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Risks and opportunities of the metaverse

Report[1]
Committee on Culture, Science, Education and Media
Rapporteur: Mr Andi-Lucian CRISTEA, Romania, Socialists, Democrats and Greens Group

Summary

Immersive technologies, such as the metaverse, are being used to great positive effect in multiple sectors including education, healthcare, art, culture, sport, design, engineering, media and communication and, increasingly, in participatory democracy. Whilst governance and legislation struggle to keep pace with technological innovation, questions of accountability for person-to-person criminal behaviour in metaverse environments persist, such as harassment, violence, abuse, fraud and theft, and other serious human rights violations. Without corrective measures, unequal access to the metaverse may generate new forms of discrimination and increase social gaps.

The report analyses threats to democracy, human rights and the rule of law, but also the many opportunities for breakthrough advances which the metaverse triggers, and puts forward relevant recommendations to governments to take informed and responsible action to maximise the benefits of the metaverse while avoiding potential misuses which would undermine society.

The report also calls for enhanced international co-operation among governments, as well as for their collaboration with the private sector and researchers which is essential to address the complexities of metaverse technology, promote sound competition and incentivise the development of safe creative immersive ecosystems and ethical metaverse standards.

1. Reference to committee: Doc. 15636, Reference 4699 of 23 January 2023.

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A. Draft Resolution[2]

1. The metaverse represents a new frontier for digital technology and a step change in the way that people can interact with information, one another and society. Immersive media, such as fully immersive virtual reality and wearable augmented reality, is experienced as an all-surrounding psychologically convincing simulative environment, in which people can interact with one another as embodied avatars, in a compelling blend of digital and physical experience.

2. The Parliamentary Assembly notes that immersive technologies are already being used to great positive effect in multiple sectors including education, healthcare, art, culture, sport, design, engineering, media and communication and, increasingly, in participatory democracy. The persistent, interconnected and inherently social metaverse environments may trigger social and societal benefits, including meeting with like- and unlike-minded communities, without the need for physical travel. Enhanced remote and virtual working and social gatherings offer new opportunities to those currently isolated by their location or lack of mobility, health or financial means.

3. However, the Assembly is concerned that, whilst governance and legislation struggle to keep pace with technological innovation, questions of accountability for person-to-person criminal behaviour in metaverse environments persist, such as harassment, violence, abuse, fraud and theft, and other serious human rights violations. The metaverse environments can also be exploited to fuel hatred and manipulate public opinion, thus biasing democratic processes, or may facilitate Orwellian State control of authoritarian regimes over the opinions and social behaviour of the population. Moreover, without corrective measures, unequal access to the metaverse – because of its costs – may generate new forms of discrimination and increase social gaps.

4. Decision makers should carefully consider, understand and assess threats to democracy, human rights and the rule of law, but also the many opportunities for breakthrough advances which the metaverse triggers, and they should take informed and responsible action to maximise its benefits while avoiding potential misuses which would undermine our societies.

5. Self-regulation might not be enough, and the Assembly stresses the need to address the rights and obligations of private companies providing metaverse services and infrastructure, including approaches to data management, integration of artificial intelligence, enforcement of terms of use and the reporting of criminal behaviour. Corporate entities, including manufacturers of hardware, publishing platforms and developers of content should have clear safeguarding responsibilities and be held accountable when tools and technologies are repeatedly utilised for illegal and abusive activities.

6. At the same time, public authorities must commit to upholding democratic principles and fundamental freedoms, and they should foster a culture of responsibility and accountability in this emerging socio-technical space. Core principles such as equality and non-discrimination, transparency, privacy and safety of all users should be embedded in the design and development of the metaverse architecture and of artificial intelligence (AI) systems operating therein.

7. Responsible governance may encourage creativity, innovation and entrepreneurialism, while upholding democracy, human rights and the rule of law within and through metaverse environments. To achieve these results and remain in control of their future, European countries should not confine themselves to the role of regulators, while others create the technologies which will shape our world, and they should spur the innovation processes, driving them in the right direction and ensuring that our societies benefit from technological developments.

8. Learning from the desktop and mobile era of computing, targeted investment and sound incentives can pave the way for alternatives to the formation of large, concentrated monopolies, exclusionary design, corrosive cultures, and unsustainable production practices. In this respect, the legislative and regulatory framework should consider competition and markets, particularly in relation to distributed monopoly interests spanning hardware, software, content production, publishing, data management, research, advertising and user safety markets.

2. Draft resolution adopted unanimously by the committee on 26 June 2024.

9. Therefore, the Assembly calls on Council of Europe member States to ensure that the legislative and regulatory frameworks applicable to metaverse environments uphold democracy, human rights and the rule of law, responding to law infringements with adequate measures concerning policing, jurisdiction, evidence gathering and deterrent sanctions, and in particular that they:

9.1. counteract harassment, violence, abuse – with particular attention to sexual abuse and child abuse – and manipulative and exploitative conducts, bearing in mind that interpersonal contact in metaverse environments are more psychologically convincing than other screen-based media, and that legislation should properly address this new psychosocial dynamic;

9.2. safeguard freedom of expression and deal with new forms of social and political manipulation, including disinformation, deep fake avatars, radical ideology and propaganda which could find ground in metaverse environments;

9.3. actively promote Recommendation CM/Rec(2018)7 of the Committee of Ministers to member States on Guidelines to respect, protect and fulfil the rights of the child in the digital environment, among individuals, public authorities and business enterprises and take specific measures regarding its implementation in order to enable all children to fully exercise their human rights and fundamental freedoms in the context of the metaverse;

9.4. guarantee users' rights to cognitive liberty and mental privacy and all rights enshrined by the Council of Europe modernised Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data and its amending Protocol (ETS No. 108 and CETS No. 223, "Convention 108+") including:

9.4.1. the prohibition, for corporate or State entities, to collect, analyse, exploit or commodify user data generated in the metaverse environments without users' free and explicit consent;

9.4.2. the prohibition to use subconsciously contributed biometric information – such as involuntarily eye movements and pupil dilation – for behavioural, social or political profiling;

9.4.3. the processing of sensitive data – such as genetic or biometric data, but also those relating to racial or ethnic origin, political opinions, beliefs, health or sexual life, among others – only when this is necessary to pursue a stated legitimate aim, and with appropriate safeguards established by law;

9.4.4. reinforced information security to protect data gathered;

9.5. set up transparency requirements in the operation of AI systems requirements, according to Council of Europe standards.

10. The Assembly considers that Council of Europe member States should support inclusive access to, and informed use of the metaverse, and encourage democratic engagement therein. Thus, it calls on Council of Europe member States to:

10.1. prioritise, at different levels of governments, policy action aimed at broadening access to emerging technologies and consider targeted investments to narrow the digital divide by removing existing and potential barriers, including costs;

10.2. encourage metaverse literacy of elected representatives, the judiciary, law-enforcement agencies and public officials in healthcare, education, culture and other relevant policy areas, to increase professional understanding of virtual and augmented reality tools and their affordances;

10.3. undertake public literacy campaigns, also via public service media and their digital platforms, to support the population in equitably accessing and leveraging the opportunities of the metaverse, whilst developing an understanding of the risks, especially for children;

10.4. consider hosting governmental and civil society citizenship initiatives in metaverse environments, to model best practices that prioritise inclusion and encourage participation and engagement of a wide range of the public, in particular youth groups, across diverse communities, actively enabling the contribution of minority groups.

11. The Assembly is convinced that international co-operation among governments, as well as their collaboration with the private sector and researchers are essential to address the complexities of metaverse technology, promote sound competition and incentivise the development of safe creative immersive

ecosystems and ethical metaverse standards. Therefore, the Assembly urges member States to strengthen dialogue and collaboration with business and industry stakeholders, and civil society organisations, with an aim to:

11.1. prevent monopolies and anti-competitive practices; consider limitations to the scale of influence that a single State or a corporate entity may be entitled to accrue across metaverse ecosystems, and create opportunities for new entrants across the metaverse technology stack;

11.2. agree on codes of ethics for publicly funded metaverse projects, to ensure that these projects uphold human rights and democratic values;

11.3. develop partnerships with actual and potential metaverse providers, to support research and strategic investment in immersive platforms that model positive social and community structures, mirroring public sector approaches to town planning;

11.4. put in place sound content regulation akin to the broadcast and cinema sectors, and apply learnings from social media regulation to avoid that mechanisms are set up in metaverse environments by which State or private sector parties could manipulate user behaviour;

11.5. build sustainability into the supply chain and ecosystems of immersive technology, promoting and monitoring compliance with internationally agreed climate targets and the United Nations Sustainable Development Goals; consider in this respect, for example, codes of practice or regulations on life cycle assessment of immersive technologies, which should encourage responsible practices (such as repair and reuse of devices, recycling of gold and other rare earth minerals; minimising transportation, etc.) and enable them by creating adequate facilities;

11.6. adopt a participatory and dynamic approach to policy making and legislation, subjecting policies to regular reviews to maintain comprehensive up-to-date protection for the population, as technologies continue to evolve;

11.7. strengthen international co-operation agreements, in particular to enhance cross-jurisdictional prevention and responses to criminal activities in metaverse environments, and encourage mutual learning and exchanges of best practice at international level, making best use of the potential of the Council of Europe in this respect;

11.8. sign and ratify the Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy, and the Rule of Law (CETS No. 225), which was open for signature on 5 September 2024 in Vilnius, and opt to fully apply its provisions to the activities of private actors, and to put in place limitations, or even bans, on certain uses of AI deemed incompatible with human rights, especially in relation to health and the environment.

12. For its part, the Assembly will continue following developments in this field and resolves to strengthen its partnership with the European Parliamentary Technology Assessment (EPTA) Network, with a view to providing its contribution to policy makers in shaping technology development and ensuring democratic governance and respect for human rights and fundamental freedoms.

B. Explanatory memorandum by Mr Andi-Lucian Cristea, rapporteur

1. Introduction

1. In today's digital age, a significant misalignment exists between the public's digital fluency and the outdated structures of industrial-era institutions. These institutions, originally designed for a less interconnected world, struggle to keep pace with the rapid dissemination of information and the new ways people engage with each other and with the authorities. Unlike the past, where the flow of information was tightly controlled by top-down media like TV, radio, and newspapers, today's digital platforms enable direct, two-way communication, fundamentally changing how individuals receive information and respond to it.

2. Moreover, the democratic processes and consensus building that were staples of the industrial era are being reshaped by digital technologies. Modern tools and platforms, built on silicon, offer unprecedented capabilities for gathering consensus and facilitating more inclusive decision-making processes. However, this shift also poses challenges as technological innovation often outstrips the human capacity to adapt. This rapid evolution can lead to disconnects between how institutions operate and how people expect them to function, based on their experiences in a digital environment.

3. Historically, people's lives and identities were significantly shaped by the institutions of their time, which were themselves products of industrial-age thinking. These institutions were not just physical structures but also included the norms, values, and expectations that governed public life. In contrast, today, digital platforms play a pivotal role in shaping cultural and social interactions, often bypassing traditional institutional gatekeepers and empowering individuals with more autonomy and influence than ever before. This fundamental shift represents a move from a top-down imposition of culture and information to a more democratised, participatory form of engagement, where individuals have the power to challenge and redefine norms in real time.

4. The metaverse separates human cognitive presence from physical presence, offering a deeply immersive and intensely subjective experience. This heightened state of engagement facilitates active participation, allowing users to interact in ways previously confined to the imagination. Moreover, our society functions as a complex adaptive system, where even minor variations in the frequency, density, and intensity of interactions can lead to significant long-term transformations. The metaverse amplifies these interactions, potentially reshaping societal structures and dynamics more profoundly than ever before. This is likely to impact democracy, human rights and the rule of law.

5. My report seeks to offer an insight into the many opportunities offered by these emerging technologies as well as their risks and to make recommendations to support positive decision making whilst mitigating threats. The benefits of technological advances should be distributed fairly across society and the negative impacts should be mitigated, especially for the most vulnerable groups. To this end, it is essential to have a multi-stakeholder approach that involves governments, civil society organisations, the private sector as well as international organisations.

6. This report builds on the expert report by Ms Verity McIntosh, Associate Professor of Virtual and Extended Realities, University of the West of England, United Kingdom, and Catherine Allen, CEO, Limina Immersive, United Kingdom. I would like to express my deep gratitude to them, and the many experts who contributed to the work of the Committee on Culture, Science, Education and Media.[3]

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3. The committee held hearings on: 23 March 2023, with the participation of Mr Patrick Penninckx, Head of the Information Society Department of the Council of Europe and Professor Verity Mcintosh, Researcher, Senior lecturer in virtual and extended realities at the University of the West of England, Bristol, and member of the Digital Cultures Research Centre, United Kingdom; 1 June 2023, with the participation of Ms Irene Kitsara, European Standardisation Initiatives Director, Institute of Electrical and Electronics Engineers (IEEE), Austria and Mr Edward Lewin, Vice-President Government and Public Affairs, LEGO Group, United Kingdom; 5 December 2023, with the participation of Ms McIntosh and Ms Cristina Voinea, Hosted Research Fellow, Oxford Uehiro Centre for Practical Ethics, Faculty of Philosophy, University of Oxford, United Kingdom; 21 March 2024, with the participation of Mr Martin Signoux, Public Policy Manager, Immersive technology, Metaverse and AI policy, META, Paris, and Mr Patrick Penninckx, in his new capacity as Head of Digital Development and Governance Department, Directorate General Human Rights and Rule of Law, Council of Europe; 27 May 2024, with the participation of Mr Mikael Bomholt, Head of Division for International Affairs, Ministry of Digital Government and Gender Equality, Denmark, Mr Bjørn Bedsted, Democracy X (formerly Danish Board of Technology), Denmark and representative of the European Parliamentary Technology Assessment (EPTA) network, and Ms Molly Lesher, Head of the Digital Policy, Economics, and Measurement Unit at the Directorate for Science, Technology and Innovation, Organisation for Economic Co-operation and Development (OECD). I also exchanged views with

2. Definition of the metaverse and scope of the report

7. A single coherent definition of the term “metaverse” is yet to be formulated. This report refers to the Extended Reality Safety Initiative (XRSI) definition of the metaverse as: “A network of interconnected virtual worlds with the following key characteristics: Presence, Persistence, Immersion and Interoperability”. However, most definitions share a common emphasis on immersive reality technology as a central element, highlighting its pivotal role in creating engaging and interactive environments.

8. If the internet is a medium of interaction among people as users, digital content, and computational processes, then the metaverse represents a more advanced stage of this interaction. In the metaverse, users engage through avatars, artificial intelligence (AI) entities, and other digital personas, enhancing the sense of presence and interactivity.

9. The content in the metaverse is enriched by technologies such as immersive realities, augmented reality (AR), virtual reality (VR), and extended reality (XR), creating immersive and multi-sensory experiences. Furthermore, the processes that drive the metaverse are predominantly powered by AI, enabling more dynamic, responsive, and personalised interactions compared to the traditional internet. Closely related terms include “Web3”, “Web 3.0” and “spatial computing”.

10. The report focuses primarily on the experience of current and potential users accessing the metaverse using immersive technologies such as wearable virtual and augmented reality devices. It is structured around three main themes: the metaverse and democratic processes; human development and quality of life; and key challenges. It is not intended to cover all areas of operation and problems related to the use of immersive realities.

11. Other Parliamentary Assembly committees, if they deem it appropriate, may address other specific aspects of the metaverse within their remit, such as digital territoriality, jurisdiction, policing and justice, political participation and fundamental freedoms, safety, sexual assault and harassment, non-discrimination, children's rights, organised crime, money laundering, fraud, data protection and cybersecurity aspects, etc.

3. The metaverse and democratic processes

3.1. Community, fundamental freedoms, and democratic participation

12. Emerging technologies such as virtual and augmented reality reimagine human interaction by incorporating a sense of “presence” into online communication and by connecting communities. Users report a strong sense of “being there”, which is usually reserved for direct, physical contact.[4]

13. Unlike traditional digital communication, people can meet with one another as embodied avatars, form communities of interest and engage in group activities worldwide. This can potentially support the extension of freedoms of association and assembly into digital realms. However, creating a sense of community does not happen automatically and it requires both purpose and context, and freedom of expression and collective action are largely dependent on the approaches taken by companies and governments.

14. Metaverse tools also open up new possibilities for remote working, potentially democratising people’s access to global employment opportunities and creating pathways for international collaboration, research and entrepreneurship. Unfortunately, barriers to entry remain costly and significant,[5] especially for the elderly and other vulnerable groups, potentially exacerbating existing digital gaps.

15. Governments and metaverse providers could therefore support strategic investment in immersive platforms that model positive social and community structures, mirroring public sector approaches to town planning and social democracy as opposed to urban sprawl and libertarianism.

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ministers’ deputies, tech companies and experts at the Informal Committee of Ministers meeting in September 2023, and attended the Central and Eastern European Innovation Day, organised by META on 12 December 2023, (video is available here).

4. Bailenson, J. (2018). “Experience on demand: what virtual reality is, how it works, and what it can do” (First edit). W.W. Norton & Company.

5. Bennett, J., Dalton, P., Goriunova, O., Preece, C., Whittaker, L., Verhulst, I., & Woods, A. (2021). “Audience Insight Report: The story of immersive users”. StoryFutures.

16. They could also consider establishing a code of ethics for publicly funded metaverse projects aimed at diverse community participation, to ensure that users can reasonably expect human rights, fundamental freedoms and the rule of law to be upheld,[6] while ensuring that legislation on freedom of expression, association and assembly explicitly includes metaverse contexts.

3.2. Empowering young people for an equitable digital democracy

17. Like the internet revolution before it, the 3D embodied metaverse offers opportunities to expand people's access to information, new platforms for expression and active democratic participation.

18. Many young people are currently growing up with "proto-metaverse" gaming environments such as Fortnite, Roblox and Minecraft, cultivating high levels of digital literacy and skills, and likely seeking out new forms of engagement in these spaces. Forward-thinking governments and public institutions may wish to encourage young people's participation by integrating metaverse contexts into their engagement activities and social development initiatives, to enable younger generations to play a greater role in informing policy and to participate more actively in the democratic process.

19. However, access to this technology is heavily concentrated in the Global North and around existing centres of privilege, with reliable, high-capacity internet connectivity, and structural work is needed to close the "digital divide".[7,8]

20. Governments and metaverse providers could therefore plan to also site public engagement and active citizenship initiatives in metaverse contexts and co-design them with young people to remain in sync with the rapid pace of techno-cultural change and encourage empowered democratic citizenship.

21. They could consider creating initiatives that prioritise inclusion, actively enabling the contribution of otherwise minority groups, and investments that connect those isolated by geography, mobility, health or lack of economic opportunity.

4. The metaverse, human development and quality of life

4.1. Education and culture

4.1.1. Virtual learning environments and play

22. Virtual or augmented reality has already begun to be used in classrooms, by taking students on virtual reality 'field trips', travelling through space and time, accessing hidden histories, or recreating ruined buildings. "Metaversities", digital twin campuses, are expanding, and in July 2022 a student at the University of Turin was the first person to ever graduate inside the metaverse.[9] The spatial, embodied and interactive qualities of virtual learning environments (VLEs) have been shown to be effective in myriad educational contexts including design, architecture, engineering and science,[10] and can improve knowledge and skill development.[11]

23. The social element of the metaverse also provides greater opportunities for children to play together, develop their interpersonal skills, and encourage creative, co-operative and competitive play.

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6. Adherence to such a code could be mandatory or made desirable through kite marking and commercial (dis)incentives.
7. Kopp, I. (2017) "Who Is VR For? Immerse News" (online). https://immerse.news/who-is-vr-for-20b3f077a912.
8. Sinclair, K., Clark, J. (2020) "Making New Reality: A toolkit for inclusive media futures" (online) https://makinganewreality.org/.
9. *La Repubblica*, Edoardo Di Pietro, primo laureato nel metaverso: "Vorrei un mondo virtuale che sia bello da vivere", 19 September 2022.
10. Hamilton, D., McKechnie, J., Edgerton, E., & Wilson, C. (2021). "Immersive virtual reality as a pedagogical tool in education: a systematic literature review of quantitative learning outcomes and experimental design". Journal of Computers in Education, 8(1), 1–32. https://doi.org/10.1007/s40692-020-00169-2.
11. Wu, B., Yu, X., & Gu, X. (2020). "Effectiveness of immersive virtual reality using head-mounted displays on learning performance: A meta-analysis". British Journal of Educational Technology, 51(6). https://doi.org/10.1111/bjet.13023.

4.1.2. Age guidance

24. Appropriate age thresholds for children vary, tending to range between 10 and 13 years old, but numerous companies offer immersive learning packages for children as young as 4 or do not recommend a lower age range. User behaviour in multi-person environments can be volatile, unpredictable and therefore difficult to pre-classify. As a result, the Pan European Game Information (PEGI) has chosen to designate such metaverse apps as "Parental Guidance Recommended".

25. Recent reports suggest that unmoderated metaverse spaces are over-populated by users who appear to be significantly under the recommended age thresholds and are vulnerable to exploitation and abuse.[12]

4.1.3. Neuroplasticity

26. Research suggests that children, who are forming their optical, vestibular and neurological systems, may be particularly susceptible to a "blurring of the lines" between imagination and reality, which generates false memories in preschool-age children,[13] or leads to an outsized influence by media messages.[14]

4.1.4. Harms and abuse

27. Recent research reveals evidence of offenders using immersive technologies to meet with, groom, abuse and exploit children, as well as to produce deep fake avatars of real children in order to simulate child sexual abuse scenarios with other offenders.[15] Offenders also use virtual reality spaces to swap tools and techniques for committing abuse and evading scrutiny. Law-enforcement intelligence also suggests that they have a low expectation of discovery or prosecution due to minimal levels of oversight and technology literacy in law enforcement.

4.1.5. Industry-led activity

28. Controls beyond parental control often involve gated permissions and information about apps access but not about who children meet in multi-person spaces or their experiences. Some companies implement 'safety by design' policies, such as LEGO and Epic Games, who, as presented at a hearing in London, prioritise children's safety, well-being, and privacy and provide them with tools to control their digital experience, in line with the requirements of the United Nations[16] and with UNICEF's "Responsible Innovation in Technology for Children" initiative.[17]

29. Governments and metaverse providers could consider launching a public education programme to inform parents and caregivers about the potential risks and benefits of the use of virtual realities by children. Resources should also be allocated to the training of specialist policing and judiciary to specifically tackle crimes in the virtual reality domain.

30. Enhanced co-location features, allowing simultaneous use of two or more linked devices in the same physical location and facilitating joint parent-child experiences in the virtual realm are also measures that could be implemented.

12. Allen, C., & McIntosh, V. (2023). "Child Safeguarding and Immersive Technologies: An Outline of the Risks". https://learning.nspcc.org.uk/research-resources/2023/child-safeguarding-immersive-technologies.
13. Segovia, K. Y., & Bailenson, J. N. (2009). Virtually True: Children's Acquisition of False Memories in Virtual Reality. Media Psychology, 12(4), 371–393. https://doi.org/10.1080/15213260903287267.
14. Bailey, J. O., Bailenson, J. N., Obradović, J., & Aguiar, N. R. (2019). Virtual reality's effect on children's inhibitory control, social compliance, and sharing. Journal of Applied Developmental Psychology, 64, 101052. https://doi.org/10.1016/j.appdev.2019.101052.
15. McIntosh, V., & Allen, C. (2023). "Child Safeguarding and Immersive Technologies: Key Concepts". https://learning.nspcc.org.uk/research-resources/2023/child-safeguarding-immersive-technologies.
16. The UN Convention on the Rights of the Child details the '3Ps' of children's rights: 'Protection' from harms; 'Provision' of age-appropriate content; and the right to 'Participate' in the culture that they are themselves a part of.
17. UNICEF. (2022). "Responsible innovation in technology for children digital technology, play and child well-being". www.unicef-irc.org/ritec.

4.2. Culture, creativity and media

4.2.1. New art forms and sport reaching new audiences

31. The European creative industries and artists in all art forms are incorporating immersive media into their craft, eliciting physiological responses in audience members and altering mood, perspectives, or behaviour. Various immersive-only arts venues have opened across Europe and internationally and existing cultural institutions are reviving historical moments to fantastical sensory journeys and organising immersive art or nature exhibitions and film and games festivals. Artistic experiences can also be downloaded via app stores and experienced by large audiences in their own homes.

32. Sports experiences, as players and spectators, can be enhanced in the metaverse, along with 3D broadcasting of sports events. However, accessibility depends on the use of expensive devices, and violence, riots, gambling and doping can also occur in virtual reality.

4.2.2. Transforming media landscapes

33. With traditional media companies standing back, most immersive media is now created by independent production companies, with revenue supplemented by public funding and private investment. Consumers generally access media directly from tech companies via app stores with varying approaches to content curation and moderation.

34. Policy makers should avoid that the digital media ecosystem, including immersive environments, disempower the public sphere[18] and widen the gap of distrust between the public and democratic institutions, including parliaments and regional or local assemblies.

4.2.3. Public service media

35. With the continued decline of traditional media usage, metaverse contexts can offer a new forum to share news, information and provide access to public services. Public literacy campaigns would enable citizens to engage confidently with new platforms, and to distinguish between authentic and inauthentic sources. However, equivalent (non-metaverse) sources will still be needed to avoid discrimination for those without access to immersive tools.

36. Governments and metaverse providers could foster thriving creative, immersive ecosystems while establishing financially sustainable distribution channels, and incentivise creative industry organisations. Approaches to public service media should reflect the shift away from traditional media and towards online information channels, including metaverse spaces.

4.3. Health and well-being

37. Immersive technologies are in use in numerous clinical and therapeutic contexts, in support of patients' physical and mental well-being, and in managing both acute and chronic pain[19] (treating phobias through exposure therapy,[20] helping people with autism to rehearse social scenarios,[21] treating post-traumatic stress disorder,[22] providing physical therapy and stroke rehabilitation, supporting mental health, etc.). Further research and investment could improve patient independence, allow for consultations in virtual spaces and group sessions, and address overcrowding in hospitals. Wearable augmented reality devices are also being used in surgeries and support the teaching of complex patient care with a reduced need for live subjects and cadavers.[23, 24] Multiple providers have their own sets of standards, checks, and balances.

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18. Approaching The Infopocalypse (noemamag.com), 23 June 2023.
19. Pourmand, A., Davis, S., Marchak, A., Whiteside, T., & Sikka, N. (2018). "Virtual Reality as a Clinical Tool for Pain Management. Current Pain and Headache Reports", 22(8), 53. https://doi.org/10.1007/s11916-018-0708-2.
20. Carl, E., Stein, A. T., Levihn-Coon, A., Pogue, J. R., Rothbaum, B., Emmelkamp, P., Asmundson, G. J. G., Carlbring, P., & Powers, M. B. (2019). "Virtual reality exposure therapy for anxiety and related disorders: A meta-analysis of randomized controlled trials. Journal of Anxiety Disorders", 61, 27–36. https://doi.org/10.1016/j.janxdis.2018.08.003.
21. Bradley, R., & Newbutt, N. (2018). "Autism and virtual reality head-mounted displays: a state of the art systematic review. Journal of Enabling Technologies", 12(3), 101–113. https://doi.org/10.1108/JET-01-2018-0004.
22. Rizzo, A., Parsons, T. D., Lange, B., Kenny, P., Buckwalter, J. G., Rothbaum, B., Difede, J., Frazier, J., Newman, B., Williams, J., & Reger, G. (2011). "Virtual Reality Goes to War: A Brief Review of the Future of Military Behavioral Healthcare". Journal of Clinical Psychology in Medical Settings, 18(2), 176–187. https://doi.org/10.1007/s10880-011-9247-2.

38. Governments and metaverse providers could promote knowledge sharing across healthcare providers and consider the development of internationally relevant professional standards (i.e. sterility and hygiene, patient privacy and data security, accessibility and inclusivity, training for clinical staff, patient support and safe use of new technologies) to support clinicians in engaging with emerging technologies.

4.4. Climate and sustainability

39. The social, spatial and productive connectivity of metaverse technologies has significantly lowered financial and environmental costs when compared with road and air travel, especially business travel. These technologies can also support those cut off from nature due to hospitalisation, incarceration, confinement, limited mobility, and lack of access to non-urban spaces (for example, via simulated nature walks, virtual "forest bathing" experiences).[25] However, the production of metaverse hardware, with the associated use of scarce resources, global distribution and data processing, will further exacerbate worldwide waste and pollution.[26]

40. To help reach internationally agreed climate targets and the United Nations Sustainable Development Goals across the supply chain, governments and metaverse providers could trial metaverse destinations for conferences, events, projects to cut down on international travel. They might consider codes of practice or regulations that involve life cycle assessments of immersive technologies, encourage responsible practices (such as recycled gold and other rare earth minerals, minimising transportation, etc.) and improve public literacy on and access to repair and reuse centres, and recycling facilities for consumer electronics.

4.5. Access to public services

41. The opportunities offered by the metaverse are also being seized by some governments, cities and institutions in a variety of fields, potentially increasing transparency and efficiency while decreasing costs and complexity. However, the consequences for the populace, especially the most marginalised groups who cannot access these services, should be carefully considered.

4.6. Competition and standardisation

42. In the early stages of an emergent sector, monopolies can go undetected or seen as a necessity to catalyse the growth of a small marketplace with relatively few players to dictate the business model, user expectations and commercial imperatives of the industry. New entrants are *de facto* excluded due to the scale and power of larger players.

43. At present no single set of standards has been universally applied to the metaverse. A number of industry-led entities have been formed to collectively design standards that will enable metaverse products and services to be compatible and interoperable.

44. Governments and metaverse providers should carefully consider the level of monopoly and create opportunities for new entrants across the metaverse technology stack. Closer collaboration between industry, policy makers and civil society is necessary for the development of practical and ethical metaverse standards.

5. Key challenges

5.1. Social and political manipulation

45. The risk of anti-democratic political manipulation and large-scale radicalisation, misinformation and coercion should be carefully considered, particularly for younger users,[27] as they can also influence voting behaviour or encourage non-participation of particular groups. Additional risks include: the use of "bot" avatars

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23. Barsom, E. Z., Graafland, M., & Schijven, M. P. (2016). "Systematic review on the effectiveness of augmented reality applications in medical training. Surgical Endoscopy", 30(10), 4174–4183. https://doi.org/10.1007/s00464-016-4800-6.
24. Palumbo, A. (2022). "Microsoft HoloLens 2 in Medical and Healthcare Context: State of the Art and Future Prospects". *Sensors,* 22(20), 7709. https://doi.org/10.3390/s22207709.
25. Reese, G., Stahlberg, J., Menzel, C. (2022) "Digital shinrin-yoku, Journal of Virtual Reality", 26(3) https://doi.org/10.1007/s10055-022-00631-9.
26. Andrea, A. (2017) "Life Cycle Assessment of a Virtual Reality Device". Challenges. 8(2). www.mdpi.com/2078-1547/8/2/15.
27. Slater, M. (2009). "Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments". Philosophical Transactions. Biological Sciences, 364(1535), 3549–3557. https://doi.org/10.1098/rstb.2009.0138.

with no human operator, designed to steer social encounters towards specific political agendas; deep fake avatars created to impersonate a natural person to gain users' confidence or commit fraud; nudge psychology to steer users towards a particular point of view, including radical ideology; propaganda and targeted advertising, leveraging data-based social profiling to deliver tailored propaganda materials.

46. Governments and metaverse providers should consider a form of content regulation akin to the broadcast and cinema sectors and apply lessons learned from social media regulation to intervene in the mechanisms by which State and private sector parties can manipulate user behaviour. The scale of investment and influence that State and corporate entities are entitled to accrue across metaverse ecosystems should also be limited.

5.2. Harassment, abuse, hate speech, violence

47. Harassment and abuse within metaverse multiperson platforms represent a well-evidenced risk,[28] especially if devoid of managed hosting, with female users and minorities most likely to be targeted.[29] Physical threats, simulated violence, unwanted touching or invasion of personal space can result in severe psychological distress. The so-called "phantom touch" phenomenon could increase the traumatic impact felt by victims, differentiating it from traditional cyberbullying.[30] Rapid disconnecting, particularly under stress or anxiety, is not a simple solution and can provoke panic or dissociative episodes.[31]

48. A META representative, speaking before the Committee on Culture, Science, Education and Media, pointed to some important features that already exist in social networks, such as the ability to block or report content, or to mute other users. Also, a "safe zone", indicated by the image of a shield, allows users to move away from other users and "personal boundaries" determine an unbreakable space of two metres around the user. I wonder whether that is enough.

49. Governments and metaverse providers should recognise that the metaverse space is a public space and that safety, human rights and fundamental freedoms extend into virtual and augmented territories. Third-party platform developers must strictly adhere to the terms and conditions set by app stores to reduce instances of harassment and abuse and ensure consistent oversight and accountability for breaches of trust. Stronger links should be created between metaverse activities and national law enforcement agencies and existing laws on sexual violence should be revisited to address violence in the metaverse (legal definition of "touch" and other loopholes and gaps).

5.3. Privacy and data protection

50. Existing protections around management of personal data such as names and protected characteristics may no longer be sufficient as behavioural data[32] can be used to uniquely identify and profile users through alternate means.[33] Neurological data such as EEG (brain signals) and EMG (muscle micro-movements) will soon form part of consumers' everyday interface with wearable technologies such as in-ear headphones[34] and wristbands,[35] further enhancing the level of biometric information, known as "biometric psychography",[36] that is potentially available to providers; companies take different approaches to data usage, processing, storage etc.[37]

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28. Eccles, L. (2022, January 22). "My journey into the metaverse – already a home to sex predators". The Sunday Times.
29. Limina Immersive. (2018). "Immersive Content Formats for Future Audiences". www.digicatapult.org.uk.
30. McIntosh, V., & Allen, C. (2023). "Child Safeguarding and Immersive Technologies: Key Concepts". https://learning.nspcc.org.uk/research-resources/2023/child-safeguarding-immersive-technologies.
31. Allen, C., & McIntosh, V. (2022). "Safeguarding the metaverse". www.theiet.org/media/9836/safeguarding-the-metaverse.pdf.
32. Miller, M. R., Herrera, F., Jun, H., Landay, J. A., & Bailenson, J. N. (2020). "Personal identifiability of user tracking data during observation of 360-degree VR video". Scientific Reports, 10(1), 17404. https://doi.org/10.1038/s41598-020-74486.
33. Kröger, J. L., Lutz, O. H.-M., & Müller, F. (2020). "What Does Your Gaze Reveal About You? On the Privacy Implications of Eye Tracking" (pp. 226–241). https://doi.org/10.1007/978-3-030-42504-3_15.
34. Apple Inc. (2023). "Biosignal sensing device using dynamic selection of electrodes" (Patent US-20230225659-A1). https://image-ppubs.uspto.gov/dirsearch-public/print/downloadPdf/20230225659.
35. Facebook Reality Labs (now Meta). (2021). "Inside Facebook Reality Labs: Wrist-based interaction for the next computing platform". Tech at Facebook. https://tech.facebook.com/reality-labs/2021/3/inside-facebook-reality-labs-wrist-based-interaction-for-the-next-computing-platform/.
36. Heller, B. (2020). "Watching Androids Dream of Electric Sheep: Immersive Watching Androids Dream of Electric Sheep: Immersive Technology, Biometric Psychography, and the Law". Technology Law Vanderbilt Journal of Entertainment & Technology Law, 23(1). https://scholarship.law.vanderbilt.edu/jetlaw/vol23/iss1/1.

51. The Digital Economy Outlook 2024 of the Organisation for Economic Co-operation and Development (OECD) points to relevant research highlighting that 20 minutes in virtual reality creates 2 million unique recordings of body language and identifies 95% of users with less than 5 minutes of tracking data. Consent-centric legislation is less relevant for virtual reality as one cannot "opt out" or "go incognito" and definitions in privacy regulation need to evolve in tandem with technology.

52. This represents significant risks to user privacy and compliance with the Council of Europe Convention for the Protection of Individuals with regard to Automatic Processing of Personal Data (ETS No. 108, "Convention 108"), as well as the European Union General Data Protection Regulation (GDPR).

53. Governments and metaverse providers should review how existing data protection legislation applies in metaverse contexts and assess current and future issues of (non)compliance for platform providers and content creators. The right to mental privacy should also be preserved in this context, including new generations of "neuro rights".

5.4. Convergence with artificial intelligence

54. Developments in metaverse technologies and services are likely to be entwined with parallel developments in AI, in three main areas: generative AI; moderation in social spaces (age validation, screening for illegal content, etc.); and behavioural modelling (aggregating large-scale user data).

55. The European Parliament AI Act sets out a series of rules according to the risk level, the uppermost of which is classified as "unacceptable risk", including cognitive behavioural manipulation of people or specific vulnerable groups, social scoring, and real-time and remote biometric identification systems.[38] Some metaverse architecture is structurally at risk of violating all of the above.

56. Governments and metaverse providers should consider how AI might be made transparent to users in immersive environments (i.e. clear and legible signalling enabling users to distinguish between avatars operated by a natural person and AI-driven "bot" avatars). AI monitoring and moderation systems should also be limited to an *in situ* consideration of user behaviour, upholding users' rights and the rule of law. They should be properly understood by users and the data generated should be used in accordance with the declared terms of use. Finally, appropriate reporting systems should identify potentially illegal behaviours and refer them to the proper authorities, who require additional resources, including training in immersive technologies, virtual criminality and the role, limitations and biases of reporting AI systems.

5.5. Cyber criminality and justice

57. As regards jurisdiction, criminality in the metaverse may take place on platforms run by a company registered in one territory, utilising server capacity in another, and with offenders and victims using the platform worldwide. Crime detection, evidence gathering and prosecution can prove challenging and international co-operative frameworks are needed to discourage and protect against criminality. In 2022, the Europol Innovation Lab recommended that law enforcement should be supported to gain first-hand experience of immersive technologies, identify shortfalls, and develop new measures.[39]

58. Governments and metaverse providers should encourage a strategic promotion of immersive literacy across governments, and regularly review and update legislation to maintain comprehensive protections for citizens, in particular vulnerable groups, in co-operation with international agencies, such as Interpol and Europol. International co-operation agreements should be enhanced to support cross-jurisdictional prevention and responses to crimes using metaverse technologies.

5.6. Geopolitics and cyberwars

59. The decentralised nature of the metaverse poses global problems of governance and sovereignty. Countries will likely seek to assert their influence and control within the metaverse, leading to potential friction and conflicts over digital sovereignty.[40] Security researchers also predict that a kind of "darknet" structure could emerge in virtual reality environments and underground marketplaces inaccessible to law enforcement agencies.[41]

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37. Meta. (2023). "Supplemental Meta Platforms Technologies Privacy Policy". www.meta.com/gb/legal/privacy-policy/.
38. Artificial Intelligence Act: MEPs adopt landmark law | News | European Parliament (europa.eu).
39. Europol. (2022). "Policing in the metaverse: what law enforcement needs to know, an observatory report from the Europol Innovation Lab". https://doi.org/10.2813/81062.
40. "How China Threatens to Splinter the Metaverse" | WIRED.

60. The oversight of metaverse platforms requires proactive and reactive interventions. Collaboration and dialogue are essential and present an opportunity for governments to shape a future technology that is inclusive, equitable, and sustainable for all.

5.7. Individual freedom and autonomy

61. As highlighted at the December 2023 hearing of the Committee on Culture, Science, Education and Media, metaverse developers are profit maximising entities and users are often treated as commodities. The symbiotic relationship between attention, user engagement, and advertising revenue drives the continuous refinement and optimisation of algorithms to maximise profit. Powerful tech companies will have even more control, potentially inducing compulsive buying behaviours, addictions or excessive use of technology and invasive advertisements. This is not just a matter of data protection, but one of freedom and autonomy.

62. Governments should consider passing regulations to prevent monopolies and anti-competitive practices and give control back to users, with the possibility to block content. Key measures include appropriate content moderation (i.e. flagging and reporting mechanisms), algorithmic accountability (i.e. regular audits to ensure fairness and transparency), education and digital literacy programmes, as well as participatory governance to ensure that the metaverse will be used for public good.

6. Council of Europe and European Union work

63. The Council of Europe, jointly with the Standards Association of the Institute for Electrical and Electronics Engineers (IEEE), a global standard-setting organisation within the IEEE, published a preliminary report entitled "The metaverse and its impact on Human Rights, Rule of Law, and Democracy", whose findings were presented to the Committee on Culture, Science, Education and Media. The full report was launched on 17 June 2024 at EuroDIG in Vilnius.

64. On 17 May 2024, the Council of Europe Framework Convention on Artificial Intelligence and Human Rights, Democracy, and the Rule of Law was adopted by the Committee of Ministers, and is open to non-European countries. The legal framework covers the entire lifecycle of AI systems and addresses the risks they may pose, while promoting responsible innovation. The framework convention (CETS No. 225) was open for signature in Vilnius on 5 September 2024 at a conference of Ministers of Justice.

65. The Assembly's opinion of 18 April 2024 called on all Council of Europe member States, when ratifying the convention, to recognise the full applicability of its provisions to the activities of private actors, and to put in place limitations, or even bans, on certain uses of AI deemed incompatible with human rights, especially in relation to health and the environment.

66. Further work on virtual realities, also in relation to the implementation of the framework convention, will continue in various sectors of the Organisation from 2025 onwards, including in the Assembly and its Committee on Culture, Science, Education and Media, as well as the Sub-Committee on Artificial Intelligence and Human Rights of the Committee on Legal Affairs and Human Rights.

67. The Council of Europe should continue to analyse whether existing instruments and legal frameworks are broad enough to cover immersive realities or whether additional tools are needed. The Committee of Ministers has already entrusted the Steering Committee on Media and Information Society (CDMSI) to conduct a feasibility study on the matter, as a first step to provide future guidance in the field. Also, the European Court of Human Rights may have to address future cases of rights' infringement in virtual realities.

68. On the use of AI, immersive realities and data protection, the Council of Europe Data Protection and the Children Rights Departments are also working on neurotechnologies, safety and data protection as key issues for the future development of virtual reality. There is a strong need to raise awareness on these issues among youth in the face of rapid digitalisation. As clarified by the Committee of the Parties to the Convention on the Protection of Children against Sexual Exploitation and Sexual Abuse (ETS No. 201, "Lanzarote Convention"), the Lanzarote Convention applies regardless of the means used to commit the offences, including where these are facilitated by information and communication technologies (ICTs).[42]

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41. "Researchers warn of darkverse emerging from the metaverse" | OSINTer.

42. "Interpretative Opinion on the applicability of the Lanzarote Convention to sexual offences against children facilitated through the use of information and communication technologies (ICTs)", adopted by the Lanzarote Committee on 12 May 2017; see also: "Implementation report: The protection of children against sexual exploitation and sexual abuse facilitated by information and communication technologies (ICTs): addressing the challenges raised by child self-generated sexual images and/or videos", adopted by the Lanzarote Committee on 10 March 2022.

69. At European Union level, in July 2023, the European Commission adopted a new strategy on Web 4.0 and virtual worlds, in order to steer the next technological transition and ensure an open, secure, trustworthy, fair and inclusive digital environment for EU citizens, businesses and public administrations.[43] In January 2024, the European Parliament adopted an own-initiative report entitled "Virtual worlds – opportunities, risks and policy implications for the single market" stressing the need to base this technology on EU values, in a sustainable and human-centric manner. It calls on the European Commission to prepare guidelines clarifying legal obligations and responsibilities of all stakeholders in virtual worlds, and emphasises the need to raise public awareness, improve digital skills and access to technologies.

70. Council of Europe member States should harmonise approaches and enable closer collaboration between the private sector, policy makers and civil society organisations in the development of practical and ethical metaverse standards, and strengthen international co-operation agreements wherever possible.

7. Concluding remarks and overview of recommendations

71. One of the challenges we face today is to keep society stable in the face of rapid technological change and to calibrate existing legal and institutional tools to help protect and promote democracy, human rights and the rule of law.

72. The metaverse embodies the non-deterministic nature of technology, which is neither inherently good, bad, nor even neutral, but serves as an amplifier of human behaviour and must be guided in a responsible and ethical manner. This technology presents challenges in terms of conceptual and legal definitions, making it difficult to establish clear boundaries, and continues to evolve within the dynamic landscape of interconnected systems.

73. The metaverse represents a socially constructed and computationally mediated concept, characteristic of emergent processes seen in complex adaptive systems. Its definition is elusive both conceptually and legally, reflecting its intricate nature. Predicting the metaverse's evolution is inherently speculative, and this uncertainty poses significant challenges for lawmakers striving to keep pace with rapid advancements in science and technology.

74. There is a pressing need for new governance structures that are open, informed, and robust, alongside public debates and innovative legislative mechanisms to guide the development of this emergent technology. The metaverse holds tremendous potential to alter fundamental interaction flows within society. Changes in these flows can lead to profound transformations in societal structures and dynamics. As these interaction flows evolve, so too does society, underscoring the transformative impact of the metaverse on our collective future.

75. Presence, immersion and embodiment create the illusion of being in a real environment and users are actively involved in the creation of virtual worlds. They may adopt digital personas that might not align with their real-world identities, which challenges the traditional, centralised frameworks of identity established by nation States and institutions. A comprehensive understanding of these dynamics will be essential in devising adaptive strategies that accommodate the rapidly evolving landscape of human interaction and identity in the digital age.

76. Web3 and the metaverse are shaped by AI helping the system make decisions for itself and improve language processing, facial recognition and the overall efficiency of the system. The quick development of generative AI also opens new perspectives concerning the possible interactions between users and the system itself.

77. While the metaverse has a great potential to improve people's lives, a toxic culture seems to be evolving around immersive spaces, including harassment and abuse, hate speech, racist language, homophobic language, transphobic language, simulated violence, as well as disinformation, propaganda and social and political manipulation. Age limitations for children appear ineffective, as reporting processes and consequences of breaching terms of references are very opaque.

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43. A European Citizens Panel on Virtual Worlds organised in 2023 highlighted 8 values and principles: freedom of choice, sustainability, human-centred, health, education and literacy, safety and security, transparency, inclusion. The 23 recommendations included public control and oversight, the preservation and harmonisation of labour market legislation for the virtual labour market, access for vulnerable groups, the need for education and training, sustainability, recyclable equipment and renewable energy sources, the need for further research on adverse health effects as well as for users' control over their personal data (opt-in models). These were all duly taken into account in the preparation of my report.

78. The way data is being collected, interpreted and used (biometric psychography, i.e. data captured by eye trackers and body motions as diagnostic of personal identity, medical conditions and mental states) is also problematic and the right to mental privacy and cognitive liberty must be carefully considered.

79. A distorted perception of the actual risks, benefits, and implications of this new technology may potentially influence the formulation of policies and regulations that do not adequately address the complexities involved. Policy makers need to strike a delicate balance between fostering innovation and ensuring the protection of users and society at large.

80. The lessons learnt from the social media era can help to shape metaverse environments and promote the same values which are actively defended and promoted in democratic societies, possibly even further, thanks to the potential outreach of this technology which can foster public participation. Policy makers need to update their skills to make sure that public safety, security, accessibility and inclusion requirements drive technologies that benefit as many people as possible from the outset.[44]

81. Human rights and fundamental freedoms must be well embedded in the metaverse from the start. Its full potential as an inclusive digital infrastructure can only be unlocked when everyone can access it, with the removal of existing and potential barriers, including costs.

82. Self-regulation might not be enough and dialogue and co-operation among governments, researchers and the private sector are of the essence, with a view to fostering a culture of transparency and creating policies that are better equipped to address the complexities of this technology.

83. The idea that regulation would prevent innovation is a false dichotomy, as responsible governance can encourage creativity, innovation and entrepreneurialism, but also uphold democracy, human rights and the rule of law through the metaverse. The challenge is to properly understand harassment, corruption, fraud, violence and other human rights abuses and threats to democracy in the metaverse and to adapt and update legislation accordingly to protect against them, and to rethink privacy and data rights in the virtual world.

84. The draft resolution puts forward detailed recommendations for positive action, as presented throughout this report and stemming from the intense debates in the Committee on Culture, Science, Education and Media, with the invaluable input of several experts and stakeholders, including tech companies, to whom I am deeply grateful.

85. The last hearing in Copenhagen on 27 May 2024 also highlighted the need for technology assessment to explore the relationship between science, technology and society and to contribute to the formation of public and political opinion on societal aspects of science and fast-developing technology. The Assembly should continue to strengthen its activities as a partner of the European Parliamentary Technology Assessment (EPTA) network, and provide its contribution to policy makers in shaping technology development and ensuring democratic governance and respect for human rights and fundamental freedoms.

44. See also “Metaverse for UN SDGs – An Exploratory Study”, Science-Policy Brief for the Multistakeholder Forum on Science, Technology and Innovation for the SDGs, May 2022.