Executive summary

Enabling transitions in times of disruption

Longstanding trends and recent disruptions have created a new operating environment for STI policy. Climate change and its impacts are increasingly driving STI agendas, as is the fast pace of change implied by the digital transformation, in what is often termed the "twin transitions". At the same time, the two most salient disruptions of the last couple of years – the COVID-19 pandemic and Russia's war of aggression against Ukraine – have had far-reaching, cascading effects, including on STI.

Global crises are contributing to a growing "securitisation" of STI policy agendas

Climate change, growing geopolitical tensions and the COVID-19 pandemic have highlighted risk, uncertainty and resilience as conditions and concerns for STI policy. Taken together, these have contributed to a growing "securitisation" of STI policy. As the pandemic has shown, STI is essential to building capacity for resiliency and adaptation to shocks. However, it can only perform this role effectively if it is well-prepared to respond to known risks and unknown uncertainties. International scientific co-ordination and co-operation structures and mechanisms were severely tested by the pandemic and showed their limitations. Many countries and populations could not access the benefits of science and technology, such as vaccines and therapeutics. Good preparation requires long-term investments in research and development, skills and infrastructures, but this alone is insufficient. It also needs strong relationships in "normal times" among those who should mobilise rapidly to deal with crisis situations, as well as a strong "strategic intelligence" capacity to identify, monitor and evaluate emerging risks and responses. It is in the mutual interest of all countries to ensure these relationships and capacities are globally distributed to enable an inclusive scientific and technological response to future crises.

Geopolitical tensions are contributing to strategic competition in emerging technologies

The growing ascendancy of China in frontier technologies raises various concerns for liberal market economies, including rising competition in critical technologies that are expected to underpin future economic competitiveness and national security; and growing vulnerability from technology supply-chain interdependencies, for example, in semiconductors and critical minerals. These concerns translate into a growing convergence between economic and security policy agendas and intensifying global technology-based competition. Governments are putting in place measures to (i) reduce STI interdependency risks and restrict international technology flows; (ii) enhance industrial performance through STI investments; and (iii) strengthen international STI alliances among like-minded economies. These measures could disrupt integrated global value chains and the deep and extensive international science linkages that have built up over the last 30 years. Coupled with a growing emphasis on "shared values" in technology development and research, they could lead to a "decoupling" of STI activities at a time when global challenges require global solutions underpinned by international STI co-operation. A major test for multilateralism will be to reconcile growing strategic competition with the need to address global challenges like climate change.

STI systems are crucial for enabling sustainability transitions

The climate emergency requires nothing short of a total transformation of sociotechnical systems in areas such as energy, agrifood and mobility. STI systems have essential roles in these transformations, but governments must be more ambitious and act with greater urgency in their STI policies to support them. They need to design policy portfolios that enable transformative innovation and new markets to emerge, challenge existing fossil-based systems, and create windows of opportunity for low-carbon technologies to break through. Larger investments and greater directionality in research and innovation activities are needed, for example, by using mission-oriented innovation policies, to help direct and compress the innovation cycle for low-carbon technologies. These should coincide with a reappraisal of STI systems and their supporting STI policies to ensure they are "fit-for-purpose" to contribute to sustainability transitions. Systems thinking can help identify and understand critical linkages, synergies and trade-offs and empower policy makers to better recognise policy constraints and identify leverage points where they could act to unblock transition barriers.

The global STI response to COVID-19 provides important lessons for sustainability transitions

Science played an essential role in generating the knowledge and technologies needed to respond to the COVID-19 crisis. The pandemic offers lessons that can position science to respond more effectively to future crises. For instance, much can be learned from successful co-operation between various actors during the pandemic, but reinforcing these relationships over the longer term may require significant change to academic culture, structures, incentives and rewards. Many of the required changes – including in research performance assessment, public engagement, and transdisciplinary research – are already underway but have not yet been adopted at the necessary scale and speed because of embedded inertia in science systems. More radical change is necessary to spur science to engage with other societal stakeholders to produce the broader range of outputs and solutions that are urgently required to deal with complex global challenges and crises.

Mission-oriented innovation policies could help achieve net-zero targets

Mission-oriented innovation policies are increasingly popular as a policy response to meeting net-zero targets. They have clear objectives and measurable targets, promote broader co-ordination of policy plans across administrative silos, and better integrate various support instruments across the different stages of the innovation chain. These policies remain unproven, however, and early indications suggest they lack sufficient scale and reach to non-STI policy domains to have wide-ranging impact. The challenge remains to move these initiatives from effective coordination platforms to integrated policy frameworks that mobilise and align a wide range of actors. Overcoming many of the barriers – including administrative and legal rules, accounting structures and governance models – requires changes that are far beyond the reach of STI authorities alone and will need significant political support.

Good technology governance can encourage the best from technology

Emerging technologies can be pivotal for much needed transformations and responses to crises, but rapid technological change can carry negative consequences and risks for individuals, societies and the environment including social disruption, inequality, and dangers to security and human rights. The democratic community is increasingly asserting that "shared values" of democracy, human rights, sustainability, openness, responsibility, security and resilience should be embedded in technology, but questions remain on how this should be accomplished, especially when technology trajectories are set by developments in firms and public labs that are widely distributed across the globe in a variety of governance contexts. Using "upstream" design principles and tools can help balance the need to drive the development of technologies and to scale them up while helping to realise just transitions and values-based technology.