Italian initiative "Research Capacity Building with Africa", which is aimed at addressing structural challenges hindering the research and innovation potential in Africa. This initiative includes the development of a joint executive program, co-designed with African stakeholders, and dedicated to African public administration and innovation agencies managers and

officers. This initiative is open to interested universities and other stakeholders of G7 members and beyond.

We welcome the G7 Conference on Research and Capacity Building with African Countries organized by the Italian Presidency. It will focus on promoting synergies between academia, research centers, and the private sector to facilitate the development of innovative projects, while strengthening existing partnerships and programs.

5. Seas, Ocean, and their Biodiversity

Ocean observations are increasingly important in addressing climate change, biodiversity loss, pollution, and natural disasters. Scientific innovation, connecting science and engineering, as well as economics and social science, should support the measurement, within official statistics, of natural capital accounts and the implementation of the System of Environmental Economic Accounting.

To enhance the Global Ocean Observing System, we acknowledge the importance of sustaining comprehensive global ocean research and observations of the physical, biogeochemical, biological and ecological properties of the seas and ocean, including utilization of research and survey vessels, Argo floats, fixed and autonomous platforms, satellites, and other ocean observation facilities based on international collaboration and coordination. Furthermore, we consider it crucial to fill data and research gaps in areas such as climate change and the carbon cycle, biodiversity loss and ecosystem restoration, and pollution to better understand the ocean-climate-biodiversity nexus.

We emphasize the significance of strengthening international partnerships and infrastructures and advancing the development of Digital Twins of the Ocean capabilities. This development will enable the sharing of observational data and value-added information such as analyses, forecasts, and "what-if" scenarios. Likewise, it is essential to define and implement "locally" tailored strategies for sustainable management of the marine resources under different future scenarios. Also, local and traditional knowledge, including Indigenous Knowledge, should be recognised and considered. Indigenous Knowledge, guided by the principle of free, prior and informed consent, should be applied in consultation with the knowledge-holder.

The G7 recognizes the significant impact of climate change on the Arctic and Antarctic regions, and the increasingly important role polar research plays in this regard. We, therefore, support continued international cooperation in the field of polar research and efforts to launch the International Science & Infrastructure for Synchronous Observation (Antarctica InSync), to allow for a circumpolar assessment of the connections between ice, ocean, climate, environment, and biodiversity. Polar observations can be strengthened by capitalizing on technological developments, sharing various data, and developing human resources and capacity through international observation platforms such as Arctic and Antarctic research vessels.

We recognize that more research of deep-sea ecosystems and their interactions with the general functioning and health of the ocean is urgently needed in light of the growing interest in the sustainable exploitation of deep-sea resources. We, therefore, call for and support international cooperation in the field of deep-sea research and observation technology to enhance knowledge on the deep-sea ecosystems and on the potential impacts of possible activities such as mining, taking

into account the needs and rights of Indigenous Peoples and members of coastal communities, where applicable, who are most dependent on healthy and well-functioning marine ecosystem services.

We support the implementation of the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) and its Ocean Decade Vision 2030. In this context, we welcome the Barcelona Statement, the outcome of the 2024 Ocean Decade Conference, and look forward to the 2025 United Nations Ocean Conference in Nice organised by the Governments of France and Costa Rica. Moreover, we support the further development of concrete G7 strategies based on policy papers such as the "G7 Ocean Decade Navigation Plan" and the "G7 Ocean Deal" to connect science to policy, translate knowledge into action, and ensure a sustainable, resilient, and productive ocean economy.

We, therefore, seek to reinforce and enhance collaboration among G7 members in these domains. We commend the achievements of the G7 Future of the Seas and Oceans Initiative (FSOI) Working Group and endorse its name change to "G7 Future of the Seas and Ocean Initiative" in recognition of the concept of "One Ocean", widely accepted by the scientific community, and the revision of the action areas description to reflect the scientific-technological evolution. We promote the sharing of best practices from existing initiatives in line with the current G7 commitments and the G7 FSOI Working Group.

We call for an integrated approach to leverage the potential of marine research infrastructures in the context of Sustained Ocean Observing, by strengthening partnerships and developing a common vision and coordinated action plans.

We welcome the G7 High Level Conference on Mediterranean and Atlantic Ocean Health and Coastal Resilience under the auspices of the Horizon Europe Mission "Restore our Ocean & Waters" to be held in Bologna after our Ministerial meeting, organised by the Italian Presidency together with the European Commission, with the aim to showcase the international ongoing efforts to conserve, protect, and restore marine biodiversity, enhance climate resilience, and mitigate the impacts of extreme weather events and pollution on coastal communities.

We welcomed the participation and contributions of the AU and UNESCO as invited organizations to the session dedicated to research and innovation with Africa. Furthermore, we thank the European Organization for Nuclear Research (CERN), the European Research Council, and the United Nations University for their insights.

We acknowledge the work of the G7 engagement groups, in particular Science 7, Universities 7+, and Youth 7, and the contributions provided by the Research 7+.

We thank the Working Groups of the G7 Science and Technology track for their contributions.

We express gratitude to Bologna and Forlì for the hospitality and welcome the incoming Canadian presidency.