

TECHETHOS

FUTURE ○ TECHNOLOGY ○ ETHICS

Analysis of international and EU law and policy for the governance of climate engineering, neurotechnologies, and digital extended reality

D4.1

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D4.1 Analysis of international and EU law and policies

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The TechEthos Project

TechEthos is an EU-funded project that deals with the ethics of the new and emerging technologies anticipated to have high socio-economic impact. The project involves ten scientific partners and six science engagement organisations and runs from January 2021 to the end of 2023.

TechEthos aims to facilitate “ethics by design”, namely, to bring ethical and societal values into the design and development of new and emerging technologies from the very beginning of the process. The project will produce operational ethics guidelines for three to four technologies for users such as researchers, research ethics committees and policy makers. To reconcile the needs of research and innovation and the concerns of society, the project will explore the awareness, acceptance and aspirations of academia, industry and the general public alike and reflect them in the guidelines.

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Definitions and abbreviations

Table 1: List of Definitions

Term	Explanation
Augmented reality	Overlay of digital information or objects with a person's current view of reality; enhancement of reality by computer-generated perceptual information across multiple sensory, visual or auditory modalities.
Carbon dioxide removal (CDR)	A type of climate engineering, also known as "negative emissions techniques", that removes atmospheric CO ₂ and stores it in geological, terrestrial, or oceanic reservoirs.
Climate engineering	Also known as geoengineering, refers to "... the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming." ¹
Digital extended reality (XR)	Refers to a collection of technologies that are related to each other, with a common functionality to emulate and imitate human traits and social circumstances: language, appearance, lived spaces, objects,

¹ Shepherd, J., Caldeira, K., Cox, P., Haigh, J., Keith, D., Launder, B., & Mace, G. (2009) *Geoengineering the Climate: Science, Governance, and Uncertainty*. Available at: <http://royalsociety.org>.

	experiences, etc. XR is also known as a “mix of virtual reality (VR), augmented reality (AR) and mixed reality.” ²
Mixed reality	Blending the real and virtual worlds to create new digital or manufactured realities, where physical and digital objects co-exist and interact in real-time.
Neurotechnologies	Refers to devices and procedures used to access, monitor, investigate, assess, manipulate, and/or emulate the structure and function of the neural systems of natural persons. ³
Solar radiation management (SRM)	A type of climate engineering that aims to reflect some sunlight and heat back into space.
Virtual reality	Environment that is completely simulated by digital means, completely obscuring the view of their existing reality.

Table 2: List of Abbreviations

Term	Explanation
AI HLEG	European High-Level Expert Group on Artificial Intelligence
AIA	Artificial Intelligence Act (AIA)
AR	Augmented Reality
BCI	Brain-computer interface
BECCS	Bioenergy with carbon capture and storage
BMI	Brain-machine interface
CAT	Convention Against Torture
CBD	Convention on Biological Diversity
CCPR	United National Human Rights Committee
CCS	Carbon capture and storage
CCU	Carbon capture and utilisation
CDR	Carbon dioxide removal

² European Commission. (2022) *Extended Reality* [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/extended-reality>.

³ OECD. (2019) *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457.

CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CERD	International Convention on the Elimination of All Forms of Racial Discrimination
CIL	Customary international law
CFREU	Charter of Fundamental Rights of the European Union
CJEU	Court of Justice of the European Union
CO ₂	Carbon dioxide
CoE	Council of Europe
COP	Conference of Parties (UNFCCC)
COPOUS	United Nations Committee on the Peaceful Uses of Outer Space
CPRMW	Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families
CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
DA	Data Act (EU)
DAC	Direct Air Capture
DBS	Deep brain stimulation
DGA	Data Governance Act (EU)
DNA	Deoxyribonucleic acid
DoA	Description of Action
DOALAW	United Nations Division for Ocean Affairs and the Law of the Seas
DSA	Digital Services Act (EU)
EC	European Commission
ECHR	European Convention on Human Rights (CoE)
ECtHR	European Court of Human Rights (EU)
EEG	Electroencephalogram
EEZ	Exclusive Economic Zone



ENGO	Environmental non-governmental organisation
EOR	Enhanced recovery of oil and gas
EP	European Parliament
ESA	European Space Agency
EU	European Union
EUSPA	EU Agency for the Space Programme
fMRI	Functional magnetic resonance imaging
FRA	Fundamental Rights Agency (EU)
GDPR	General Data Protection Regulation (EU)
GHG	Greenhouse gas
HRC	Human Rights Council (UN)
IBC	International Bioethics Committee (UNESCO)
ICCPR	International Covenant on Civil and Political Rights
ICESCR	International Covenant on Economic, Social and Cultural Rights
IEEE	Institute of Electrical and Electronics Engineers
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ITRE	Committee for Industry, Research and Energy
LC/LP	London Convention / London Protocol
MR	Mixed Reality
MRB	Media Ratings Bodies
MRI	Magnetic Resonance Imaging
NASA	United States National Aeronautics and Space Administration
NDC	Nationally Determined Contributions
NET	Negative emissions technologies
NGO	Non-governmental organisation



OECD	Organisation for Economic Co-operation and Development
OHCHR	Office of the United Nations High Commissioner for Human Rights
Oviedo Convention	The Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine
PEGI	Pan European Game Information
SDGs	U.N. Sustainable Development Goals
SRM	Solar radiation management
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
XR	Digital extended reality
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNOOSA	United Nations Office for Outer Space Affairs
VR	Virtual Reality
WMO	World Meteorological Organisation
XR	Extended reality



Executive Summary

This report was developed as part of TechEthos, a project funded by the European Union's Horizon 2020 Research and Innovation Programme. TechEthos aims to facilitate "ethics by design" by bringing ethical and societal values into the design and development of new and emerging technologies with a high socio-economic impact. The technology families selected for the project are climate engineering, neurotechnologies, and digital extended reality (XR). These three technology families present many significant legal issues that impact socio-economic equality and fundamental rights.

This report explores and analyses relevant international and EU laws and policies for their relevance and applicability to the three technology families. Based on the analysis of the characteristics, applications and ethics and socio-economic impacts of these technologies, as emerged in previous phases of the TechEthos project, the report served different purposes:

- To review the legal domains and related obligations at international and EU levels.
- To identify potential implications for fundamental rights and principles of democracy and rule of law, considering both enhancements and interferences.
- To reflect on issues and challenges of existing legal frameworks to address current and future implications of the technologies.

For the purpose of this report, these technology families are defined as follows:

- **Climate engineering (CE)**, also known as geoengineering, refers to "... the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming."⁴
- **Neurotechnologies** refers to devices and procedures used to access, monitor, investigate, assess, manipulate, and/or emulate the structure and function of the neural systems of natural persons.⁵
- **Digital Extended Reality (XR)** refers to a collection of technologies that are related to each other, with a common functionality to emulate and imitate human traits and social circumstances: language, appearance, lived spaces, objects, experiences, etc. XR is also known as a "mix of virtual reality (VR), augmented reality (AR) and mixed reality."⁶

There is no comprehensive or dedicated international or EU law governing these technology families. However, there are many legal obligations under existing legal frameworks. The legal issues and challenges discussed in this report are grouped into applicable legal frameworks at the international and EU level. The legal frameworks relevant to each technology family are analysed in three separate chapters, and cover human rights law, rules on state responsibility, environmental law, climate law,

⁴ Shepherd, J., Caldeira, K., Cox, P., Haigh, J., Keith, D., Launder, B., & Mace, G. (2009) *Geoengineering the Climate: Science, Governance, and Uncertainty*. Available at: <http://royalsociety>.

⁵ OECD. (2019) *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457.

⁶ European Commission. (2022) *Extended Reality* [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/extended-reality>.

space law, law of the seas, privacy and data protection law, consumer rights law, and the law related to artificial intelligence, digital services and data governance.

This report presents the obligations of States (for international law) and/or Member States (for EU law) and the rights of private individuals under those laws. Discussion of the obligations of private individuals and entities will be the focus on a report on the legal frameworks at the national level (forthcoming Winter 2022). The work of these two reports, and the gaps and challenges in existing legal frameworks identified by this work, will form the basis for legal and policy recommendations in the TechEthos project in the coming months (forthcoming Spring 2023).

Climate engineering

The chapter on climate engineering discusses how climate engineering is or might be governed by international and EU law in the specific domains of human rights, rules on state responsibility, environmental and climate law, space law, and the law of the seas. While not required, some specific types of climate engineering activities—CCS, CCU, and nature-based solutions—are explicitly referenced in law as potential options available to States. Following an overview of the international and EU laws for each legal framework, the following specific laws and legal issues are considered:

Table 3: Legal framework and issues in relation to climate engineering

Legal framework	Legal issues
Human rights law	<ul style="list-style-type: none"> Freedom of scientific research Right to benefit from science Right to protect moral and material interests of scientific research Rights of research participants Right to information Right to participate in public affairs Right to access legal remedies Right to life Right to a healthy environment Right to health Right to access food Right to water
Rules of state responsibility	Prohibition on transboundary environmental harm
Environmental law	<ul style="list-style-type: none"> Environmental impact assessments Corporate disclosure and sustainable finance Public participation Pollution prevention Environmental management including waste and chemicals Environmental protection and liability for harm
Climate law	<ul style="list-style-type: none"> Emission reduction goals Carbon emissions trading



	Geological storage of CO ₂
Space law	State responsibilities in outer space Environmental protection and liability for environmental harm in space Exploitation and mining of space resources
Law of the seas	States' obligations: assessment, permitting and monitoring Marine pollution and dumping Non-binding international ban on ocean iron fertilisation Deep seabed drilling and carbon storage

It is considered that climate engineering technologies present various legal issues and challenges with wide-ranging socio-economic and human rights implications. With some exceptions, there is no comprehensive legal framework for the governance of climate engineering, other than general climate obligations and environmental protection. The analysis reveals four key points about the governance of climate technologies:

- The specific approach and type of climate engineering proposal is very important. As each type of climate engineering involves very different elements, activities, and physical spaces, even a slight difference in the technology triggers different concerns and legal frameworks.
- Despite the existence of accountability frameworks, it would likely be very difficult to hold an actor – public or private – responsible for harm caused directly or indirectly by climate engineering. In addition to a lack of effective redress mechanisms, the challenges of establishing legal liability include defining 'harm', assessing causation, identifying the responsible party, and weighing mitigating circumstances.
- There is a unique tension between competing interests in the legal frameworks, particularly environmental law and climate law. It is arguably impossible to achieve the goals of climate law without climate engineering, but climate engineering activities may frustrate the purpose or directly violate environmental protection objectives. At present, this significant tension in the objectives of the different legal frameworks may be irreconcilable.
- Policy and legal developments have often contemplated whether a specific technology should be subject to prohibition. With the exception of CCS, conversations about the governance of climate engineering do not focus on how the technology should be regulated, but rather whether the technology should be permitted at all.

At the time, there is no initiative towards the comprehensive regulation of climate engineering at the international or EU level. If the past is any indication, further development of any legal frameworks will continue to address specific types of climate engineering individually. Given the inherently global impacts and scale of climate engineering, regulation of this technology family may require governance at the international and EU level. The possibility of national level governance will be analysed in a forthcoming TechEthos report on national legal frameworks.



Neurotechnologies

The chapter on neurotechnologies discusses the ways in which neurotechnologies are or may be governed by international and EU law and policy within the frameworks of human rights and privacy and data protection. While no international or EU law directly addresses or explicitly mentions neurotechnologies, many aspects are subject to international and EU law. Following an overview of the international and EU laws for each legal framework, the following specific laws and legal issues are considered:

Table 4: Legal framework and issues in relation to neurotechnologies

Legal framework	Legal issues
Human rights law	Right to life Right to dignity Right to autonomy Right to privacy Freedom of opinion and expression Right to health Access to justice and right to a fair trial Right to rest and leisure Right to benefit from science Non-discrimination and vulnerable groups
Privacy and data protection	Right to privacy Classification of data Potential developments and future trends

It is considered that neurotechnologies present various legal issues and challenges with wide-ranging socio-economic and human rights implications. A survey of the legal landscape, specifically the applicable international and EU law, has shown that there is no dedicated legislation with direct application to neurotechnologies. Such technologies are nonetheless subject to various domain-specific legal frameworks, including human rights law, and privacy and data protection law, and further regulatory measures with application to neurotechnologies are expected, particularly under EU law.

The human rights-based framework is designed to be adaptable to the issues raised by new and emerging technologies in order to better protect the rights of individuals against interference. Furthermore, the introduction of so-called “neurorights” to supplement the existing international and EU human rights frameworks would impact States’ obligations vis-à-vis neurotechnologies, potentially requiring that States strengthen the protection of individuals against intrusions by neurotechnologies into, inter alia, notions of mental privacy, cognitive liberty, mental integrity and psychological continuity. The necessity of such additional rights may depend on the effectiveness of existing human rights law to respond to the specific challenges posed by neurotechnologies, which include, inter alia, neurodiscrimination, the status of brain data, and instances of so-called “brain-hacking”.

Without clear initiative to regulate at the international or EU level, it is possible that further governance of this technology family will occur at the national level (the possibility for which will be analysed in a forthcoming TechEthos report on legal frameworks at the national level).



Digital Extended Reality (XR)

The chapter on digital extended reality (XR) discusses the ways in which XR is or may be governed by international and EU law and policy within the legal frameworks for human rights, privacy and data protection, consumer rights, artificial intelligence, and digital services. While no international or EU law directly addresses or explicitly mentions XR, many aspects are subject to international and EU law. Following an overview of the international and EU laws for each legal framework, the following specific laws and legal issues are considered:

Table 5: Legal framework and issues in relation to XR

Legal framework	Legal issues
Human rights law	Right to dignity Right to autonomy Right to privacy Freedom of expression Right to health Right to education Access to justice and the right to a fair trial Right to just and favourable conditions of work Right to rest and leisure Right to benefit from science Non-discrimination and vulnerable groups Trends and emerging rights
Privacy and data protection	Privacy Classification of data Consent Transparency Vulnerable users Potential developments and future trends
Consumer protection	Right to safety Right to be informed Right to choose Right to redress Right to consumer education Right to a healthy environment Potential developments and future trends
AI governance	Risk classification of XR technologies with AI Environmental impacts of AI in XR
Digital services governance	Digital service providers' obligations Discrimination

It is considered that XR technologies present various legal issues and challenges with wide-ranging socio-economic and human rights implications. A survey of the international and EU law landscape has revealed that there is no dedicated legislation with direct application to XR. Such technologies are nonetheless subject to various domain-specific international and EU law frameworks. Further legislative measures at the EU level are also expected, with each of the e-Privacy Regulation, the AI



Act, the Digital Services Act, the Data Act and the Data Governance Act at varying stages of the legislative schedule and all likely to impact upon the regulation of XR technologies. Even in the absence of additional regulatory measures, a key advantage of rights-based legal frameworks is the built-in flexibility to adapt to the challenges posed by new and emerging technologies, including XR, in order to better protect the rights of individuals against interference.

A future challenge, however, concerns the definition to be attributed to XR technologies, the significance of which is in determining the applicable basis for legal regulation. Legislators and policymakers at the international and EU level will be required to carefully consider the question of the most suitable and comprehensive definition for XR technologies. Policy and legal developments have focused on how the technology should be regulated, not whether the technology should be permitted.

At present, there is no proposal to comprehensively regulate XR at the international or EU level. Further governance of this technology family may occur at the national level, the possibility for which will be analysed in a forthcoming TechEthos report on legal frameworks at the national level.



1. Introduction

Climate engineering, neurotechnologies, and digital extended reality (XR) present many significant legal issues that impact socio-economic equality and fundamental rights. There is no comprehensive or dedicated international and EU law governing these technology families, though many elements of the technologies are subject to existing laws and policies.

This report explores and analyses relevant international and EU laws and policies for the three technology families. While there are some cross-cutting issues, each technology family is subject to different legal frameworks. The following table outlines the legal frameworks presented in this report.

Table 6: International and EU legal frameworks

Climate engineering	Neurotechnologies	Digital extended reality
<ul style="list-style-type: none"> • Human rights law • Rules of state responsibility • Environmental law • Climate law • Space law • Law of the Seas 	<ul style="list-style-type: none"> • Human rights law • Privacy and data protection 	<ul style="list-style-type: none"> • Human rights law • Privacy and data protection • Consumer protection

1.1 Defining the technology families

For the purpose of the TechEthos project and this report, we have used the following definitions for the three technology families:

- **Climate engineering (CE)**, also known as geoengineering, refers to "... the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming."⁷
- **Neurotechnologies** refers to devices and procedures used to access, monitor, investigate, assess, manipulate, and/or emulate the structure and function of the neural systems of natural persons.⁸
- **Digital Extended Reality (XR)** refers to a collection of technologies that are related to each other, with a common functionality to emulate and imitate human traits and social

⁷ Shepherd, J., Caldeira, K., Cox, P., Haigh, J., Keith, D., Launder, B., & Mace, G. (2009) *Geoengineering the Climate: Science, Governance, and Uncertainty*. Available at: <http://royalsociety.org>.

⁸ OECD. (2019) *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457.

circumstances: language, appearance, lived spaces, objects, experiences, etc. XR is also known as a “mix of virtual reality (VR), augmented reality (AR) and mixed reality.”⁹

For more information about the technology families and their innovation ecosystems, visit: <https://www.techethos.eu/resources/>.

1.2 Key legal issues

For each technology family, there are many legal issues relevant within each of the legal frameworks. While some issues are cross-cutting (e.g., privacy, safety) across the technology families, the issues manifest in different ways. Furthermore, even within a technology family, distinct legal frameworks treat the same issues in different ways. Therefore, some legal issues are discussed in the context of more than one technology family and legal framework.

As this report presents international and EU law, discussions focus on the obligations of States (for international law) and/or Member States (for EU law) and the rights of private individuals under those laws.

Discussion of the obligations of private individual and entities will be the focus of a report on the legal frameworks at the national level (forthcoming Winter 2022).

Table 7: Legal issues in climate engineering

Legal issues in international and EU law: Climate engineering

- Human rights related to scientific research (freedom of scientific research, right to benefit from scientific research, moral and material interests from scientific research, and rights of research participants)
- Procedural human rights (right to information, right to participate in public affairs, and right to access legal remedies)
- Substantive human rights (right to life, right to healthy environment, right to health, right to food, and right to water)
- Prohibition on transboundary environmental harm
- Environmental protection (terrestrial, in space and in marine environments)
- Liability for environmental harm (terrestrial, in space and in marine environments)
- Environmental assessments
- Corporate disclosure
- Public participation
- Pollution management and prevention (including ‘polluter pays’ principle)
- Waste and chemicals management
- Emission reduction targets
- Obligations for objects put in space
- Management of the exploitation and mining of space resources
- Obligations for vessels on the high seas

⁹ European Commission. (2022) *Extended Reality* [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/extended-reality>.

- Management of deep-seabed drilling and storage

Table 8: Legal issues in neurotechnologies

Legal issues in international and EU law: Neurotechnologies
<ul style="list-style-type: none"> ○ Right to life ○ Right to dignity ○ Right to autonomy ○ Right to privacy ○ Freedom of opinion and expression ○ Right to health ○ Right to education ○ Access to justice and right to a fair trial ○ Right to rest and leisure ○ Right to benefit from science ○ Non-discrimination and vulnerable groups ○ Emerging 'neurorights' ○ Data protection and classification of 'brain data' ○ Consent ○ Transparency

Table 9: Legal issues in XR

Legal issues in international and EU law: Digital extended reality (XR)
<ul style="list-style-type: none"> ○ Right to dignity ○ Right to autonomy ○ Right to privacy ○ Freedom of expression ○ Right to health ○ Right to education ○ Access to justice and right to a fair trial ○ Right to just and favourable conditions of work ○ Right to rest and leisure ○ Right to benefit from science ○ Non-discrimination and vulnerable groups ○ Right to healthy environment ○ Right to disconnect ○ Right to online access ○ Data protection and classification of data ○ Consent ○ Transparency ○ Right to safety

- Right to be informed
- Right to choose
- Right to redress
- Right to consumer education

1.3 Structure of report

Following this introduction, **Section 2** describes the methodology for developing this report. **Section 3** provides a high-level summary of the legal frameworks discussed in this report, some of which are relevant to more than one technology family. The following three sections are dedicated to each of the technology families. **Section 4** presents the legal frameworks for climate engineering, **Section 5** presents the frameworks for neurotechnologies, and **Section 6** presents the frameworks for digital extended reality. The report concludes with a high-level discussion of gaps, challenges and trends in **Section 7**. A reference list is included at the end.

2. Methodology and scope

This report is part of the policy, legal and regulatory analysis conducted in the EU-funded TechEthos project. The development of this report followed the description of action in the TechEthos Description of Action (DoA):

- T4.2: For each of the 3-4 selected tech, we will identify the legal issues and challenges – with a focus on those affecting/contributing to the stimulation of innovation, socio-economic inequalities including, in health treatment, social status and social inclusion and gender equality and fundamental human rights and freedoms of individuals. We will carry out a literature review of documents addressing legal aspects, i.e., articles in academic and legal practitioner journals, books, legal commentaries or legal policy studies (last five years). This review will be a starting point to help determine which specific legal issues are being discussed and debated in relation to the selected topic areas and should be further explored in the project and particularly investigated in the country studies.
- T4.3: In this task using desktop research, we will identify and analyse relevant international and EU laws and policies with respect to each of the identified technologies and carry out a comparison on both the legal/regulatory and procedural framework (existing or under development) for the identified technologies. We will explore whether international policies and laws cover the issues identified in Task 4.2 and the adequacy of these.

The overall approach to legal analysis, in particular the human rights analysis, was informed by and builds on past work in the EU-funded SHERPA and SIENNA projects, which also looked at the ethical

and human rights implications of new and emerging technologies.¹⁰ Some TechEthos partners with legal expertise were partners in the SHERPA and SIENNA projects and also contributed to the legal analysis work in those projects.

For each technology family, we began by compiling a list of key legal issues. To identify legal issues, we used the TAPP legal analysis method:

- T: Things (What are the relevant objects?)
- A: Actions (What actions are done or not done?)
- P: People (Who is involved or impacts by the action?)
- P: Places (Where (physical space or domain) does the action take place?)¹¹

With a TAPP list, we identified the corresponding legal frameworks governing the things, actions, people, and/or places relevant to the three technologies areas. To select the issues discussed in this report, we were guided by the language in the DoA to “focus on those affecting/contributing to the stimulation of innovation, socio-economic inequalities including, in health treatment, social status and social inclusion, and gender equality and fundamental human rights and freedoms of individuals.” Additionally, we considered which legal issues were particularly significant and timely, and worked in parallel to an ethical analysis of the three technologies in the project.

The focus of the report is legal frameworks at the international and EU level. A subsequent report, to be finalised in late 2022, will look at the same legal issues through the lens of domestic law in nine countries.

We carried out the research for this report from March-June 2022, primarily through desk research. To best understand the legal context, we looked at both hard (binding) law and soft (non-binding) law, as well as policies and judicial jurisprudence. Our analysis of the laws has been made with reference to legal and academic scholarship. To understand how the law may develop, we also look at proposed laws and policies.

As the three technology families are new and emerging, the legal scholarship does not always use the same terminology. For climate engineering, our search terms also included ‘geoengineering’ and the specific types of climate engineering (e.g., solar radiation management, marine cloud brightening). For neurotechnologies, we also used the search terms ‘neuroscience’, ‘brain-computer interfaces’, and ‘brain-machine interfaces’, as well as specific forms of neurotechnology (e.g., EEG, fMRI). For digital extended reality, we used the search terms ‘extended reality’, ‘virtual reality’, ‘augmented reality’, and ‘mixed reality’.

The gaps and challenges identified in this report will serve as a basis for legal and policy recommendations in the TechEthos project in the coming months (forthcoming Spring 2023).

¹⁰ For SHERPA, the technology focus was smart information systems (a combination of artificial intelligence (AI) and Big Data). See: <https://www.project-sherpa.eu/>. For SIENNA, the three technologies families analysed were genomics, human enhancement, and AI and robotics. See: <https://www.sienna-project.eu/>.

¹¹ See, Danner, R.A. (1987) ‘From the Editor: Working with Facts’, *Law Library Journal*, 79.

3. International laws and policies

The legal issues and challenges discussed in this report are grouped into applicable legal frameworks at the international and EU level. The legal frameworks reviewed in this report are human rights law, rules on state responsibility, environmental law, climate law, space law, law of the seas, privacy and data protection law, and consumer rights law.

Cross-cutting issues, like privacy or non-discrimination, are primarily discussed in a dedicated section, with references made to that section where the issue appears in other frameworks. Two legal frameworks families (human rights; privacy and data protection) are applicable to multiple technology families; the remaining legal frameworks are only discussed in relation to one technology family.

In the context of climate engineering, most relevant law and policy exists principally in the context of international law. The bodies of law limited to discussion at the international level are rules on state responsibility, space law, and the law of the seas.

The **sources of international law and policy** referred to in this report include binding treaties (which may also be called conventions, covenants, agreements, protocols, etc.), customary international law, decisions from international courts (e.g., International Court of Justice, European Court of Human Rights), non-binding guidance documents, statements from policymakers and official reports. For the purpose of this report, the Council of Europe is included in discussions of international law.

The **sources of EU law and policy** include treaties, directives, regulations, decisions of the European Court of Justice, statements from EU policymakers, and reports from EU agencies and committees.

The following sub-sections provide a brief summary of the legal frameworks analysed.

3.1 Human rights law

International human rights law is comprised of international treaties and customary international law (CIL).

The 1948 Universal Declaration of Human Rights (UDHR), while not binding on States, is the primary source of human rights law and many articles are considered customary international law.¹² Subsequent treaties are legally binding on contracting States.¹³ There are seven core international human rights treaties, each with a committee of experts (treaty body) responsible for monitoring treaty implementation.¹⁴ The UDHR and two of those treaties – International Covenant on Civil and

¹² United Nations. *The Foundation of International Human Rights Law* / [Online]. Available at: <https://www.un.org/en/about-us/udhr/foundation-of-international-human-rights-law#:~:text=The%20Universal%20Declaration%20of%20Human,binding%20international%20human%20rights%20treaties>.

¹³ Vienna Convention Law of Treaties, Article 2(1).

¹⁴ The seven core treaties and their respective treaty bodies are: (1) Human Right Committee (HRC) - International Covenant on Civil and Political Rights (ICCPR); (2) Committee on Economic, Social and Cultural Rights (CESCR) – International Covenant on Economic, Social and Cultural Rights (ICESCR); (3) Committee on the Elimination of Racial

Political Rights (ICCPR) and International Covenant on Economic, Social and Cultural Rights (ICESCR) – are collectively known as the International Bill of Human Rights.¹⁵ To assist States with interpreting treaty language, the treaty bodies publish non-binding guidance in the form of *General Comments* or *General Recommendations*.¹⁶ The Office of the United Nations High Commissioner for Human Rights (OHCHR) is the department of the U.N. Secretariat responsible for promoting and protecting human rights at the international level.¹⁷ Human rights experts advise the U.N. High Commissioner for Human Rights on specific thematic topics or countries, such as ‘the rights of persons with disabilities’, ‘the right to privacy’, and ‘the issue of human rights and transnational corporations and other business enterprises’.¹⁸ These experts take the form of Working Groups, Independent Experts and Special Rapporteur; collectively, they are known as the OHCHR ‘Special Procedures’.¹⁹ Also relevant is the U.N. Human Rights Council, an inter-governmental body responsible for addressing human rights violations.²⁰ There is no international human rights court, but U.N. treaty bodies and Special Procedures can respond to complaints filed by victims of human rights abuses.²¹ Other relevant rule making bodies for human rights at the U.N. level include the U.N. Secretary-General, who issues statements and commissions reports, and the U.N. General Assembly, which adopt declaration, convention and resolutions.²² Work on human rights at the international level is complemented by work on the U.N. Sustainable Development Goals, a set of seventeen global goals related to ending poverty, reducing inequality, and protecting the environment.²³

Other international and regional organisations also support the promotion and protection of human rights. For the purpose of this report, the two key organisations are the Council of Europe and the European Union.

The Council of Europe (CoE) is an international organisation with 46 member states, founded to promote and protect human rights, democracy and the rule of law.²⁴ The European Convention on Human Rights (ECHR) was negotiated within the auspices of the CoE and all CoE Member States are party to the Convention.²⁵ The European Court of Human Rights (ECtHR) is the body of the CoE

Discrimination (CERD) – International Convention on the Elimination of All Forms of Racial Discrimination (CERD); (4) Committee on the Elimination of Discrimination Against Women (CEDAW) – Committee on the Elimination of Discrimination Against Women (CEDAW); (5) Committee Against Torture (CAT) – Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment (CAT); (6) Committee on the Rights of the Child (CRC) – Convention on the Rights of the Child (CRC); (7) Committee on Migrant Workers (CMW) – International Convention on Protection of the Rights of All Migrant Workers and Members Their Families (ICMRW).

¹⁵ U.N. General Assembly. (1948) *Resolution 217 (III) international Bill of Human Rights*, adopted 10 December 1948.

¹⁶ U.N. Office of the High Commissioner for Human Rights. *General Comments* / [Online]. Available at: <https://www.ohchr.org/en/treaty-bodies/general-comments>.

¹⁷ U.N. Office of the High Commissioner for Human Rights. *High Commissioner* / [Online]. Available at: <https://www.ohchr.org/en/about-us/high-commissioner>.

¹⁸ U.N. Office of the High Commissioner for Human Rights. *About special procedures* / [Online]. Available at: <https://www.ohchr.org/en/special-procedures-human-rights-council>.

¹⁹ Ibid.

²⁰ U.N. Office of the High Commissioner for Human Rights. *United Nations Human Rights Council* / [Online]. Available at: <https://www.ohchr.org/en/hrbodies/hrc/home>.

²¹ See *What the treaty bodies do* / [Online]. Available at: <https://www.ohchr.org/en/treaty-bodies/what-treaty-bodies-do> and U.N. Office of the High Commissioner for Human Rights. *What are Communications?* / [Online]. Available at: <https://www.ohchr.org/en/special-procedures-human-rights-council/what-are-communications>.

²² United Nations. *Main Bodies* / [Online]. Available at: <https://www.un.org/en/about-us/main-bodies>.

²³ U.N. Department of Economic and Social Affairs. *The 17 Goals* / [Online]. Available at: <https://sdgs.un.org/goals>.

²⁴ Council of Europe. *Values: Human rights, Democracy, Rule of Law* / [Online]. Available at: <https://www.coe.int/en/web/about-us/values>.

²⁵ European Convention on Human Rights (ECHR) (as amended by Protocols 11, 14 and 15) (entry into force 3 September 1953) E.T.S. 5, 4.XI.1950.



responsible for hearing cases under the ECHR.²⁶ Decisions of the ECtHR are binding on Member States of the CoE.²⁷

Human rights within the 27-Member State European Union (EU) are enshrined in the Charter of Fundamental Rights of the European Union (Charter of Fundamental Rights or CFREU).²⁸ The European Court of Justice (CJEU), the supreme court of the EU, is responsible for interpreting EU law, including the Charter of Fundamental Rights.²⁹ The current EU policy on human rights is laid out in the *EU Action Plan on Human Rights and Democracy (2020-2024)*, which includes ‘new technologies: harnessing opportunities and addressing challenges’ as one of the five main areas of action.³⁰ The Fundamental Rights Agency (FRA) is the EU agency that supports the promotion and protection of human rights within the EU.³¹ EU policy and work on human rights is complemented by the ‘European Pillar of Social Rights’, an initiative for “building a fairer and more inclusive European Union” through work on twenty principles.³²

3.2 Rules on state responsibility

Rules of state responsibility are a set of principles governing how a state is held responsible for breaching an international obligation causing harm to another sovereign state. The rules on state responsibility only exist in international law, though EU law includes many directives and regulations governing transboundary harm within the EU.

All states globally are subject to international rules of state responsibility. The rules are codified in the International Law Commission (ILC) Articles on Responsibility of States for Internationally Wrongful Acts, which reflect customary international law.³³ The International Court of Justice (ICJ) at the U.N., which settles cases between states in accordance with international law, may hear cases related to an alleged breach of the rules of state responsibility.

3.3 Environmental law

International environmental law concerns the protection of the environment and human health. Its development started in the 1960s and transformed to become an increasingly sophisticated, yet with its weaknesses, since the Rio U.N. Conference on Environment and Development (UNCED) in 1992.³⁴ The Rio Declaration that was adopted at the UNCED is the most significant universally endorsed

²⁶ Council of Europe. *European Court of Human Rights* / [Online]. Available at: <https://echr.coe.int/Pages/home.aspx?p=home>.

²⁷ ECHR, Article 46.

²⁸ Charter of Fundamental Rights of the European Union (entry into force 18 December 2009), 2000/C 364/01 (CFREU).

²⁹ E.U. Court of Justice. *Presentation* [Online] Available at: https://curia.europa.eu/jcms/jcms/Jo2_7024/en/.

³⁰ Council of the European Union. (2020) *EU Action Plan on Human Rights and Democracy 2020-2024*, 18 November 2020, 12848/20

³¹ E.U. Fundamental Rights Agency. *FRA – Promoting and protecting your fundamental rights across the EU* / [Online]. Available at: <https://fra.europa.eu/en>.

³² European Commission. *European Pillar of Social Rights* / [Online]. Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en.

³³ Adopted by the U.N. General Assembly in Resolution 56/83 *Responsibility of States for Internationally Wrongful Acts*, G.A. Res. 56/83, U.N. Doc. A/RES/56/83, Annex (Jan. 28, 2002) [Articles on State Responsibility].

³⁴ Birnie P., Boyle A., and Redgwell C. (2021). *International Law and the Environment*. 4th ed, Oxford: Oxford University Press, p. 2.



statement of the rights and obligations of States relating to the environment.³⁵ Whilst the Declaration itself is not legally binding, it is in many places a restatement of existing customary international law and environmental law principles.³⁶

The international environmental law regime is not a self-contained field of law, but is rather a collection of environmental treaties, customary international law, principles of environmental law, and international case law. It overlaps with other legal regimes, including climate law, human rights law, trade law, and the law of the sea. Since the 1992 Rio Declaration, environmental disputes form a significant proportion of the case load of the International Court of Justice (ICJ), the dispute settlement body of the WTO, the International Tribunal for the Law of the Sea (ITLOS), and arbitration tribunals.³⁷

3.4 Climate law

Climate law concerns the regulatory regime in relation to climate change. It generally addresses States with the objective to reduce the emission of greenhouse gas (GHG) emissions (i.e., climate change mitigation) and to adapt to an inevitably changing climate (i.e., climate change adaptation). Given the inherent global nature of climate change, international law has been used by the international community to coordinate a global response to prevent and address the effects of climate change.

The United Nations Framework Convention on Climate Change (UNFCCC) is the main regulatory tool and has provided the legal framework for the adoption of subsequent international agreements on climate change, including the 1997 Kyoto Protocol and the 2015 Paris Agreement.³⁸ Today, 197 countries are Party to the Framework Convention and meet annually to discuss climate matters during the Conference of the Parties (COP).³⁹ Many EU and national climate laws and policies are grounded in the international climate law regime. In fact, the 2015 Paris Agreement commits Parties to determining their national contributions to combatting climate change, and to pursuing domestic measures to achieve their objectives.⁴⁰

³⁵ Ibid, p. 112.

³⁶ Ibid.

³⁷ Ibid, p 109. See also, *Southern Bluefin Tuna Cases* (Provisional Measures) ITLOS Reports (1999); *MOX Plant Case* (Provisional Measures) ITLOS Reports (2001); *Case Concerning Land Reclamation by Singapore in and around the Straits of Johor* (Provisional Measures) ITLOS Reports (2003) ['Land Reclamation Case']; *Advisory Opinion on Responsibilities and Obligations of States Sponsoring Persons and Entities with Respect to Activities in the Area*, ITLOS Seabed Disputes Chamber (2011) ['AO on Activities in the Area']; *MOX Plant Arbitration*, PCA (2003); *Land Reclamation Arbitration*, PCA (2005); *Iron Rhine Arbitration*, PCA (2005); *Indus Waters Kishenganga Arbitration* (Partial Award and Final Award) PCA (2013) ['Kishenganga Arbitration']; *Chagos Marine Protected Area Arbitration*, PCA (2015); *South China Sea Arbitration* (Jurisdiction and Merits), PCA (2016).

³⁸ United Nations Framework Convention on Climate Change (entry into force 21 March 1994) 1771 UNTS 107 (UNFCCC); Kyoto Protocol to the United Nations Framework Convention on Climate Change (entry into force 16 February 2005) 2303 UNTS 162 (1997 Kyoto Protocol); Paris Agreement (entry into force 4 November 2016) 3156 UNTS (Paris Agreement); Birnie P., Boyle A., and Redgwell C. (2021), *supra* note 34, p. 357.

³⁹ United Nations Climate Change, *What is the United Nations Framework Convention on Climate Change?* [Online]. Available at: <https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change>.

⁴⁰ Paris Agreement, Article 4 (2).

3.5 Space law

Outer space is outside the territory of any sovereign state and is therefore it is governed by international law (treaties and agreements) and non-binding guidance. International space law is comprised of five U.N. treaties, all of which entered into force between 1967 and 1984.⁴¹ The primary treaty in the context of climate engineering is the 1967 Outer Space Treaty, which governs the activities of states in outer space. The U.N. Committee on the Peaceful Uses of Outer Space (COPOUS) is responsible for implementation of the U.N. treaties; the U.N. Office for Outer Space Affairs (UNOOSA) is its secretariat.

Today, instead of consensus-built international treaties, developments in space governance are driven by smaller multi-lateral and bi-lateral agreements negotiated outside the U.N. system and non-binding sets of principles and norms.⁴² A prominent example is the 2020 *Artemis Accords*, a non-binding international agreement drafted by the United States laying out a common set of principles for space exploration.⁴³ In comparison to the 1984 Moon Agreement, which only has 18 State parties,⁴⁴ the barely two-year old *Artemis Accords* has 19 signatories.⁴⁵

'Outer space' is not defined in any international treaty, but a customary definition has emerged that puts 'outer space' beginning at approximately 100-110 kilometres above sea level (a.k.a. the Kármán line), which is the boundary of Earth's atmosphere.⁴⁶

3.6 Law of the seas

Any activity in the oceans and seas is governed by a body of law called law of the seas. States can explore and exploit the oceans and seas up to 200 nautical miles from their border, an area that includes territorial waters and an Exclusive Economic Zone (EEZ),⁴⁷ and any activity within the 200 nautical miles is governed mostly by domestic law. Beyond that point, the high seas (or

⁴¹ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty). 1967. 610 U.N.T.S. 205; Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (Rescue Agreement). 1968. Convention on International Liability for Damage Caused by Space Objects (Space Liability Convention). 1972. 961 U.N.T.S. 187; Convention on Registration of Objects Launched into Outer Space (Registration Convention). 1976. 1023 U.N.T.S. 15; Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement) 1984. 1363 U.N.T.S. 22.

⁴² See, e.g., Wright Nelson, Jack. (2020) 'The Artemis Accords and the Future of International Space Law', *American Society of International Law Insights*, 24(31). Available at: <https://www.asil.org/insights/volume/24/issue/31/artemis-accords-and-future-international-space-law>.

⁴³ NASA. (2020) *The Artemis Accords: principles for cooperation in the civil exploration and use of the Moon, Mars, comets, and asteroids for peaceful purposes*. Available at: <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>.

⁴⁴ U.N.T.C. (2022) *Treaty Status: Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* [Online]. Available at: https://treaties.un.org/pages/ViewDetails.aspx?src=IND&mtdsg_no=XXIV-2&chapter=24&clang=_en.

⁴⁵ NASA. (2022) *NASA Welcomes Vice President of Colombia for Artemis Accords Signing*. Available at: <https://www.nasa.gov/feature/nasa-welcomes-vice-president-of-colombia-for-artemis-accords-signing> ("Colombia became the 19th country to sign the Artemis Accords").

⁴⁶ For a discussion on the issue of defining 'outer space', see, e.g., Vereshchetin, V.S. (2006) 'Outer Space', Max Planck Encyclopaedia of Public International Law. Available at: https://spacelaw.univie.ac.at/fileadmin/user_upload/p_spacelaw/EPIL_Outer_Space.pdf.

⁴⁷ United Nations Convention on the Law of the Sea (UNCLOS) (entry into force 16 November 1994) 1833 U.N.T.S. 3, Parts II-IV.

international waters) are considered “the common heritage of mankind”⁴⁸ and activities are governed by international law. The following international treaties and resolutions are relevant to marine climate engineering activities.

The U.N. international treaties most relevant to climate engineering are the United Nations Convention on the Law of the Sea (UNCLOS), the London Convention and London Protocol, and the Convention on Biological Diversity. The EU Marine Strategy Framework Directive is based on and contributes to key international agreements.⁴⁹ There are also a number of regional sea conventions that address issues unique certain geographic regions, including the OSPAR Convention for the North-East Atlantic, the Helsinki Convention for the Baltic Sea Area, the Barcelona Convention for the Midstream Sea Area, and the Bucharest Convention for the Black Sea.⁵⁰ While not discussed in detail in this report, they contain provisions on marine environment protection that could be relevant if a climate engineering activity impacts a particular marine region.

3.7 Privacy and data protection law

The right to privacy is applicable to everyone under international law.⁵¹ The right to privacy is, moreover, recognised in regional organisations, including the Council of Europe. The European Convention on Human Rights (ECHR), for instance, provides that “Everyone has the right to respect for his private and family life and his correspondence.”⁵² Conversely, the right to data protection is not explicitly protected under international law. However, the United Nations Human Rights Committee (CCPR) has suggested that the protection of personal data is an integral aspect of the right to privacy, as indicated by the explanation that “[i]n order to have the most effective protection of his private life, every individual should have the right to ascertain in an intelligible form, whether, and if so, what personal data is stored in automatic data files, and for what purposes.”⁵³

There are various EU laws and draft legislation applicable to privacy and data protection, including the Charter of Fundamental Rights of the European Union (CFREU), the General Data Protection Regulation (GDPR), and legislative proposals, including the Regulation on Privacy and Electronic Communications (e-Privacy Regulation), the Artificial Intelligence Act (AIA), the Digital Services Act (DSA), the Data Governance Act (DGA) and the Data Act (DA).

Charter of Fundamental Rights of the European Union (CFREU)⁵⁴ The CFREU provides citizens of the EU with an essential catalogue of fundamental rights protections, with the enactment of the Treaty on European Union (TEU) in 2009 establishing that the Charter is primary EU law and has “the

⁴⁸ Ibid, Article 136.

⁴⁹ Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (OJ L 164 25 June 2008).

⁵⁰ See, U.N. Environmental Programme. Regional Seas Programme. Available at: <https://www.unep.org/explore-topics/oceans-seas/what-we-do/regional-seas-programme>.

⁵¹ Universal Declaration of Human Rights (8 December 1948) G.A. Res 217(A) III, Article 12; International Covenant on Civil and Political Rights (entry into force 23 March 1976) G.A. Res 2200A (XXI), Article 17; Convention on the Rights of the Child (entry into force 2 September 1990) 1577 U.N.T.S. 3, Article 16; International Convention on the Protection of All Migrant Workers and Members of Their Families (entry into force 18 December 1990) G.A. Res 45/158, Article 14; Convention on the Rights of Persons with Disabilities (entry into force 3 May 2008) A/RES/61/106, Article 22.

⁵² ECHR, Article 8.

⁵³ CCPR General Comment No.16: Article 17 (Right to Privacy) The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation (8th April 1988), para. 10.

⁵⁴ Charter of Fundamental Rights of the European Union (CFREU) (entry into force 18 December 2009) 2000/C 364/01.

same legal value as the Treaties.”⁵⁵ The Charter makes provision for various fundamental freedoms, including a substantive right to respect for private and family life,⁵⁶ and a procedural right to data protection,⁵⁷ as discussed below.⁵⁸ Each of these articles has a shared provenance in the ECHR, in accordance with which the CFREU provides that, whilst not precluding “Union law providing more extensive protection”, the meaning and scope of the rights contained in the Charter “shall be the same as those laid down by the said Convention.”⁵⁹ According to the Explanations relating to the Charter, this formulation “is intended to ensure the necessary consistency between the Charter and the ECHR”.⁶⁰ As the Grand Chamber of the Court of Justice of the EU (CJEU) has observed, “the rights enshrined in Articles 7 and 8 of the Charter are not absolute rights but must be considered in relation to their function in society”.⁶¹ According to the Charter, however, “[a]ny limitation on the exercise of the rights and freedoms recognised by the Charter must be provided for by law and respect the essence of those rights and freedoms.”⁶² Further, in view of “the principle of proportionality, limitations may be made only if they are necessary and genuinely meet objectives of general interest recognised by the Union or the need to protect the rights and freedom of others.”⁶³ In addition to these restrictions on derogations, the protection of the various fundamental rights contained in the CFREU is enhanced by the rights to an effective remedy and a fair trial for those whose rights and freedoms guaranteed under EU law are violated.⁶⁴

General Data Protection Regulation (GDPR)⁶⁵ Adopted in April 2016 and implemented in May 2018, the General Data Protection Regulation (GDPR) lays down a harmonised framework for data protection in the EU which seeks to strike a balance between “the protection of natural persons with regard to the processing of personal data”, as provided for under Article 8 CFREU (see above) and the Treaty on the Functioning of the European Union (TFEU),⁶⁶ and “the free movement of personal data.”⁶⁷ The GDPR “applies to the processing of personal data wholly or partly by automated means”,⁶⁸ with data controllers⁶⁹ and processors⁷⁰ required to comply with various principles relating to the processing of personal data,⁷¹ such as the requirement that personal data shall be “processed lawfully, fairly, and in a transparent manner in relation to the data subject”.⁷²

In addition to compliance with these principles, the processing of personal data must have a lawful basis, yet this differs depending on the type of personal data being processed, specifically whether or

⁵⁵ Consolidated Version of the Treaty on European Union (TEU) 2012/C 326/15, Article 6(1).

⁵⁶ CFREU, Article 7.

⁵⁷ Ibid, Article 8.

⁵⁸ Politou E., Alepis E., and Patsakis C., (2018) ‘Forgetting personal data and revoking consent under the GDPR: Challenges and proposed solutions’, *Journal of Cybersecurity*, vol.4(1), pp.1-20, pp.2.

⁵⁹ CFREU, Article 52(3).

⁶⁰ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32007X1214%2801%29>.

⁶¹ Judgement of 16 July 2020, *Data Protection Commissioner v Facebook Ireland Ltd and Maximillian Schrems*, C-311/18, ECLI:EU:C: 2020:559, para. 172.

⁶² CFREU, Article 52(1).

⁶³ Ibid.

⁶⁴ Ibid, Article 47

⁶⁵ Regulation (EU) 2016/679 (General Data Protection Regulation) COM/2012/010 final.

⁶⁶ Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union 2012/1 326/01, Article 16(1).

⁶⁷ GDPR, Article 1(1).

⁶⁸ Ibid, Article 2(1).

⁶⁹ Ibid, Article 4(7).

⁷⁰ Ibid, Article 4(8).

⁷¹ Ibid, Article 5.

⁷² Ibid, Article 5(1).



not such data is listed in the “special categories of personal data” under the GDPR.⁷³ Pursuant to this distinction, the processing of personal data characterised as special category is, in principle, prohibited,⁷⁴ unless one of the exhaustively listed exceptions to the rule applies,⁷⁵ for instance “the data subject has given explicit consent to the processing of those personal data for one or more specified purposes”,⁷⁶ whereas the processing of all other personal data is in principle permitted provided that at least one of the in principle less rigorous conditions for lawfulness of processing is applicable,⁷⁷ for instance “the data subject has given consent to the processing of his or her personal data for one or more specific purposes”.⁷⁸ The types of personal data characterised as special category are exhaustively listed in the GDPR and include,⁷⁹ inter alia, “genetic data”,⁸⁰ “biometric data for the purpose of uniquely identifying a natural person”⁸¹ and “data concerning health”.⁸²

Consistent with the framing in the language of fundamental rights,⁸³ the GDPR makes provision for various rights of the “data subject”, including to “the rectification of inaccurate personal data concerning him or her”,⁸⁴ the “right to erasure” or the “right to be forgotten”,⁸⁵ and the right to “data portability”.⁸⁶ Furthermore, the data subject is empowered to lodge a complaint with a supervisory authority⁸⁷ and to an effective judicial remedy against either a supervisory authority,⁸⁸ or a controller or a processor.⁸⁹ Such rights are contained within Chapter 8, which details the remedies, liabilities and penalties associated with breaches of the GDPR, such as the general conditions for imposing administrative fines, principally that such penalties shall be “effective, proportionate and dissuasive.”⁹⁰ Thus, for infringements of “the basic provisions for processing, including conditions for consent”, the financial penalty is up to 4% of an organisation’s global annual turnover or 20 million euros, whichever is higher.⁹¹

Proposed Regulation on Privacy and Electronic Communications (e-Privacy Regulation)⁹² The draft e-Privacy Regulation, one of several legislative changes proposed as part of the European Commission’s Digital Single Market Strategy,⁹³ purports to repeal and replace Directive 2002/58/EC (e-Privacy Directive) on the basis that the former “has not fully kept pace with the evolution of technological reality, resulting in an inconsistent or insufficient effective protection of privacy and

⁷³ Ibid, Article 9.

⁷⁴ Ibid, Article 9(1).

⁷⁵ Ibid, Article 9(2)(a)-(j).

⁷⁶ Ibid, Article 9(2)(a).

⁷⁷ Ibid, Article 6.

⁷⁸ Ibid, Article 6(1)(a).

⁷⁹ Ibid, Article 9(1).

⁸⁰ Ibid, Article 4(13).

⁸¹ Ibid, Article 4(14).

⁸² Ibid, Article 4(15).

⁸³ Politou E. Alepis E. and Patsakis C. (2018), *supra* note 58, pp.2.

⁸⁴ GDPR, Article 16.

⁸⁵ Ibid, Article 17.

⁸⁶ Ibid, Article 20.

⁸⁷ Ibid, Article 77.

⁸⁸ Ibid, Article 78.

⁸⁹ Ibid, Article 79.

⁹⁰ Ibid, Article 83.

⁹¹ Ibid, Article 83(5)(a).

⁹² Proposal for a Regulation of the European Parliament and the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications) COM/2017/010 final.

⁹³ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A Digital Single Market Strategy for Europe COM/2015/0192 final.



confidentiality in relation to electronic communications.”⁹⁴ It follows that the draft Regulation seeks to enhance the protection of the “fundamental rights and freedoms of natural and legal persons in the provision and use of electronic communication services”,⁹⁵ specifically the rights to privacy and data protection provided for in the CFREU (see above). According to the proposal, “the processing of electronic communications data”⁹⁶ is prohibited “by persons other than the end-users” under the principle of confidentiality,⁹⁷ except for the instances in which such processing is permitted,⁹⁸ for example “if all end-users concerned have given their consent to the processing of their electronic communications content for one or more specified purposes that cannot be fulfilled by processing information that is made anonymous”.⁹⁹ Consistent with the legislative intention to “particularise and complement” the GDPR under the principle of *lex specialis*,¹⁰⁰ the proposed e-Privacy Regulation provides that the definition of and conditions for consent of end-users are the same as those provided for under the GDPR.¹⁰¹

3.8 Consumer rights law

Consumer rights and consumer protection law provide a way for individuals to fight back against abusive business practices by enterprises. Significant events in consumer protection history¹⁰² were the struggles against capitalism, the birth of consumer protection organisations in Europe (in Denmark and Great Britain), the creation of the Federal Trade Commission (1914) in the USA, president John F Kennedy’s 1962 Special message to Congress on protecting consumer interests,¹⁰³ enactment of the Single European Act (modified by the Treaty of Rome that strengthened the role of the Economic and Social Committee, the Maastricht Treaty (1992) and the enactment of the United Nations Guidelines for Consumer Protection (UNGCP) (adopted 1985, revised 1999).

Consumer protection law has evolved over the years and consumer rights generally include the following basic rights:

- Right to safety (reasonably safe for intended purpose)
- Right to be informed (sufficient information to weigh alternatives and to protect the consumer from false and misleading claims in advertising and labeling practices; includes truth in advertising laws)

⁹⁴ Proposal for a Regulation of the European Parliament and the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications) COM/2017/010 final, para. 6.

⁹⁵ Ibid, Article 1(1).

⁹⁶ Ibid, Article 2(1).

⁹⁷ Ibid, Article 5.

⁹⁸ Ibid, Article 6.

⁹⁹ Ibid, Article 6(3)(b).

¹⁰⁰ Ibid, Article 1(3).

¹⁰¹ Ibid, Article 9.

¹⁰² Corradi, A. (2015) *International Law and Consumer Protection: The history of consumer protection*. /Hauser Global Law School Program [Online]. Available at: https://www.nyulawglobal.org/globalex/International_Law_Consumer_Protection.html.

¹⁰³ *Special message to Congress on protecting consumer interest, 15 March 1962* / John F. Kennedy Presidential Library and Museum [Online]. Available at: <https://www.jfklibrary.org/asset-viewer/archives/JFKPOF/037/JFKPOF-037-028>.



- Right to choose (competing goods and services that offer alternatives in terms of price, quality, and service; includes anti-trust and unfair competition laws)
- Right to be heard (assurance that government will take heed of the concerns of consumers and will protect those interests through wisely enacted statutes and administrative regulations)
- Right to satisfaction of basic needs
- Right to redress
- Right to consumer education, and
- Right to healthy environment.¹⁰⁴

3.9 Artificial intelligence, digital services, and data governance

At present, there is no international or EU legal framework dedicated to the governance of artificial intelligence (AI) technologies. However, in April 2021, the European Commission proposed a regulatory framework for AI, which includes a draft regulation on the governance of AI (**proposed AI Act**). If adopted as written, the AI Act would prohibit some types of AI systems and place mandatory *ex ante* and *ex post* requirements on 'high-risk' AI systems. The requirements relate to risk management, data governance, documentation, transparency, human oversight, accuracy, robustness, and cybersecurity. Other 'low-risk' systems would be subject to transparency requirements. In April 2022, a year after the finalisation of the proposal by the European Commission (EC) in exercise of its right of legislative intention, the European Parliament (EP) published a joint report from the Committee on the Internal Market and Consumer Protection, and Committee on Civil Liberties, Justice, and Home Affairs with recommendations arising from its first reading. A key amendment requested by the EP is for closer alignment with the GDPR.¹⁰⁵ Pursuant to this legislative intention, the Draft Report amends the various definitions provided for in the AIA¹⁰⁶ to include biometric data¹⁰⁷ and special category personal data,¹⁰⁸ as defined in the GDPR. The Council will consider this and other proposed amendments and either accept or amend the EP's position, after which a legislative act will be adopted, or the proposal will be returned to the EP for a second reading.¹⁰⁹ The proposed AI Act

¹⁰⁴ National Consumer Federation, *The 8 consumer rights* / [Online]. Available at: <https://www.nationalconsumer.org.uk/consumer-voice/consumer-rights/>.

¹⁰⁵ Committee on the Internal Market and Consumer Protection, and Committee on Civil Liberties, Justice, and Home Affairs, (2022) *Draft Report on the proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts*, 2021/0106(COD), Amendment 63 and 66. Available at: https://iapp.org/media/pdf/publications/CJ40_PR_731563_EN.pdf.

¹⁰⁶ Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) And Amending Certain Union Legislative Acts COM/2021/206 final, Article 3.

¹⁰⁷ GDPR, Article 4(14).

¹⁰⁸ GDPR, Article 9(1).

¹⁰⁹ Council of the European Union, *The ordinary legislative procedure* / [Online]. Available at: <https://www.consilium.europa.eu/en/council-eu/decision-making/ordinary-legislative-procedure/>.

will not come into effect until finalised and adopted by both the Council and the EP, as per the interinstitutional ordinary legislative procedure.¹¹⁰

At present, there is also no comprehensive international or EU legal framework dedicated to the governance of digital services. However, the EC has proposed a regulation for digital services (**proposed Digital Services Act or DSA**). Expanding on the essential aspects of the e-Commerce Directive, such as the prohibition on general monitoring, the proposed DSA seeks to establish “harmonised rules on the provision of intermediary services in the internal market.”¹¹¹ Specifically, the DSA purports to establish “a framework for the conditional exemption from liability of providers of intermediary services”,¹¹² “rules on specific due diligence obligations tailored to certain categories of providers of intermediary services”,¹¹³ and rules on implementation and enforcement of the terms of the provision, “including as regards the cooperation and coordination between competent authorities.”¹¹⁴ Such measures are consistent with the aims of the DSA, specifically to “contribute to the proper functioning of the internal market for intermediary services”¹¹⁵ and to establish “uniform rules for a safe, predictable, and trusted online environment, where fundamental rights enshrined in the Charter are effectively protected.”¹¹⁶ The provisional political agreement reached by the European Parliament and European Council in April 2022 marked the first steps towards the enactment of the DSA. In June, however, the European Parliament rejected a revised version of the DSA, citing a lack of consultation on added recitals which were not the subject of the initial political agreement.¹¹⁷ The DSA is nonetheless expected to pass, with a final vote scheduled in the European Parliament plenary in July, after which official acceptance by the Council will be necessary in order for the DSA to enter into force, as per the ordinary legislative procedure detailed under the Treaty on European Union (TEU) and Treaty on the Functioning of the European Union (TFEU).¹¹⁸

Lastly, while there is also no comprehensive international or EU legal framework dedicated to the governance of data, the EC has also proposed a regulation for data governance. The **proposed Data Governance Act (DGA)**, proposed in November 2020, purports to establish a framework for sharing data in the European single market between individuals and the public and private sectors. Key provisions include the conditions for re-use of data¹¹⁹ and the creation of a notification system for providers of data sharing services.¹²⁰ The **proposed Data Act (DA)**, meanwhile, was proposed in February 2022 and complements the DGA by establishing the conditions under which and the compensation obtainable for making data available. Key provisions include the right of users to access

¹¹⁰ Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union 2012/1 326/01, Articles 289 and 294.

¹¹¹ Proposal for A Regulation of the European Parliament and of the Council on a Single Market for Digital Services (Digital Services Act) and amending Directive 2000/31/EC COM/2020/825 final, Article 1(1).

¹¹² Ibid, Article 1(1)(a).

¹¹³ Ibid, Article 1(1)(b).

¹¹⁴ Ibid, Article 1(1)(c).

¹¹⁵ Ibid, Article 2(a).

¹¹⁶ Ibid, Article 2(b).

¹¹⁷ Bertuzzi L. (2022) *European Parliament rejects consolidated text of the Digital Services Act* / EURACTIV [Online]. Available at: <https://www.euractiv.com/section/digital/news/european-parliament-rejects-consolidated-text-of-the-digital-services-act/>.

¹¹⁸ Consolidated versions of the Treaty on European Union and the Treaty on the Functioning of the European Union 2012/1 326/01, Articles 289 and 294.

¹¹⁹ Proposal for a Regulation of the European Parliament and of the Council on European Data Governance (Data Governance Act) COM (2020) 767 final, Article 5.

¹²⁰ Ibid, Article 9.

and use data generated by the use of products or related services¹²¹ and the non-binding status of a contract for the access to or use of data if the terms are unfair and unilaterally imposed on a micro, small or medium-sized enterprise.¹²² In March 2022, the EP appointed the Committee for Industry, Research and Energy (ITRE) as the committee responsible for the Data Act, yet a draft report is not expected to be forthcoming.¹²³ The DGA, by contrast, received final approval from one of the two co-legislators, namely the EP, in April 2022 and awaits the equivalent final approval from the Council.¹²⁴ Both the DGA and DA are within the framework of the European Strategy for Data,¹²⁵ the objective of which is to establish the EU as a leader in digital technologies, the data economy, and trustworthy Artificial Intelligence.¹²⁶

4. Climate engineering

Climate engineering may be subject to international and EU laws and policies on human rights, rules of state responsibility, environmental law, climate law, space law, and the law of the seas.

The following sections discuss how climate engineering is or might governed by international and EU law in the specific domains of human rights, rules on state responsibility, environmental and climate law, space law, and the law of the seas. Each section begins with a brief introduction to the relevant legal issues and a summary of the international and EU legal framework (for more details on the legal frameworks, see Section 3). Specific legal issues within the legal framework are then presented in more detail; each discussion includes specific references to existing (and proposed) law and an explanation of how the law may apply to climate engineering.

It must be noted that very little international or EU law directly addresses or explicitly mentions climate engineering. Furthermore, much of the current law predates climate engineering and international courts have yet to review a case related to climate engineering. Therefore, it is not precisely clear how – or even whether – the law would apply. However, if the laws discussed below are applied as written, many elements of climate engineering would be subject to international and EU law.

¹²¹ Proposal for a Regulation of the European Parliament and of the Council on harmonised rules on fair access to and use of data (Data Act) COM (2022) 68 final, Article 4.

¹²² Ibid, Article 13.

¹²³ European Parliament Legislative Train Schedule, *Data Act* / [Online]. Available at: <https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-data-act>.

¹²⁴ European Parliament Legislative Train Schedule, *Proposal for a Regulation on European Data Governance* / [Online]. Available at: <https://www.europarl.europa.eu/legislative-train/theme-a-europe-fit-for-the-digital-age/file-data-governance-act>.

¹²⁵ European Commission, *A European Strategy for Data* / [Online]. Available at: <https://digital-strategy.ec.europa.eu/en/policies/strategy-data>.

¹²⁶ European Commission, *Shaping Europe's digital future: Commission presents strategies for data and artificial intelligence* / [Online]. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ip_20_273.

4.1 Human rights and climate engineering

Climate engineering has the potential to impact human rights in many ways, both positive and negative. There is a growing awareness that the impacts of climate change and environmental degradation are devastating for the enjoyment of human rights (e.g., the right to life, food security, health) for people today and in future generations.¹²⁷ Therefore, the use of climate engineering to mitigate harms associated with climate change could enhance enjoyment of human rights. On the other hand, manipulating Earth's climate through climate engineering may cause unforeseen and uncontrollable consequences that would further threaten human rights.¹²⁸

States have an obligation under human rights law to ensure that climate engineering activities respect and promote human rights. Furthermore, the Paris Agreement recognised that the actions to address climate change, which may include climate engineering, must be guided by human rights.¹²⁹

In this section, we look at three clusters of rights that encompass the main issues related to human rights and climate engineering: (1) human rights pertaining to scientific research, (2) procedural human rights, and (3) substantive human rights. The specific rights discussed are:

Table 10: Human rights clusters in relation to climate engineering

Cluster	Right
Rights related to scientific research	Freedom of scientific research
	Right to enjoy the benefits of scientific progress
	Moral and material interests resulting from any scientific production
	Rights of research participants
Procedural human rights	Right to information
	Right to participate in public affairs
	Right to access legal remedies
Substantive ¹³⁰ human rights	Right to life
	Right to a healthy environment

¹²⁷ On the relationship between climate change and human rights see, e.g., Adelman, S. (2010) 'Rethinking Human Rights: The Impact of Climate Change on the Dominant Discourse' in Humphreys S. (ed.) *Human Rights and Climate Change*, Cambridge: Cambridge University Press, pp. 159-182.

¹²⁸ Adelman, S. (2017) 'Geoengineering: Rights, risks and ethics', *Journal of Human Rights and the Environment*, 8(1), pp. 119-138.

¹²⁹ Paris Agreement (entry into force 4 November 2016) 3156 UNTS, preamble: "Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights."

¹³⁰ Substantive refers to "primarily positive second-generation human rights such as those to the highest attainable standard of health, to an adequate standard of living, and to be free from hunger, as well as positive interpretations of the right to life." Reynolds, J.L. (2020) 'Nonstate governance of solar geoengineering research', *Climate Change*, p.113. DOI: <https://doi.org/10.1007/s10584-020-02702-9>.

	Right to health
	Right to food
	Right to water

All sections outline the relevant international and EU laws and policies, then move to a discussion of how the rights are relevant and might be affected by climate engineering.

4.1.1 International and EU law and policies

The rights relevant to climate engineering are guaranteed in the Universal Declaration of Human Rights (UDHR), International Covenant on Economic, Social and Cultural Rights (ICESCR), International Covenant on Civil and Political Rights (ICCPR) and the European Convention for the Protection of Human Rights and Fundamental Freedoms (ECHR).

General Comments and General Recommendations from U.N. treaty bodies and reports from Special Procedures provide interpretative guidance explaining how the rights apply in specific contexts. Where relevant, specific reference is made to the U.N. Sustainable Development Goals and the jurisprudence of the European Court of Human Rights (ECtHR). At the EU level, the primary legal document is the Charter of Fundamental Rights of the European Union (CFREU).

Climate engineering is not explicitly referenced in international or EU human rights law, nor is it the explicit topic of any guidance or reference documents. Nevertheless, States have an obligation to respect, protect and fulfil human rights applicable in the context of climate engineering.

4.1.2 Freedom of scientific research

Climate engineering technologies are developed through scientific research and the researchers have a right to enjoy the freedom of scientific research. While international human rights law on the freedom of scientific research does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the freedom in the context of climate engineering and may not place any arbitrary limitations on scientific research, including research for climate engineering.

International and EU human rights law

Under international law, States have the responsibility “to respect the freedom indispensable for scientific research and creative activity.”¹³¹ This includes protection from undue influence, freedom to “freely and openly question the ethical value of certain projects”, the right to withdraw, freedom to cooperate with other researchers, and sharing of scientific data and analysis.¹³² States may set limits on scientific research, but only if they are established in law, promote “the general welfare in a democratic society”, and are “compatible with the nature of the right restricted.”¹³³ Furthermore, “any

¹³¹ International Covenant on Economic, Social and Cultural Rights (entry into force 3 January 1976) G.A. Res 2200A (XXI), Article 15(3).

¹³² Committee on Economic, Social and Cultural Rights. (2020) *General comment No. 25 (2020) on science and economic, social, and cultural rights (article 15 (1) (b), (2), (3) and (4) of the International Covenant on Economic, Social and Cultural Rights*, E/C.12/GC/25, para. 13.

¹³³ Ibid, para.21; ICESCR, Article 4.

limitation on the content of scientific research implies a strict burden of justification by States, in order to avoid infringing freedom of research.”¹³⁴

While the European Convention on Human Rights contains no provisions related to science, the European Court of Human Rights has brought issues regarding scientific research within the ambit of the ECHR under Article 10, which guarantees freedom of expression.

Similarly, it is guaranteed under EU law that “the arts and scientific research shall be free of constraint.”¹³⁵

Relevance to climate engineering

The scientists and developers working on climate engineering have the human right to enjoy the freedoms associated with the freedom indispensable for scientific research. To facilitate enjoyment of the right, States should create “an institutional framework and [adopt] policies and laws in relation to science and technology that enable individuals to freely conduct scientific research (...)”,¹³⁶ which may include establishing mechanisms for cooperation and sharing of scientific knowledge.¹³⁷

States may put limitations on research on climate engineering without violating this human right, but only if certain conditions are met. The most difficult to assess may be whether a limitation on climate engineering research promotes “the general welfare in a democratic society”, as that requires identifying which ‘societies’ to assess (local, national, international) and balancing simultaneous positive and negative possible impacts.

Concerns about potential future deployment of climate engineering, particularly solar radiation management (SRM) technologies, have also been directed at the scientific research activities, as climate engineering research is treated as a proxy for future implementation.¹³⁸ Outdoor experiments face particularly strong opposition, which may constitute an interference with the freedom of research.

4.1.3 Right to benefit from scientific research

Everyone has the right under international law to benefit from scientific progress, which includes the potential benefits of climate engineering. While international human rights law on the right to benefit from scientific research does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the right in the context of climate engineering. States may not arbitrarily interfere with the ability to enjoy this right, particularly if climate engineering is “instrumental” for enjoyment of other fundamental rights. However, States may not, except in limited situations, force anyone to benefit from science including the benefits of climate engineering – a challenging obligation given the potential global impact of climate engineering.

¹³⁴ Committee on Economic, Social and Cultural Rights. (2020), *supra* note 132, para. 22.

¹³⁵ Charter of Fundamental Rights of the European Union (entry into force 18 December 2009) 2000/C 364/01 (CFREU), Article 13.

¹³⁶ Muller, A. (2010) ‘Remarks on the Venice Statement on the right to enjoy the benefits of scientific progress and its applications (Article 15 (1)(b) ICESCR)’, *Human Rights Law Review*, 10(4), pp 765–784.

¹³⁷ Reynolds, J.L. (2020), *supra* note 130, pp. 323–342; Reynolds, J.L. (2019) *Governance of Solar Geo-engineering and Human Rights*, Cambridge: Cambridge University Press.

¹³⁸ Reynolds, J.L. (2020), *supra* note 130, pp. 323–342.

International and EU law and policy

Under international law, everyone has the right to “to share in scientific advancement and its benefits.”¹³⁹ Historically, this right is one of the least studied and applied in international human rights law, but recent interest from UNESCO, the UN Special Rapporteur in the Field of Cultural Rights, and the UN Committee on Economic, Social and Cultural Rights has prompted new interest in the right.¹⁴⁰

In this context, the definition of ‘science’ encompasses both process and the results of process,¹⁴¹ and “the technology deriving from scientific research”.¹⁴² The term ‘benefits’ refers to “the material results” and “the scientific knowledge and information directly deriving from scientific activity”.¹⁴³ States have obligations “to abstain from interfering in the freedom of individuals and institutions to develop science and diffuse its results” and to ensure individuals can enjoy the benefits of science without discrimination.¹⁴⁴ In particular, States must ensure “that everyone has equal access to the applications of science, particularly when they are instrumental for the enjoyment of other economic, social and cultural rights.”¹⁴⁵ The U.N. Committee on Economic, Social and Cultural rights identifies that new emerging technologies present many risks and promises for the enjoyment of other rights, and calls on States to “adopt policies and measures that expand the benefits of these new technologies while at the same time reducing their risks.”¹⁴⁶ This right does not create an obligation on individuals to benefit from or to use technologies, except in limited circumstances determined by law and “solely for the purpose of promoting the general welfare in a democratic society”.¹⁴⁷

A similar right does not exist at the EU level.

Relevance to climate engineering

All individuals have the right to share in the potential benefits of climate engineering and States have the obligation to ensure the benefits can be enjoyed without discrimination. In practice, this may be particularly difficult to guarantee, as the impacts of many climate engineering approaches are largely unknown and are likely to affect regions of the world (and communities) very differently. States would, therefore, need to ensure that unequal distribution of benefits is non-discriminatory.

Furthermore, States cannot force individuals to benefit from scientific progress. This is very complicated in the context of climate engineering, as these technologies, by definition, impact the global climate. Therefore, individuals do not have the same opportunities to refuse or opt-out of “benefitting” from climate engineering. To fulfil obligations under international human rights law given these realities, States may need to articulate a clear argument that it is necessary for all individuals to ‘benefit’ from climate engineering “solely for the purpose of promoting the general welfare in a democratic society.”

¹³⁹ Universal Declaration of Human Rights (8 December 1948), G.A. Res. 217(A) III, Article 27; ICESCR, Article 15(b): the “right to benefit from scientific progress and its application”.

¹⁴⁰ See, e.g., Yotova, R. and Knoppers, B.M. (2020) ‘The Right to Benefit from Science and Its Implications for Genomic Data Sharing’, *The European Journal of International Law*, 31(2), pp.665-691. DOI: <https://doi.org/10.1093/ejil/chaa028>.

¹⁴¹ Committee on Economic, Social and Cultural Rights. (2020), *supra* note 132, paras.4-5 (discussing United Nations Educational, Scientific and Cultural Organization. (2017) *Records of the General Conference, 39th session, Annex II – Recommendation on Science and Scientific Research*).

¹⁴² *Ibid*, para.7.

¹⁴³ *Ibid*, para.8.

¹⁴⁴ *Ibid*, para.15.

¹⁴⁵ *Ibid*, para.17.

¹⁴⁶ *Ibid*, para.74.

¹⁴⁷ *Ibid*, para.44

4.1.4 Moral and material interests from scientific research

Everyone has the right under international law to protect the moral and material interests of their research, including scientific research on climate engineering. While international human rights law on the right to protection of moral and material interests does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the right in this context. States also have an obligation to take the necessary steps to ensure effective protection of those interests.

International and EU human rights law

Under international law, everyone has the right “to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he is the author.”¹⁴⁸ The right refers to “creations of the human mind”, including scientific publications and innovations.¹⁴⁹ ‘Moral interests’ refers to the “intrinsically personal character of every creation of the human mind and the ensuing durable link between creators and their creations.”¹⁵⁰ ‘Material interests’ are those that “contribute to the enjoyment of the right to an adequate standard of living.”¹⁵¹ The human right does not prescribe specific intellectual property (IP) but obligates States to take necessary steps to ensure effective protection of the interests.¹⁵²

The protection of these interests is associated with a recognition that intellectual products have intrinsic value as expressions of human dignity and creativity, along with an awareness of the deep link between intellectual property and the right to participate in cultural life and benefit from scientific progress. It is important to note, however, that the approach in human rights and prevailing intellectual property law is not identical. There is no human right, for example, to patent protection, especially when a patent undermines enjoyment of other rights.¹⁵³

At the EU level, the CFREU also protects intellectual property.¹⁵⁴

Relevance to climate engineering

Climate engineering research is a scientific innovation, and therefore researchers and developers working on climate engineering have a right to protection of the moral and material interests of their work. However, some have suggested limiting the possibility to patent climate engineering inventions¹⁵⁵. Others have recommended that in the case of important inventions with environmental applications, States should consider the exercise of march-in rights for patented inventions funded in part by the government. There have also been proposals to form “data commons” that would assure research data is free and publicly available.¹⁵⁶

¹⁴⁸ UDHR, Article 27(2); ICESCR, Article 15(1)(c).

¹⁴⁹ U.N. Committee on Economic, Social and Cultural Rights. (2006) *General Comment No. 17 (2005) on the right of everyone to benefit from the protection of the moral and material interests resulting from any scientific, literary or artistic production of which he or she is the author (article 15, paragraph 1 (c), of the Covenant)*, E/C.12/GC/17.

¹⁵⁰ Ibid, para. 12.

¹⁵¹ Ibid, para. 15.

¹⁵² Ibid.

¹⁵³ See, e.g., U.N. Special Rapporteur in the field of cultural rights. (2015) *Report on implications of patent policy for the human rights to science and culture*, A/70/279.

¹⁵⁴ CFREU, Article 17(2).

¹⁵⁵ See, e.g., Chavez, A. E. (2015) ‘Exclusive rights to saving the planet: The patenting of geoengineering inventions’, *Northwestern Journal of Technology and Intellectual Property*, 13(1), pp. 1–35. Available at: <https://scholarlycommons.law.northwestern.edu/nitip/vol13/iss1/1/>.

¹⁵⁶ See, e.g., Proposal for a data commons for SRM: Reynolds, J.L., Contreras, J. and Sarnoff, J.D. (2018) ‘Intellectual property policies for solar geoengineering’, *WIREs Climate Change*, 9(2). DOI: <https://doi.org/10.1002/wcc.512>.

Furthermore, there are challenges of guaranteeing IP rights that impact the right to protect moral and material interests. One, protection under international human rights law would have a transnational character, while the main requirements and competencies of IP and data access law remain within national jurisdictions. Two, climate engineering technologies would be a “public good” in the economic sense, which are typically provided by the state because the rights holder cannot necessarily exclude anyone from benefitting. As climate engineering may provide “nonexcludable and nonrivalrous benefits of expected lessened climate change”¹⁵⁷ in ways that preclude excluding anyone from benefitting, the economic incentive for IP protection is diluted.

4.1.5 Rights of research participants

Everyone has the right under international law to be free from torture and cruel, inhuman or degrading treatment, which includes being subject to scientific experimentation without consent. While international human rights law on the right of research participants does not explicitly address climate engineering, States have an obligation to ensure research participants can enjoy their rights in the context of climate engineering and that necessary measures are in place to prevent scientific experimentation without consent. However, while the prohibition is absolute and clear in theory, the practical challenges of obtaining consent from all individuals impacted by climate engineering research activities are significant, making the issue of consent one of the most challenging for human rights and climate engineering.

International and EU human rights law

While not exclusive to the context of research, international and EU human rights law prohibits torture, and any other inhuman, cruel and degrading treatment.¹⁵⁸ The prohibition is absolute, meaning that there are no legally permissible reasons for a State to derogate.¹⁵⁹ Part of that prohibition is that “no one shall be subjected without his free consent to medical or scientific experimentation.”¹⁶⁰ The obligation to obtain informed consent is a fundamental instrument for fulfilling the obligation to guarantee the dignity and human rights of a person participating in research. The attainment of consent ensures that the decision to participate in the study and accept the accompanying violation of psychophysical integrity is autonomous. In the EU Charter, the rights of research participants are also protected under the right to the integrity of the person, which includes the obligation to obtain the free and informed consent of participants in the fields of medicine and biology.¹⁶¹

Relevance to climate engineering

Under the law, no individual should be subjected to climate engineering experimentation without their consent. However, due to the scale of geoengineering projects and the fact that their results are difficult to contain within one specific area, the question of free consent to participate in climate engineering research becomes particularly challenging. This is partly because of power imbalances between the actors running the research and its participants, as a consequence of which the validity of

¹⁵⁷ Ibid.

¹⁵⁸ UDHR, Article 5; International Covenant on Civil and Political Rights (entry into force 23 March 1976) G.A. Res 2200A (XXI), Article 7; European Convention on Human Rights (as amended by Protocols 11, 14 and 15) (entered into force 3 September 1953), E.T.S. 5, 4. XI. 1950, Article 3; CFREU, *supra* note 135, Article 19(2).

¹⁵⁹ Committee on Civil and Political Rights. (1992) *General comment No. 20: Article 7 (Prohibition of torture, or other cruel, inhuman or degrading treatment or punishment)*, para. 3.

¹⁶⁰ ICCPR, Article 7.

¹⁶¹ CFREU, Article 3.

consent can be easily undermined. Some argue that consent is, in fact, one of the most critical ethical and legal issues in climate engineering,¹⁶² and would directly challenge human rights protections.

4.1.6 Right to information

As part of the right to freedom of expression, everyone has the right under international law to impart and receive key information from public authorities, which includes information about climate engineering activities. While international human rights law on the right to information does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the right to information in the context of climate engineering and that individuals have access to climate engineering information.

International and EU human rights law

The right to information can be linked to the right to freedom of expression.¹⁶³ This right includes a general right of access to information held by public bodies,¹⁶⁴ especially information necessary to realise other human rights. The EU Charter of Fundamental Rights protects the right of access to documents of the institutions, bodies, offices and agencies of the Union.¹⁶⁵ The human right to information is directly linked to the right to information under the Aarhus Convention (see Section 4.3.4).

Relevance to climate engineering

Information about climate engineering activities, particularly from public bodies, falls within the remit of the right to information. Therefore, individuals have the right to information about climate engineering.

The ECtHR has assessed cases concerning access to environmental information in relation to the right to respect for private and family life and, under specific circumstances, the right to freedom of expression. For example, in *McGinley et Egan c. Royaume-Uni* the Court noted that, where a government engages in hazardous activities which might have hidden adverse consequences on the health of those involved in such activities, respect for private and family life requires that an effective and accessible procedure be established which enables such persons to seek all relevant and appropriate information. In *Roche v. the United Kingdom*, the Court held that there had been a violation of the right to family life, finding that the United Kingdom had not fulfilled its positive obligation to provide an effective and accessible procedure enabling the applicant to have access to all relevant and appropriate information which would allow him to assess any risk to which he had been exposed during his participation in the tests. In *Association BURESTOP 55 and Others v. France*, the Court observed that although the right to freedom of expression did not confer a general right of access to information held by the authorities, it could, to some extent and under certain conditions, guarantee a right of that nature and could require the authorities to communicate information (see *Magyar Helsinki Bizottság v. Hungary*). The same principle also applies to access to information

¹⁶² See, e.g., Coerner, A and Pidgeon, N. (2017) 'Geoengineering the Climate: The Social and Ethical Implications', *Environment: Science and Policy for Sustainable Development*, 52(1), pp. 24-37.

¹⁶³ UDHR, supra note 139, Article 19; ICCPR, supra note 158, Article 19(2); ECHR, supra note 158, Article 10(1). See, also, McDonagh, M. (2013) 'The right to information in international human rights law', *Human Rights Law Review*, 13(1), p. 29. Available at: <https://www.corteidh.or.cr/tablas/r30698.pdf>.

¹⁶⁴ Committee on Civil and Political Rights. (2011) *General comment No. 34 Article 19: Freedoms of opinion and expression*, CCPR/C/GC/34, para. 18.

¹⁶⁵ CFREU, Article 42.

concerning projects whose implementation is liable to have an impact on the environment (see *Cangi v. Turkey*). Interference with the right to information might encompass both a failure as well as a refusal on the part of the state to provide information - the ECtHR has accepted that a violation of the right to respect for private life may arise in the case of the withholding of or failure to supply information which is not personal to the applicant, but in which he or she has a personal interest in obtaining access (e.g., information related to environmental hazards).¹⁶⁶

4.1.7 Right to participate in public affairs

Everyone has the right to engage in public affairs, which may include public debate and decision-making related to climate engineering. While international human rights law on the right to participate in public affairs does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the right in the context of climate engineering and that individuals are able to participate in public affairs without discrimination.

International and EU human rights law

International human rights law supports participatory and representative models of democracy insofar as it protects the right to take part in the conduct of public affairs, directly or through freely chosen representatives.¹⁶⁷ The conduct of public affairs is “a broad concept which relates to the exercise of political power, in particular the exercise of legislative, executive and administrative powers. It covers all aspects of public administration, and the formulation and implementation of policy at international, national, regional and local levels.”¹⁶⁸ Citizens may participate directly in the conduct of public affairs by, for example, taking part in popular assemblies which have the power to make decisions about local issues or about the affairs of a particular community, and in bodies established to represent citizens in consultation with government.¹⁶⁹ Citizens also take part in the conduct of public affairs by exerting influence through public debate and dialogue with their representatives, or through their capacity to organize themselves. This participation is supported by ensuring freedom of expression, assembly, and association.¹⁷⁰

The Charter of Fundamental Rights of the EU (CFREU) guarantees the right of every citizen of the Union to vote and stand as candidate at elections to the European Parliament¹⁷¹ and at municipal elections.¹⁷² The right to participation in public affairs for EU citizens is protected by the TEU,¹⁷³ which lays down that every citizen shall have the right to participate in the democratic life of the Union and that decisions shall be taken as openly and as closely as possible to the citizen. Furthermore, the TEU requires the institutions of the EU to give, by appropriate means, citizens and representative associations the opportunity to make known and publicly exchange their views in all areas of Union action, and to maintain an open, transparent and regular dialogue with representative associations and civil society.¹⁷⁴

¹⁶⁶ McDonagh, M. (2013), *supra* note 163, p. 41.

¹⁶⁷ ICCPR, Article 25; McDonagh, M. (2013), *supra* note 163, p. 38.

¹⁶⁸ Committee on Civil and Political Rights. (1996) *General Comment No. 25: The right to participate in public affairs, voting rights and the right of equal access to public service*, CCPR/C/21/Rev.1/Add.7.

¹⁶⁹ *Ibid.*

¹⁷⁰ *Ibid.*

¹⁷¹ CFREU, Article 39.

¹⁷² *Ibid.*, Article 40.

¹⁷³ Consolidated Version of the Treaty on European Union (TEU) C 326/15, Article 10(3).

¹⁷⁴ *Ibid.*, Article 11(1)-(2).



Relevance to climate engineering

Decisions by public authorities about the development and implementation of climate engineering technologies should be considered a form of conducting “public affairs”. Citizens should, therefore, be given the possibility to participate directly in this process, for example by taking part in popular assemblies which have the power to make decisions about local issues or the affairs of a particular community, and in bodies established to represent citizens in consultation with the government. Citizens should also be able to participate in public affairs by exerting influence through public debate and dialogue with their representatives or through their capacity to organize themselves.

4.1.8 Right to access legal remedies

Everyone has the right to a fair trial and to access legal remedies for violations of their fundamental and human rights. While international human rights law on these rights does not explicitly address climate engineering, States have an obligation to ensure individuals have access to fair trials and legal remedies without discrimination in the event of alleged violations of their fundamental and human rights attributable to climate engineering.

International and EU human rights law

International law guarantees the right to a fair trial and “an effective remedy by the competent national tribunals for acts violating the fundamental rights granted him by the constitution or by law”.¹⁷⁵ States have an obligation to ensure that “any person whose rights or freedoms as herein recognized are violated shall have an effective remedy”.¹⁷⁶

The ECtHR has held that the right to respect for private and family life also specifically includes a right for the individuals concerned to appeal to the courts’ environmental decisions, acts or omissions where they consider that their interests or comments have not been given sufficient weight in the decision-making process.¹⁷⁷

The CFREU also guarantees the right to a fair trial and an effective remedy.¹⁷⁸

Relevance to climate engineering:

Everyone has the right to a fair trial and to access legal remedies for violations of their fundamental and human rights in the context of climate engineering. This applies to both alleged violations, both procedural and substantive. For example, an individual should have recourse if they are not adequately informed, involved in public dialogue, or their informed consent is not obtained. Individuals should also have a right to recourse if they are harmed by climate engineering activities. States have an obligation to ensure individuals have access to fair trials and legal remedies without discrimination.

4.1.9 Right to life

Climate engineering has the potential to impact the right to life. While climate engineering may mitigate the environmental life-threatening harms of climate change, it could also result in serious

¹⁷⁵ UDHR, Article 8; ICCPR, Article 2(3); ECHR, Articles 6, 13.

¹⁷⁶ Ibid.

¹⁷⁷ See, e.g., *Taskin and others v. Turkey* (Application no. 46117/99) (30 March 2005).

¹⁷⁸ CFREU, Article 47.

environmental impacts that directly or indirectly create life-threatening situations. While international human rights law on the right to life does not explicitly address climate engineering, States have an obligation to ensure individuals can enjoy the right to life in the context of climate engineering and must seek to prevent foreseeable harms or risks.

International law and policies

Under international law, everyone has the right “to life.”¹⁷⁹ This right is also recognised in regional organisations, including the Council of Europe.¹⁸⁰

The right includes both a prohibition against arbitrary deprivation of life and a positive duty to protect life.¹⁸¹ States have a “duty to refrain from engaging in conduct resulting in arbitrary deprivation of life”¹⁸² and “must establish a legal framework to ensure the full enjoyment of the right to life,”¹⁸³ which should include taking appropriate measures to address conditions in society that interfere with “enjoying the right to life with dignity.”¹⁸⁴ The right is non-derogable¹⁸⁵ and must be ensured without discrimination.¹⁸⁶ The EU Charter of Fundamental Rights also includes the “right to life.”¹⁸⁷

Relevance to climate engineering

The right to life encompasses threats to the quality and dignity of life, including those related to human health and access to food and water. Environmental harms, in particular, are some of the most serious live threats to this right.¹⁸⁸ Many climate geoengineering options could threaten the right to life. These include potential impacts that might induce drought conditions, deplete the ozone layer, reduce food security, or precipitate large and rapid pulses of warming.¹⁸⁹

4.1.10 Right to a healthy environment

Climate engineering has the potential to impact the right to a healthy environment. While climate engineering may mitigate the environmental harms of climate change, it could also result in serious environmental harm (and perhaps do so simultaneously). International human rights law on the right to a healthy environment does not explicitly address climate engineering, but States nevertheless have an obligation to ensure individuals can enjoy a healthy environment in the context of climate engineering.

¹⁷⁹ UDHR, Article 3; ICCPR, Article 6; Convention on the Rights of the Child (CRC) (entry into force 2 September 1990), 1577 U.N.T.S. 3, Article 6.

¹⁸⁰ ECHR, Article 2.

¹⁸¹ Human Rights Committee. (2019) *General Comment No. 36: Article 6: right to life*, CCPR/C/CG/36, 3 September 2019, para. 6: ‘Deprivation of life’ involves “intentional or otherwise foreseeable and preventable life-terminating harm or injury, caused by an act or omission.”

¹⁸² Ibid, para. 7.

¹⁸³ Ibid, para. 18.

¹⁸⁴ Ibid, para. 26.

¹⁸⁵ Ibid, para. 2.

¹⁸⁶ Ibid, para. 61.

¹⁸⁷ CFREU, Art. 2.

¹⁸⁸ Human Rights Committee. (2019), *supra* note 181, para. 62.

¹⁸⁹ Burns, W.C.G. (2016) ‘The Paris Agreement and Climate Geoengineering Governance: The need for a human rights-based component’, CIGI Papers, No. 111. Available at: <https://www.cigionline.org/static/documents/documents/CIGI%20Paper%20no.111%20WEB.pdf>.

International law and policy

The right to healthy environment is very new. While it does not appear in the UDHR or core international human rights treaties, the U.N. Human Rights Council recognised it in a 2021 resolution.¹⁹⁰ The right includes substantive elements like “healthy ecosystems, clean air and water, a safe and stable climate, adequate and nutritious food, and a non-toxic environment.”¹⁹¹ It also encompasses the procedural rights to participation, of access to information and access to justice.¹⁹² As with all human rights, States are obligated to take preventative and responsive actions and are specifically encouraged to “build capacities for the efforts to protect the environment” and adopt policies as appropriate to support enjoyment of the right.¹⁹³ Additionally, States have special obligations towards vulnerable populations, including indigenous communities and communities in poverty.¹⁹⁴ The CFREU calls for “a high level of environment protection”.¹⁹⁵

Relevance to climate engineering

Climate engineering has the potential to enhance and undermine the right to a healthy environment. Climate engineering that effectively mitigates climate change, resulting in a safer and more stable climate, would support the enjoyment of the right. However, climate engineering that results in environmental harm, such as SRM that causes depletion of the ozone layer or changes to weather patterns that cause severe droughts, would have a negative impact on the right to a healthy environment.

4.1.11 Right to health

Climate engineering has the potential to impact the right to a health. While climate engineering may have positive health impacts that result from mitigating the environmental harms of climate change, it could also directly or indirectly cause health risks. International human rights law on the right to a health does not explicitly address climate engineering, but States nevertheless have an obligation to ensure individuals can enjoy the right to health in the context of climate engineering.

International and EU law and policy

Under international law, everyone has the right “to the enjoyment of the highest attainable standard of physical and mental health.”¹⁹⁶ This right is also recognised in regional organisations, including the

¹⁹⁰ Human Rights Council. (2021) *Resolution 48/13 The human rights to a clean, health and sustainable environment*, A/HRC/RES/48/13, 18 October 2021.

¹⁹¹ Bachelet, M. (2022) “*The right to a clean, healthy, and sustainable environment – what does it mean for States, for rights-holders and for nature?*”, Speech by UN High Commissioner for Human Rights, 16 May 2022. Transcript available at: <https://www.ohchr.org/en/statements/2022/05/right-clean-healthy-and-sustainable-environment-what-does-it-mean-states-rights>.

¹⁹² Ibid; See, also, U.N. Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy and sustainable environment. (2020) *Human rights depend on a healthy biosphere*, A/75/161, 15 July 2020.

¹⁹³ Human Rights Council. (2021) *Resolution 48/13 The human rights to a clean, healthy, and sustainable environment*, A/HRC/RES/48/13, 18 October 2021, para. 4.

¹⁹⁴ U.N. Special Rapporteur on the issue of human rights obligations relating to the enjoyment of a safe, clean, healthy, and sustainable environment. (2020), supra note 192, Section G.

¹⁹⁵ CFREU, Article 37.

¹⁹⁶ ICESCR, Article 12. See also, UDHR, Article 25(1); International Convention on the Elimination of All Forms of Racial Discrimination (entry into force 4 January 1969), 660 U.N.T.S. 195, Article 5(e)(iv); Convention on the Elimination of All Forms of Discrimination against Women (entry into force 3 September 1981), 1249 U.N.T.S. 13, Article 12; Convention on the Rights of the Child, supra note 179, Article 24; and Convention on the Rights of Persons with Disabilities (entry into force 3 May 2008), A/RES/61/106, Annex I, Article 25.



Council of Europe.¹⁹⁷ It is not a right to be *healthy*, but rather a right to certain freedoms, such as the right to control one's health and be freed from interference, and entitlements, such as equal opportunity to enjoy the highest attainable level of health.¹⁹⁸ The CFREU provides the specific right "of access to preventative health care" and right "to benefit from medical treatment."¹⁹⁹

Sustainable Development Goal 3 is to "ensure healthy lives and promote well-being for all at all ages."²⁰⁰

Relevance to climate engineering

Climate engineering could enhance the right to health if it mitigates harms associated with climate change. However, climate engineering also has the potential to cause direct or indirect harm to health. For example, research on SRM, specifically sulphur aerosol injection, suggests the technique may lead to regional increases in malaria²⁰¹ or higher risk of skin cancer and pollution-related illness.²⁰² Moreover, to the extent that food production might be adversely impacted by deployment of SRM or CDR approaches,²⁰³ this would undermine one of the "underlying determinants of health."²⁰⁴ Therefore, in addition to direct risks, the right to health would be increasingly indirectly threatened if access to food and water is undermined.

4.1.12 Right to access food

Climate engineering has the potential to impact the right to food. While climate engineering may have positive impacts on global food production that result from mitigating the environmental harms of climate change, it could also directly or indirectly cause interfere with food production. International human rights law on the right to food does not explicitly address climate engineering, but States nevertheless have an obligation to ensure individuals can enjoy the right to food in the context of climate engineering.

International and EU law and policy

Under international law, everyone has the right "to be free from hunger" and "adequate food" is a considered part of the right "to an adequate standard of living".²⁰⁵ Furthermore, "an adequate supply of safe food" is an underlying determinant of health necessary to enjoy the right to health.²⁰⁶ No similar rights exist in the ECHR or CFREU.

Sustainable Development Goal 2 is to "end hunger, achieve food security and improved nutrition and promote sustainable agriculture."²⁰⁷

¹⁹⁷ European Social Charter (entered into force 26 February 1965), E.T.S. 35 – Social Charter, 18.X.1961, Part I, para. 11.

¹⁹⁸ Committee on Economic, Social and Cultural Rights. (2000) *General Comment No. 14: The Right to the Highest Attainable Standard of Health* (Art. 12), adopted 11 August 2000, para. 8.

¹⁹⁹ CFREU, Article 35.

²⁰⁰ Sustainable Development Goal, Goal 3.

²⁰¹ Carlson et al. (2022) 'Solar geoengineering could redistribute malaria risk in developing countries', *Nature Communications*, 13(1). DOI: [10.1038/s41467-022-29613-w](https://doi.org/10.1038/s41467-022-29613-w).

²⁰² Eastham et al. (2018) 'Quantifying the impact of sulphate geoengineering on mortality from air quality and UV-B exposure', *Atmospheric Environment*, 187, pp.424–434. DOI: <https://doi.org/10.1016/j.atmosenv.2018.05.047>.

²⁰³ See, e.g. Simon, M. (2018) *How Engineering the Climate Could Mess With Our Food* / *WIRED* [Online]. Available at: <https://www.wired.com/story/how-engineering-the-climate-could-mess-with-our-food/>.

²⁰⁴ Burns, W.C.G. (2016), *supra* note 189.

²⁰⁵ UDHR, Article 25; ICESCR, Article 11.

²⁰⁶ Committee on Economic, Social and Cultural Rights. (2000), *supra* note 198, para. 11.

²⁰⁷ Sustainable Development Goals, Goal 2.

Relevance to climate engineering

Climate engineering may cause – directly or indirectly – alterations to precipitation patterns, potentially threatening food security. Such impacts could result in higher food prices and displace agricultural production in ways that imperil food security. In case the ‘termination effect’²⁰⁸ occurs, the rapid spikes in temperature might undermine food production.²⁰⁹ Furthermore, water withdrawals required by some geoengineering methods, such as Bioenergy with Carbon Capture and Storage, or BECCS, might aggravate water scarcity in the poorer regions of the world, thereby disadvantaging people living in the respective regions and jeopardising their right to adequate food even more.²¹⁰

4.1.13 Right to water

Climate engineering has the potential to impact the right to water. While climate engineering may have positive impacts on clean water supply that result from mitigating the environmental harms of climate change, it could also directly or indirectly interfere with that supply. International human rights law on the right to water does not explicitly address climate engineering, but States nevertheless have an obligation to ensure individuals can enjoy the right to water in the context of climate engineering.

International and EU law and policy: While a right to water is not included in the core international human rights treaties, the U.N. General Assembly recognised the “right to safe and clean drinking water and sanitation” in 2010.²¹¹ No similar rights exist in the ECHR or CFREU.

Sustainable Development Goal 6 is to “ensure availability and sustainable management of water and sanitation for all.”²¹²

Relevance to climate engineering

Climate engineering may cause – directly or indirectly – impacts that alter precipitation cycles and water supplies, imperilling the right to water for vast numbers of people. For example, marine cloud brightening involving the potential deposition of seawater could reduce freshwater availability for islands where water resources are already severely constrained. The massive demands on water that some CDR approaches, such as BECCS, would entail, could similarly impact this right.²¹³

4.2 Rules of state responsibility

Under international law, States could be held liable for harm caused to another State from a climate engineering activity.

²⁰⁸ Effect that may occur “if SRM were ever used to mask a high level of warming and its deployment were terminated suddenly, temperature would rebound toward the levels they would have reached without the geoengineering.” Parker, A. and Irvine, P.J. (2018) ‘The Risk of Termination Shock From Solar Geoengineering’, *Earth’s Future*, 6(3), pp.456-467. DOI: 10.1002/2017EF000735.

²⁰⁹ Burns, W.C.G. (2016), *supra* note 189.

²¹⁰ Hohlwegler, P. (2019) ‘Moral Conflicts of several “green” terrestrial Negative Emission Technologies regarding the Human Right to Adequate Food - A Review’, *Advances in Geosciences*, 49, pp. 37-45.

²¹¹ U.N. General Assembly. (2010) *Resolution 64/292 The Human Right to Water and Sanitation*, A/RES/64/292.

²¹² Sustainable Development Goals, Goal 3.

²¹³ Burns, W.C.G. (2016), *supra* note 189.

All states are subject to international rules of state responsibility, which dictate how “a breach of an international obligation entails the responsibility of the state concerned.”²¹⁴ One such obligation is ensuring activities within a state’s jurisdiction and control respect the environment of other states, which is known as the prohibition of transboundary environmental harm or the ‘no-harm rule’. This duty to prevent harm “provides a kind of ‘floor’ for the regulation of climate engineering proposals of all types.”²¹⁵

4.2.1 International and EU law and policies

International law and policies: In international law, the rules of state responsibility are codified in the International Law Commission (ILC) Articles on Responsibility of States for Internationally Wrongful Acts, which reflects customary international law.²¹⁶ States can also be liable for harm within the framework of the ILC Draft Articles on Prevention of Transboundary Harm from Hazardous Activities.²¹⁷ While there are few international cases from the International Court of Justice and other international tribunals on transboundary environmental harms, as “generally, international law has difficulties making individual states responsible for complex environmental effects,”²¹⁸ the international judgments nevertheless provide important insights and interpretations.²¹⁹

A cornerstone of international environmental law, the ‘no-harm rule’ means a state must use “all means at its disposal” to prevent causing “significant damage to the environment of another States.”²²⁰ The obligation applies to the direct activities of State and private actors within the state’s jurisdiction and control.²²¹ Establishing responsibility for harm requires proving that (1) the activity is attributable to the state in question and (2) that the activity caused harm outside the state’s boundaries.²²² The prohibition includes harm to the global commons (e.g., high seas, outer space, atmosphere, Polar Regions).²²³ To be prohibited, the harm must be ‘significant’,²²⁴ which is “something more than ‘detectable’ but need not be at the level of ‘serious’ or ‘substantial’.”²²⁵ While ‘harm’ is not

²¹⁴ Crawford, J. (2008) ‘The Law of Responsibility’ in Brownlie, I. (ed.) *Brownlie’s Principles of Public International Law*. 8th ed. Oxford: Oxford University Press., pp.539-602.

²¹⁵ Hubert, A. (2020) ‘International legal and institutional arrangements relevant to the governance of climate engineering technologies’ in Florin, M.V. (ed.). *International Governance of Climate Engineering. Information for policymakers*. Lausanne: EPFL International Risk, p.51.

²¹⁶ Resolution 56/83 Responsibility of States for Internationally Wrongful Acts, G.A. Res. 56/83, U.N. Doc. A/RES/56/83 (Jan. 28, 2002).

²¹⁷ International Law Commission. (2001), Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities A/56/10.

²¹⁸ Bodle, R. (2010) ‘Geoengineering and International Law: The Search for Common Legal Ground’, *Tulsa Law Review*, vol. 46, p308. Available at: <https://core.ac.uk/download/pdf/232681458.pdf>.

²¹⁹ See, e.g., Jervan, M. (2014) The Prohibition of Transboundary Environmental Harm: An Analysis of the Contribution of the International court of Justice to the Development of the No-harm Rule. *PluriCourts Research Paper No. 14-17*, pp.57-8; Tignino, M. and Brethaut, C. (2020) ‘The role of international case law in implementing the obligation not to cause significant harm,’ *International Environment Agreements*, 20, 634. Available at: <https://doi.org/10.1007/s10784-020-09503-6>.

²²⁰ *Pulp Mills on the River Uruguay (Argentina v Uruguay)* (Judgment of 20 April 2010) ICJ Rep 14, para. 101: “A State is thus obliged to use all the means at its disposal in order to avoid activities which take place in its territory, or in any area under its jurisdiction, causing significant damage to the environment of another State.”

²²¹ Jervan, M. (2014), supra note 219, pp.57-8.

²²² U.N. Conference on Environment and Development. (1992) *Rio Declaration on Environment and Development*, A/CONT.151/26 (Vol. I) (Rio Declaration) 12 August 1992, Principle 2: “States have...the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.”

²²³ Jervan, M. (2014), supra note 219, p. 5.

²²⁴ International Law Commission. (2001), supra note 217.

²²⁵ Commentaries on The Articles on Prevention of Transboundary Harms, A/56/10, 2001, Article 2, para. 4.

defined by the ILC, a recommendation from the OCED in the context of transboundary pollution provides a definition that could be used: “the introduction by man [...] of substances or energy into the environment resulting in deleterious effects of such nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment.”²²⁶ The state alleging harm has the burden to prove the attribution and harm.²²⁷

The obligation to prevent harm has both a procedural and substantive element. To fulfil the procedural element, states have a duty to “acquire knowledge concerning the possible environmental impacts” – usually in the form of a prior environmental impact assessment (EIA) and on-going monitoring – and a duty of cooperation, notification, consultation, and negotiation.²²⁸ The duty to conduct an EIA, enshrined in international law²²⁹ and recognised by the ICJ,²³⁰ is discussed further in Section 4.3.2. Obligations to cooperate, notify, consult, and negotiate are enshrined in international environmental conventions and soft law,²³¹ including human rights legal instruments (see Section 3.1).

The substantive element is a requirement to exercise due diligence. A state must “exert its best possible efforts to minimize the risk” of transboundary environmental harm,²³² but there is no requirement to ensure that no harm occurs. The standard of due diligence is case dependent, proportionate to the degree of risk, and evolving.²³³ Therefore, there is “considerable legal uncertainty” on what constitutes sufficient due diligence for the purpose of determining whether a state is in violation of the ‘no-harm rule.’²³⁴

A state found in violation of the prohibition on transboundary environmental harm has a duty to stop the activity causing harm²³⁵ and is liable for reparations for the harm caused.²³⁶ In some circumstances, a state may not be liable even when harm occurs, such as when an affected state consents or when the harm is necessary “to safeguard an essential interest against grave and imminent peril.”²³⁷

EU law and policy: In the European Union, there are many environmental directives and regulations relevant to transboundary environmental harm, discussed in detailed in Section 4.3. A Member State in violation of its obligations under EU law is subject to the judgment of the Court

²²⁶ OECD, Recommendation C(74)224 of 14 November 1974, Principles Concerning Transfrontier Pollution, Part A (Introduction).

²²⁷ Jervan, M. (2014), supra note 219, p.39.

²²⁸ Jervan, M. (2014), supra note 219, p.76.

²²⁹ See, e.g., Rio Declaration, Principle 17: “Environmental impact assessment, as a national instrument, shall be undertaken for proposed activities that are likely to have a significant adverse impact on the environment ...”; United Nations Convention on the Law of the Sea (UNCLOS) (entered into force 16 November 1994) 1833 U.N.T.S. 3, Article 206; Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) (entry into force 10 September 1997) No.34028, Article 1(vi): “a national procedure for evaluating the likely impact of a proposed activity on the environment”;

²³⁰ Jervan, M. (2014), supra note 219, pp78-88. (discussion of *Nuclear Test*, *Gabčíkovo-Nagymaros*, and *Pulp Mills* cases).

²³¹ See, e.g., Rio Declaration, Principle 18, 19, and 27; UNCLOS, Articles 123 and 194; Convention on Long-Range Transboundary Air Pollution (LRTAP) (entry into force 13 November 1979) 1302 U.N.T.S. 217, Articles 3-5; and International Law Commission. (2001), supra note 217, Articles 4, 8-9.

²³² Commentaries on The Articles on Prevention of Transboundary Harms. (2001), supra note 225, paragraph 7.

²³³ Hubert, A. (2020), supra note 215, p.51; and Bodle, R. (2010), supra note 218, p.307.

²³⁴ Bodle, R. (2010), supra note 218, p.307.

²³⁵ Resolution 56/83, Articles 30.

²³⁶ Ibid, Articles 31, 36-9.

²³⁷ Ibid, Articles 20-5: The harm must also “not seriously impair an essential interest of the State or States towards which the obligation exists, or of the international community as a whole”.



of Justice of the European Union (CJEU).²³⁸ Under the *Francovich* doctrine, a Member State may be liable for damages to victims of transboundary environmental harm, but only if certain conditions are met.²³⁹

4.2.2 Prohibition on transboundary environmental harm

To the authors' knowledge, there are no cases relating to a climate engineering activity before an international court or tribunal. Therefore, application of existing international law on state responsibility is theoretical and speculative.

Under the rules of state responsibility, a state could be responsible for transboundary environmental harm resulting from its climate engineering activities. A violation of the 'no-harm rule' would require showing that the climate engineering activity is attributable to the state and that specific activity caused a particular significant transboundary harm. To fulfil the procedural element of the obligation, any climate engineering activity would likely require (1) an *ex ante* EIA, (2) engaging in cooperation, notification, consultation, and negotiation and (3) monitoring. More precise details on content and adequacy would be derived from obligations other environmental and human right legal instruments, including domestic law. To determine whether the substantive duty of due diligence has been met, the standard is even less clear, but relevant factors may include "the scale and duration of the intervention, the magnitude of the adverse effects that it is likely to cause, and the current state of scientific and technological knowledge."²⁴⁰

While the duty to prevent transboundary environmental harm prohibits "unrestrained and uncontrolled" activity "where there is a risk of significant environmental harm"²⁴¹ there are many limitations to its practical application.²⁴² In all environmental harm cases, it is difficult to identify specific significant harm (specifically harm in the global commons) and prove causation, particularly as the burden of proof falls to the state alleging harm. Even if it is relatively easy to identify the State (or actor) who conducted the activity, linking the activity to a specific harm (i.e., causation) is likely to be very difficult. The duty of due diligence only extends to foreseeable and avoidable harm; states cannot be held responsible for unpredicted or unavoidable harm. Furthermore, the due diligence standard is abstract and vague,²⁴³ particularly as states are only required to take reasonable efforts and capacities in environmental protection to achieve "best possible efforts" varies widely across states.²⁴⁴ Additionally, the rules of state responsibility do not distinguish between research and deployment, further complicating questions on standard of due diligence (e.g., would certain research criteria fulfil due diligence obligations).²⁴⁵ Lastly, state responsibility is retrospective, meaning that the rules are triggered only after harm has occurred. It is possible to obtain provisional measures (i.e., interim

²³⁸ *Treaties of Rome (1958), Article 258.*

²³⁹ The violation must concern individual rights, the breach must be sufficiently serious, and there must be a direct causal link. See, e.g., Dougan, M. (2017) 'Addressing Issues of Protective Scope within the Francovich Right to Reparation', *European Constitutional Law Review*, vol. 13, p. 126. DOI: <https://doi.org/10.1017/S1574019616000390>.

²⁴⁰ Hubert, A. (2020), *supra* note 215, p.51.

²⁴¹ *Ibid.*

²⁴² See, e.g., Bodle, R. (2010), *supra* note 218; Brunnée, J. (2005) International Legal Accountability Through the Lens of the Law of State Responsibility. *Netherlands Yearbook of International Law*, vol. 36, pp. 9-10; Ellis, J. (2018) *Liability for International Environmental Harm*, Oxford Bibliographies. Available at: 10.1093/OBO/9780199796953-0017; and Hubert, A. (2020), *supra* note 215, p.51.

²⁴³ Hubert, A. (2020), *supra* note 215, p.51.

²⁴⁴ Brunnée, J. (2005), *supra* note 242, pp. 9 and Ellis, J. (2018), *supra* note 242.

²⁴⁵ Bodle, R. (2010), *supra* note 218, p.307.

injunction) to stop an activity that may cause harm, but they are rarely granted.²⁴⁶ Therefore, it would likely be difficult to invoke the rules of state responsibility to stop transboundary environmental harm from climate engineering technologies before they occur.

4.3 Environmental law

Climate engineering has the potential to impact environmental law in many ways, both positive and negative. The use of climate engineering technologies to mitigate harms associated with climate change could enhance the protection of the environment. On the other hand, however, manipulating Earth's climate through climate engineering may redistribute environmental risks and cause unforeseen consequences to the environment and human health.²⁴⁷

States have an obligation under international environmental law to ensure to protect the environment and human health when deploying climate engineering activities and to take steps to prevent transboundary environmental harm as much as possible.

In this section, we look at the main environmental law regimes applicable to climate engineering technologies: environmental impact assessments; corporate disclosure; public participation; sustainable development; pollution prevention; environmental management of waste and chemicals; and environmental protection and liability for harm.

4.3.1 International and EU law and policies

Environmental law is primarily concerned with the protection of the environment and human health. The environment has been regarded not only as an abstraction, but as a representation of "the living space, the quality of life and the very health of human beings, including generations unborn."²⁴⁸ As such, there is a general obligation on States to ensure that activities within their jurisdiction respect the environment of other States.²⁴⁹

Environmental law is a collective term and covers a wide range of areas, such as state responsibility, environmental liability and environmental crime, climate change and atmospheric pollution, nuclear energy, regulation of toxic and persistent pollutants and waste, conservation, biodiversity, conservation of the marine environment, and environmental protection in relation to international trade.²⁵⁰ This section reviews the international and EU environmental laws with relevance to climate engineering techniques, and analysis what the legal implications are, focusing specifically on CDR and SRM.

²⁴⁶ Ibid, p. 308.

²⁴⁷ Reichwein D. et al. (2015) 'State Responsibility for Environmental Harm from Climate Engineering', *Climate Law*, 5, pp.142-181. DOI: <https://doi.org/10.1163/18786561-00504003>; Adelman, S. (2017), supra note 128, pp. 119-138.

²⁴⁸ ICJ Reports (1996) *Nuclear Weapons Advisory Opinion*, para 29.

²⁴⁹ Ibid.

²⁵⁰ See generally, Birnie P., Boyle A., and Redgwell C. (2021). *International Law and the Environment*. 4th ed, Oxford: Oxford University Press.



4.3.2 Environmental impact assessments

In international environmental law, the Environmental Impact Assessment (EIA) is “a procedure for evaluating the likely impact of a proposed activity on the environment.”²⁵¹ It seeks to inform decision-makers about possible environmental impacts when authorising potentially harmful activities.²⁵² At an international level, the EIA seeks to inform other states and international organisations of the potentially transboundary environmental impacts of certain activities.²⁵³

European Union environmental assessment directives apply to projects, and plans and programmes, in Europe, and apply either through Member States or indirect application to activities of public authorities. Environmental assessment directives aim to account for systemic environmental impacts of sectors on humans, fauna, flora, soil, air, water, climate, landscape, material assets and cultural heritage, as well as interactions among these affected aspects. Although two different directives cover plans and programmes, and public and private projects, respectively, no rigorous distinction between the two is offered.²⁵⁴

Climate engineering activities are specifically carried out with a view to creating an environmental impact – or to put more accurately – avoiding the catastrophic environmental impact that would otherwise be caused by climate change. Yet, climate engineering activities by themselves pose a risk to the environment, which may trigger the international and EU law on environmental impact assessments.

International law and policy

The Rio Declaration recognises the EIA as a national instrument to be undertaken for activities with a potentially significant impact on the environment and subject to authorisation by a competent national body.²⁵⁵ Furthermore, the Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention) was adopted with a view to prevent, reduce and control significant transboundary environmental impact from proposed activities.²⁵⁶ It obliges states to take all appropriate and effective measures to do so, and to establish an environmental impact assessment procedure at an early stage of planning.²⁵⁷ The Convention was adopted in 1991 and 44 states plus the European Union are Party to the Convention. The EIA focuses on projects and activities, whereas the strategic environmental assessment (SEA) was developed in some jurisdictions to complement the EIA to cover more strategic government plans, programmes, and policies.²⁵⁸ States

²⁵¹ Espoo Convention, Article 1(iv). See generally, Wathern P. (ed) (1988). *Environmental Impact Assessment: Theory and Practice*. 1st ed, London: Routledge; Glasson J., Therivel R., and Chadwick A (2005). *Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice, and Prospects*. 2nd ed, London: Routledge; Wood C. (2003). *Environmental Impact Assessment: A Comparative Review*. 2nd ed, Harlow: Routledge, Chapter 1; Holder J. (2004) *Environmental Assessment*. Oxford: Oxford University Press; Holder J. and McGillivray D. (eds) (2007). *Taking Stock of Environmental Assessment*. 1st ed, London: Routledge-Cavendish; UNEP (2004) *Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach*. Nairobi: UNEP.

²⁵² Birnie P., Boyle A., and Redgwell C. (2021), *supra* note 250, p. 216.

²⁵³ *Ibid.*

²⁵⁴ Farmer, A. et al. (2010) ‘Sourcebook on EU Environmental Law’, *Institute for European Environmental Policy*, p.389. Available at: https://www.eib.org/attachments/strategies/sourcebook_on_eu_environmental_law_en.pdf.

²⁵⁵ Rio Declaration, Principle 17.

²⁵⁶ Espoo Convention, Article 2(1).

²⁵⁷ *Ibid.*, Article 2(1)-(2).

²⁵⁸ Birnie P., Boyle A., and Redgwell C. (2021), *supra* note 250, p. 218; UNEP (2004) *Environmental Impact Assessment and Strategic Environmental Assessment: Towards an Integrated Approach*. Nairobi: UNEP; Sadler B. et al (eds) (2010). *Handbook on SEA*. 1st ed, London: Routledge; Fischer T. B. (2007). *Theory and Practice of SEA: Towards a More Systematic Approach*. 1st ed, London: Earthscan; Dalal-Clayton B. and Sadler B. (2005). *SEA: A Sourcebook and Reference Guide to International Experience*. London: Routledge.



also have an obligation to assess activities and report potential environmental impacts in relation to the marine environment.²⁵⁹

At a minimum, an EIA should assess the possible effects of a project or activity on the people, property and environment of other states likely to be affected.²⁶⁰ Essentially, the EIA is a national procedural measure designed to help inform other states of the potential transboundary effects of a certain project or activity, and to be consulted in the decision-making process. However, it is not a process of prior joint approval.²⁶¹ It does not give affected states a veto on the proposed activity, yet the state deciding to proceed with a project must give due account to the findings of the EIA.²⁶²

Whilst international law does not make specific reference to climate engineering technologies, such as CDR or SRM, an EIA is likely to be required. Particularly given the global nature and impact of climate engineering technologies, EIA would be required to establish potentially transboundary impacts.

EU law and policy

The EU directives on environmental assessments are very likely to apply to climate engineering technologies. Although neither CDR nor SRM are mentioned by name, the information required – and effects likely to be considered significant – would result from CDR or SRM deployment. The EU Directive on Environmental Impact Assessment (EIA Directive) of public or private projects directly applies to climate engineering technologies approaching CDR through CO₂ capture, transport, and storage.²⁶³ Although SRM is not directly mentioned, the nature of chemical dispersion and the kinds of environmental information required – and effects likely to be considered significant – from SRM deployment make it likely the Directive would apply to such projects.

Strategic Environmental Assessment Directive: The Strategic Environmental Assessment (SEA) Directive establishes environmental assessment of plans and programmes in Europe.²⁶⁴ “Plans and Programmes” are defined as those co-financed by the European Community, either required by legislative, regulatory, or administrative provision or subject to preparation by national, regional, or local level governments.²⁶⁵ The objective of the directive is to enhance environmental protection and consideration of the environment in adoptions of plans and programmes that are “likely to have significant environmental effects.”²⁶⁶ The criteria for significant environment effect are established in Annex II to the Directive. Plans and programmes deemed in scope of the law include agriculture, forestry, energy, industry, transport, waste management, water management and others. However, national defence, civil emergency, financial, and budget plans and programmes are exempt.²⁶⁷

²⁵⁹ UNCLOS, Article 206; *The South China Sea Arbitration* (The Republic of Philippines v. The People’s Republic of China) (Permanent Court of Arbitration) (2013-2016) PCA 2013-19; Birnie P., Boyle A., and Redgwell C. (2021), supra note 250, p. 220.

²⁶⁰ Birnie P., Boyle A., and Redgwell C. (2021), supra note 250, pp. 228-229.

²⁶¹ Ibid, pp. 225-226.

²⁶² Ibid; Espoo Convention, Article 6.

²⁶³ Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (OJ L124/1).

²⁶⁴ Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment (OJ L197/30).

²⁶⁵ Ibid, Article 2(a).

²⁶⁶ Ibid, Article 3.

²⁶⁷ Ibid, Article 3 (8).



The SEA Directive provides that SEAs must be carried out in the preparation phase, before adoption on or submission of plans or programmes.²⁶⁸ Assessments must prepare an environmental report²⁶⁹ on likely significant effects on the environment, and evaluation of reasonable alternatives based on objectives and geography.²⁷⁰ Draft plans or programmes and the environmental report must be made available to authorities and the public in early and effective opportunities to consult and express opinion.²⁷¹ Member States are ensured an opportunity to opt into transboundary consultations in cases where plans or programmes being prepared are likely to have significant effects in their territories.²⁷² All of the aforementioned forms of consultation must be taken into account in final preparation of plans or programmes.²⁷³

Environmental Impact Assessment Directive: Directive 2011/92/EU establishes environmental assessment of the effects of public and private projects in Europe.²⁷⁴ For the directive, a “project” means the construction of installations or schemes, or other interventions in landscapes involving mineral resource extraction. Member States are required to adopt measures to ensure projects likely to have a significant effect on the environment carry out environmental impact assessments, and subsequently, decide on the authorisation of the project concerned.

Environmental impact assessments, carried out by the developer according to Member State’s national implementation of the Directive, require information on the project, likely significant effects on the environment; measures to offset adverse effects; and a non-technical summary.²⁷⁵ Potentially concerned authorities, trans-boundary parties (i.e., other Member States) or publics are required to be informed of the project early in environmental decision-making procedures and entitled to comment before decisions are made.²⁷⁶ Member States are required to consider results of assessment information and consultations, together, in developing decisions.²⁷⁷ Members of the public are granted rights to review procedures before a court or impartial body to challenge decisions subject to public participation provisions of the directive.²⁷⁸

Other relevant EU legislation: In addition to the EIA and SEA Directives, a host of other directives, regulations, and decisions in the EU related to environmental assessment may apply to climate engineering technologies. These include the Directive on public access to environmental information;²⁷⁹ species and habitat protection;²⁸⁰ and environmental liability.²⁸¹ Furthermore, Regulation (EC) No 401/2009 provides for the European Environment Agency and a European Environment Information and Observation Network to support environmental protection and is likely

²⁶⁸ Ibid, Article 4.

²⁶⁹ Ibid, Annex I.

²⁷⁰ Ibid, Article 5.

²⁷¹ Ibid, Article 6.

²⁷² Ibid, Article 7.

²⁷³ Ibid, Article 8.

²⁷⁴ Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (OJ L26/1).

²⁷⁵ Ibid, Article 5.

²⁷⁶ Ibid, Articles 6 and 7.

²⁷⁷ Ibid, Article 8.

²⁷⁸ Ibid, Article 11.

²⁷⁹ Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EEC (OJ L41/26).

²⁸⁰ Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L206/7).

²⁸¹ Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L143/56).



to be relevant to the development and use of climate engineering technologies.²⁸² The information network is required to provide the Community and Member States with reliable, comparable information to support environmental protection and inform the public about the state of the environment. The Agency is required to further support the Community and Member States with environmental information in preparation of legislation related to the environment; report on the state of the environment; and ensure comparability of European environmental data. Environmental data related to air quality, soil, land use, presence of chemical substance, and atmospheric emissions are required, making it likely that the Agency would be involved in data collection and monitoring related to CDR and SRM.

Climate engineering and EIAs

The text of the SEA Directive makes no direct mention of CDR, negative emissions technologies, or SRM. Yet, Annex 1 details that environmental reports must include information about plans and programmes related to a number of issues, which CDR and SRM technologies are likely to impact. The first of these issues is the effect on (e) environmental objectives. As elaborated in the new framework to facilitate sustainable investment²⁸³ there are now six environmental objectives enshrined as part of the European Green Deal. Among these environmental objectives are (a) climate change mitigation; (b) climate change adaptation; and (f) the protection and restoration of biodiversity and ecosystems. To the extent that climate engineering plans and programmes – such as CDR affecting climate change mitigation, SRM affecting climate change adaptation, or afforestation or biomass programmes affecting biodiversity and ecosystems – it is very likely that the SEA Directive will apply.²⁸⁴

Furthermore, Annex I (h) (1) of the SEA Directive requires information on any difficulties in assessment of secondary, cumulative, synergistic, short, medium, and long-term permanent and temporary, positive and negative effects. As such, this may particularly apply to SRM, a technology whose deployment may have significant such effects and are difficult to assess without testing. Additionally, Annex II of the SEA Directive elaborates on the characteristics that will be assessed to determine likely significance of effects. Several of these effects are very likely to be implicated by CDR and or SRM. Firstly, effect duration and reversibility will very likely be relevant to SRM as well as any leaks from carbon storage facilities. Secondly, transboundary effects will also likely be relevant to SRM, as injected aerosols, or the weather patterns impacted by them, will likely extend beyond local zones of deployment. Finally, characteristic effects on human health or environmental risks, as well as magnitude and spatial extent (geographical area and size of population affected), are very likely to be affected by the outcomes of SRM deployment, triggering the SEA Directive to apply.

The EIA Directive requires projects related to capture, transport, and storage of CO₂ to complete environmental impact assessments.²⁸⁵ On a case-by-case basis, or upon reaching a certain threshold (set by Member States), projects conducting land use conversion involving afforestation or deforestation may also be subject to conducting environmental impact assessments. This suggests possible application of the Directive to bioenergy with carbon capture and storage (BECCS), or other afforestation, reforestation, or soil remediation and regenerative agriculture projects. The Directive

²⁸² Regulation (EC) No 401/2009 of the European Parliament and of the Council of 23 April 2009 on the European Environment Agency and the European Environment Information and Observation Network (OJ L126/13 2009).

²⁸³ Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment and amending Regulation (EU) 2019/2088 (OJ L198/13 2020).

²⁸⁴ Relatedly, Annex I(f) requires information on "likely significant effects on, among other issues, biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape" and the interrelationship among these.

²⁸⁵ Directive 2011/92/EU, Annex I.

does not make explicit mention of SRM, however the requirement (Annex 1) or consideration (Annex 2) of various chemical installations or projects to produce environmental impact statements suggests it is likely SRM activities will be covered by the Directive.

The EIA Directive stipulates that the impact magnitude, nature, intensity, complexity, probability, reversibility, cumulative effect with other projects, and remediation measures must be reported.²⁸⁶ In relation to SRM projects, assessing reversibility and remediation measures of the climate interventions may be particularly difficult. Finally, the law states that environmental impact assessments must cover potentially significant effects on populations, human health, land, soil, water, air, climate, and landscape. As such, again, it is likely that the EIA Directive would require SRM projects or activities to demonstrate the absence of significant impact for them to be permitted; as well as any BECCS or CO₂ storage facilities.

The SEA Directive is very likely to apply to any plans or programmes to develop and deploy Climate Engineering technologies. Although neither CDR nor SRM are mentioned by name, the information required – and effects likely to be considered significant – would result from CDR or SRM deployment. Such requirements include information related to environmental objectives like climate change adaptation (SRM) or mitigation (CDR); difficulties in assessing various and dynamic effects (SRM); and likely significant, irreversible, transboundary affects over potential large spatial extents and populations (SRM).

The EIA Directive directly applies to climate engineering technologies projects and activities, approaching CDR through CO₂ capture, transport, and storage. Although SRM is not directly mentioned, the nature of chemical dispersion and the kinds of environmental information required – and effects likely to be considered significant – from SRM deployment make it likely the EIA Directive would apply to such projects.

4.3.3 Corporate disclosure and sustainable finance

Laws on private sector information disclosure in the EU explicitly apply to CDR technologies and nature-based approaches, and would likely apply to SRM technologies, receiving private sector financial support and claiming to contribute to European environmental objectives.

Economic actors, including individual companies or industries, play a major role in EU environmental governance, from environmental assessment to public information and liability.²⁸⁷ Economic actors possess key knowledge, resources, and information pertaining to environmental regulations (vis-à-vis implementation and compliance).²⁸⁸ However, the involvement of economic actors creates issues with legitimacy, accountability, and conflicts of interest in EU environmental law.²⁸⁹ A range of legal safeguards in EU law generally and environmental law specifically aim to balance the benefits and risk of private economic actors participation including: ensuring involvement of private and public actors beyond singularly affected industry; transparency in processes of environmental decisions; and public oversight and accountability. In addition, and critically, the EU legal system cannot “discriminate

²⁸⁶ Ibid, Annex III.

²⁸⁷ Abbot, C., and Lee, M. (2015) ‘Economic Actors in EU Environmental Law’, *Yearbook of European Law*. DOI: 10.1093/yel/yev002.

²⁸⁸ Ibid.

²⁸⁹ Ibid.

between different areas of law concerning enforcement of common obligations”²⁹⁰, meaning that economic property rights are neither absolute nor unqualified when it comes to environmental protection and nature conservation.

In addition to these regulations directly targeting financial activities (discussed below), a range of more general corporate disclosure laws, in the EU may apply to climate engineering technologies. Such laws, set out to ensure transparency and comparability of financial reporting; govern banking and insurance undertakings; cover information on corporate governance codes; internal control; and risk management systems related to corporate operations and financial reporting. While none of these directives make any mention of environmental information, sustainability objectives, climate, nature, carbon, greenhouse gasses, or other matters of substance related to climate engineering, to the extent that Member States either enact or support activities of economic actors to advance CDR or SRM; or economic actors themselves undertake or otherwise insure, issue debt, or underwrite CDR or SRM enterprises, these corporate disclosure laws will likely apply.

International law and policy

While there have been international initiatives related to corporate disclosure,²⁹¹ there are no binding international laws on corporate disclosure.

EU law and policy

In the European Green Deal,²⁹² transitioning private sector investment toward sustainability is one among a set of key policies and measures, complementing public sector action by the Commission, for example in use of regulatory, standardisation, investment and innovation, social dialogue, and national and international cooperation policy levers.

The **Sustainable Finance Disclosures Regulation (SFDR)** is thus part of the larger financial apparatus being put in place by the EU to direct financial flows toward achieving climate neutrality targets and advancing European environmental objectives (as set forth in the Taxonomy Regulation, discussed below) and a cornerstone of the Commission’s efforts to mobilize private sector sustainable investment in support of the broader European Green Deal Investment Plan.²⁹³ The **SFDR** lays down harmonised rules for financial market participants and financial advisers in regard to sustainability of financial processes and products.²⁹⁴ Financial market participants include insurance, investment management, pension, venture capital, social entrepreneurship, credit, and financial companies or advisers.²⁹⁵ The rules requires transparency and disclosure related to financial market risk policies,²⁹⁶ potential adverse impacts of investment decisions and degree of alignment with Paris Agreement objectives.²⁹⁷ The Regulation directs the European Environment Agency and Joint Research Centre of

²⁹⁰ Ibid, p. 39; Darpö, J. (2021). ‘Can Nature Get It Right? A Study on Rights of Nature’, *European Parliament, Policy Department for Citizens’ Rights and Constitutional Affairs, Directorate-General for Internal Policies*, PE 689.328, p. 73. DOI: 10.2861/4087.

²⁹¹ White, A. (2006) ‘Why we need global standards for corporate disclosure’, *Law and Contemporary Problems*, 69. Available at: <https://scholarship.law.duke.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1392&context=lcp>.

²⁹² Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee of the Regions, The European Green Deal COM(2019) 640 final.

²⁹³ European Commission. (2020) *The European Green Deal Investment Plan and Just Transition Mechanism Explained* / [Online]. Available at: https://ec.europa.eu/commission/presscorner/detail/en/ganda_20_24.

²⁹⁴ Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (OJ L 317 2019).

²⁹⁵ Ibid, Article 2.

²⁹⁶ Ibid, Article 3.

²⁹⁷ Ibid, Article 4.



the European Commission to draft regulatory technical standards on indicators of adverse impacts on environmental objectives. The law applies to pre-contractual disclosures, financial product disclosures, promotional statements on environmental or social characteristics of investments, elaborations of benchmarking and indexing methodologies, websites, and periodic investment reporting.²⁹⁸ In general, the SFDR requires transparency in all of the aforementioned articles on (a) description of environmental or social characteristics of the sustainable investment; (b) methodologies of assessment, measuring, and monitoring, as well as data sources and screening criteria; and (c) explanations on how or why designated investments align with environmental objectives. Financial market participants have an obligation to keep disclosure information up-to-date,²⁹⁹ and not contradict disclosed information in marketing communications.³⁰⁰ Member States are delegated authority of monitoring compliance and cooperate in supervision and investigation.³⁰¹

As a precursor law to the Taxonomy Regulation, the SFDR sets groundwork by defining “sustainable investment” as those which contribute to environmental objectives of the EU and do not significantly harm any environmental or social objectives of the Regulation. This private sector elaboration of sustainability disclosure is a precursor to broader public sector applicability.

The 2020 Taxonomy Regulation establishes the EU framework for sustainable investments, establishing criteria for determining qualification of an economic activity as environmentally sustainable to support environmentally sustainable investments.³⁰² The regulation applies to Member States or Union entities that set forth measures governing requirements of financial markets participants or products available as “environmentally sustainable,” or undertakings related to non-financial statements. The law defines as “environmentally sustainable” an investment where beneficial contributions to environmental objectives are not outweighed by harm.³⁰³ Qualifying for “environmentally sustainable” means an economic activity: a) substantially contributes to one or more environmental objectives³⁰⁴; b) does not significantly harm any environmental objectives³⁰⁵; c) complies with minimum safeguards with respect human and labour rights³⁰⁶; d) complies with technical screening criteria³⁰⁷. The Commission, under advisement of a Platform on Sustainable Finance (The Platform) and a Member State Expert Group on Sustainable Finance, assumes responsibility for answering the question of what constitutes “substantial contribution” and “significant harm”.³⁰⁸

The Taxonomy regulation directs Member States and the Union to use the criteria for environmentally sustainable economic activities in public measures, standards, and labelling activities in the financial market as “environmentally sustainable”.³⁰⁹ For example, this covers financial products or corporate bonds issued under the banner of being environmentally sustainable. The law distinguishes three types of pre-contractual disclosures and periodic reports related to financial product economic

²⁹⁸ Ibid, Article 6-11.

²⁹⁹ Ibid, Article 12.

³⁰⁰ Ibid, Article 13.

³⁰¹ Ibid, Article 14.

³⁰² Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, Article 1.

³⁰³ Ibid, Recital 34.

³⁰⁴ Ibid, Article 9-16.

³⁰⁵ Ibid, Article 9, 17.

³⁰⁶ Ibid, Article 18.

³⁰⁷ Ibid, Article 10.

³⁰⁸ Ibid, Article 20.

³⁰⁹ Ibid, Article 4.



activities³¹⁰—those claiming to be environmentally sustainable; those promoting environmental characteristics, and other financial products.³¹¹ Products claiming environmental sustainability must describe qualification as environmental sustainability per the four criteria. In addition, details must be provided on the proportion of “enabling” and “transitional activities.” Enabling activities do not lead to lock-in of assets counter to long-term environmental goals and have positive environmental impact based on life-cycle considerations.³¹² “Transitional economic activities”, applies to activities and sectors where no technologically or economically feasible low-carbon alternatives exist; in such cases, substantial contribution—specifically related to mitigation of greenhouse gas emissions—means activity emissions are lower than industry average, do not block future low-carbon alternatives, and do not lock-on assets incompatible with climate neutrality.³¹³

Products claiming only “environmental characteristics” need not take into account the “do no significant harm” principle and must disclaim this as well as that they do not account for the EU criteria for environmentally sustainable economic activities. All other products must disclaim not considering the EU criteria for environmentally sustainable economic activities. Non-financial statements—for processes associated with qualifying environmentally sustainable activities—must disclose turnover of environmentally sustainable products or services; proportions of capital and operational expenditures on such processes and assets; and the methodology of accounting and technical screening criteria used.³¹⁴

Environmental objectives referenced throughout the legislation include a) climate change mitigation; (b) climate change adaptation; (c) the sustainable use and protection of water and marine resources; (d) the transition to a circular economy; (e) pollution prevention and control; (f) the protection and restoration of biodiversity and ecosystems.³¹⁵

For any economic activity claiming environmental sustainability, the principle of “do no significant harm” must be observed.³¹⁶ Potential harm is explicitly defined for each of the environmental objectives, for example related to significantly increasing greenhouse gas emissions; adversely impacting current or expected future climate; damages water and marine resources; increases inefficiencies in material cycling, or generation of wastes; increases pollutants into air, water, or land; damages resilience of ecosystems or habitats and species. Environmental impacts of the activity and of associated products and services, throughout life cycles, must be considered.

In addition to the two main sustainability and financial framework laws, a host of other directives, regulations, and decisions in the EU may apply to climate engineering technologies from the perspective of corporate disclosure. Many of these laws share a common root in Directive 78/660/EEC,³¹⁷ which sets out to ensure transparency and comparability of financial reporting of publicly traded companies.³¹⁸ These regulations cover harmonisation of accounting standards and

³¹⁰ Elaboration of economic activities is carried out in Regulation (EU) 2019/2088, and financial product is referenced in Article 9 of that regulation.

³¹¹ Regulation (EU) 2020/852, Article 5-7.

³¹² Ibid, Article 16.

³¹³ Ibid, Article 10(2).

³¹⁴ Ibid, Article 8.

³¹⁵ Ibid, Article 9.

³¹⁶ Ibid, Article 17.

³¹⁷ Fourth Council Directive 78/660/EEC of 25 July 1978 based on Article 54 (3) (g) of the Treaty on the annual accounts of certain types of companies, 31978L0660, The Council of European Communities, (OJ L 222 1978).

³¹⁸ See also, Directive 2003/51/EC of the European Parliament and of the Council of 18 June 2003 amending Directives 78/660/EEC, 83/349/EEC, 86/635/EEC and 91/674/EEC on the annual and consolidated accounts of certain types of companies, banks and other financial institutions and insurance undertakings.

presentation of financial information;³¹⁹ securities information published on stock exchanges;³²⁰ disclosures related to financial reporting and issuance of securities, bonds, and debts;³²¹ banking and insurance undertakings.³²² These directives also cover requirements related to corporate governance codes; internal control; and risk management systems related to financial reporting. Additional directives also apply to public-interest entities (of significant public relevance because of nature of business or size or number of employees), credit and insurance institutions.³²³ While none of these directives make any mention of environmental information, sustainability objectives, climate, nature, carbon, greenhouse gasses, or other matters of substance related to Climate Engineering, to the extent that Member States either enact or support activities of economic actors to advance CDR or SRM, or economic actors themselves undertake or otherwise insure, issue debt, or underwrite CDR or SRM enterprises, these corporate disclosure laws will likely apply.

Climate engineering and corporate disclosure

The SFDR does not explicitly mention climate engineering (CDR or SRM technologies, or nature-based solutions), but it does show regard for transitioning to a low-carbon, more sustainable, resource-efficient and circular economy in line with the sustainable development goals, as well as The Paris Agreement.

The Taxonomy Regulation explicitly applies to CDR technologies and nature-based approaches, and would likely apply to SRM technologies, receiving private sector financial support and claiming to contribute to European environmental objectives. As the private sector elaboration of The Taxonomy regulation is a precursor to broader European alignment of financial investment flows with the European Green Deal,³²⁴ and application of The Taxonomy to public sector investments (e.g., in green bonds or in infrastructure development) is anticipated according to the European Green Deal Investment Plan,³²⁵ it is likely that any emerging climate engineering technologies, natural or otherwise, privately or publicly financed, would need to comply with this regulation.

The Taxonomy Regulation covers qualification of substantial contribution of economic activities to climate change mitigation—highly relevant for CDR activities.³²⁶ Activity contributions to this environmental objective must relate to atmospheric greenhouse gas concentration stabilisation consistent with long-term temperature goals of the Union.³²⁷ The Regulation explicitly qualifies economic activities as environmentally sustainable by “Increasing the use of environmentally safe

³¹⁹ Regulation (EC) No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards.

³²⁰ Directive 2001/34/EC of the European Parliament and of the Council of 28 May 2001 on the admission of securities to official stock exchange listing and on information to be published on those securities.

³²¹ Directive 2004/109/EC of the European Parliament and of the Council of 15 December 2004 on the harmonisation of transparency requirements in relation to information about issuers whose securities are admitted to trading on a regulated market and amending Directive 2001/34/EC.

³²² Directive 2006/46/EC of the European Parliament and of the Council of 14 June 2006 amending Council Directives 78/660/EEC on the annual accounts of certain types of companies, 83/349/EEC on consolidated accounts, 86/635/EEC on the annual accounts and consolidated accounts of banks and other financial institutions and 91/674/EEC on the annual accounts and consolidated accounts of insurance undertakings.

³²³ Directive 2013/34/EU of the European Parliament and of the Council of 26 June 2013 on the annual financial statements, consolidated financial statements and related reports of certain types of undertakings, amending Directive 2006/43/EC of the European Parliament and of the Council and repealing Council Directives 78/660/EEC and 83/349/EEC.

³²⁴ The European Green Deal.

³²⁵ European Commission. (2020), *supra* note 293.

³²⁶ Regulation (EU) 2020/852, Article 10.

³²⁷ Either through avoidance or reduction of greenhouse gas emissions or increase of greenhouse gas removal.

carbon capture and utilization (CCU) and carbon capture and storage (CCS) technologies that deliver a net reduction in greenhouse gas emissions.”³²⁸ Additional explicit mention is made to efforts that enhance land carbon sinks, either through reduced deforestation, forest and other land restoration, afforestation, and regenerative agriculture.

The Taxonomy Regulation covers explicitly qualifies economic activities as environmentally sustainable by either substantially reducing the risk of current or expected future adverse climate impacts on economic activity or people, nature, or assets without adverse impact on people, nature, or assets.³²⁹ Adaptation solutions are to be assessed by best available climate projections on prevention or reduction of location- and context-specific adverse impacts on economic activity or potential adverse impact of climate change on the environment in which the economic activity occurs. Specific issues include substantial contribution to use and protection of water and marine resources;³³⁰ the circular economy;³³¹ pollution prevention and control;³³² protection and restoration of biodiversity and ecosystems.³³³

No reference is made to SRM, ocean iron fertilization, or related activities, although any efforts to pursue such efforts as economic activities claiming environmental sustainability would likely need to demonstrate compliance with The Taxonomy Regulation.

Any economic activity claiming environmental sustainability—whether through CDR, SRM or other innovations—would need to comply with the principle of “do no significant harm” when accounting for the life cycle of products or services of the economic activity.³³⁴ Technical criteria for ‘substantial contribution’ and ‘significant harm’ are to be updated regularly, based on scientific evidence, and with input from expert and relevant stakeholders through the multi-stakeholder platform on sustainable finance.³³⁵ Harms in excess of benefits will not qualify; where scientific evidence is insufficient or not allow for determinations with “sufficient certainty,” the precautionary principle is to apply.

4.3.4 Public participation

States have obligations to provide information to public, create opportunities for public participation in the decision-making process, and provide remedy when these rights are not adequately guaranteed. Although neither the term ‘climate engineering’ or any specific type of activity are not explicitly referenced in the laws, climate engineering activities would very likely meet the definition of the activities covered by the laws because of their direct and indirect effects impacts on the environment.

³²⁸ Regulation (EU) 2020/852, Article 10(e).

³²⁹ Ibid, Article 11.

³³⁰ Ibid, Article 12. Where conditions in this and subsequent Articles refer to “good environmental status” or “good ecological potential,” Article 2 (21) and (22) point to Directives 2008/56/EC, establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (OJ L 164, 25.6.2008, p. 19) and Directive 2000/60/EC establishing a framework for Community action in the field of water policy (OJ L 327, 22.12.2000, p. 1).

³³¹ Regulation (EU) 2020/852, Article 13.

³³² Ibid, Article 14.

³³³ Ibid, Article 15. See also, Recital 31: Protection and restoration of biodiversity and ecosystems relates to ecosystem services of: provisioning (e.g., of food and water), regulating (e.g., control of climate or disease), supporting (e.g., nutrient cycling or oxygen production), and cultural services (e.g., spiritual or recreational benefits).

³³⁴ Regulation (EU) 2020/852, Article 17.

³³⁵ Ibid, Article 20 and Recital 38. See also Recital 47: Technical screening is to be legally clear, practicable, verifiable, reasonably costed, and require life-cycle assessment where practicable.

International law and policy

Under international law, the right to public participation is protected by legal frameworks devoted to environmental governance, in addition protection under human rights law (see Section 4.1.7).

The **1992 Rio Declaration** set the policy direction for public participation as a part of environmental governance. Principle 10 states that “environmental issues are best handled with the participation of all concerned citizens, at the relevant level. At the national level, everyone shall have appropriate access to information concerning the environment that is held by public authorities, including information on hazardous materials and activities in their communities, and the opportunity to participate in decision-making processes. States shall facilitate and encourage public awareness and participation by making information widely available. Effective access to judicial and administrative proceedings, including redress and remedy, shall be provided.”³³⁶

The **Aarhus Convention of 25 June 1998** obliges States to guarantee the rights of access to information, public participation in decision-making, and access to justice in environmental matters for both individuals and associations.³³⁷ The Aarhus Convention focuses on interactions between the public and the public authorities. Public access to information on environmental matters might concern information on procedures (including legislative or administrative procedures), installations, investments, or substances. In the Aarhus Convention, “environmental information” is understood broadly, encompassing information on the of the environment, factors affecting or likely to affect the environment, as well as the state of human health and safety, and their surroundings, in as much as they are or may be affected by the state of the environment.³³⁸ Public authorities are obliged to collect and update environmental information, including the establishment of systems that guarantee a flow of information to public authorities about proposed and existing activities which may significantly affect the environment.³³⁹

Regarding public participation, the Aarhus Convention lays down rules on public participation in decisions on specific activities.³⁴⁰ In addition, States should make appropriate provisions for the public to participate during the preparation of plans and programmes relating to the environment, within a transparent and fair framework, having provided the necessary information to the public³⁴¹ and during the preparation of executive regulations and other generally applicable legally binding rules that may have a significant effect on the environment.³⁴²

Additionally, public authorities are required to make relevant environmental information available to the public in accordance with requirements, such as timeliness, and with limitations, such as preventing adverse effects on intellectual property rights.³⁴³ If any person who considers that his or her request for information been ignored, wrongfully refused, whether in part or in full, inadequately answered, or otherwise not dealt with, the State is obligated to ensure they have access to a review procedure before a court of law or another independent and impartial body established by law.³⁴⁴

³³⁶ Rio Declaration, Principle 10.

³³⁷ United Nations Economic Commission for Europe (UNECE). (1998) *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters*, 25 June 1998.

³³⁸ Ibid, Article 2.3.

³³⁹ Ibid, Article 5(1)(b).

³⁴⁰ Ibid, Article 6, Annex I.

³⁴¹ Ibid, Article 7.

³⁴² Ibid Article 8.

³⁴³ Ibid, Article 4.

³⁴⁴ Ibid, Article 9.



EU law and policy

Directive 2003/35/EC provides for public participation in environmental assessment of plans and programmes.³⁴⁵ The aim of the Directive is to support implementation of European obligations from the Aarhus Convention. This is carried out by amending previous rules on access to justice³⁴⁶ concerning effects of public and private projects on the environment, and integrated pollution prevention and control. Directive 2003/35/EC defines “public” as persons, associations, or groups (including environmental nongovernmental organizations), and requires Member States to ensure the public be given early, effective opportunities to participate in preparation and modification of plans or programmes.³⁴⁷ A range of media must be pursued to share information; the public is entitled to express comments; these results must be taken into due account by the decision making authority, and inform the public of reasons and considerations upon which decisions are based.³⁴⁸

EU ascension to the international Aarhus Convention in 2005 set in motion a range of additional rights and protections related to environmental justice proceedings.³⁴⁹

The 2006 Regulation (EC) No 1367/2006 ensures public access to information, participation in decision-making, and recourse to justice in environmental decision making in the EU.³⁵⁰ The regulation requires European institutions, bodies, and national authorities to inform the public and open possible public participation—and a duty to accurately account for the results—for environmental plans and programs. Environmental information is defined by any medium of material on the state of the environment (air, water, coasts, atmosphere, biodiversity, etc.); factors affecting or likely to affect these aspects of the environment (e.g., noise, radiation, emissions); measures to protect these elements; cost-benefit analysis of such measures; and effect on human health, safety (e.g., on food chain, human life, cultural sites).³⁵¹ The public has the right to apply for access to information regardless of citizenship, nationality, or domicile.³⁵² The EU and associated institutions and bodies are required to organize and systematically disseminate environmental information to the public and maintain updated databases of various kinds of environmental information, assessments, and impact studies.³⁵³ Member States are permitted to decline applications requesting environmental information based on determinations or potential harm to environment from such disclosure (e.g., breeding site of rare species). Participation is to be supported by practical arrangements for submission and reasonable time frames, and input gathered must be taken into “due account” in environmental decision making.³⁵⁴ Independent, non-profit public bodies or legal persons with primary objectives of promoting environmental protection, more than two years old, have the right to make requests in writing and not exceeding 8 weeks after adoption of the administrative act.³⁵⁵

³⁴⁵ Directive 2003/35/EC of the European Parliament and of the Council of 26 May 2003 providing for public participation in respect of the drawing up of certain plans and programmes relating to the environment and amending with regard to public participation and access to justice Council Directives 85/337/EEC and 96/61/EC.

³⁴⁶ Since repealed: Directive of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (85/337/EEC) and Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control.

³⁴⁷ Directive 2003/35/EC, Article 2.

³⁴⁸ Ibid.

³⁴⁹ Darpö, J. (2021), *supra* note 290, p.73.

³⁵⁰ Regulation (EC) No 1367/2006 of the European Parliament and of the Council of 6 September 2006 on the application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Union institutions and bodies, Article 1.

³⁵¹ Ibid, Article 2.

³⁵² Ibid, Article 3.

³⁵³ Ibid, Article 4.

³⁵⁴ Ibid, Article 9.

³⁵⁵ Ibid, Article 10-11.

Administrative bodies or the EU institution to whom the review was requested must respond no later than 16 week after the 8 week deadline. The requesting body may institute proceedings before the Court of Justice of the European Union (CJEU) against the Union institution or body failing to comply with the requirements (response to review or other failure to comply).

Access to environmental justice in EU and national courts was recently expanded by Regulation (EU) 2021/1767³⁵⁶ to grant the public and environmental non-governmental organisations (ENGOS) increased recourse to redress environmental harms where public and private actors violate EU environmental law. The revised regulation now grants ENGOS and other publics to request the ability to review of administrative acts impinging on their rights. Defendants still need to demonstrate direct effect (e.g., imminent threat to health and safety or contravention of a Union right based on EU environmental law) greater than what is posed to the general public. This modification of the EU law governing adoption of the Aarhus Convention demonstrates how the Aarhus Compliance Committee, charged with reviewing and providing feedback on the law, does allow for environmental justice reforms may unfold over time, as cultural and technological factors change (although in instances taking 10 -20 years or more).³⁵⁷

European environmental case law, decided by the Court of Justice of the European Union, has also been gradually strengthening potential standing of environmental complaints and cases. Under the Aarhus Convention and environmental procedural justice statutes, publics concerned with nature conservation and environmental protection are increasingly able to bring cases to the Court of Justice of the European Union (CJEU). CJEU case law is thus an important source not only for implementing and understanding environmental justice proceedings, but also in strengthening them over time. Primary successes here have involved creating more ground for ENGO standing in court and overcoming the cost barriers to environmental justice such cases often entail. Essentially, these outcomes elevate civil society as a check on EU institutions and private sector actors, as well as helping ensure delivery of the aspirations of the European Green Deal.³⁵⁸

Climate engineering and public participation

Under international and EU law, the public has a right to participate in decision-making about climate engineering. Although neither the term ‘climate engineering’ or any specific type of activity are not explicitly referenced in the laws, climate engineering activities would very likely meet the definition of the activities covered by the laws because of their direct and indirect effects impacts on the environment, pollution of water, air quality, and atmospheric pollution. For example, Directive 2003/35/EC Annex I lists plans and programmes – and associated Directives – to which the amendments will be carried out. Amendments are carried into a range of directives on protection of waters against pollution by nitrates from agricultural sources, hazardous wastes, ambient air quality, and reduction of national emissions of atmospheric pollutions. Given the substantive focus of such directives, it is very likely that SRM plans and programmes would be required to comply with these public participation requirements, owing to the potential effects of altered weather on storms precipitating significant agricultural run-off or generating atmospheric pollution. Similarly, compliance

³⁵⁶ Regulation (EU) 2021/1767 of the European Parliament and of the Council of 6 October 2021 amending Regulation (EC) No 1367/2006 on the application of the provisions of the Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters to Community institutions and bodies (PE/63/2021/REV/1. OJ L 356, 8.10.2021) pp. 1–7.

³⁵⁷ Darpö, J. (2021), *supra* note 290, p. 37.

³⁵⁸ See generally, Darpö, J. (2021), *supra* note 290.

by CDR plans and programmes would also seem likely given the substantive focus on activities related to reduction of national atmospheric pollution emissions.

Therefore, States have obligations to provide information to the public, create opportunities for public participation in the decision-making process, and provide remedies when these rights are not adequately guaranteed.

It should be noted that some critiques of the Aarhus Convention suggest its application may be more limited in the context of climate engineering. Those critics point out that the design of the Aarhus Convention reflects traditional structure of decision-making and may fail to cover all types of decision-making relevant for environmental protection, e.g., decisions related to “the application of modern technologies, which involve high degree of risk, like for example carbon capture and storage, shale gas extraction, nanotechnology, geo-engineering and even nuclear power stations. They all tend to be included into the regulatory scheme the same way as traditional activities, whereby the impact on the environment and human health is more or less predictable and well recognized and its magnitude and scale are rather manageable.”³⁵⁹

4.3.5 Pollution prevention

The prevention of pollution is a key element in the international environmental law regime. Whilst there is a lot of scientific uncertainty around the potential negative externalities of climate engineering technologies, certain environmental laws and principles would apply to climate engineering applications to prevent and remedy pollution which negatively affects human health and the environment. Various elements of the whole life-cycle of climate engineering techniques are associated with a risk of pollution, or scientific uncertainty as to what the potential risks are. It is unclear, for example, what the long-term impacts of geological carbon storage on the quality of soil, water, and air.³⁶⁰ Any pollution that occurs as a result of climate engineering techniques may result in liability for States under international and European Union law. Furthermore, States are under an obligation to prevent pollution as much as possible. On the other hand, climate engineering also has the potential to positively impact air quality, by reducing other emissions harmful to human health when capturing GHGs. It is important that a whole life-cycle assessment is considered for climate engineering to fully assess the risks of pollution.

International law and policy

States’ obligation to prevent, reduce and control transboundary pollution and environmental harm, and the duty to cooperate can be regarded as customary international law.³⁶¹ These principles are also reflected in the Rio Declaration and in international jurisprudence, which reinforces that States can be held liable for transboundary pollution.³⁶² ‘Pollution’ is generally understood to be a form of environmental harm, and as such constitutes a narrower concept.³⁶³ Yet, various international agreements are solely or primarily concerned with the prevention, reduction and control of

³⁵⁹ Jendroška, J. (2012) ‘Citizen’s Rights in European Environmental Law: Stock-Taking of Key Challenges and Current Developments in Relation to Public Access to Information, Participation and Access to Justice’, *Journal for European Environmental & Planning Law*, 9(1), pp. 71-90. DOI: <https://doi.org/10.1163/187601012X632265>.

³⁶⁰ See, e.g., Newmark R. L, Friedmann S. J and Carroll S. A. (2010) ‘Water Challenges for Geologic Carbon Capture and Sequestration’, *Environmental Management*, 45(4), pp. 651-661. DOI: <https://doi.org/10.1007/s00267-010-9434-1>.

³⁶¹ Birnie P., Boyle A., and Redgwell C. (2021), supra note 250, p. 153.

³⁶² Rio Declaration, Principles 2, 18, 19; *Trail Smelter case* (United States v Canada) (Arbitration Tribunal) (1938 and 1941) 3 R.I.A.A. 1905; *Pulp Mills on the River Uruguay (Argentina v Uruguay)*, *Judgment*, I.C.J. Reports 2010, p. 14.

³⁶³ Birnie P., Boyle A., and Redgwell C. (2021), supra note 250, p. 212-213.

pollution.³⁶⁴ Furthermore, the Rio declaration places an obligation on States to adopt laws regarding liability and compensation for victims of pollution,³⁶⁵ and holds that polluters should, in principle, bear the cost of pollution, also known as the polluter-pays principle.³⁶⁶ Two important underlying principles of international environmental law related to pollution prevention are the precautionary principle and the customary obligation of due diligence.³⁶⁷

Various international treaties deal with the regulation of specific pollutants or types of pollution. The 1979 Convention on Long-Range Transboundary Air pollution (LRTAP), for example, is the first multilateral agreement on transboundary air pollution and creates a regional framework for the reduction of transboundary air pollution and for the better understanding air pollution science. It has various protocols, the broad aim of which is to reduce and control certain types of emissions that negatively impact air quality.³⁶⁸ The Gothenburg Protocol, for instance, seeks to regulate emissions contributing to acid rain, eutrophication and ground level ozone, targeting sulphur dioxide, nitrogen oxides, and volatile organic compounds.³⁶⁹ Following amendments, the Protocol now also addresses particulate matter, including black carbon.³⁷⁰

The 1998 Rotterdam Convention on Prior Informed Consent, for example, regulates the international trade of hazardous chemicals and pesticides contained in Annex III.³⁷¹ It codifies the Prior Informed Consent procedure aimed at helping governments make informed decisions when importing hazardous chemicals.³⁷² The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) regulates chemicals recognised as posing long-term hazards to human and animal health.³⁷³ The 2013 Minamata Convention on Mercury seeks to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.³⁷⁴ Finally, the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal seeks to “provide for a comprehensive regime for liability and for adequate and prompt compensation for damage resulting from the transboundary movement of hazardous wastes and other wastes and

³⁶⁴ Ibid, p. 213; see, e.g., the Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (entry into force 24 February 2004) 2244 UNTS 337 (1998 Rotterdam Convention); Stockholm Convention on Persistent Organic Pollutants (entry into force 17 May 2004) 2256 UNTS 119 (Stockholm POPs Convention); Minamata Convention on Mercury (entry into force 16 August 2017) UNTS No. 54669 (Minamata Convention); Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel Convention) (entered into force 5 May 1992), 1673 UNTS 57; UNCLOS, part XII.

³⁶⁵ Rio Declaration, Principle 13.

³⁶⁶ Ibid, Principle 16.

³⁶⁷ Birnie P., Boyle A., and Redgwell C. (2021), *supra* note 250, p. 205.

³⁶⁸ UNECE, *Protocols/UNECE* [Online]. Available at: <https://unece.org/protocols>.

³⁶⁹ Protocol to the 1979 Convention on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone (entry into force 17 May 2005) 2319 UNTS 81 (Gothenburg Protocol).

³⁷⁰ Amendment to the text and annexes II to IX to the Protocol to the 1979 Convention on Long-range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone and the addition of new annexes X and XI (entry into force 7 October 2019) UNTS 21623 (Amendment to the Gothenburg Protocol); Office of Environmental Quality, *Convention on Long-Range Transboundary Air Pollution / U.S. Department of State* [Online]. Available at: <https://www.state.gov/key-topics-office-of-environmental-quality-and-transboundary-issues/convention-on-long-range-transboundary-air-pollution/#:~:text=The%201979%20Convention%20on%20Long,pollution%20and%20better%20understanding%20air>

³⁷¹ Rotterdam Convention, Annex III.

³⁷² Ibid; United Nations Environment Programme, *History of the negotiations of the Rotterdam Convention / U.N. Environment Programme: Rotterdam Convention* [Online]. Available at <http://www.pic.int/TheConvention/Overview/History/Overview/tabid/1360/language/en-US/Default.aspx>.

³⁷³ Stockholm POPs Convention, Article 1.

³⁷⁴ Minamata Convention, *supra* note 364, Article 1.

their disposal including illegal traffic in those wastes.”³⁷⁵ The legal regimes in relation to the regulation of space debris and marine pollution are considered in sections 4.5.1 and 4.6.3, respectively.

EU law and policy

When it comes to environmental protection and the prevention of pollution, European Union law codifies the precautionary principle, the principle of preventive action, and the principle that the polluter should pay.³⁷⁶ The objective of EU environmental policy is to contribute to “[i] preserving, protecting and improving the quality of the environment; [ii] protecting human health; [iii] the prudent and rational utilisation of natural resources; [and, iv] promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change.”³⁷⁷ This forms the legal basis for the European Parliament and the Council to decide what action is required on a Union level to achieve these environmental objectives.³⁷⁸

The Environmental Liability Directive establishes a framework based on the polluter pays principle to prevent and remedy environmental damage.³⁷⁹ Furthermore, pollution is a key consideration in Environmental Impact Assessments.³⁸⁰ More specific legal regimes have been adopted to deal with different types of pollution, including industrial emissions, air quality, water, noise and waste.

Industrial emissions are addressed by Directive 2010/75/EU on integrated pollution prevention and control.³⁸¹ The Air Quality Directive establishes ambient air quality objectives to protect human health and the environment from harmful effects.³⁸² The framework for managing water resources, improving water quality, preventing water pollution, and protecting the water environment is laid out in the Water Framework Directive (2000/60/EC),³⁸³ and Directive (91/676/EEC) concerns the protection of waters against pollution caused by nitrates from agricultural sources.³⁸⁴ Directive 2002/49/EC on the assessment and management of environmental noise is the main instrument to identify noise pollution and trigger necessary action at Member State and EU level.³⁸⁵ Directive 2008/98/EC sets out the waste framework for the reduction of waste and appropriate management of waste including hazardous waste, and the controls on shipments of waste.³⁸⁶ The control of major

³⁷⁵ Basel Convention, Article 1.

³⁷⁶ Consolidated Version of the Treaty on the Functioning of the European Union (TFEU) (2012) (OJ C326/01), Article 191(2).

³⁷⁷ Ibid, Article 191(1).

³⁷⁸ Ibid, Article 192 (1).

³⁷⁹ Directive 2004/35/EC of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L143/56).

³⁸⁰ Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the Assessment of the Effects of Certain Public and Private Projects on the Environment (OJ L26/1) as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 (OJ L124/1), Articles 4 (3) and 5 (1), and Annexes III and IV.

³⁸¹ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L334/17).

³⁸² Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (OJ L52/1), Article 1 (1).

³⁸³ Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (OJ L327/1).

³⁸⁴ Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (OJ L375/1).

³⁸⁵ Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise – Declaration by the Commission in the Conciliation Committee on the Directive relating to the assessment and management of environmental noise (OJ L189/12).

³⁸⁶ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L312/3).

accident hazards involving dangerous substances is addressed in Directive 2012/18/EU. Finally, Regulation (EC) No 166/2006 establishes a European Pollutant Release and Transfer Register.³⁸⁷

Climate engineering and pollution prevention

International and European Union law place an obligation on States to prevent or remedy pollution. This means that if certain climate engineering activities within a State's jurisdiction cause pollution, the State may be held responsible if the pollution is attributable to them. It may be that the climate engineering activity is commissioned by and carried out on behalf of the State,³⁸⁸ which would make any pollution the responsibility of the State. Nevertheless, even if the climate engineering activities are carried out by a private actor, States have a responsibility to regulate these activities to prevent and remedy pollution.³⁸⁹

In relation to air pollution, for instance, Solar Radiation Management (SRM) may negatively impact air quality, and some of the aerosols considered for stratospheric aerosol injection are regulated pollutants, such as sulphur dioxide, and black carbon.³⁹⁰ Furthermore, the potential health impacts of the aerosols that may be used for stratospheric aerosol injection can be significant.³⁹¹ On the other hand, however, one could argue that the reduction of GHGs from various sources could also result in a reduction of SO₂,³⁹² whereas some level of sulphur particulates in the atmosphere would be desirable for their cooling effect as can be observed following volcanic eruptions.³⁹³ Yet, it is unclear to what extent stratospheric aerosol injection may affect air quality or to what extent they will affect public health.³⁹⁴ If this technique does result in an endangerment to human health or the environment, whether introduced directly or indirectly through the stratosphere and into the troposphere, it can be reasonably be assumed to fall within the international and European Union legal regimes on air pollution.

Carbon Capture and Storage (CCS) may also result in increased pollution. Whilst CO₂ is captured by the CCS plant, the operation of the plant itself, transport and storage processes are associated with additional indirect emissions, which affect air quality and human health.³⁹⁵ Leakage of stored CO₂ may also result in local air pollution, as 10% of CO₂ in the air is assumed to be fatal.³⁹⁶ Furthermore, other forms of pollution, including air and noise pollution, may be associated with the development of the

³⁸⁷ Regulation (EC) No 166/2006 of the European Parliament and of the Council of 18 January 2006 concerning the establishment of a European Pollutant Release and Transfer Register and amending Council Directives 91/689/EEC and 96/61/EC (OJ L33/1).

³⁸⁸ Lockley A. (2016) 'Licence to chill: building a legitimate authorisation process for commercial SRM operations', *Environmental Law Review*, 18(1), p.2. DOI: <https://doi.org/10.1177/1461452916630082>.

³⁸⁹ Ibid.

³⁹⁰ Gothenburg Protocol; Amendment to the Gothenburg Protocol.

³⁹¹ Effiong U. and Neitzel R. J. (2016) 'Assessing the Direct Occupational and Public Health Impacts of Solar Radiation Management with Stratospheric Aerosols' *Environmental Health*, 15(7), p.4. DOI: <https://doi.org/10.1186/s12940-016-0089-0>.

³⁹² Ming T., De Richter R., Caillol S. (2014) 'Fighting global warming by climate engineering: Is the Earth radiation management and the solar radiation management any option for fighting climate change?' *Renewable and Sustainable Energy Reviews*, 31. DOI: <https://doi.org/10.1016/j.rser.2013.12.032>.

³⁹³ Rash P. J. et al. (2008) 'An overview of geoengineering of climate using stratospheric sulphate aerosols' *Philosophical Transactions of the Royal Society*, 366, 4007-4037. DOI: <https://doi.org/10.1098/rsta.2008.0131>

³⁹⁴ Effiong U. and Neitzel R. J. (2016) 'Assessing the Direct Occupational and Public Health Impacts of Solar Radiation Management with Stratospheric Aerosols' *Environmental Health*, 15(7), p.1 DOI: <https://doi.org/10.1186/s12940-016-0089-0>.

³⁹⁵ European Environment Agency (2011), 'Air pollution impacts from carbon capture and storage (CCS)' *European Environment Agency*, Technical Report No 14/2011, p.43. Available at: <https://www.eea.europa.eu/publications/carbon-capture-and-storage>.

³⁹⁶ Ibid, p. 24.

required infrastructure for CCS, during transport and storage processes. The international and European Union regimes on pollution and obligation of States to prevent pollution will apply to the development of climate engineering techniques.

Whilst GHGs and air pollutants are generally regulated by separate legal regimes, both categories often originate from similar emission sources.³⁹⁷ That means that measures targeting GHG emissions can have both synergistic and antagonistic effects on emissions of other pollutants.³⁹⁸ As might be expected, afforestation and reforestation clearly also have a positive impact on air quality.³⁹⁹ By reducing GHG emissions, climate engineering techniques may also positively impact air quality and therefore human health and the environment.⁴⁰⁰ It is therefore important that the overall benefit of climate engineering techniques is greater than their negative impacts. Given the scientific uncertainty around the full implications of climate engineering, and having regard to the precautionary principle, this is potentially problematic.

Another possible tension with the use of climate engineering techniques is that the benefit (GHG removal) is on a global scale, whereas the potential negative consequences, such as air pollution, often have a very local impact. As Lockley points out, there is a risk of poor compliance with local rules that lack adequate enforcement.⁴⁰¹ This has been seen in the mining and waste disposal industry.⁴⁰² Furthermore, Lockley points out the risk that the SRM industry may lead to a 'race to the bottom', where states compete to attract investment by laxing their national legal and regulatory control frameworks.⁴⁰³ Tax havens are the prime example of this, although it has also been seen in polluting industries.⁴⁰⁴ Given the global scale and impact of climate engineering techniques, further international and European Union regulation may be required to regulate their use in good order.

4.3.6 Environmental management including waste and chemicals

The environmental management of chemicals and waste is closely related to the international and EU law regime around the prevention of pollution. The main objective around these international and EU laws is often around the protection of human health and the environment. Climate engineering may involve the use of chemicals that fall within these regulations. Furthermore, climate engineering techniques may produce waste, making these activities subject to international and EU waste

³⁹⁷ Ibid, p. 13.

³⁹⁸ Ibid.

³⁹⁹ See, e.g., Brack C. L. (2002) 'Pollution mitigation and carbon sequestration by an urban forest' *Environmental Pollution*, 116. DOI: [https://doi.org/10.1016/s0269-7491\(01\)00251-2](https://doi.org/10.1016/s0269-7491(01)00251-2).

⁴⁰⁰ European Environment Agency. (2011), supra note 395, p. 13.

⁴⁰¹ Lockley A. (2016), supra note 388, p. 6.

⁴⁰² See, e.g., Lemaitre D. (2014) *Peru's informal mining sector threatens economic growth* / Global Risk Insights [Online]. Available at: <https://globalriskinsights.com/2014/02/perus-informal-mining-sector-threatens-economic-growth/>; Spiegel S. J. (2012) 'Governance Institutions, Resource Rights Regimes, and the Informal Mining Sector: Regulatory Complexities in Indonesia' *World Development*, 40 (1). DOI: <https://doi.org/10.1016/j.worlddev.2011.05.015>; Massari M. and Monzini P. (2004) 'Dirty Businesses in Italy: A Case-study of Illegal Trafficking in Hazardous Waste', *Global Crime*, 6 (3-4), pp.285-304. DOI: <https://doi.org/10.1080/17440570500273416>.

⁴⁰³ Lockley A. (2016), supra note 388, p.6; Dong B., Gong J. and Zhao X. (2011) 'FDI and Environmental Regulation: Pollution Haven or a Race to the Top?', *Journal of Regulatory Economics*, 41(2), pp.216-237. DOI: <https://doi.org/10.1007/s11149-011-9162-3>.

⁴⁰⁴ Lockley A. (2016), supra note 388, p. 6; Altshuler R. and Grubert H. (2005) 'The Three Parties in the Race to the Bottom: Host Governments, Home Governments and Multinational Companies', *CESifo Working Paper No. 1613*, [Online]. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=875308; Kirsch S. (2012) 'Cultural Geography I: Materialist Turns', *Progress in Human Geography*, 37(3), pp.433-441. DOI: <https://doi.org/10.1177%2F0309132512459479>.

regulations. This section considers how the international and EU law regimes on chemicals and waste may apply to climate engineering.

International law and policy

The international law regime on the environmental management of chemicals and waste to a large extent overlaps with the prevention of pollution. The 1979 LRTAP Convention seeks to reduce transboundary air pollution and create a better understanding air pollution science. It has various protocols which target the environmental management of certain chemicals that negatively impact air quality.⁴⁰⁵ The Gothenburg Protocol, for instance, seeks to regulate emissions contributing to acid rain, eutrophication and ground level ozone, targeting sulphur dioxide, nitrogen oxides, and volatile organic compounds. Following amendments, the Protocol now also addresses particulate matter, including black carbon.⁴⁰⁶

The 1998 Rotterdam Convention on Prior Informed Consent, for example, regulates the international trade of hazardous chemicals and pesticides contained in Annex III.⁴⁰⁷ It codifies the Prior Informed Consent procedure aimed at helping governments make informed decisions when importing hazardous chemicals.⁴⁰⁸ The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) regulates chemicals recognised as posing long-term hazards to human and animal health.⁴⁰⁹ The 2013 Minamata Convention on Mercury seeks to protect the human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.⁴¹⁰

With regard to the environmental management of waste, the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal seeks to “provide for a comprehensive regime for liability and for adequate and prompt compensation for damage resulting from the transboundary movement of hazardous wastes and other wastes and their disposal including illegal traffic in those wastes.”⁴¹¹ The legal regimes in relation to the regulation of space debris and marine pollution are considered in sections 4.5.1 and 4.6.3, respectively.

EU law and policy

Similar to the regime on pollution prevention, European Union law on environmental management of chemicals and waste seek to protect the environment and human health.⁴¹² With regard to waste prevention and management, the 2008 Waste Framework Directive introduced “measures to protect the environment and human health by preventing or reducing the adverse impacts of the generation and management of waste and by reducing the overall impacts of resource use and improving efficiency of such use.”⁴¹³ It also introduces a waste hierarchy, which prioritises waste management in the order of prevention, re-use, recycling, other recovery (such as energy recovery), and finally

⁴⁰⁵ UNECE, *Protocols* / UNECE [Online]. Available at: <https://unece.org/protocols>.

⁴⁰⁶ Amendment to the Gothenburg Protocol; Office of Environmental Quality, *supra* note 370.

⁴⁰⁷ Rotterdam Convention, Annex III.

⁴⁰⁸ Rotterdam Convention; United Nations Environment Programme, *History of the negotiations of the Rotterdam Convention / U.N. Environment Programme: Rotterdam Convention* [Online]. Available at <http://www.pic.int/TheConvention/Overview/History/Overview/tabid/1360/language/en-US/Default.aspx>.

⁴⁰⁹ Stockholm POPs Convention, Article 1.

⁴¹⁰ Minamata Convention, Article 1.

⁴¹¹ Basel Convention, Article 1.

⁴¹² European Commission, *Waste Law / European Commission* [Online]. Available at: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-law_en.

⁴¹³ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives [2008] OJ L312/3, Article 1.

disposal.⁴¹⁴ The EMAS Regulation created a voluntary scheme for organisations to participate in eco-management and environmental audit.⁴¹⁵ Furthermore, EU law establishes procedures and control regimes for the shipment of waste,⁴¹⁶ and implements the Stockholm Convention on Persistent Organic Pollutants and the Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution on Persistent Organic Pollutants with a view to minimise the release of substances subject to the Convention and the Protocol by establishing provisions regarding waste which contains or is contaminated by such substances.⁴¹⁷

With regard to the management of chemicals, the European Chemicals Agency (ECHA) was established to implement the EU's 2006 Regulation concerning the registration, evaluation, authorisation, and restriction of chemicals (REACH) for the protection of human health and the environment.⁴¹⁸ The ECHA also contributes to the functioning of the internal market, innovation and competitiveness of the chemicals industry in Europe.⁴¹⁹

The EU has adopted various regulations, Directives and decisions concerned with specific elements of environmental management, including packaging and packaging waste,⁴²⁰ end-of life vehicles,⁴²¹ batteries and accumulators,⁴²² industrial emissions,⁴²³ restriction on the use of certain hazardous substances in electrical and electronic equipment,⁴²⁴ on waste electrical and electronic equipment,⁴²⁵ port facilities for the delivery of waste from ships,⁴²⁶ reduction of single-use plastic,⁴²⁷ and the landfill

⁴¹⁴ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L312/3), Article 4.

⁴¹⁵ Regulation (EC) No 1221/2009 of the European Parliament and of the Council of 25 November 2009 on the voluntary participation by organisations in a Community eco-management and audit scheme (EMAS), repealing Regulation (EC) No 761/2001 and Commission Decisions 2001/681/EC and 2006/193/EC (OJ L342/1 2009).

⁴¹⁶ Regulation (EC) No 1013/2006 of the European Parliament and of the Council of 14 June 2006 on shipments of waste (OJ L190/1 2006).

⁴¹⁷ Regulation (EU) 2019/1021 of the European Parliament and of the Council of 20 June 2019 on persistent organic pollutants (OJ L169/45 2019), Article 1.

⁴¹⁸ Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC (OJ L396/1 2006).

⁴¹⁹ European Chemicals Agency, *About us* / ECHA [Online]. Available at: <https://echa.europa.eu/about-us>

⁴²⁰ Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (OJ L365/10).

⁴²¹ Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L269/34).

⁴²² Directive 2006/66/EC of the European Parliament and of the Council of 6 September 2006 on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC (OJ L266/1).

⁴²³ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L334/17).

⁴²⁴ Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (OJ L174/88).

⁴²⁵ Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electrical equipment (WEEE) (OJ L197/38).

⁴²⁶ Directive (EU) 2019/883 of the European Parliament and of the Council of 17 April 2019 on port reception facilities for the delivery of waste from ships, amending Directive 2010/65/EU and repealing Directive 2000/59/EC (OJ L151/116).

⁴²⁷ Directive (EU) 2019/904 of the European Parliament and of the Council of 5 June 2019 on the reduction of the impact of certain plastic products on the environment (OJ L155/1).

of waste.⁴²⁸ Finally, EU policy focuses an action plan and strategy for the implementation of a circular economy.⁴²⁹

Climate engineering and environmental management

Climate engineering techniques may involve the use of certain chemicals, such as during Stratospheric Aerosol Injection as a form of Solar Radiation Management (SRM). Some of the proposed chemicals for this technique are regulated chemicals, making the climate engineering technique subject to the regulatory control processes of international and EU law.⁴³⁰ These chemical regulations often target the chemical itself, meaning that regardless of whether the climate engineering technique causes pollution or harm to human health or the environment, the use of the chemical would by definition be subject to regulation.

Waste resulting from the use of climate engineering techniques would be subject to international and EU regulations on the management of waste. With regard to Carbon Capture and Storage (CCS), CO₂ may be regarded as falling within the definition of a waste, in the sense that it is a substance that is being disposed of by permanent storage.⁴³¹ According to the IPCC, the main risk of transporting CO₂ are leakage and unintended release,⁴³² which could harm human health and the environment.⁴³³ There may also be an impact on climate change if CO₂ is suddenly released back into the atmosphere.⁴³⁴ An analysis of CO₂ indicated that CO₂ may even be classified as hazardous waste.⁴³⁵ Whilst the Basel Convention does not directly impose restrictions on the transportation of CO₂, CO₂ during transportation arguably has the characteristics of a hazardous waste within the definition of the Basel Convention.⁴³⁶ That would make the transboundary movement of CO₂ subject to the compliance with the constraints on the movement of hazardous wastes laid out by the Basel Convention.⁴³⁷ Furthermore, whilst CO₂ is not currently listed as a hazardous waste within the meaning of the EU's Waste Framework Directive, the characteristics of CO₂ during transportation and storage may render it hazardous within the scope of Annex III.⁴³⁸ Such classification would affect CCS activities and would also have an impact on the treatment of CO₂ under other EU Directives, including the Integrated

⁴²⁸ Directive 1999/31/EC of 26 April 1999 on the landfill of waste (OJ L182/1).

⁴²⁹ Communication From the Commission to The European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2015) 0614 final, *Closing the loop - An EU action plan for the Circular Economy* / [Online]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614>; Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, COM2018/028 final, *A European Strategy for Plastics in a Circular Economy* / [Online]. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:28:FIN>

⁴³⁰ See, e.g., Gothenburg Protocol and Amendment to the Gothenburg Protocol.

⁴³¹ Basel Convention, Article 2(1).

⁴³² Metz B. et al. (2005). *Special Report on Carbon Dioxide Capture and Storage by Working Group III of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, p.188. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/srrccs_wholereport-1.pdf.

⁴³³ Ibid.

⁴³⁴ Raine, A. (2008) 'Transboundary Transportation of CO₂ Associated with Carbon Capture and Storage Projects: An Analysis of Issues under International Law', 2008 Carbon & Climate Law Review, 2(4), pp.353-365, p.355; See also, Holloway, S. et al. (2006) 'Carbon Dioxide Transport, Injection and Geological Storage' in Eggleston H.S. et al. (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 2: Energy*. [Online]. Available at: <https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html>.

⁴³⁵ Raine, A. (2008), supra note 434, p.359.

⁴³⁶ Basel Convention, Article 1 and Annex III; Raine, A. (2008), supra note 434, p.358.

⁴³⁷ Raine, A. (2008), supra note 434, p.359.

⁴³⁸ Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (OJ L312/3), Annex III; UCL, *Onshore Carbon Capture and Storage: European Waste Legislation: Hazardous Waste Directive (Directive 91/689/EC)* / UCL Carbon Capture Legal Programme [Online]. Available at: <https://www.ucl.ac.uk/ccp/ccsoneuropewaste-3.php#key>

Pollution Prevention and Control (IPPC) Directive and Environmental Impact Assessment (EIA) Directive.⁴³⁹

Environmental management regimes on chemicals and waste may affect climate engineering activities. The use of certain chemicals, such as for Stratospheric Aerosol Injection for the purpose of Solar Radiation Management (SRM), may be subject to the international and EU regulations. Furthermore, CCS activities may be subject to international and EU regulations on waste and waste management. In particular, concentrated CO₂ during transportation and storage processes of CCS may render CO₂ a hazardous waste, making it subject to the international and EU waste regimes on the treatment of hazardous wastes.

4.3.7 Environmental protection and liability for harm

States have obligations under international and EU law to ensure that activities within their jurisdiction and control do not cause environmental harm or interfere with environmental protection measures. Climate engineering activities, by definition, would have an impact on the environment. While there is much debate on whether the overall impact would be net positive or negative, the potential for any environmental harm triggers States' obligations under the law. Key issues in this context are State's obligations and liability for environmental harm, the emerging 'rights of nature' movement, and the potentially conflicting objectives of environmental and climate law.

International laws and policies

While all environmental treaties have the ultimate objective of environmental protection, the key international instruments with broad application to environmental protection are the Stockholm Declaration and Rio Declaration, Convention on Biological Diversity, UNESCO World Heritage Convention, and Bern Convention. At the EU level, the EU Habitats Directive is the basis for the Union's nature conservation policy. To supplement these broad frameworks, there are a number of international and regional treaties dealing with specific issues in environmental protection (e.g., migratory birds, endangered species, rare wetlands), which are not discussed in detail here but may be relevant if a climate engineering activity causes a particular environmental impact or harm.

Stockholm Declaration and Rio Declaration Environmental protection at the international level was addressed for the first time in 1972 at the U.N. Conference on the Environment, which resulted in the adoption of the Stockholm Declaration and the creation of the U.N. Environmental Programme (UNEP). The Stockholm Declaration laid the foundation for international environmental protection with its 26 principles about the rights and responsibilities of humankind and nature, recognising the "solemn responsibility to protect and improve the environment for present and future generations."⁴⁴⁰ It continues language on natural resources, wildlife conservation, and pollution management, as well as a call for States to develop law on liability and compensation for

⁴³⁹ UCL, *Onshore Carbon Capture and Storage: European Waste Legislation: Hazardous Waste Directive (Directive 91/689/EC) / UCL Carbon Capture Legal Programme* [Online]. Available at: <https://www.ucl.ac.uk/ccdp/ccsoneuropewaste-3.php#key>; Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L334/17); Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the Assessment of the Effects of Certain Public and Private Projects on the Environment (OJ L26/1) as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 (OJ L124/1).

⁴⁴⁰ U.N. Conference on the Human Environment. (1972) *Declaration of the United Nations Conference on the Human Environment* (Stockholm Declaration) A/CONF.48/14/Rev.1, Principle 1.



environmental damage.⁴⁴¹ The Stockholm Declaration was accompanied by an action plan for implementation. A follow-up conference in Rio de Janeiro in 1992 (the 'Earth Summit') reviewed the Stockholm Declaration framework, resulting in the adoption of an updated Rio Convention and an implementation action plan (known as 'Agenda 21'). The Earth Summit also led to creation of the Convention on Biological Diversity (CBD) and UN Framework Convention on Climate Change (UNFCCC), discussed below in Section 4.4.1. The Rio Declaration, which is also a set of principles, builds on the Stockholm Declaration, but with the express focus on reconciling environmental protection and sustainable development. States are called on to "cooperate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem."⁴⁴² A key part of the Rio Declaration is Principle 2, which articulates the 'no-harm' rule prohibiting transboundary environmental harm (discussed above in Section 4.2.2). Underpinning the Rio Declaration is an implementation plan containing specific recommendations for the U.N. and States on a series of issues related to environmental protection and development.⁴⁴³

Convention on Biological Diversity The Convention on Biological Diversity (CBD) is the primary international treaty for the conservation of biodiversity, recognising that "biological diversity is a common concern of humankind."⁴⁴⁴ The CBD reiterates the 'no-harm' rule and directs States to develop national plans for conservation and sustainable use of biodiversity. The CBD does not prohibit damage or harm to the environmental or biological diversity, but requires States "to prevent or minimize such danger or damage" that may arise from activities originating under its jurisdiction and control "as far as possible and as appropriate".⁴⁴⁵ The definition of and liability for harm at the international level are not addressed in CBD text, but left to the governing body (the Conference of Parties) to be decided at a later time.⁴⁴⁶ The Conference of Parties meets periodically⁴⁴⁷ and issues decisions and recommendations on particular issues (for example, ocean iron fertilization, discussed in Section 4.6.4).

UNESCO World Heritage Convention Adopted in 1972, the World Heritage Convention brought together the concepts of nature conservation and cultural property. It provides a definition of "natural heritage" that includes environmental 'natural' features, geological and physiographical formations, and natural sites. States have a responsibility, "in so far as possible", take measure to protect and conserve designated site of natural heritage.⁴⁴⁸

Bern Convention Negotiated under the auspices of the Council of Europe, the Bern Convention on the Conservation of European Wildlife and Natural Habitats covers the protection of wild flora and fauna and their natural habitats through most of the European continent (and some States of Africa). States are required to take steps to conserve natural habitats and species through policies and law.⁴⁴⁹ However, the Convention does not have any provisions on liability for or remediation of harm.

⁴⁴¹ Ibid, Principles 2, 3, 4, 5, 6, 7, 13, and 22.

⁴⁴² Rio Declaration, Principle 7.

⁴⁴³ Ibid, Agenda 21.

⁴⁴⁴ Convention on Biological Diversity (CBD) (entered into force 29 December 1993) 1750 UNTS 79, 31 ILM 818, Preamble, para. 3.

⁴⁴⁵ Ibid, Article 14(1)(d).

⁴⁴⁶ Ibid, Article 14(2). See, also, Convention on Biological Diversity. (2007) *Liability and Redress, Article 14.2* / Convention on Biological Diversity [Online]. Available at: <https://www.cbd.int/liability/>

⁴⁴⁷ CBD, Article 23.

⁴⁴⁸ UNESCO. (1972) Convention Concerning the Protection of the World Culture and Natural Heritage.

⁴⁴⁹ Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). (1979) E.T.S. No. 104, Articles, 3-4.



EU laws and policies

EU Habitats Directive A cornerstone of the EU nature conservation policy, Council Directive 92/43/EEC (The Habitats Directive) aims to protect “bio-diversity through the conservation of natural habitats and of wild fauna and flora” in the EU.⁴⁵⁰ For habitat conservation, the Directive established framework for the ‘Natura 2000 network’ of special areas for conservation; Member States are required to “take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats.”⁴⁵¹ If environmental harm to a habitat results from a plan or project “carried out for imperative reasons of overriding public interest”, the Member State is required “to take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected”.⁴⁵² For species protection, flora and fauna are classified by level of protection, with some designated for ‘strict protection’⁴⁵³ while others can be taken or exploited within reason.⁴⁵⁴ Member States are required to report on their status of and progress of certain conservation activities, including any compensatory measures.⁴⁵⁵

State’ responsibilities and liability for environmental harm

International environmental law obligates States to take action to protect the environment from particular types of harm. All of the legal instruments presented above articulate a need to protect the environment and recognise the role States play in developing and implementing national policies and laws to address specific environmental objectives. States do, therefore, have an obligation to ensure that any climate engineering activities within their jurisdiction and control are compliant with the relevant environmental protection laws.

However, there are important caveats to a States’ obligation to protect the environment. One, the necessary protection measures are not specified and can be limited in response to local context (e.g., the CBD requires measures “as far as possible and as appropriate” and the World Heritage Convention “in so far as possible”). Furthermore, most requirements are predominately procedural. So long as impact assessments are carried out, monitoring is on-going, and other States are notified of potential harms, for example, a state has fulfilled its obligations. This type of compliance should not be confused with a substantive requirement to ensure that no environmental harm occurs. In fact, some legal instruments explicitly allow for environmental harms to occur if certain conditions are met and/or compensatory measures are taken (e.g., EU Habitats Directive). Lastly, the lack of effective enforcement mechanisms within international environmental law poses a perennial challenge to accountability for harms.⁴⁵⁶ Given these limitations, international environmental law may only serve as a symbolic framework for recognising environmental harm that potentially results from climate engineering activities and may not, practically speaking, be an avenue for ensuring accountability.

⁴⁵⁰ Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206).

⁴⁵¹ Ibid, Article 6.

⁴⁵² Ibid, Article 6 (4).

⁴⁵³ Ibid, Article 12-13.

⁴⁵⁴ Ibid, Article 14(2): “If...Member States deem it necessary, they shall take measure to ensure that the taking in the wild of specimens of species of wild fauna and flora...as well as their exploitation is compatible with their being maintained at a favourable conservation status.”

⁴⁵⁵ Ibid, Article 6, 16-17.

⁴⁵⁶ United Nations Environment Programme. (2019) *Environmental Rule of Law First Global Report*. Available at: <https://www.unep.org/resources/assessment/environmental-rule-law-first-global-report>



It should be noted that the related, but distinct, framework of state responsibility for transboundary environmental harm (discussed above in Section 4.2.2) would also be very difficult, in the practical sense, to apply to environmental harms resulting from climate engineering.

Rights of nature

Generally speaking, existing environmental protection law is in place to protect the rights of human beings to live in a safe and clean environment. Protection is not for the sake of the environment itself, nor does nature have rights to assert for its own protection. However, a growing movement towards recognizing the rights of nature is challenging the current anthropocentric approach to environmental protection. At the international level, a non-binding *Universal Declaration of Rights of Mother Earth* was adopted at the World People's Conference on Climate Change and the Rights of Mother in 2010.⁴⁵⁷ The rights of nature are beginning to be recognised by States and local governments, most notably by Columbia in its 2008 constitutional amendment to include the rights of nature.⁴⁵⁸ This movement, should it develop further, may influence the governance of climate engineering, though it could either enhance or constrain such proposals. On the one hand, if a climate engineering activity has a positive impact on the environment by reducing the harms associated with climate change without causing new harms, arguments could be made that the rights of nature support the need for climate engineering activities for the sake of the environment itself. However, if a climate engineering activity causes environmental harm, the rights of nature would support limitations or restrictions on the activity to protect the environment.

Conflicting objectives: environmental law and climate law

The objective of many international agreements like the CBD, UNCLOS, and the London Convention/London Protocol vis-à-vis the environment is the protection and preservation of the environment and biodiversity.⁴⁵⁹ This means that activities must not, in general, cause harm to living and non-living resources, regardless of the activity's ultimate purpose. The agreements do not reference climate change or mitigation strategies, and do not provide exceptions for activities that cause harm in the furtherance of addressing climate change.

This makes some instruments of international law somewhat incompatible with international climate law, which explicitly contemplates (and arguably requires) research and funding for such activities. Therefore, there is tension between these bodies of law with different objectives and purposes,⁴⁶⁰ as a state may be in violation of one set of rules while upholding the objective of the other. Some experts have called for "an urgent rethinking of the current international governance

⁴⁵⁷ The World People's Conference on Climate Change and the Rights of Mother Earth. (2010) *Universal Declaration of the Rights of Mother Earth*. Available at: <https://www.garn.org/universal-declaration/>

⁴⁵⁸ "Nature, or Pacha Mama, where life is reproduced and occurs, has the right to integral respect for its existence and for the maintenance and regeneration of its life cycles, structure, functions and evolutionary processes." Constitution of the Republic of Ecuador, Article 71. Available in English:

<https://pdba.georgetown.edu/Constitutions/Ecuador/english08.html>. For more information, see: Espinosa, C. (2014) 'The Advocacy of the Previously Inconceivable: A Discourse Analysis of the Universal Declaration of the Rights of Mother Earth at Rio+20', *Journal of Environment and Development*, 23(4). DOI: 10.1177/1070496514536049.

⁴⁵⁹ UNCLOS, Article 145 and Section XII; Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) (entry into force 30 August 1975) 1046 UNTS 138, Preamble; and 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol) (entry into force 24 March 2006) ATS 11, Articles 2-3.

⁴⁶⁰ Brent, K. (2020) 'Marine geoengineering governance and the importance of compatibility with the law of the sea' in McDonald, J., McGee, J., and Barnes, R. (eds). *Research Handbook on Climate Change*. Cheltenham: Edward Elgar, pp.442-61, pp.452-453.

regimes”, arguing, for example, that “protecting the marine environment from harm might no longer be appropriate as the primary goal of marine geoengineering governance” in light of climate change.⁴⁶¹ In seeking to reconcile these conflicting legal regimes, a key consideration is whether and to what extent the risks of *not* developing climate engineering technologies would cause harm to the environment.

4.4 Climate law

Climate engineering activities may help States meet their climate obligations within climate law regimes. While not required, some specific types of climate engineering activities, such as CCS, CCU, and nature-based solutions, are explicitly referenced in law as potential options available to States.

4.4.1 International and EU law and policies

At the international level, the key agreement is the United Nations Framework Convention on Climate Change (UNFCCC), which provides the legal framework for subsequent international agreements on climate change, including the 1997 Kyoto Protocol and the 2015 Paris Agreement. Climate law in the EU is based on the UNFCCC framework. At the EU level, the key climate-related laws are the European Climate Law, the EU Emissions Trading Scheme (EU ETS), and the CCS Directive.

International law and policy

The basis for global climate legislation is the United Nations Framework Convention on Climate Change (UNFCCC).⁴⁶² The conclusion of the first assessment report in 1990 by the Intergovernmental Panel on Climate Change (IPCC), formed by the United Nations Environment Programme (UNEP) and the World Meteorological Organisation (WMO) in 1988, paved the way for the development of the international legal framework to address climate change in order to stabilise GHG concentrations “at a level that would prevent dangerous anthropogenic interference with the climate system.”⁴⁶³ The UNFCCC opened for signature at the UN Earth Summit of Rio de Janeiro in 1992, and entered into force in 1994. Today, 197 countries are Party to the UNFCCC and come together to discuss climate matters during the yearly Conference of the Parties (COP).⁴⁶⁴

The 1997 Kyoto Protocol was adopted during the third session of the Conference of the Parties (COP3).⁴⁶⁵ The Protocol sets out the first quantified GHG emission reduction targets. Since these targets were only set for developed States, the emissions from developing states, including China and India, both with rapidly growing economies and associated CO₂ emissions, were left unregulated.

⁴⁶¹ McGee, J., Brent, K. and Burns, W. (2017) ‘Geoengineering the oceans: an emerging frontier in international climate change governance’, *Australian Journal of Maritime & Ocean Affairs*, pp.8-9. DOI: <https://doi.org/10.1080/18366503.2017.1400899>

⁴⁶² United Nations Framework Convention on Climate Change (UNFCCC) (entry into force 21 March 1994) 1771 UNTS 107.

⁴⁶³ Ibid, Article 2.

⁴⁶⁴ United Nations Climate Change, *What is the United Nations Framework Convention on Climate Change?* [Online]. Available at: <https://unfccc.int/process-and-meetings/the-convention/what-is-the-united-nations-framework-convention-on-climate-change>

⁴⁶⁵ Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol) (entry into force 16 February 2005) 2303 UNTS 162.

The 2015 Paris Agreement, adopted during COP21, took a different approach, requiring all Parties to “prepare, communicate and maintain” their own Nationally Determined Contributions (NDCs).⁴⁶⁶ Furthermore, having regard to climate science and global warming pathways, the objective of the Paris Agreement is to hold “the increase in the global average temperature to well below 2°C above pre-industrial levels and pursu[e] efforts to limit the temperature to 1.5°C above pre-industrial levels [...]”.⁴⁶⁷ This concretises the objective of UNFCCC to stabilise “greenhouse concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.”⁴⁶⁸

EU law and policy

EU climate law is concerned primarily with GHG emission reduction, energy security, energy efficiency, and renewable energy.⁴⁶⁹ Advancing Member State solidarity, EU industrial competitiveness, and low-carbon technology export capabilities are often secondary goals of legislation. In this context, the EU set its own goal of climate neutrality by 2050 and supports the Paris Agreement objective to keep global temperature increases well below 2°C and pursue efforts to keep it below 1.5°C.⁴⁷⁰ Much of EU Climate law connects to the polluter-pays principle of the Treaty on the Functioning of Europe (TFEU).⁴⁷¹

EU climate policy tracks strongly with international legal influences of the UNFCCC. Between 1990 and 2000, EU climate policy was a patchwork of incomplete market-based approaches to regulating consumer good standards or promoting energy efficiency. Following the Kyoto protocol, the EU advanced a more comprehensive Climate and Energy policy package, including energy efficiency directives.⁴⁷² The centrepiece of this era of legislation was the revised Emissions Trading Scheme, with phase-outs of free emission allowances, new European-wide emission caps, and other changes (see Section 4.4.3). In 2014, the EU introduced its Climate Policy 2030 framework, with goals of 40 percent emission reductions, and renewables and energy efficiency targeting, and mechanisms to ensure greenhouse gas reduction and green growth.⁴⁷³ The succeeding EU Climate Roadmap for 2050⁴⁷⁴ has placed a long-term vision of climate neutrality by 2050, 80-95 percent greenhouse gas reductions over 1990 levels, and a 2030 intermediate target reduction of 55%.⁴⁷⁵

The first key EU law discussed in this section is the 2021 **European Climate Law**, which established a framework for the “gradual reduction of anthropogenic greenhouse gas emissions” in the EU.⁴⁷⁶ The

⁴⁶⁶ Conference of the Parties, Adoption of the Paris Agreement (Paris Agreement) (entry into force 4 November 2016) 3156 UNTS, Article 4(2).

⁴⁶⁷ Ibid, Article 2(1)(a); Birnie P., Boyle A., and Redgwell C. (2021), supra note 250, p. 392.

⁴⁶⁸ UNFCCC, Article 2.

⁴⁶⁹ Woerdman, E. Roggenkamp, M. and Holwerda, M. (2021) (eds) *EU Climate Law*. Edward Elgar Publishing, pp.10-42. DOI: <https://doi.org/10.4337/9781788971300.00013>

⁴⁷⁰ European Commission. *2050 long-term strategy* [Online]. Available at: https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2050-long-term-strategy_en

⁴⁷¹ TFEU, Article 191(2).

⁴⁷² Woerdman, E. Roggenkamp, M. and Holwerda, M. (2021), supra note 469.

⁴⁷³ European Commission. *2030 climate & energy framework – Greenhouse gas emissions – raising the ambition* / [Online]. Available at: https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2030-climate-energy-framework_en#greenhouse-gas-emissions-raising-the-ambition

⁴⁷⁴ European Commission. *Climate strategies & targets – 2050 long-term strategy* / [Online]. Available at: https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2050-long-term-strategy_en

⁴⁷⁵ European Commission. *European Green Deal – 2030 Climate Target Plan* / [Online]. Available at: https://ec.europa.eu/clima/eu-action/european-green-deal/2030-climate-target-plan_en

⁴⁷⁶ Regulation (EU) 2021/1119 of 2021 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 (European Climate Law) (OJ L 243), Article 1.



law sets forth binding EU targets of domestic reduction in GHG emissions⁴⁷⁷ for 2030 (55% reduction compared to 1990 levels) and climate neutrality by 2050,⁴⁷⁸ and negative emissions are targeted thereafter. The legal framework directs the EU institutions and Member States to reduce anthropogenic GHG emissions at source and enhance removal by sinks.⁴⁷⁹

The climate-neutrality objective is to be achieved in consideration of broader European policies related to social, economic, and environmental impacts; just and fair transitions; energy security; biodiversity protection and restoration; cost-effectiveness; and competitiveness of EU economic actors.⁴⁸⁰ Numerous articles reference the 2016 Paris Agreement, including emissions reductions through climate change mitigation and adaptation measures (e.g., phase-out of fossil fuel energy subsidies). Member States are called to attend particularly to nature-based solutions⁴⁸¹ and ecosystem-based adaptation.⁴⁸²

The second key law is the **EU Emissions Trading Scheme (EU ETS)**, which establishes a cap-and-trade system for GHG emission trading within the EU.⁴⁸³ The premise is that allowances are made for every tonne of emissions, and such allowances are either given for free or bought at auction on an “allowance market” by Member States. The idea behind the market function is to incentivise industrial operators capable of cheaply reducing emissions to do so and sell excess allowance to those operators facing more expensive emission reduction pathways.⁴⁸⁴

The EU ETS allows for increasing reduction requirements as necessary to avoid dangerous climate change.⁴⁸⁵ Annex I sets out five specific types of industrial activities that produce significant amounts of CO₂.⁴⁸⁶ Under the EU ETS, Member States are responsible for ensuring any Annex I activities hold a permit issued by competent authority.⁴⁸⁷ Applications for permits must include installation descriptions and technologies, material and emission sources, planned measures for monitoring and reporting, and a non-technical summary.⁴⁸⁸ Changes to stationary installations increasing or reducing

⁴⁷⁷ Greenhouse gases are identified from Part 2 of Annex V to Regulation (EU) 2018/1999: Carbon dioxide (CO₂), Methane (CH₄), Nitrous Oxide (N₂O), Sulphur hexafluoride (SF₆), Nitrogen trifluoride (NF₃), Hydrofluorocarbons (HFCs), and Perfluorocarbons (PFCs).

⁴⁷⁸ European Climate Law, Article 4.

⁴⁷⁹ A “source” references an entity (e.g., industrial plant) that releases emissions into the atmosphere. A “sink” references a natural or technological entity (e.g., a tree or forest, but also a human-made geologic storage site) that removes emissions from the atmosphere in a durable way.

⁴⁸⁰ European Climate Law, Article 2.

⁴⁸¹ Nature-based solutions include afforestation and reforestation.

⁴⁸² European Climate Law, Article 5.

⁴⁸³ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC (OJ L 275).

⁴⁸⁴ Müller, M.N. (2021) ‘Directive 2003/4/EC as a Tool to Learn from the Successes and Failures of the EU ETS: Reflecting on the EU Emission Trading System’ in Boeve M. et al. (eds), *Environmental Law for Transitions to Sustainability*. Intersentia, pp.109-128. DOI: <https://doi.org/10.1017/9781780689302.008>

⁴⁸⁵ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, OJ L 275, Article 1.

⁴⁸⁶ These are, respectively: (1) energy activities (three types of facilities are subject to the system: combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations)); mineral oil refineries and coke ovens), (2) production and processing of ferrous metals, (3) the mineral industry, (4) the production of pulp from timber or other fibrous and (5) the production of paper and board for plants with a production capacity exceeding 20 tons per day.

⁴⁸⁷ Directive 2003/87/EC, Chapter III.4.

⁴⁸⁸ Ibid, Chapter III.5.



capacity require emission permit updates.⁴⁸⁹ Permitting must be coordinated with Europe's integrated pollution prevention and control regulation (see Section 4.3.5).

Under the framework, EU-wide allowances decrease more and more over time (from 2008 – 2021 by 1.74% per year; starting 2021, by 2.2% per year).⁴⁹⁰ The framework stipulates rules governing auctioning of allowances not allocated free-of-charge,⁴⁹¹ including share of allowances to auction, percentage of quantity of allowances auctioned to establish a fund to improve energy efficiency and energy system modernization of certain member states,⁴⁹² and required use of revenues generated from auction.⁴⁹³

The framework also harmonises free emissions allocations and revision of free allocation benchmarks.⁴⁹⁴ It provides Member States with instructions to establish financial measures for sectors in which there is a genuine risk of carbon leakage occurring which may distort competition in the internal market. For example, it further constrains free-allowance allocation to sectors where industry passes on costs of production to consumers.⁴⁹⁵ In an attempt to equalise provision of free allocations across Member States, they are based on GDP per capita and the EU average. Additional provisions in the EU ETS govern transfer, surrender, and cancellation of allowances to prevent market manipulation,⁴⁹⁶ and monitoring and reporting of emissions requirements, based on up-to-date scientific evidence.⁴⁹⁷ Monitoring and reporting are further governed by Regulation (EU) 2917/2066.⁴⁹⁸

In pursuit of climate neutrality objectives, active removal—whether through direct air capture (DAC), carbon capture and storage (CCS) or other means—will require storage of GHG in safe, permanent containment. In this context, the **CCS Directive** establishes the legal framework for the environmentally safe, permanent geological storage of carbon dioxide (CO₂).⁴⁹⁹ The law is specifically targeted to deployment of CCS in Europe to support meeting objectives of climate-neutrality. The law applies to Member States' territories and continental shelves, establishing rules for capture; transport; storage; and site closure of CO₂. Obligations under the CCS Directive relate to draft permitting reviews, decisions to transfer storage sites, site maintenance post-closure and transfer to competent public authorities. Implementation is accompanied by extensive guidance documents covering lifecycle risk, CO₂ stream composition, transfers of responsibility and financial security of operators.⁵⁰⁰

⁴⁸⁹ Ibid, Chapter III.7.

⁴⁹⁰ Ibid, Chapter III.9.

⁴⁹¹ Ibid, Chapter III.10.

⁴⁹² Ibid, Chapter III.10(d).

⁴⁹³ For example, Chapter III.10.3.a stipulates actions contributing to global energy efficiency and renewable energy or adaptation funds; measures to avoid deforestation or increase reforestation; storage of CO₂, public transport; and to finance research and development in energy efficiency and clean technologies.

⁴⁹⁴ Directive 2003/87/EC, Chapter III.10.a.

⁴⁹⁵ Ibid, Chapter III.10.b.4.

⁴⁹⁶ Ibid, Article 12.

⁴⁹⁷ Ibid, Article 14.

⁴⁹⁸ Regulation (EU) 2018/2066 of 19 December 2018 on the monitoring and reporting of greenhouse gas emissions pursuant to Directive 2003/87/EC of the European Parliament and of the Council and amending Commission Regulation (EU) No 601/2012 (OJ L 334).

⁴⁹⁹ Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006.

⁵⁰⁰ European Commission. *Implementation of the CCS Directive* / [Online]. Available at: https://ec.europa.eu/clima/eu-action/carbon-capture-use-and-storage/implementation-ccs-directive_en#ecl-inpage-1460 ; See also, European

The law exempts small-scale research and development storage projects (e.g., testing of storage in water columns, although this is in general not permitted).⁵⁰¹ Enhanced recovery of oil and gas (EOR) is only covered when combined with use of geologic storage—however there is some debate as to whether EOR should be under the remit of the CCS Directive and storage permitting requirements more generally, given that EOR often results in significant storage *de facto*.⁵⁰²

Under the CCS Directive, operators bear environmental, climate, and civil liability for geological storage.⁵⁰³ Environmental liability covers damage from storage activities, preventative, and remedial measures. Climate liability translates to surrendering GHG emissions allowances (based upon emission trading prices). Civil liability pertains to damage to individuals or property as regulated under national law. Recognition of complete and permanent containment, or a minimum of 20 years, marks occasion of transfer of closed sites to competent authorities. At the time of transfer, competent authorities take on environmental and climate liability, but civil liability remains arbitrated by national authority (e.g., if post-closure fault is found with operators, costs can be recovered). Financial security and contributions of operators to competent authorities is modelled and required at minimum a 30-year monitoring period. Penalties may be levied by Member States to be effective, proportionate, and dissuasive.⁵⁰⁴

In addition to the European Climate Law, EU ETS, and CCS Directive, a host of other directives, regulations, and decisions in the EU may apply to climate engineering technologies. These directives include those structuring the internal market for natural gas,⁵⁰⁵ the public sector loan facility for the Just Transition Mechanism (which includes eligible projects working toward climate neutrality by 2050),⁵⁰⁶ the Union greenhouse gas ETS market stability reserve,⁵⁰⁷ the activities related to governance of the Energy Union and Climate Action,⁵⁰⁸ directives on energy efficiency,⁵⁰⁹ and monitoring greenhouse gas emissions.⁵¹⁰ Finally, the Regulation (EU) 2018/841 on GHG emissions

Commission. (2011) *Implementation of directive 2009/31/EC on the geological storage of carbon dioxide: guidance document 2, characterisation of the storage complex, CO₂ stream composition, monitoring and corrective measures*. Publications Office. DOI: <https://data.europa.eu/doi/10.2834/98293>

⁵⁰¹ Directive 2009/31/EC, Article 2.

⁵⁰² Woerdman, E. Roggenkamp R. and Holwerda M. (2021), *supra* note 469, pp.156-189.

⁵⁰³ Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage (OJ L143/56).

⁵⁰⁴ Directive 2009/31/EC, Article 28.

⁵⁰⁵ Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC (OJ L 211).

⁵⁰⁶ Regulation (EU) 2021/1229 of the European Parliament and of the Council of 14 July 2021 on the public sector loan facility under the Just Transition Mechanism, (OJ L 274).

⁵⁰⁷ Decision (EU) 2015/1814 of the European Parliament and of the Council of 6 October 2015 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC (OJ L 264).

⁵⁰⁸ Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council (OJ L 328).

⁵⁰⁹ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, OJ L 315.

⁵¹⁰ Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC (OJ L 140).



removals from land use, land use change, and forestry would specifically apply to CRD projects involving afforestation and reforestation, and avoiding deforestation.⁵¹¹

4.4.2 Emissions reduction goals

The European Climate Law explicitly mentions Carbon Dioxide Removal (CDR) insofar as it explicitly refers to CCS, CCU, and nature-based solutions, although does not use the umbrella term CDR. While not explicitly stated, the Law would likely apply to novel and emerging CDR technologies as well as Negative Emissions Technologies (NETs) more broadly.

While CE activities are not required under the Law, these technologies are contemplated as technological sinks in decarbonization efforts, particularly in order to process emissions in industry.⁵¹² The Law makes explicit mention of nature-based solutions as beneficial contributors not only to climate neutral objectives (in terms of carbon sink and storage), but also climate change adaptation and biodiversity protection.⁵¹³ The Law specifically encourages maintenance, management, and enhancement of natural emissions sinks in the long-term.⁵¹⁴

Under the Law, CE technologies may be integrated in Union and Member State actions to achieve carbon-neutrality targets for 2030 and thereafter.⁵¹⁵ Any implementations of CE technologies would then need to be deployed in compliance with broader European policies (e.g., use best available, cost-effective, safe and scalable technologies; attend to social, economic, and environmental impacts; just and fair transitions; energy security; biodiversity protection and restoration; cost-effectiveness; and competitiveness of Union economic actors) as well as all other relevant pieces of EU environmental law.

There is no mention of BECCS approaches to CDR, solar radiation management (SRM), or other technological approaches to mitigating the impacts of climate change on weather.

Where novel and emerging CDR technologies are developed and specifically work to support GHG, the Law would likely apply. Amendments to Regulation (EU) 2018/1999 on activities related to governance of the Energy Union and Climate Action gives Member States the opportunity to involve diverse societal actors in the consideration of novel and emerging technological approaches to achieving climate-neutrality objectives (per multilevel climate and energy dialogues).⁵¹⁶

4.4.3 Carbon emissions trading

The EU Emissions Trading Scheme (EU ETS) directly applies to CE, particularly CCS and nature-based solutions. The law governing the EU ETS permits allowances for these types of CE but does not create any obligation that these CE activities must occur. Although not explicit, the EU ETS would likely apply to novel and emerging technologies that incorporate capture, storage, and transport of CO₂ not contemplated in the current language.

⁵¹¹ Regulation (EU) 2018/841 of the European Parliament and of the Council of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU (OJ L 156).

⁵¹² European Climate Law, Recital 20.

⁵¹³ Ibid, Recital 23, 32.

⁵¹⁴ Ibid, Article 4.

⁵¹⁵ Ibid.

⁵¹⁶ Regulation (EU) 2018/1999.

Annex 1 explicitly mentions capture, transport, and storage of GHG as eligible for allowances. Free allocations are not permitted to installations capturing CO₂, or transporting CO₂ to storage sites; however, some 400 million allowances can be made to support “environmentally safe carbon capture and storage”.⁵¹⁷ Additionally, auction revenues are explicitly mentioned to support afforestation, reforestation, and avoiding deforestation in Europe and developing countries; and carbon capture and storage.⁵¹⁸ Emissions from biomass are excluded from small installations,⁵¹⁹ and for units with thermal input under 3MW using exclusively biomass (excepting start-up / shut-down). Furthermore, Annex 1 specifically excludes allowances for installations researching, developing, and testing biomass installations. For cases of larger units, the law is unclear.

No mention is made of SRM in the law.

It should be noted that several of these features of the EU ETS have been critiqued for generating a perverse incentive for operators to undercount emissions when costs of compliance are higher than expected costs of noncompliance.⁵²⁰ One critique is that verifiers are hired and paid for by operators, presenting a major conflict of interest whereby verifiers have an incentive to validate undercounting to ensure future verification contracts.⁴³³ Another critique is that more expensive allowances generate incentives for undercounting, lowering demand for allowances and thus also price of allowances, thereby further reducing the incentive for emission reduction (e.g., for those otherwise well positioned to reduce emission), and simultaneously lowering the penalty cost of emissions for major polluters. In light of these critiques, some have argued for stronger public availability of information at the level of individual installations and verifiers (licensed by public authorities and serving public function).⁵²¹

4.4.4 Geological storage of CO₂

The CCS Directive directly applies to climate engineering, specifically CCS technologies. CCS activities by Member States within their territory or continental shelf must adhere to the requirements related to the capture, transport, storage, and site closure of CO₂. While not explicitly stated, the CCS Directive would likely apply to other novel and emerging CDR technologies, as well as NETs more broadly, which incorporate any permanent storage of carbon dioxide in liquid, gaseous, or, presumably, solid form.

While the CCS Directive provides a legal framework, there are a number of regulatory obstacles to large-scale CCS deployment in the EU (in addition to public opposition or technical or financial feasibility questions).⁵²² One, the CCS directive leaves a significant lack of detail and discretion to Member States related to permitting, inspection, and determination of financial security, raising single-market transaction costs and running contrary to EU legislative principles of solidarity.⁵²³ Two, long-term civil liability of 20 years may, on the one hand, be dissuasive to investment in CCS (e.g., lack of private insurance coverage and expense contingency on emissions prices partially being a function of lack of a sufficient market across which to spread risk), yet too limited liability may reduce incentive

⁵¹⁷ Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a system for greenhouse gas emission allowance trading within the Union and amending Council Directive 96/61/EC, OJ L 275, Chapter III.10.a.8.

⁵¹⁸ Ibid, Chapter III.10.3.c-e.

⁵¹⁹ Ibid, Article 27.

⁵²⁰ Müller, M.N. (2021), supra note 484.

⁵²¹ Ibid.

⁵²² Woerdman, E. Roggenkamp, M. and Holwerda, M. (2021), supra note 469.

⁵²³ Ibid, p.207.

for precaution. Three, the CCS Directive introduces uncertainty related to financial security, where worst-case scenario leakages, tied to a dynamic price of carbon, may become very expensive.⁵²⁴ As the price of emissions allowances rises, the cost of storage errors increases significantly. Four, there is a lack of accounting for biomass storage (which is also an issue in the emissions trading scheme).⁵²⁵ Emissions capture from biomass combustion is not considered, creating a disincentive to capture biomass emissions and regulatory uncertainty related to bioenergy with carbon capture and storage technologies (BECCS). And five, Member States must make available public environmental information associated with storage in compliance with the Aarhus Convention.⁵²⁶ However no public consultation, beyond that stipulated by environmental impact assessment activities, is required in storage siting activities.

The CCS Directive does not mention carbon capture and use (CCU), nature-based solutions, or SRM.

4.5 Space law

Some proposals for solar climate engineering would involve activities in outer space.⁵²⁷ Though more science fiction than reality at present, proposals for space-based climate engineering include reflective objects (solar screens, deflectors, mirror, 'parasol' shades, dust particles, etc), launchers and transport networks to move objects into and above Low Earth Orbit (LEO), infrastructure for lunar and asteroid mining for raw materials, lunar and orbiting manufacturing and control centres to assemble the reflective objects *in situ*, and power stations to fuel the entire process.

As international space law predates climate engineering, there is no international space treaty dedicated to climate engineering, nor do any existing space law treaties explicitly refer to climate technologies. However, it is likely that specific aspects of space-based climate engineering activities would be governed by existing international space law treaties,⁵²⁸ and States' responsibilities in outer space law would likely extend to climate engineering activities, though the extent and specifics of those obligations are unclear.

4.5.1 International and EU law and policies

The U.N. international treaties most relevant to climate engineering are the Outer Space Treaty, Space Liability Convention, Registration Convention, and the Moon Agreement. The U.S.-led *Artemis Accords* are an example of a non-U.N. multilateral agreement that could be relevant to climate engineering.

⁵²⁴ As an aside, it is interesting to note that in the spirit of the precautionary principle, if pollution remediation is deemed 'too expensive', then perhaps permissions to pollute in this manner in the first place ought not have been granted.

⁵²⁵ Directive 2003/87/EC.

⁵²⁶ Regulation (EC) No 1367/2006.

⁵²⁷ For a discussion of space-based solar geoengineering proposals, see, e.g., Baum, C.M, Low, S. and Sovacool, B.K. (2022) 'Between the sun and us: Expert perceptions on the innovation, policy, and deep uncertainties of space-based solar geoengineering', *Renewable and Sustainable Energy Reviews*, vol.158; Larsen, P.B. (2020) 'Climate Change Management in the Space Age', *William & Mary Environmental Law and Policy Review*, 45(1), p. 116; and Dicaire, I, and Summerer, L. (2013) 'Climate Engineering: Which Role for Space?', *64th International Astronautical Congress, Beijing, China*. Available at: <https://www.esa.int/gsp/ACT/doc/ESS/ACT-RPR-ESS-2013-IAC-ClimateEngineeringWhichRoleForSpace.pdf>

⁵²⁸ Eliason, A. (2022) 'Avoiding Moonraker: Averting Unilateral Geoengineering Efforts', *University of Pennsylvania Journal of International Law*, 43(2), pp.442, 448.

At the EU level, laws on space are not as directly relevant to climate engineering. The 2021 EU Space Regulation lays out EU space policy for 2021-2027, which includes the objective to “enhance the safety, security and sustainability of all outer space activities pertaining to space objects and debris proliferation, as well as space environment,” but there is no explicit reference to climate engineering.⁵²⁹ EU space policy is implemented by the EU Agency for the Space Programme (EUSPA), which coordinates with the European Space Agency (ESA), an intergovernmental organisation with many members from the EU.⁵³⁰

Outer Space Treaty The basic legal framework is laid out in the 1967 U.N. Outer Space Treaty (or the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies). There are 11 state parties to the treaty, including all major space-faring nations,⁵³¹ and the key obligations in the Treaty are accepted as part of customary international law.⁵³² The treaty stipulates that the exploration and use of outer space must be “for the benefit and in the interests of all countries” and in accordance with international law.⁵³³ All states have free access for the exploration of space, including “freedom of scientific investigation,”⁵³⁴ and states cannot make any claims of sovereignty in outer space, which includes the Moon.⁵³⁵ In carrying out activities, all states should be “guided by the principle of cooperation and mutual assistance,”⁵³⁶ and are required to inform the United Nations and the public about their activities.⁵³⁷

Under the Outer Space Treaty, states are responsible for their activities in space (carried out by governmental agencies or private parties)⁵³⁸ and are liable for damages caused to another state or person by an object launched into space.⁵³⁹ As part of this responsibility, states are required to authorize and supervise the activities of private parties in space.⁵⁴⁰ States must adopt “appropriate measures” to avoid “harmful contamination and also adverse changes in the environment of the Earth.”⁵⁴¹ If a State has “reason to believe” that “potentially harmful interference” with the peaceful activities of other states may occur as a result of its activities in outer space, that State must “undertake appropriate international consultations before proceeding with any such activity or experiment.”⁵⁴²

⁵²⁹ Regulation (EU) 2021/696 of the European Parliament and of the Council of 28 April 2021 establishing the Union Space Programme and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013 and (EU) No 377/2014 and Decision No 541/2014/EU (OJ L 170, 12.5.2021).

⁵³⁰ EUSPA and ESA. (2004) Framework Agreement between the European Community and the European Space Agency (L. 261/64).

⁵³¹ Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space. (2022) *Status of International Agreements relating to activities in outer space as of 1 January 2022* (A/AC.105/C.2/2022/CRP.10)

⁵³² Larsen, P.B. (2020) ‘Climate Change Management in the Space Age’, *William & Mary Environmental Law and Policy Review*, 45(1), p.120. DOI: <https://scholarship.law.wm.edu/wmelpr/vol45/iss1/5/>

⁵³³ Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and other Celestial Bodies (Outer Space Treaty), (entry into force 10 October 1967) 610 U.N.T.S. 205, Article 1.

⁵³⁴ Ibid.

⁵³⁵ Ibid, Article 2.

⁵³⁶ Ibid, Article IX.

⁵³⁷ Ibid.

⁵³⁸ Ibid, Article VI.

⁵³⁹ Ibid, Article VII.

⁵⁴⁰ Ibid, Article VI.

⁵⁴¹ Ibid, Article IX.

⁵⁴² Ibid.



To further safeguard international peace and security and to ensure space is used “exclusively for peaceful purposes”, the Outer Space Treaty prohibits placing nuclear weapons or “any other kinds of weapons of mass destruction” into outer space.⁵⁴³ The U.N. General Assembly has reaffirmed the importance of international cooperation for the peaceful uses of space in a resolution as recently as December 2020.⁵⁴⁴

Space Liability Convention Elaborating on the Outer Space Treaty, the 1972 Space Liability Convention (or Convention on International Liability for Damage Caused by Space Objects) is a U.N. treaty that lays out the international rules and procedures concerning liability for damages caused by space objects, including procedures for claiming compensation. Under the Convention, ‘damage’ is defined as “loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of persons, natural or juridical, or property of international intergovernmental organizations.”⁵⁴⁵ This Convention is somewhat unique in international law because a state party is liable for harm regardless of the circumstances, even if the state exercised due diligence and acted lawfully.⁵⁴⁶ State parties are ‘absolutely liable’ (i.e. strict liability) for damage caused by national space object on the surface of the Earth or to aircraft in flight,⁵⁴⁷ and liable for damage caused by fault to another space object in orbit.⁵⁴⁸ While there has only been one claim for compensation under the Convention to date, four governing norms emerged from the case: a state responsible for damage caused by its own space object has as a duty to (1) forewarn of danger; (2) provide information about the danger; (3) clean up; and (4) compensate for injury.⁵⁴⁹ However, there is no global consensus on these duties, particularly as there was no formal judicial review.

Registration Convention The 1976 Registration Convention (Convention on the Registration of Objects Launched into Outer Space) is a U.N. treaty that requires state parties to register and provide information about space objects launched into orbit to a centralised registry at the U.N.⁵⁵⁰ The U.N. Office for Outer Space Affairs (UNOOSA) currently maintains the registry, available publicly online.⁵⁵¹

Moon Agreement The Moon Agreement (Agreement Governing the Activities of States on the Moon and Other Celestial Bodies), which came into effect in 1984, states that outer space is “the common heritage of mankind”⁵⁵² and provides some guidance on the exploration of resources in

⁵⁴³ Ibid, Article IV.

⁵⁴⁴ Reducing space threats through norms, rules and principles of responsible behaviours (7 December 2020) G.A. A/RES/75/36.

⁵⁴⁵ Convention on International Liability for Damage Caused by Space Objects (Space Liability Convention), (entry into force September 1972) 961 U.N.T.S. 187, Article I.

⁵⁴⁶ Eliason, A. (2022), supra note 528, p.450; Crawford, J. (2008), supra note 214, p.561: “the sole example unanimously accepted as creating liability for an act that is completely lawful under international law is contained in the 1972 Convention on International Liability for Damage Caused by Space Object”.

⁵⁴⁷ Space Liability Convention, Article II.

⁵⁴⁸ Space Liability Convention, Article III.

⁵⁴⁹ Cohen, A.F. (1984) ‘Cosmos 954 and the International Law of Satellite Accidents’, *Yale Journal of International Law*, vol. 10(78). DOI: <https://core.ac.uk/download/pdf/72839474.pdf>

⁵⁵⁰ Convention on Registration of Objects Launched into Outer Space (Registration Convention) (15 September 1976) 1023 U.N.T.S. 15.

⁵⁵¹ United Nations Register of Objects Launched into Outer Space. *UNOOSA* / [Online]. Available at: <https://www.unoosa.org/oosa/en/spaceobjectregister/index.html>

⁵⁵² Agreement Governing the Activities of States on the Moon and Other Celestial Bodies (Moon Agreement) (entry into force 11 July 1984) 1363 U.N.T.S. 22, Article 11.

outer space. Elaborating on provisions in previous treaties, it reiterates that outer space must be used exclusively for peaceful purposes, that claims of sovereignty are prohibited, and that states have obligations to prevent harm to the environment. For example, states can establish bases on the Moon for scientific exploration⁵⁵³ and have the right to collect and remove minerals and resources from outer space.⁵⁵⁴

Artemis Accords The *Artemis Accords* are a non-binding international agreement for principles governing space exploration drafted by the United States.⁵⁵⁵ Though not limited to participating countries, the principles are meant to be a cooperation framework for NASA's Artemis missions to the Moon.⁵⁵⁶ The Artemis Accords reiterate some core principles from international outer space law (e.g., exclusive peaceful purposes, in accordance with international law) and address the specific issues of space debris, outer space heritage, space resources, and the "deconfliction of space activities".⁵⁵⁷

4.5.2 State responsibilities in outer space

At present, outer space law does not make climate engineering exempt from its principles and obligations. Therefore, States' responsibilities in outer space law would likely extend to climate engineering activities. This means they must be exclusively peaceful and for the benefit of all, and States could not claim any part of outer space for their exclusive use in the process of carrying out a climate engineering activity. States would have obligations to cooperate with and inform the international community about their space-based climate engineering activities and register any associated launched object (e.g., rocket to disperse aerosols, reflective sunshield) on the international registry in compliance with the Registration Convention. States may also need to consult with other States if a climate engineering activity is likely to interfere with space navigation.⁵⁵⁸ States would also be required to authorise and supervise the activities of private companies deploying space-based objects for climate engineering purposes. During launch and orbit, a State must ensure appropriate measures are taken to avoid harm to the Earth's environment from the space objects and would be liable for any damage caused by the space object.

However, many questions remain, as international space law does not explicitly permit or prohibit climate engineering activities, nor is it clear how the vague treaty provision would be applied. For one, there is no consensus on whether or not climate engineering, particularly space-based SRM, would be "for the benefit and in the interests of all countries" and therefore permissible under the Outer Space Treaty. While reducing the impacts of climate change may be beneficial to some countries but cause significant harm to others, the Outer Space Treaty framework provides no guidance on the balancing of benefits and risks.

⁵⁵³ Ibid, Article 3(4)

⁵⁵⁴ Ibid, Article 6(2).

⁵⁵⁵ NASA. (2020) *The Artemis Accords: Principles for cooperation in the civil exploration and use of the Moon, Mars, comets, and asteroids for peaceful purposes* / [Online]. Available at: <https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf>

⁵⁵⁶ NASA. (2020) *Press Release: NASA, International Partners Advance Cooperation with First Signing of Artemis Accords* / [Online]. Available at: <https://www.nasa.gov/press-release/nasa-international-partners-advance-cooperation-with-first-signings-of-artemis-accords>

⁵⁵⁷ NASA. (2020), supra note 555.

⁵⁵⁸ Larsen, P.B. (2020), supra note 532, p.116.

4.5.3 Environmental protection and liability for environmental harm in space

International outer space law says very little about the protection of the space environment. Liability for harm in space is addressed, but it is limited to direct physical damage caused by a space object.⁵⁵⁹ Liability of harm for the space environment is not addressed. Under the Outer Space Treaty, States are directed to avoid “harmful contamination of celestial bodies”,⁵⁶⁰ though harmful contamination is not defined, nor is there a framework for accountability and liability. Furthermore, whether international environmental law applies in outer space is an open question.⁵⁶¹ Therefore, international law provides no clear answer on whether and who would be held responsible for environmental harm in space caused by climate engineering.⁵⁶²

The issue of space debris poses a particular challenge given the lack of environmental protection and liability for environmental harm in space. Though not defined in international law, the common technical definition is “any human-made object in orbit about the Earth that no longer serves a useful function.”⁵⁶³ Space debris is not addressed in any binding instruments of space law, but there are a number of non-binding guidelines.⁵⁶⁴ Climate engineering technologies may be both impacted by space debris (e.g., if deployment into space is made difficult by presence of debris in launching trajectory) and contribute to the proliferation of space debris (e.g. if break-up occurs because of collision with other space objects or a device becomes inoperable).⁵⁶⁵ Although there is currently no binding international law on this issue, space debris from space-based climate engineering would likely be covered by existing non-binding guidance and any binding rules that are adopted in the future.

4.5.4 Exploitation and mining of space resources

International space law is not clear on the legality of exploiting and mining space resources. Some of these resources have been proposed for use in climate engineering.⁵⁶⁶ Under current international space law, in particular the Outer Space Treaty and the Moon Agreement (see above), States are prohibited from appropriating outer space (in other words, claiming a part of space as natural territory).⁵⁶⁷ The Moon Agreement also calls on States to establish an international regime to govern

⁵⁵⁹ Space Liability Convention.

⁵⁶⁰ Outer Space Treaty, Article IX.

⁵⁶¹ Viikari, L. (2008). *The Environmental Element in Space Law: Assessing the present and charting the future*. Leiden, Boston: Martinus Nijhoff. “As they may have initially been drafted with primarily (or solely) terrestrial applications in mind, their wordings may occasionally also raise questions as to their applicability to outer space or celestial bodies even where it is clear that the intention has not been to knowingly exclude space activities.”

⁵⁶² Eliason, A. (2022), *supra* note 528, p. 339

⁵⁶³ NASA. (2021) *Space Debris and Human Spacecraft* / [Online]. Available at: https://www.nasa.gov/mission_pages/station/news/orbital_debris.html. Regulation (EU) 2021/696, Article 2(4) defines space debris as: any space object including spacecraft or fragments and elements thereof in Earth’s orbit or re-entering Earth’s atmosphere, that are non-functional or no longer serve any specific purpose, including parts of rockets or artificial satellites, or inactive artificial satellites.

⁵⁶⁴ International Law Association (ILA). (1994) *International Instrument on the Protection of the Environment from Damage Caused by Space Debris*; U.N. Inter-Agency Space Debris Coordination Committee. (2003) *Space debris mitigation guidelines*, A/AC.105/C.1/L.260; and the UNOOSA Committee on the Peaceful Uses of Outer Space. (2007) *Space Debris Mitigation Guidelines*, A/AC.105/890.

⁵⁶⁵ See, e.g., Angel, R. (2006) ‘Feasibility of cooling the Earth with a cloud of small spacecraft near the inner Lagrange point (L1)’, *Proceedings of the National Academy of Sciences of the United States of America*, 103(46). DOI: [10.1073/pnas.0608163103](https://doi.org/10.1073/pnas.0608163103).

⁵⁶⁶ See, e.g., Bewick, R. Sanchez, J.P. McInnes, C.R. (2013) ‘Usage of Asteroid Resources for Space-Based Geoengineering’ in Badescu, V. (ed) *Asteroids*. Berlin, Heidelberg: Springer, pp.581-03. DOI: https://doi.org/10.1007/978-3-642-39244-3_25

⁵⁶⁷ Outer Space Treaty, Article 2; Moon Agreement, Article. 11(2).

the exploitation of natural resources that is orderly and safe, rational, and provides for equitable benefits sharing.⁵⁶⁸ To date, no such international regime exists. In the void, some countries have stepped in with a “finder, keepers” approach, arguing that the prohibition on national appropriation does not apply to the resources themselves once they are extracted.⁵⁶⁹ For example, the U.S. legalized space mining in the 2015 *U.S. Commercial Space Launch Competitiveness Act*⁵⁷⁰ and initial coverage of the *Artemis Accords* referred to them as a “legal blueprint for mining on the moon”.⁵⁷¹ Luxembourg’s 2017 *Law on the Exploration and Uses of Space Resources* is substantially similar to the U.S., only requiring a company to have an office in the country in order to have the property rights (e.g., to own, keep, use and sell) to space resources.⁵⁷² While these laws are part of domestic law in their respective countries, the Outer Space Treaty and Moon Agreement do not distinguish between resources pre- and post-extraction, therefore implementation of these domestic laws may violate international law. In sum, at present, it is not clear whether the exploitation of space resources for climate engineering would violate international law.

4.6 Law of the seas

Some proposals for climate engineering would involve activities in the marine environment or result in impacts to the marine environment.⁵⁷³ While “most of these proposals have not yet gone beyond the drawing board or laboratory stage”, these proposals include ocean fertilisation, artificial up-swelling and down-swelling, ocean alkalinity enhancement, enhanced kelp farming, enhanced weathering and mineral carbonation, marine cloud brightening, and increased surface albedo with microspheres or microbubbles.⁵⁷⁴

While there is no comprehensive law of the seas treaty addressing climate engineering, associated activities that impact marine environments would be governed by existing international and EU law. Furthermore, there are dedicated – though non-binding – rules on ocean fertilisation and transboundary seabed CO₂ storage, which were developed in response to concerns about proposed climate engineering projects.

4.6.1 International and EU law and policies

The international treaties on the law of the seas most relevant to climate engineering are United Nations Convention on the Law of the Sea (UNCLOS), London Convention and London Protocol, and the Convention on Biological Diversity (CBD). The EU Marine Strategy Framework Directive is

⁵⁶⁸ Moon Agreement, Article 11(7).

⁵⁶⁹ Mallick, S. and Rajagopalan, R.P. (2019) ‘If Space is ‘the Province of Mankind’, Who Owns its Resources? The Potential of Space Mining and its Legal Implications’, *Observer Research Foundation*, ORF Occasional Paper No. 182. Available at: <https://www.orfonline.org/research/if-space-is-the-province-of-mankind-who-owns-its-resources-47561/>

⁵⁷⁰ U.S. Congress. (2015) *U.S. Commercial Space Launch Competitiveness Act*, Public Law 114-90.

⁵⁷¹ Roulette, J. (2020) *Exclusive: Trump administration drafting ‘Artemis Accords’ pact for moon mining – sources / Reuters* [Online]. Available at: <https://www.reuters.com/article/us-space-exploration-moon-mining-exclusi/exclusive-trump-administration-drafting-artemis-accords-pact-for-moon-mining-sources-idUSKBN22H2SB>

⁵⁷² Luxembourg Chambre des Deputes (Chamber of Deputies). (2017) *Law on the Exploration and Uses of Space Resources*, No. 674 of 28 July 2019.

⁵⁷³ For a discussion of climate engineering activities with marine impacts, see, e.g., Lauvset, S.K., Tjiputra, J. and Muri, H. (2017) ‘Climate engineering and the ocean: effects on biogeochemistry and primary production’, *Biogeosciences*, 14, pp.5675-5691. DOI: 10.5194/bg-14-5675-2017 and McGee, J., Brent, K. and Burns, W. (2017), *supra* note 461.

⁵⁷⁴ McGee, J., Brent, K. and Burns, W. (2017), *supra* note 461, p.6.

based on these key international agreements but does not specifically address climate engineering.

UNCLOS The United Nations Convention on the Law of the Sea (UNCLOS) is the primary international legal treaty governing the world's oceans and marine resources. Currently, there are 168 parties to UNCLOS, including the European Union.⁵⁷⁵ UNCLOS guarantees freedom in the high seas for all states, including freedom of navigation, fishing, and scientific research.⁵⁷⁶ Any ship/vessel on the high seas must register with a single state and fly its flag;⁵⁷⁷ the state must then exercise jurisdiction⁵⁷⁸ and is responsible for ensuring the vessel/ship complies with international rules and standards.⁵⁷⁹ Contracting states are obligated to protect and preserve the marine environment.⁵⁸⁰ They are required to take "necessary measures...to ensure effective protection for the marine environment from harmful effects", including measures to prevent, reduce and control pollution, preserve ecological balance, and protect and conserve natural resources.⁵⁸¹ UNCLOS is concerned with five different types of pollution: land-based pollution,⁵⁸² pollution from seabed activities,⁵⁸³ dumping,⁵⁸⁴ pollution from vessels,⁵⁸⁵ and pollution from or through the atmosphere.⁵⁸⁶ The U.N. Division for Ocean Affairs and the Law of the Sea (DOALOS) is the secretariat for the UNCLOS. The International Maritime Organization (IMO) has a mandate to further regulate maritime activities based on UNCLOS provisions. Disputes under UNCLOS are settled at the International Tribunal for the Law of Sea, which can issue advisory opinions.⁵⁸⁷

London Convention and London Protocol The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the 1996 London Protocol provide a framework to govern the deliberate disposal of waste in oceans. Contracting Parties are required to take "effective measures" to regulate dumping activities,⁵⁸⁸ which includes a prior project assessment, permitting, and monitoring.⁵⁸⁹ The London Convention prohibits dumping some categories of wastes; other wastes require either a special or general permit.⁵⁹⁰ The International Maritime Organization hosts the permanent secretariat of the London

⁵⁷⁵ A notable exception is the United States, though some U.S. courts have found UNCLOS to be part of customary international law. See Crawford, J. (2008), *supra* note 214, page 296, footnote 4. *See, also*, UNCLOS Treaty Status, U.N. Treaty Collection / [Online]. Available at:

https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATY&mtdsq_no=XXI-6&chapter=21&Temp=mtdsq3&clang=en#1

⁵⁷⁶ UNCLOS, Article 87.

⁵⁷⁷ *Ibid*, Article 92.

⁵⁷⁸ *Ibid*, Article 94.

⁵⁷⁹ *Ibid*, Article 217.

⁵⁸⁰ *Ibid*, Article 192.

⁵⁸¹ *Ibid*, Article 145, 194.

⁵⁸² *Ibid*, Article 207.

⁵⁸³ *Ibid*, Article 208.

⁵⁸⁴ *Ibid*, Article 210.

⁵⁸⁵ *Ibid*, Article 211.

⁵⁸⁶ *Ibid*, Article 212.

⁵⁸⁷ *Ibid*, Annex VI.

⁵⁸⁸ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) (entry into force 30 August 1975) 1046 UNTS 138, Article II.

⁵⁸⁹ *Ibid*, Article IV and Annex III.

⁵⁹⁰ *Ibid*, Article IV.



Convention.⁵⁹¹ There are currently 87 States party to the London Convention.⁵⁹² In 1996, Contracting Parties negotiated the London Protocol, an updated version of the London Convention intended to better protect the marine environment. The Protocol is more restrictive than the Convention, expressly implementing the precautionary principle⁵⁹³ to prohibit all dumping except for certain materials.⁵⁹⁴ In this way, the Protocol reverses the burden of proof to prohibit all dumping unless proven unharmed, unlike under the Convention where dumping is permitted unless proven harmful.⁵⁹⁵ However, as under the Convention, Contracting States are required to assess, issue permits, and monitor any non-prohibited dumping activities.⁵⁹⁶ Referencing the rules of state responsibility for transboundary environmental harm (see Section 4.2.2), Contracting Parties are liable for damage to the environment⁵⁹⁷ and bear the costs of pollution ('polluter pays' principle).⁵⁹⁸ States are also prohibited from exporting their waste to other countries to dump to avoid liability.⁵⁹⁹ The Protocol directs Contracting States to promote scientific research on eliminating marine pollution, but does not include an exception to the general prohibition for scientific research purposes.⁶⁰⁰ The IMO also hosts the permanent secretariat of the London Convention.⁶⁰¹ There are currently 53 states party to the Convention.⁶⁰²

Convention Biological Diversity Discussed in more detail in Section 4.3.7, the CBD is the primary international treaty for the conservation of biodiversity, including marine biodiversity, understood as "the variability among living organism from all sources including...marine and other aquatic ecosystems."⁶⁰³ The Conference of Parties, the CBD's governing body, has adopted two non-binding decisions addressed at ocean fertilisation (discussed below).

EU Marine Strategy Framework Directive The primary aim of the EU marine strategy is achieving "good environmental status in the Community's marine environment."⁶⁰⁴ A 'good environmental status' is defined as "economically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, [thereby] safeguarding the potential for uses and activities by current and future generations."⁶⁰⁵ Additional guidance in the form of criteria and methodological standards were

⁵⁹¹ International Maritime Organization, *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter* / [Online]. Available at: <https://www.imo.org/en/OurWork/Environment/Pages/London-Convention-Protocol.aspx>

⁵⁹² Ibid.

⁵⁹³ 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Protocol) (entry into force 24 March 2006) ATS 11, Article 3(1) states that "Contracting Parties shall apply a precautionary approach to environmental protection ...when there is reason to believe that wastes or other matter introduced into the marine environment are likely to cause harm even when there is no conclusive evidence to prove a causal relation between inputs and their effects."

⁵⁹⁴ Ibid, Article 1(4).

⁵⁹⁵ See, e.g., Rayfuse, R. Lawrence M.G. and Gjerde, K.M. (2008) 'Ocean fertilisation and climate change: The Need to Regulate Emerging High Seas Uses', *The International Journal of Marine and Coastal Law*, 23, pp.297-326.

⁵⁹⁶ London Protocol, Article 4, 9.

⁵⁹⁷ Ibid, Article 15.

⁵⁹⁸ Ibid, Article 3(2).

⁵⁹⁹ Ibid, Article 6.

⁶⁰⁰ Ibid, Article 14.

⁶⁰¹ Ibid, Article 19.

⁶⁰² International Maritime Organization, *supra* note 591.

⁶⁰³ CBD, Article 2.

⁶⁰⁴ Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive) (OJ L 164), Article 1.

⁶⁰⁵ Ibid, Article 3(5).

adopted in 2017.⁶⁰⁶ To achieve ‘good environmental status’, the Directive instructs Member States to take an ecosystem-based approach to marine activities to “protect and preserve the marine environment, prevent its deterioration and, where practicable, restore marine ecosystems in areas where they have been adversely affected” and “prevent and reduce inputs in the marine environment...so as to ensure that there are no significant impacts on or risks to marine biodiversity, marine ecosystems, human health or legitimate uses of the sea.”⁶⁰⁷ Obligations for Member States include assessing the current status of their marine environment, setting environmental targets, establishing monitoring programmes, and updating the European Commission.⁶⁰⁸ Member States are responsible for achieving ‘good environmental status’ in their marine waters, but exceptions can be made if an impacting activity is outside their control, results from natural causes, or is necessary by overriding public interest.⁶⁰⁹

4.6.2 States’ obligations: assessment, permitting and monitoring

Any marine-based climate engineering activity in the high seas will be subject to the obligations in UNCLOS and the London Convention/London Protocol (LC/LP) regime. This includes activities by private actors as any ship/vessel on the high seas must be registered with a State which would, as such, be responsible for the ship’s compliance with international law. States would be required to ensure measures are taken to protect the marine environment, which include prior assessment, permitting and ongoing monitoring of climate engineering activities. If the activity involved marine pollution or dumping, the specific requirements under the LC/LP regime would be triggered.⁶¹⁰ Generally speaking, States would be liable for any transboundary harm caused to the marine environment by any climate engineering activity under its jurisdiction and control, including those by private actors.⁶¹¹

4.6.3 Marine pollution and dumping

Some marine-based climate engineering activities may result in marine pollution or constitute marine dumping, consequently triggering obligations under the LC/LC regime. A key issue in the context of climate engineering is whether the activity meets the definitions of pollution and dumping, thereby triggering the obligations.

‘Pollution’ is defined in UNCLOS as: “The introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the seas, impairment of quality for use of sea water and reduction of amenities.”⁶¹² The definition in the London Protocol is nearly identical.⁶¹³ ‘Dumping’ – a type of pollution – is defined under the UNCLOS and

⁶⁰⁶ Decision (EU) 2017/848 of 17 May 2017 laying down criteria and methodological standards on good environmental status of marine waters and specifications and standardised methods for monitoring and assessment, and repealing Decision 2010/477/EU (OJ L 125).

⁶⁰⁷ Directive 2008/56/EC, Article 1.

⁶⁰⁸ Ibid, Article 8-11.

⁶⁰⁹ Ibid, Article 14.

⁶¹⁰ Rayfuse, R. Lawrence, M.G. and Gjerde, K.M. (2008), *supra* note 595, p.313.

⁶¹¹ *Trail Smelter* case, *supra* note 362. See also, Kiss, A. and Shelton, D. (2007) ‘Strict Liability in International Environmental Law’ in Ndiaye, T.M. and Wolfrum, R. (eds). *Law of the Sea, Environmental Law and Settlement of Disputes: Liber amicorum Judge Thomas*. Brill Academic Publishers.

⁶¹² UNCLOS, Article 1(4).

⁶¹³ London Protocol, Article 1(10).



the London Convention as “any deliberate disposal of wastes or other matter...or other man-made structures at sea.”⁶¹⁴ The London Protocol expands that definition to include “any storage of wastes other matter in the seabed and the subsoil”.⁶¹⁵

For the purpose of climate engineering technologies, key elements of these definitions are *introduction, deleterious effects, and disposal*.

First, pollution must involve placement of matter into the seas. Some climate engineering proposals (e.g., ocean alkalinity enhancement, enhanced weathering and mineral carbonation, microbubbles to enhance ocean albedo) would meet this element of the definition because they involve adding something into or on the water. However, other proposals like marine cloud brightening and enhanced up- or down-welling may not introduce substances and would therefore not meet the definition of pollution.⁶¹⁶ The 2013 Amendment to the London Protocol fails to address this gap in the definition, as it also limits its prohibition to “the placement of matter”.⁶¹⁷

Second, the introduction of matter must result or be likely to result in ‘deleterious effects’ or harm. While harm is not defined in the London Protocol or Convention, States are instructed to apply the ‘precautionary approach’ when an activity is “likely to cause harm”.⁶¹⁸ States are also obligated to develop a national Action List to screen waste based on “potential effects on human health and the marine environment” to “avoid acute or chronic effects”, which gives some indication of a threshold of harm.⁶¹⁹ If a form of marine climate engineering has the potential to cause harm to the marine environment, it would likely meet this element of the definition.

Third, the purpose of the activity must be disposal. Disposal is not defined in the London Convention or Protocol, but “the ordinary meaning of the word indicates deposition for the purpose of abandonment.”⁶²⁰ This was an issue in the case of ocean fertilisation, as many proponents argued that the purpose was not disposal, but ‘eco-restoration’ or enhancement of the oceans’ ability to act as a carbon sink.⁶²¹ While the issue of ocean fertilisation was somewhat resolved by the non-binding bans on commercial development of ocean fertilisation, the question points to a serious tension, discussed in Section 4.3.7, between the objective of the international law of the seas (and international environmental law) and the international climate change law.

⁶¹⁴ UNCLOS, Article 1(5); London Convention, Article 3(1)(a).

⁶¹⁵ London Protocol, Article 1(4).

⁶¹⁶ Brent, K. (2020) ‘Marine geoengineering governance and the importance of compatibility with the law of the sea’ in McDonald, J., McGee, J., and Barnes, R. (eds). *Research Handbook on Climate Change*. Cheltenham: Edward Elgar, pp.442-61, p.452.

⁶¹⁷ Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities (adopted on 18 October 2013), Report of the Thirty-Fifth Consultative Meeting and the Eight Meeting of Contracting Parties, 35th and 8th mtgs, Agenda Item 15, Annex 4, LC 35/15 (21 October 2013), Annex (adding Article 6*bis* to read: “Contracting Parties shall not allow the placement of matter into the sea ... for marine geoengineering activities”).

⁶¹⁸ London Protocol, Article 3(1).

⁶¹⁹ London Protocol, Annex 1.

⁶²⁰ Rayfuse, R. Lawrence, M.G. and Gjerde, K.M. (2008), *supra* note 595, p.312.

⁶²¹ *Ibid*, p.313.



4.6.4 Non-binding international ban on ocean iron fertilisation

Both the CBD and the LP/LC regime have adopted non-binding bans on ocean iron fertilisation in response to concerns raised by proposed projects – including a high-profile, but ultimately cancelled, project in 2007 in the high seas near the Galapagos Islands.⁶²² While the bans are not binding, they have effectively halted many large-scale ocean iron fertilisation proposals, though smaller proposals within territorial waters have still been planned after the moratorium was adopted.⁶²³

In 2008, the LP/LC Contracting Parties adopted a non-binding resolution specific to ocean fertilisation, agreeing that the activities should not be allowed unless carried out as “legitimate scientific research.”⁶²⁴ Following up in 2010, the Contracting Parties adopted an assessment framework to assess whether proposed activities qualify as legitimate scientific research.⁶²⁵ Around the same time, the Contracting Parties began to consider binding rules for marine climate engineering beyond ocean fertilisation.⁶²⁶ They adopted a resolution in 2013 amending the London Protocol to prohibit marine geoengineering more broadly, except for legitimate scientific research.⁶²⁷ However, the resolution will not become binding until it enters into force, which requires adoption by two-thirds of the Contracting Parties.⁶²⁸ To date, only six states have adopted the resolution.⁶²⁹

Also in 2008, the CBD Conference of parties adopted a non-binding resolution calling on governments to stop ocean fertilization activities “until there is an adequate scientific basis on which to justify such activities.”⁶³⁰ There is an exception for small-scale scientific research, but only if a prior impact assessment is conducted and the research is “strictly controlled.”⁶³¹ The decision also explicitly addresses potential commercial applications, requesting that ocean fertilization “not be used for generating and selling carbon offsets or any other commercial purposes.”⁶³² Their follow-up

⁶²² Brahic, C. (2007) *Company plans ‘eco’ iron dump off Galapagos* / New Scientist [Online]. Available at: <https://www.newscientist.com/article/dn12111-company-plans-eco-iron-dump-off-galapagos/>; Thompson, K. (2008) *Carbon Discredit* / Popular Science [Online]. Available at: <https://www.popsoci.com/environment/article/2008-07/carbon-discredit/>

⁶²³ See, e.g., Tollefson, J. (2017) ‘Plankton-boosting project in Chile sparks controversy’, *Nature*, 545. Available at: <https://www.nature.com/articles/545393a.pdf?origin=ppub>

⁶²⁴ Resolution LC-LP.1 (2008) on the Regulation of Ocean Fertilization (adopted 31 October 2008), Report of the Thirtieth Meeting of the Contracting Parties to the London Convention and the Third Meeting of the Contracting Parties to the London Protocol, 30th and 3rd mtgs, Agenda Item 16, Annex 6, LC 30/16 (9 December 2008), para. 8.

⁶²⁵ Assessment Framework for Scientific Research Involving Ocean Fertilization (adopted 14 October 2010), Report of the Thirty-Second Consultative Meeting and the Fifth Meeting of Contracting Parties, 32nd and 5th mtgs, Agenda Item 15, Annex 6, LC 32/15 (9 November 2010).

⁶²⁶ For report on discussions of options for binding regulation by the Contracting Parties, see ‘Report of the thirty-second consultative meeting and the fifth meeting of contracting parties’, 32nd and 5th mtgs, Agenda Item 4, LC 32/15 (9 November 2010).

⁶²⁷ Resolution LP.4(8) on the Amendment to the London Protocol to Regulate the Placement of Matter for Ocean Fertilization and Other Marine Geoengineering Activities (adopted on 18 October 2013), Report of the Thirty-Fifth Consultative Meeting and the Eight Meeting of Contracting Parties, 35th and 8th mtgs, Agenda Item 15, Annex 4, LC 35/15 (21 October 2013), Annex (adding Article 6bis to read: “Contracting Parties shall not allow the placement of matter into the sea ... for marine geoengineering activities”).

⁶²⁸ London Protocol, Article 21(2).

⁶²⁹ Those states are Estonia, Finland, Germany, Netherlands, Norway and United Kingdom. See, IMO. (2022) *Status of IMO Treaties*, p.567. Available at: <https://wwwcdn.imo.org/localresources/en/About/Conventions/StatusOfConventions/Status%20-%202022.pdf>

⁶³⁰ Decision adopted by the Conference of the Parties to the Convention on Biological Diversity at its Ninth Meeting: IX/16. Biodiversity and climate change, 9th mtg, Agenda Item 4.5, UNEP/CBD/COP/DEC/IX/16 (9 October 2008) Section C, paragraph 4.

⁶³¹ Ibid.

⁶³² Ibid.

decision, adopted in 2010, goes further to ban any geoengineering activities, including ocean fertilization, that may affect biodiversity until more is known about the associated risks, including environmental, social, economic, and cultural impacts.⁶³³ The exception for small-scale scientific research remains, so long as the studies are controlled and subject to prior assessment.⁶³⁴

4.6.5 Deep-seabed drilling and carbon storage

Some marine-based climate engineering activities, particularly CCS, may involve seabed drilling for storage of carbon, thereby triggering obligations under the LC/LC regime.

The LC/LP regime formally prohibited CO₂ storage in the oceans, but that prohibition was lifted by a 2006 amendment.⁶³⁵ An additional amendment to the London Protocol in 2009 removed the prohibition on transboundary transport of waste to another country in the specific context of CO₂ seabed storage,⁶³⁶ making it possible for a state with insufficient seabed storage capacity to export to a state with more capacity.⁶³⁷ Two additional documents set out the rules for exporting the CO₂ to another country,⁶³⁸ and a revised framework for permitting seabed injection.⁶³⁹ Pursuant to these rules, a State has a number of obligations for CO₂ storage (or sequestration) in the seabed of another country or on the high seas so as to “ensure allowed activities are undertaken with minimum impact on the marine environment.”⁶⁴⁰ Those specific requirements include permitting, EIA, risk assessment and management, monitoring, and mitigation and remediation plans.⁶⁴¹

5. Neurotechnologies

Neurotechnologies are subject to international and EU laws and policies on human rights and privacy and data protection.

The following sections discuss some ways that neurotechnologies are or may be governed by international and EU law and policy within the frameworks of human rights and privacy and data protection. Each section begins with a brief introduction to the relevant legal issues and a summary of the international and EU legal framework (for more details on the legal frameworks, see Section 3). Specific legal issues within the legal framework are then presented in more detail; each discussion

⁶³³ Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Tenth Meeting: X/33. Biodiversity and climate change, 10th mtg, Agenda Item 5.6, UNEP/CBD/COP/DEC/X/33 (29 October 2010) paragraph 8(w).

⁶³⁴ Ibid.

⁶³⁵ For discussion, see, e.g., Dixon, T., Garret, J., and Kleverlaan, E. (2014) ‘Update on the London Protocol – Developments on Transboundary CCS and on Geoengineering’, *Energy Procedia*, vol. 63, pp.6623-28, p.6624.

⁶³⁶ Resolution LP.3(4) on the Amendment to Article 6 of the London Protocol (adopted on 30 October 2009), Report of the Fourth Eight Meeting of Contracting Parties, Annex, LP.3(4).

⁶³⁷ Dixon, T., Garret, J., and Kleverlaan, E. (2014), supra note 635, p.6624.

⁶³⁸ London Convention. (2013) Guidance on the Implementation of Article 6.2 on the Export of CO₂ Streams for Disposal in Sub-seabed Geological Formations for the Purpose of Sequestration. LC 35/15, Annex 6.

⁶³⁹ 2012 Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-seabed Geological Formations, LP.7.LC 34/15, Annex 8, 2012 [Revised CO₂ Specific Guidelines].

⁶⁴⁰ Dixon, T., Garret, J., and Kleverlaan, E. (2014), supra note 635, p.6625.

⁶⁴¹ 2012 Specific Guidelines for the Assessment of Carbon Dioxide for Disposal into Sub-seabed Geological Formations (Revised CO₂ Specific Guidelines) LP.7.LC 34/15, Annex 8.



includes specific references to existing (and proposed) law and an explanation of how the law may apply to neurotechnologies.

While no international or EU law directly addresses or explicitly mentions neurotechnologies, many aspects are subject to international and EU law.

5.1 Human rights and neurotechnologies

Neurotechnologies have the potential to impact human rights in many ways, both positive and negative. In relation to some rights in particular context, neurotechnologies have the potential to enhance enjoyment of rights, such as when neurotechnologies provide innovative treatment options that improve health and positively impact the right to health. But in other situations, such as the use of neurotechnologies in courtroom in ways that violate the right to fair trial and the prohibition on self-incrimination, neurotechnologies interferes and may even violate human rights.

The human rights discussed in this section are:

- Right to life
- Right to dignity
- Right to autonomy
- Right to privacy
- Freedom of opinion and expression
- Right to health
- Right to education
- Access to justice and right to a fair trial
- Right to rest and leisure
- Right to benefit from science
- Non-discrimination and vulnerable groups
- Trends and emerging rights

All sections outline the relevant international and EU laws and policies, then move to a discussion of key issues, gaps and challenges. For many rights, this discussion is organised into the positive and negative impacts that neurotechnologies have on realisation of a right ('potential enhancements' and 'potential interferences'); the impacts discussed include both current examples and potential future

impacts, sometimes drawn from science fiction.⁶⁴² Some rights do not have distinct positive and negative impacts, and therefore the key legal issues are discussed more generally. All sections conclude with remarks on States' current obligations under the law and identifies where the law may be updated to address gaps and challenges.

The final subsection presents a summary of the trend in human rights law towards the realisation of new human rights to explicitly address emerging challenges posed by neurotechnologies. Collectively known as 'neurorights', these proposed new rights are cognitive liberty, mental privacy, mental integrity, and psychological continuity.

5.1.1 International and EU law and policies

In the context of neurotechnologies, the most frequently referenced international legal documents are the Universal Declaration of Human Rights, International Covenant on Civil and Political Rights (ICCPR), International Covenant on Economic, Social and Cultural Rights (ICESCR), International Convention on the Elimination of All Forms of Racial Discrimination (CERD); Committee on the Elimination of Discrimination Against Women (CEDAW), Convention on the Rights of the Child (CRC), and the European Convention on Human Rights (ECHR). General Comments and General Recommendations from U.N. treaty bodies and reports from Special Procedures provide interpretative guidance explaining how the rights apply in specific contexts. Where relevant, specific reference is made to the U.N. Sustainable Development Goals and the jurisprudence of the European Court of Human Rights. At the EU level, the primary legal document is the Charter of Fundamental Rights of the European Union (CFREU). Where relevant, specific reference is made to jurisprudence of the European Court of Justice and the EU Pillar of Social Rights.

Neurotechnologies is not explicitly referenced in international or EU human rights law, nor is it the explicit topic of any guidance or reference documents. However, States obligation to respect, protect and fulfil human rights apply in the context of neurotechnologies.

5.1.2 Right to life

Neurotechnologies may challenge our understanding of the right to life as the meaning of 'alive' and 'dead', in a strict dichotomy, changes in response to developments in neurotechnology research. For example, though in the realm of science fiction, some argue that neurotechnologies may someday be used to bring someone "back from the dead" or create a virtual afterlife where life arguable continues after death. Currently, many private entities offer the possibility immortality through neurotechnologies (and related technologies), perhaps already influencing how an individual enjoys the right to life with dignity. While international human rights law on right to life does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not violate enjoyment of the right.

⁶⁴² "By highlighting possible futures, science fiction enables law to consider different strategies for dealing with new events and scenarios." Mitchell, T. (2014) 'Making Space: Law and Science Fiction', *Law and Literature*, 32(2), pp241-261, p. 248.

International law and policies

Under international law, everyone has the right “to life.”⁶⁴³ This right is also recognised in regional organisations, including the Council of Europe.⁶⁴⁴

The right includes both a prohibition against arbitrary deprivation of life and duty to protect life.⁶⁴⁵ States have a “duty to refrain from engaging in conduct resulting in arbitrary deprivation of life”⁶⁴⁶ and “must establish a legal framework to ensure the full enjoyment of the right to life,”⁶⁴⁷ which should include taking appropriate measures to address conditions in society that interfere with “enjoying the right to life with dignity.”⁶⁴⁸ The right is non-derogable⁶⁴⁹ and must be ensured without discrimination.⁶⁵⁰ In the context of international human rights law, right to life is most commonly associated with discussions on the death penalty, armed conflict, actions by law enforcement, abortion, assisted suicide, and torture.⁶⁵¹

EU law and policies

The EU Charter of Fundamental Rights includes the “right to life.”⁶⁵²

Key issues, gaps and challenges

Neurotechnologies may change the way we think of life and death, and consequently would fundamentally change what it means to enjoy the right to life.

The right to life is predicated on the understanding of a dichotomy between ‘life’ and ‘death’. Every person has the right to live, and a State is in violation of the right when it is responsible for an arbitrary death, a.k.a. the deprivation of life. While international law does not define ‘life’ or ‘death’, the general definition of death as the permanent cessation of all biological functions comes readily to mind. This includes the body’s respiratory, circulatory, and neurological systems. Simply put, a person’s life ends, and death begins, when the body stops functioning.

Neurotechnologies that enable a body or brain to somehow ‘function’ beyond the cessation of other frustrates the dichotomy between life and death. With advances neurotechnologies and related technologies, such as cryogenics, brain scanning and uploading, and cyborgs and robotic brains, some believe humankind will be able to achieve a form of immortality through neurological functioning

⁶⁴³ Universal Declaration of Human Rights (8 December 1948), G.A. Res. 217(A) III. (UDHR), Article 3; International Covenant on Civil and Political Rights (entry into force 23 March 1976) G.A. Res 2200A (XXI) (ICCPR), Article 6; Convention on the Rights of the Child (entry into force 2 September 1990), 1577 U.N.T.S. 3 (CRC), Article 6.

⁶⁴⁴ European Convention on Human Rights (as amended by Protocols 11, 14 and 15) (entry into force 3 September 1953), E.T.S. 5, 4. XI. 1950 (ECHR), Article 2.

⁶⁴⁵ ‘Deprivation of life’ involves “intentional or otherwise foreseeable and preventable life-terminating harm or injury, caused by an act or omission.” Human Rights Committee. (2019) *General Comment No. 36: Article 6: right to life*, CCPR/C/CG/36, 3 September 2019, para. 6.

⁶⁴⁶ Ibid, para. 7.

⁶⁴⁷ Ibid, para. 18.

⁶⁴⁸ Ibid, para. 26.

⁶⁴⁹ Ibid, para. 2.

⁶⁵⁰ Ibid, para. 61.

⁶⁵¹ See, e.g., *ibid*; and Korff, D. (2006). *The right to life: A guide to the implementation of Article 2 of the European Convention on Human Rights*. Council of Europe, Human rights handbooks, No. 8. Available at: <https://rm.coe.int/168007ff4e>.

⁶⁵² Charter of Fundamental Rights of the European Union (entry into force 18 December 2009), 2000/C 364/01 (CFREU), Article 2.

independent of other bodily functions.⁶⁵³ In essence, if one understands 'life' to be possible through neural activity exclusively, one could be arguably alive and dead simultaneously. Such an understanding of life and death would require a re-framing or clarification of States' duties to refrain from causing death and protecting life.

Furthermore, although still in the realm of science fiction, ideas about achieving immortality through neurotechnologies present possible futures where the concept of life and death can be exploited, e.g., worlds where consciousness is involuntarily transferred into new bodies like in the book (and now Netflix series) *Altered Carbon*⁶⁵⁴ or uploaded to a fully-commercialised virtual afterlife like in Amazon Prime Video series *Upload*.⁶⁵⁵ In a fictional world like these, the State plays a role in blurring the lines between life and death and may benefit from directly causing 'life' or 'death'. How the right to life in these worlds would apply is not clear. Should States be prohibited from involuntarily creating life, just as they are prohibited from depriving life? Can a State be prohibited for destroying a digital upload of consciousness? Is a virtual afterlife entitled to the same legal protections as 'life' as understood now, and would a State be responsible for addressing conditions that interfere with the enjoyment of a virtual afterlife with dignity? Would States have an obligation to regulate the actions of private actors within these worlds?

While many may consider it impossible or very far-fetched to achieve immortality with the assistance of neurotechnologies, a more immediate risk is that of undue or exploitative influence of private commercial actors today who offer services for those who want to someday benefit from the promise of immortality. It is an open question whether these services, especially if offered with no actual intention of fulfilling the promise of immortality, would constitute a condition in society that interferes with the right to life with dignity.⁶⁵⁶ Furthermore, the fact that death may be a requirement to benefit from the service (e.g., cryogenics) poses a unique challenge: who would have the right to know and seek redress from any harms or failed promises, particularly if the failure does not materialise for many decades or generations?

States' obligations and areas for legal development

Neurotechnologies are subject to existing international human rights law on the right to life and States have an obligation to ensure that the use of neurotechnologies support realisation of the right. States cannot use neurotechnologies to arbitrarily deprive someone of life and must ensure neurotechnologies are deployed in such a way that does not interfere with the enjoyment of life with dignity. However, neurotechnologies may challenge our understanding of 'life' and therefore necessitate a change in how the right to life is interpreted and applied. In the future, further guidance may be necessary to clarify whether a State should be prohibited from engaging with certain neurotechnology applications if such a use constitutes 'deprivation of life' or undermines life with dignity. At present, in the absence of operational 'immortality' technologies, guidance is necessary to

⁶⁵³ See, e.g., Parry, C. (2004) 'Technologies of immortality: the brain on ice', *Studies in History and Philosophy of Biological and Biomedical Sciences*, 35, pp.391-413, DOI: 10.1016/j.shpsc.2004.03.012; Turchin et al. (2017) 'Artificial Intelligence in Life Extension: from Deep Learning to Superintelligence', *Informatica*, 41(4), 401-417; Kruger, O. (2018) 'The Quest for Immortality as a Technical Problem: The Idea of Cybergnosis and the Visions of Posthumanism', in Blumberger, G. and Kakar, S (eds.) *Imaginations of Death and the Beyond in India and Europe*. Singapore: Springer, pp. 47-58; McGee, E.M. and Maguire G.Q. (2007) 'Becoming Borg to Become Immortal: Regulating Brain Implant Technologies', *Cambridge Quarterly of Healthcare Ethics*, 16. DOI: 10.1017/S0963180107070326; Kurzweil, R. (2004) 'Human Body Version 2.0' in Immortality Institute (ed.) *The Scientific Conquest of Death: Essays on Infinite Lifespans*. Buenos Aires: LibrosEnRed, pp. 93-106; and Moravec, H. (1988) *Mind Children: The Future of Robot and Human Intelligence*. Boston: Harvard University Press.

⁶⁵⁴ Morgan, R.K. (2003) *Altered Carbon*. Random House Publishing Group; and *Altered Carbon* (2018-2020) Netflix.

⁶⁵⁵ *Upload* (2020-) Amazon Prime Video.

⁶⁵⁶ These concerns would overlap with consumer protection rights, which prohibit false advertising.

address the current commercial market for immortality services, particularly whether marketing practices should be regulated to protect the right to life with dignity.

5.1.3 Right to dignity

Neurotechnologies have the potential to both enhance and interfere with the right to dignity. By providing new and better insights into the human brain, neurotechnologies can bolster our understanding of dignity and of ourselves, but intrusive, non-consensual, or unjustified applications of neurotechnologies may undermine enjoyment of the right. Whilst there is no specific international or EU law that addresses neurotechnology, there is an obligation on States to ensure neurotechnologies are developed and applied in a manner that respects the right to dignity.

International law and policy

Although not recognised as a freestanding legal right, dignity is subject to specific references within legal doctrine pertaining to international human rights law. The Universal Declaration of Human Rights (UDHR), the foundational document of the International Bill of Human Rights, provides that “All human beings are born free and equal in dignity and rights.”⁶⁵⁷ Although primarily symbolic and not formally binding upon State parties to the United Nations (UN), this provides the normative basis for the various civil, political, economic, social, and cultural rights contained within the International Covenant on Civil and Political Rights (ICCPR)⁶⁵⁸ and the International Covenant on Economic, Social and Cultural Rights (ICESCR),⁶⁵⁹ both of which assert within the preamble to the text that the rights contained therein “derive from the inherent dignity of the human person”. It follows from this that explicit reference to dignity can be found in the text of several Articles, for instance the right to education under the ICESCR⁶⁶⁰ and the rights of persons deprived of their liberty through imprisonment or detention under the ICCPR.⁶⁶¹ Various other major conventions, for instance on the Rights of the Child,⁶⁶² the Rights of Migrant Workers,⁶⁶³ and the Rights of Persons with Disabilities,⁶⁶⁴ have also since included specific references to dignity. Similarly, in international humanitarian law Common Article 3 of the Geneva Conventions protects wounded, sick and shipwrecked soldiers on (i) land and (ii) sea, (iii) prisoners of war and (iv) civilians against “outrages upon personal dignity, in particular humiliating and degrading treatment”.⁶⁶⁵

Within the legal framework of the Council of Europe, the most relevant legal instruments are the European Convention on Human Rights (ECHR)⁶⁶⁶, the Convention on Human Rights and

⁶⁵⁷ UDHR, Article 1.

⁶⁵⁸ ICCPR.

⁶⁵⁹ ICESCR.

⁶⁶⁰ Ibid, Article 13.

⁶⁶¹ ICCPR, Article 10(1).

⁶⁶² CRC, Preamble, Articles 23, 28, 37 and 39.

⁶⁶³ Convention for the Protection of the Rights of All Migrant Workers and Members of their Families (entry into force 1 July 2003) GA Res.45/158 (CPRMW), Articles 17 and 70.

⁶⁶⁴ Convention on the Rights of Persons with Disabilities (entry into force 3 May 2008) GA Res. A/61/611 (CRPD), Preamble, Articles 1, 3, 8, 16, 24 and 25.

⁶⁶⁵ See, for example, Geneva Convention relative to the Protection of Civilian Persons in Time of War (Fourth Geneva Convention) (entry into force 21 October 1950) 75 UNTS 287.

⁶⁶⁶ ECHR.



Biomedicine (Oviedo Convention),⁶⁶⁷ and the Convention on Action against Trafficking in Human Beings.⁶⁶⁸ The former eschews establishing a codified right and instead, analogous to the formulation of the two Covenants (see above), conceptualises dignity as an overarching principle. In *Pretty*, for instance, the European Court of Human Rights (ECtHR) observed that “[t]he very essence of the Convention is respect for human dignity and human freedom.”⁶⁶⁹ The Oviedo Convention, meanwhile, whilst not defining dignity explicitly, refers within the preamble to “the importance of ensuring the dignity of the human being”, and moreover, imposes an obligation on State Parties to “protect the dignity and identity of all human beings”, specifically within the context of biology and medicine.⁶⁷⁰ Finally, the Council of Europe adopted the Convention on Action against Trafficking in Human Beings in 2005, the preamble of which asserts “that trafficking in human beings constitutes a violation of human rights and an offence to the dignity and the integrity of the human being”. Further reference to dignity is provided in relation to measures to discourage demand for trafficking of human beings,⁶⁷¹ and repatriation and return of victims.⁶⁷²

EU law and policy

Mirroring the international human rights law approach to human dignity, Article 2 of the Treaty on European Union (TEU)⁶⁷³ establishes dignity as the first of the EU’s foundational values.⁶⁷⁴ In a clear separation from the former, however, EU law also codifies a substantive and enforceable right to human dignity in primary law under the terms of the Charter of Fundamental Rights (CFREU), specifically within Chapter 1 entitled “Dignity”, wherein it is asserted that “Human dignity is inviolable. It must be respected and protected.”⁶⁷⁵ Whilst judicial interpretation is limited, with the Court of Justice of the EU (CJEU) often referring to dignity in conjunction with other protected rights,⁶⁷⁶ such as the prohibition of torture and inhuman or degrading treatment or punishment⁶⁷⁷ and the right to privacy,⁶⁷⁸ an indication of the European Commission’s understanding of the right to dignity can be obtained from the 2018 Annual Report on the Application of the EU Charter of Fundamental Rights, according to which human dignity “guarantees the right of human beings to be protected from being treated as mere objects by the state or by their fellow citizens.”⁶⁷⁹ The prominence of the positioning of the right, coupled with the eponymous title of the Chapter, is indicative of the fundamental importance of dignity in the

⁶⁶⁷ Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine (Oviedo Convention) (entry into force 1 December 1999), E.T.S 164 4.IV.1997.

⁶⁶⁸ Convention on Action against Trafficking in Human Beings (entry into force 1 February 2008), E.T.S No 197 16.V.2005 (Convention on Action against Trafficking Human Beings).

⁶⁶⁹ *Case of Pretty v the United Kingdom* (Application no. 2346/02) (2002), [65].

⁶⁷⁰ Oviedo Convention, *supra* note 667, Article 1.

⁶⁷¹ Convention on Action against Trafficking Human Beings, *supra* note 668, Article 6.

⁶⁷² *Ibid*, Article 16.

⁶⁷³ Consolidated Version of the Treaty on European Union C 326/15 (TEU).

⁶⁷⁴ Alongside freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons belonging to minorities.

⁶⁷⁵ CFREU, Article 1.

⁶⁷⁶ Dupré, C. (2021) ‘Article 1’ in Peers S., Hervey T., Kenner J., and Ward A., (eds) *The EU Charter of Fundamental Rights: A Commentary* (Hart Publishing) pp.3-24.

⁶⁷⁷ CFREU, Article 4.

⁶⁷⁸ *Ibid*, Article 7.

⁶⁷⁹ 2018 Report on the Application of the EU Charter of Fundamental Rights COM (2019) 257 final. Available at: <https://data.europa.eu/doi/10.2838/44400>.



CFREU.⁶⁸⁰ Furthermore, the inclusion of, inter alia, the right to the integrity of the person,⁶⁸¹ the prohibition of torture, inhuman and degrading treatment or punishment⁶⁸² and the prohibition of slavery, forced labour and human trafficking⁶⁸³ within the Title of Dignity is a reflection of the interrelationship between dignity and other protected rights,⁶⁸⁴ as constituted by the former being, according to the Explanations Relating to the Charter, “the real basis of fundamental rights.”⁶⁸⁵ Finally, dignity is explicitly referred to within the rights of the elderly “to lead a life of dignity”⁶⁸⁶ and the right of workers to fair and just working conditions “which respect his or her health, safety and dignity.”⁶⁸⁷

Potential enhancements

Neurotechnologies have potential to enhance the right to dignity. Their use in a healthcare setting, for instance, can be used to better understand a person’s mental condition, allowing for appropriate treatment or support as required. Such application can help reduce the risk of interfering with the right to dignity, which – without the use of neurotechnologies – may result in a misunderstanding one’s mental state or a lack of understanding of their needs. Furthermore, neuroscience bolsters the value of protecting human rights such as the right to dignity, since “fundamental, species-typical features of the human nervous system undergird universal rights already articulated in existing [international human rights] agreements.”⁶⁸⁸ The concept of ‘dignity neuroscience’ underpins the idea that universal rights are rooted in human brain science, and that violations of these rights can cause lasting neurological and psychological effects.⁶⁸⁹

Potential interferences

In addition to potential enhancements of the right to dignity, the advancement of neurotechnologies also comes with the risk of interferences with this right. According to some, non-consensual mind-reading, for instance, constitutes a “fundamental affront to human dignity”, and should therefore be avoided.⁶⁹⁰ Neurotechnologies such as deep brain stimulation (DBS), or even less invasive techniques such as neural advertising, may interfere with neural processes and affect one’s psychological continuity, i.e. the experience of oneself as “persisting through time as the same person.”⁶⁹¹ As such, these technologies have the potential to affect “the realisation of

⁶⁸⁰ Jones J. (2012) ‘Human Dignity in the EU Charter of Fundamental Rights and Its Interpretation Before the European Court of Justice’, *Liverpool Law Review*, 33, pp. 281-300.

⁶⁸¹ CFREU, Article 3.

⁶⁸² *Ibid*, Article 4.

⁶⁸³ *Ibid*, Article 5.

⁶⁸⁴ Dupré, *supra* note 676.

⁶⁸⁵ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

⁶⁸⁶ CFREU, Article 25.

⁶⁸⁷ *Ibid*, Article 31.

⁶⁸⁸ White T. L. and Gonsalves M. A. (2021) ‘Dignity neuroscience: universal rights are rooted in human brain science’ *Annals of the New York Academy of Sciences*, 1505 [Online]. Available at: <https://doi.org/10.1111/nyas.14670>, p. 49.

⁶⁸⁹ Kimball J. (2021) *To advance human rights, consult neuroscience* / News from Brown [Online]. Available at: <https://www.brown.edu/news/2021-08-05/dignity>.

⁶⁹⁰ Stanley J. (2012) *High-Tech “Mind-Readers” Are Latest Effort to Detect Lies* / ACLU [Online]. Available at: <https://www.aclu.org/blog/national-security/high-tech-mind-readers-are-latest-effort-detect-lies?redirect=blog/high-tech-mind-readers-are-latest-effort-detect-lies>.

⁶⁹¹ Ienca M. and Andorno R. (2017) ‘Towards new human rights in the age of neuroscience and neurotechnology’, *Life Sciences, Society and Policy*, 13 (5) [online]. Available at <https://doi.org/10.1186/s40504-017-0050-1>, p. 20.



the rights needed for one's dignity and free development of their personality" to which everyone is entitled."⁶⁹²

States' obligations and areas for legal development

The right to dignity is often regarded as closely connected to other fundamental rights. In the context of neurotechnologies, the effective protection of the right to dignity, may extend to or require the protection of one's cognitive liberty, freedom of mind, and mental integrity. These concepts are regarded by some scholars as constituting a new set of human rights,⁶⁹³ which are considered in more detail in Section 5.1.13.

5.1.4 Right to autonomy

Neurotechnologies have the potential to both enhance and interfere with the right to autonomy. Whilst international and European Union human rights law on the right to autonomy does not specifically refer to neurotechnologies, the right applies in the context of neurotechnologies and relevant provisions under international law and EU law are applicable.

International law and policy

Although not expressly provided for within any of the major conventions under international human rights law, the right to "autonomy" is nonetheless listed as one of the general principles of the Convention on the Rights of Persons with Disabilities (CRPD),⁶⁹⁴ finding specific reference in articles pertaining to freedom from exploitation, violence and abuse,⁶⁹⁵ and health.⁶⁹⁶ The right, alongside associated variations,⁶⁹⁷ has also been recognised in regional organisations, including the Council of Europe. The European Court of Human Rights (ECtHR) has recognised the right to autonomy as derivative of, and therefore protected by, the right to respect for private and family life, conceptualised as "the personal sphere of each individual".⁶⁹⁸ In *Pretty v UK*, for instance, the ECtHR observed that "[a]lthough no previous case has established as such any right to self-determination as being contained in Article 8 of the Convention, the Court considers that the notion of personal autonomy is an important principle underlying the interpretation of its guarantees."⁶⁹⁹ Furthermore, the ECtHR has strengthened this position by recognising that protecting "the right to personal autonomy" imposes positive obligations on States,⁷⁰⁰ in addition to the classical formulation of a negative obligation of non-interference.⁷⁰¹ The factual elements of these cases highlights the primary basis upon which the right to autonomy is given legal effect, namely healthcare decision-making and,

⁶⁹² UDHR, Article 22. <https://www.un.org/en/about-us/universal-declaration-of-human-rights>; Ienca and Andorno, supra note 691, p. 22.

⁶⁹³ Ienca and Andorno, supra note 691.

⁶⁹⁴ CRPD, Article 3.

⁶⁹⁵ Ibid, Article 16(4).

⁶⁹⁶ Ibid, Article 25(d).

⁶⁹⁷ See, e.g., African Charter on Human and Peoples' Rights (Banjul Charter) (entry into force 21 October 1986) CAB/LEG/67/3 rev.5, 21 I.L.M. 58, Article 20 on the "unquestionable and inalienable right to self-determination."

⁶⁹⁸ See, e.g., *Case of Christine Goodwin v. The United Kingdom* (Application no.28957/95) (11 July 2002), para.90.

⁶⁹⁹ *Case of Pretty v. The United Kingdom*, supra note 669, para.61.

⁷⁰⁰ *Case of Tysiąc v. Poland* (Application no.5410/03) (20 March 2007), para.107.

⁷⁰¹ Donnelly M., (2011) *Healthcare Decision-Making and the Law: Autonomy, Capacity and the Limits of Liberalism* (Cambridge University Press), p.78.

more specifically, “the requirement for consent to treatment and a corresponding right to refuse treatment.”⁷⁰²

EU law and policy

The right to “autonomy” is not directly protected within the Charter of Fundamental Rights of the European Union (CFREU); however, it can be construed as an aspect of several protected fundamental rights. In accordance with Article 52(3) CFR, pursuant to which the rights in the CFR which correspond with the European Convention of Human Rights (ECHR) are to have the same “meaning and scope”, there are three potential bases of protection for the right to autonomy. The first potential source, for the reasons outlined above, is Article 7 CFR corresponding to Article 8 ECHR. A further potential source of protection, derived from reference the ECtHR’s reference to “a person’s physical and psychological integrity” in conjunction with “the right to personal autonomy”,⁷⁰³ is the right to integrity of the person.⁷⁰⁴ A final potential basis for protection of the right to “autonomy” is Article 1 CFREU, with legal scholars having highlighted the conceptual overlap with the right to human dignity.⁷⁰⁵

Potential enhancements

Neurotechnologies have potential to enhance the right to autonomy. The use of neurotechnologies such as deep brain stimulation (DBS) to treat certain diseases, including essential tremor, Parkinson’s disease, dystonia, or OCD,⁷⁰⁶ may enhance the right to autonomy by giving patients back a sense of autonomy which they had lost as a result of their disease. Furthermore, neurotechnologies – and neuroscience more generally – can unveil insights into the neurological and psychological roots of universal rights, including the right to autonomy.⁷⁰⁷ This may help to understand the value of and increase respect for the right to autonomy.

Potential interferences

Neurotechnologies, in some instances, may interfere with the right to autonomy. The non-consensual use of deep brain stimulation (DBS) to treat a medical condition, for example, would go against the requirement for consent to treatment and the right to refuse treatment, which give legal effect to the right to autonomy in a healthcare setting.⁷⁰⁸ Also, neurotechnologies which rely on machine learning techniques and computer-brain interfaces (BCI), ‘completing’ automated tasks on behalf of the user, may threaten the right to autonomy, and certainly give rise to various questions around the extend of the individuals autonomy and agency versus the decisions made by the computer.⁷⁰⁹ Arguably, even less invasive, unconscious neuromarketing techniques may constitute a threat to the right to autonomy, if they unduly influence one’s cognitive liberty and psychological continuity.⁷¹⁰

⁷⁰² Ibid, p.52.

⁷⁰³ *Case of Tysiąc v. Poland*, supra note 700, para.107.

⁷⁰⁴ CFREU, Article 3.

⁷⁰⁵ See, e.g., Dupré, supra note 676

⁷⁰⁶ Ienca and Andorno, supra note 691, p. 5.

⁷⁰⁷ White and Gonsalves, supra note 688.

⁷⁰⁸ Donnelly, supra note 701, p.52.

⁷⁰⁹ Yuste R., Goering S., Arcas B., et al. (2017) ‘Four ethical priorities for neurotechnologies and AI’, *Nature*, 551, 159-163. Available at <https://doi.org/10.1038/551159a>, p. 162.

⁷¹⁰ Ienca and Andorno, supra note 691, p. 22.

States' obligations and areas for legal development

The right to autonomy is closely related to a sense of cognitive liberty, one's entitlement to freedom of thought, mental integrity, and psychological continuity. Without respect for these notions, one's right to autonomy may be compromised. This has prompted a scholarly debate around the possible need to recognise a new set of human rights, called neurorights, which is considered in section 5.1.13 below.

5.1.5 Right to privacy

Neurotechnologies, such as neuroimaging, can give unique insights into people's mental states and behaviour.⁷¹¹ Neuroimaging can show whether information is new or familiar, and the use of such techniques in criminal proceedings, for instance, could help establish whether the person concerned is concealing further information.⁷¹² This raises important legal questions as the unrestricted use of neurotechnologies may threaten the right to privacy. Whether the general right to privacy provides sufficient safeguards, or whether there is a need to recognise a novel right to mental privacy, is considered in section 5.1.13 below.

International law and policy

Everyone has the right to privacy under international law.⁷¹³ This right entails that "No one shall be subjected to arbitrary or unlawful interference with his privacy, family, correspondence, nor to unlawful attacks on his honour and reputation."⁷¹⁴ It follows that States are under an obligation "to adopt legislative and other measures to give effect to the prohibition against such interferences and attacks as well as to the protection of this right."⁷¹⁵ The right to privacy is also recognised in regional organisations, including the Council of Europe.⁷¹⁶

The OECD adopted a Recommendation of the Council on Responsible Innovation in Neurotechnology,⁷¹⁷ calling upon adherents and actors to "avoid harm, and show due regard for human rights and societal values, especially privacy, cognitive liberty, and autonomy of individuals."⁷¹⁸ Confidentiality and privacy should be promoted to "safeguard brain data and other information gained through neurotechnology."⁷¹⁹ Furthermore, adherents and actors should "anticipate and monitor the potential unintended use and/or misuse of neurotechnology" by "implement[ing] safeguards and consider[ing] mechanisms to support the protection of private life to anticipate and monitor the potential."⁷²⁰

⁷¹¹ Ibid, p. 3.

⁷¹² Lighthart S., et al. (2021) 'Forensic Brain-Reading and Mental Privacy in European Human Rights Law: Foundations and Challenges', *Neuroethics*, 14, 191-203 [online]. Available at <https://doi.org/10.1007/s12152-020-09438-4>, p. 193. See also Ganis G. 'Detecting Deception and Concealed Information with Neuroimaging' in Peter J. Rosenfeld (ed) (2018) *Detecting Concealed Information and Deception: Recent Developments*. Academic Press, pages 145-163. Available at: [https://groups.psych.northwestern.edu/rosenfeld/documents/Rosenfeld,%20J.%20Peter.%20Detecting%20Concealed%20Information%20and%20Deception%20Recent%20Developments.%20\(PDF\).pdf](https://groups.psych.northwestern.edu/rosenfeld/documents/Rosenfeld,%20J.%20Peter.%20Detecting%20Concealed%20Information%20and%20Deception%20Recent%20Developments.%20(PDF).pdf).

⁷¹³ UDHR, Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14.

⁷¹⁴ UDHR, Article 12; ICCPR, Article 17.

⁷¹⁵ CCPR General Comment No.16: Article 17 (Right to Privacy) The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation (8 April 1988) [1].

⁷¹⁶ ECHR, Article 8.

⁷¹⁷ OECD 2019, *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457.

⁷¹⁸ Ibid, principle 1 (d).

⁷¹⁹ Ibid, principle 7 (f).

⁷²⁰ Ibid, principle 9 (b).

EU law and policy

The EU Charter of Fundamental Rights similarly provides that under EU law everyone has the “right to respect for his or her private and family life, home, and communications.”⁷²¹ The right to privacy is closely related to the right to data protection, pursuant to which “data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by law.”⁷²²

Potential enhancements

Neurotechnologies have the potential to facilitate more informed decision-making in the criminal justice system.⁷²³ Brain imaging techniques, for instance, can be used to help assess criminal responsibility, rehabilitation, or the risk of recidivism.⁷²⁴ Offenders may no longer need to be subjected to the level of interrogations or the use of lie detectors that would have occurred in the past to extract the same information from an individual. Furthermore, neurotechnologies give individuals access and control over their brain data, allowing for only that information to be released as is relevant to the case.⁷²⁵ In such instances, neurotechnologies have the potential to enhance the right to privacy.

Potential interferences

Despite the possible enhancements to the right to privacy, neurotechnologies raise important legal questions as to the scope of the right to privacy, and to the adequacy of existing safeguards to protect against privacy infringements. A 2013 study indicated that offenders with low activity in the brain region associated with decision-making and action were twice as likely to be rearrested within 4 years than those with high activity in that region.⁷²⁶ Reliance on such brain scans in an individual case to determine the conditions for a convict’s release, or their risk of recidivism, for instance, could interfere with the convict’s right to privacy. Whilst the right to privacy is not absolute and may be compromised for legitimate purposes such as the protection of public security, it is unclear whether brain data has – or should have – a lower threshold for triggering a violation of the right to privacy given its highly sensitive nature and intrinsic connection to personal identity and integrity. This leads into the discussion whether the right to privacy can provide sufficient safeguards, or whether there is indeed a need to recognise a new right to mental privacy.

States’ obligations and areas for legal development

One of the uncertainties around neurotechnologies is whether brain data is protected by the right to privacy. Whilst perhaps beyond dispute at face value, the question is whether brain data constitutes more than just personal information covered by the right to privacy, given its highly sensitive nature and intrinsic connection to one’s personal identity and integrity. There is no consensus as to whether brain data should simply be treated as biological data, similar to DNA tissue or blood samples, and may therefore be legitimately accessed on certain grounds during criminal proceedings, for instance, or

⁷²¹ CFREU, Article 7.

⁷²² Ibid, Article 8(2).

⁷²³ Ienca and Andorno, supra note 691, p. 5.

⁷²⁴ Ibid, p. 5; Lighthart, et al., supra note 712, p. 1.

⁷²⁵ Ienca and Andorno, supra note 691, p. 11.

⁷²⁶ Aharoni E., Vincent G. M., Kiehl, K. A. (2013) ‘Neuroprediction of future rearrest’, *PNAS*, 110 (15), [Online]. Available at <https://doi.org/10.1073/pnas.1219302110>; Ienca and Andorno, supra note 691, p. 6.

whether brain data requires a higher level of protection because of its relation to personal identity and freedom of thought.⁷²⁷

One challenge with treating brain data the same way as other personal data, is that brain data would be subject to the same privacy rules as any other personal data.⁷²⁸

Particularly tech companies who profit from the commercialisation of personal data, will have an interest in accessing brain data.⁷²⁹ In today's privacy paradigm, however, companies often rely on users' implied consent, as opposed to informed consent, to use their personal data. This means that users often agree to their data getting used without fully understanding the value of that data. The lack of informed consent may be particularly problematic for the commercial use of brain data.⁷³⁰ Some scholars are therefore calling for the adoption of a right to mental privacy to provide enhanced protection,⁷³¹ which is considered in section 5.1.13.

5.1.6 Freedom of expression

States cannot arbitrarily restrict the right to freedom of expression, and they have an obligation to ensure private actors do not interfere with the right. Beneficial applications of neurotechnologies in clinical contexts may enhance the right to freedom of expression for some, particularly those with verbal communication impairments. The use of neurotechnologies for the purposes of assisting communication may also have application in various real-world legal contexts, including, inter alia, participation in legal proceedings and consent to medical procedures.⁷³² Although international human rights law on the right to freedom of expression does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not violate enjoyment of the right.

International law and policy

The right to freedom of expression is enshrined in international law in various human rights instruments, including the Universal Declaration of Human Rights (UDHR),⁷³³ the International Covenant on Civil and Political Rights (ICCPR),⁷³⁴ the International Convention on the Elimination of All Forms of Racial Discrimination (CERD),⁷³⁵ the Convention on the Rights of the Child (CRC),⁷³⁶ the Convention on the Rights of Persons with Disabilities (CRPD),⁷³⁷ and the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families.⁷³⁸ State parties

⁷²⁷ Paz A. W. (2021), 'Is Mental Privacy a Component of Personal Identity?', *Frontiers in Human Neuroscience*, 15 (773441), [Online]. Available at: <https://doi.org/10.3389/fnhum.2021.773441>, p. 1.

⁷²⁸ Ienca and Andorno, supra note 691, p. 14.

⁷²⁹ Mackenzie R. (2021) *Privacy in the Brain: The Ethics of Neurotechnology / Technology Networks: Neuroscience News & Research* [Online]. Available at: <https://www.technologynetworks.com/neuroscience/articles/privacy-in-the-brain-the-ethics-of-neurotechnology-353075>.

⁷³⁰ Ibid.

⁷³¹ Ienca and Andorno, supra note 691, p. 11-17.

⁷³² Chandler J.A. et al (2022) 'Brain Computer Interfaces and Communication Disabilities: Ethical, Legal, and Social Aspects of Decoding Speech from the Brain', *Frontiers in Human Neuroscience*, 16. DOI: <https://doi.org/10.3389/fnhum.2022.841035>.

⁷³³ UDHR, Article 17.

⁷³⁴ ICCPR, Article 19.

⁷³⁵ International Convention on the Elimination of All Forms of Racial Discrimination (entry into force 4 January 1969) G.A. Res. 2106 (XX) (ICERD), Article 5.

⁷³⁶ CRC, Article 13.

⁷³⁷ CRPD, Article 21.

⁷³⁸ CPMW, Article 13(2).



have an obligation to guarantee the right, which includes the “freedom to seek, receive and impart information of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media”.⁷³⁹ The right “protects all forms of expression and the means of their dissemination”, including spoken, written and non-verbal expression, in addition to all forms of audio-visual, “electronic and internet-based modes of expression.”⁷⁴⁰ Included within the broad remit of protection are expressions considered “deeply offensive”,⁷⁴¹ as well as “expressions of an erroneous opinion or an incorrect interpretation of past events.”⁷⁴² However, exercising of the right to freedom of expression entails “special duties and responsibilities”, consistent with which enjoyment of the right may be limited in exceptional circumstances if provided by law for the protection of an enumerated purpose and the restriction is necessary to achieve that purpose.⁷⁴³ Further, based on its fundamental importance to the enjoyment of all other human rights, any such limitation to the right to freedom of expression must satisfy the conditions of legality, legitimacy, necessity, and proportionality.⁷⁴⁴

The right to freedom of expression is also recognised in regional organisations, including the Council of Europe.⁷⁴⁵ The enjoyment of this right is not absolute and can be restricted where such interferences are “prescribed by law and are necessary in a democratic society”, for the purposes of, inter alia, preventing crime or disorder, or the protection of health or morals.⁷⁴⁶ However, based on the right to freedom of expression being “one of the essential foundations of a democratic society and one of the basic conditions for its progress and for each individual’s self-fulfilment”,⁷⁴⁷ the European Court of Human Rights (ECtHR) has established a high threshold for legitimate interference, observing that “the adjective “necessary” in Article 10(2) implies the existence of a pressing social need...[which]...must be convincingly established.”⁷⁴⁸ Domestic legislators and judicial bodies are, in principle, conferred a margin of appreciation to make such determinations, subject to the European Court of Human Rights’ (ECtHR) overall supervisory function and ability “to give the final ruling” on whether an interference has occurred and, if so, whether it is permitted.⁷⁴⁹

EU law and policy

The EU Charter of Fundamental Rights (CFREU) also protects “the right to freedom of expression and information”, corresponding to Article 10 of the ECHR (see above) in accordance with Article 52(3) of the CFREU, included within which is the right “to receive and impart information and ideas without interference by public authority and regardless of frontiers.”⁷⁵⁰ The right to freedom of expression under EU law is not absolute, however, any limitation “must be provided for by law and respect the essence” of the right, in addition to being “necessary” and genuinely meeting “objectives of general

⁷³⁹ ICCPR, Article 19(2).

⁷⁴⁰ Human Rights Committee, *General comment No.34, Article 19: Freedom of opinion and expression*. CCPR/C/GC/34. 12 September 2011, para.12.

⁷⁴¹ Ibid, para. 11.

⁷⁴² Ibid, para. 49.

⁷⁴³ The enumerated purposes are: “(a) For respect of the rights or reputation of others; (b) For the protection of national security or of public order (*ordre public*), or of public health or morals.” ICCPR, Article 19(3).

⁷⁴⁴ Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, A/74/486, 9 October 2019, para.6. Available at:

https://www.ohchr.org/sites/default/files/Documents/Issues/Opinion/A_74_486.pdf.

⁷⁴⁵ See, e.g., ECHR, Article 10.

⁷⁴⁶ Ibid, Article 10(2).

⁷⁴⁷ *Case of Sanchez v. France* (Application no.45581/15) (2 September 2021), para.76.

⁷⁴⁸ Ibid, para. 77.

⁷⁴⁹ *Case of Handyside v. The United Kingdom* (Application no.5493/72) (7 December 1976), para. 49.

⁷⁵⁰ CFREU, Article 11.

interest recognised by the Union or the need to protect the rights and freedoms of others”, pursuant to the principle of proportionality.⁷⁵¹

Potential enhancements

The use of neurotechnologies in a clinical context may enhance the right to freedom of expression for some neurological patients, particularly those suffering from verbal communication impairments.⁷⁵² It has been suggested that neurotechnologies “are capable of decoding mental states and translating them into observable outputs such as text, verbal signals or graphic images”,⁷⁵³ the effectiveness of which has been demonstrated by research into neuroimaging technologies, such as non-invasive electroencephalography (EEG),⁷⁵⁴ intracranial electrophysiological monitoring techniques, such as electrocorticography (ECoG),⁷⁵⁵ as well as invasive and non-invasive brain computer interfaces (BCIs).⁷⁵⁶ Each of these applications may enhance the right to freedom of expression, particularly for those with speech-affected neurological conditions such as locked-in syndrome,⁷⁵⁷ specifically by enabling the production of communication directly from neural activity. The use of neurotechnologies for the purposes of assisting communication in persons whose verbal communication skills are impaired may, moreover, be required by the Convention on the Rights of Persons with Disabilities (CRPD), which provides that, in order to ensure that the right to freedom of expression of persons with disabilities is guaranteed “on an equal basis with others”, State Parties shall accept and facilitate the use of “augmentative and alternative communication and all other accessible means, modes and formats of communication” that persons with disabilities may choose for the purposes of official interactions.⁷⁵⁸

Key issues

The use of neurotechnologies to assist communication may have application in various real-world legal contexts, including participation in legal proceedings, consent to medical procedures, and harm to users and/or others. Whilst these use cases may not constitute interferences per se, the application of neurotechnologies in such contexts could impact the right to freedom of expression, alongside the rights of vulnerable groups, such as persons with disabilities (see Sections 5.1.6 and 5.1.12).

Participation in legal proceedings: The CRPD requires that “State Parties shall ensure effective access to justice for persons with disabilities on an equal basis with others, including in order to facilitate their effective role as direct and indirect participants, including as witnesses, in all legal proceeding, including at investigative and other preliminary stages.”⁷⁵⁹ Nonetheless, persons with communication disabilities may encounter various challenges to their participation in legal

⁷⁵¹ CFREU, Article 52(1).

⁷⁵² See, e.g., Lazarou et al. (2018) ‘EEG-Based Brain-Computer Interfaces for Communication and Rehabilitation of People with Motor Impairment: A Novel Approach of the 21st Century’, *Frontiers in Human Neuroscience*, 12(14). DOI: <https://doi.org/10.3389/fnhum.2018.00014>.

⁷⁵³ Ienca and Andorno, supra note 691.

⁷⁵⁴ See, e.g., Mirkovic B. Debener S. Jaeger M. De Vos M. (2015) ‘Decoding the attended speech stream with multi-channel EEG: implications for online, daily-life applications’, *Journal of Neural Engineering*, 12 (4). DOI: <https://doi.org/10.1088/1741-2560/12/4/046007>.

⁷⁵⁵ See, e.g., Herff et al. (2015) ‘Brain-to-text: decoding spoken phrases from phone representations in the brain’, *Frontiers in Neuroscience*, 9. DOI: <https://doi.org/10.3389/fnins.2015.00217>.

⁷⁵⁶ See, e.g., McFarland D.J. and Wolpaw J. (2011) ‘Brain-Computer Interfaces for Communication and Control’, *Communications of the ACM*, 54 (5), pp.60-66. DOI: <https://doi.org/10.1145/2F1941487.1941506>.

⁷⁵⁷ See, e.g., Ienca, M. (2021) *Common Human Rights Challenges Raised by Different Applications of Neurotechnologies in the Biomedical Fields*. Council of Europe. Available at: <https://rm.coe.int/report-final-en/1680a429f3>.

⁷⁵⁸ CRPD, Article 21(b).

⁷⁵⁹ Ibid, Article 13.

proceedings, “from initial difficulty in reporting a crime to exclusion from testifying if the legal system regards a person as lacking testimonial capacity due, for example, to co-occurring mental disability.”⁷⁶⁰ Neurotechnologies, such as neuroimaging (see above), may be used to assist those with verbal communication disabilities in both civil and criminal law contexts, for instance to provide witness testimony, thereby enhancing their right to freedom of expression and ensuring their effective participation in legal proceedings, pursuant to Article 13 of the CRPD. However, it has been suggested that communication neurotechnologies may suffer from a lack of transparency and reliability,⁷⁶¹ based on which their use for participation in legal proceedings may be restricted in order to avoid harms to both users and third parties, such as a miscarriage of justice.⁷⁶² In seeking to strike a balance between these competing interests, it may be necessary for developers of communication neurotechnologies to take specific technical measures, such as introducing a mechanism by which the user can endorse or reject a given output based on the accuracy and voluntariness of the content that is communicated.⁷⁶³

Consent Another potentially high impact real-world legal context in which the right to freedom of expression may be impacted by neurotechnologies is in the attainment of valid and lawful consent, specifically for those with verbal communication disabilities. The central question here is whether consent obtained via communication neurotechnologies, such as EEG, ECoG and BCI, will be treated as legally valid for the purposes of, inter alia, medical treatment, contractual obligations and sexual interactions.⁷⁶⁴ The significance of this issue lies in the possibility that miscommunication in a clinical context, for instance, “could impede the recognition of decision-making capacity or result in life-changing treatment decisions”,⁷⁶⁵ meanwhile miscommunication of consent could more generally lead to action taken by others which would otherwise constitute a breach of contract, a crime or a tortious infringement.⁷⁶⁶ In order to mitigate against such risks, whilst also supporting the realisation of the right to freedom of expression, particularly for those with verbal communication disabilities, it may be necessary for States to adopt specific guidance on the situations in which consent obtained via communication neurotechnologies will be legally valid and effective.

States’ obligations and areas for legal development

Neurotechnologies are subject to existing international human rights law on the right to freedom of expression and States have an obligation to ensure that the use of neurotechnologies supports realisation of the right. States have a particular responsibility to ensure non-discrimination and equal opportunity to enjoy the right to freedom of expression. In relation to the right to freedom of expression, further human rights guidance specific to neurotechnologies may be required to clarify concerns around the use of communication neurotechnologies to enable participation in legal proceedings and the attainment of consent.

5.1.7 Right to health

Neurotechnologies have the potential to both enhance and undermine the right to health. Beneficial applications of neurotechnologies in medical contexts may help enhance the right to health for some,

⁷⁶⁰ Chandler, supra note 732.

⁷⁶¹ Ibid.

⁷⁶² Chandler J.A. et al (2021) ‘Building communication neurotechnology for high stakes communications’, *Nature Reviews Neuroscience*, vol.22, pp.587-588. DOI: <https://doi.org/10.1038/s41583-021-00517-w>.

⁷⁶³ Ibid; Chandler, supra note 732.

⁷⁶⁴ Chandler, supra note 732.

⁷⁶⁵ Chandler, supra note 762.

⁷⁶⁶ Chandler, supra note 732.



particularly when used to diagnose and treat neurological disorders, illness, or injury. However, neurotechnologies also have the potential to cause physical and mental harm through accident, negligence, or intentional misuse and abuse. While international human rights law on the right to health does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not violate enjoyment of the right.

International law and policies

Under international law, everyone has the right “to the enjoyment of the highest attainable standard of physical and mental health.”⁷⁶⁷ This right is also recognised in regional organisations, including the Council of Europe.⁷⁶⁸

It is not a right to be *healthy*, but rather a right to certain freedoms (right to control one’s health and be freed from interference) and entitlements (equal opportunity to enjoy the highest attainable level of health).⁷⁶⁹ States have an obligation to “take the necessary steps to the maximum of its available resources” to ensure access to timely, acceptable, and affordable healthcare.⁷⁷⁰

Also relevant to the right to health and neurotechnologies is the Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Oviedo Convention).⁷⁷¹ It is the only international binding legal instrument on human rights and biomedicine, and includes provisions on relevant topics including equitable access and informed consent.

The Council of Europe’s Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025) elaborates how the international organisation will address emerging challenges posed by new technologies, including neurotechnologies.⁷⁷² For example, its Committee on Bioethics intends to prepare a Recommendation ‘on equitable and timely access to innovative treatments and technologies in healthcare systems’.⁷⁷³

EU law and policy

The EU Charter of Fundamental Rights includes the right “of access to preventative health care and the right to benefit from medical treatment under the conditions established by national laws and practices.”⁷⁷⁴

⁷⁶⁷ ICESCR, Article 12. See, also, UDHR, Article 25(1); ICERD, Article 5(e)(iv); Convention on the Elimination of All Forms of Discrimination against Women (entry into force 3 September 1981), 1249 U.N.T.S. 13 (CEDAW), Article 12; CRC, Article 24; and CRPD, Annex I, Article 25.

⁷⁶⁸ European Social Charter (entered into force 26 February 1965), E.T.S. 35 – Social Charter, 18.X.1961, Part I, para. 11.

⁷⁶⁹ Committee on Economic, Social and Cultural Rights. (2000) *General Comment No. 14: The Right to the Highest Attainable Standard of Health (Art. 12)*, adopted 11 August 2000, para. 8.

⁷⁷⁰ Ibid, paras. 11-12, 47.

⁷⁷¹ Oviedo Convention, supra note 667.

⁷⁷² Council of Europe. (2019) ‘Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025)’. Available at: <https://rm.coe.int/strategic-action-plan-final-e/1680a2c5d2>.

⁷⁷³ Ibid, p. 11.

⁷⁷⁴ ECHR, Art. 35.

Potential enhancements

Neurotechnologies can enhance an individual's health in many ways. Brain imaging techniques like MRI, fMRI and EEG are used to identify disorders, illness, and injuries such as brain tumors, strokes,⁷⁷⁵ and mood disorders.⁷⁷⁶ Neuromodulation and neurostimulation technologies are already used to help treat physical disorders like chronic pain (e.g., spinal cord stimulation to relieve pain), Parkinson's (e.g., deep-brain stimulation to reduce tremors), and stroke (e.g., targeted nervous system stimulation to improve physical movement).⁷⁷⁷ Neurostimulation techniques, including deep-brain stimulation and magnetic brain stimulation, may also be used to treat brain diseases like dementia and Alzheimer's,⁷⁷⁸ and mental illness like addiction⁷⁷⁹ and depression.⁷⁸⁰ Research on neural implants suggest they may also be effective at helping treat disorders like Parkinson's⁷⁸¹ and depression.⁷⁸² Progress is being made on neuroprotheses to replace or restore sensory, motor or cognitive functions; applications include cochlear implants for hearing impairments,⁷⁸³ retinal prostheses for blindness,⁷⁸⁴ and prosthesis for missing limbs.⁷⁸⁵ Brain-machine interfaces (BMI) could enable someone with locked-in syndrome to communicate through a brain-computer interface⁷⁸⁶ or a quadriplegic control an external robotic exoskeleton.⁷⁸⁷ Wearable neurotechnologies are being developed for real-time collection of neural data that can be shared with users and health care providers to help develop individualized treatment protocols and alert in case of emergency.⁷⁸⁸ All of these applications have the potential to enhance an individual's ability to enjoy the highest attainable standard of health by improving access to health-related information, alleviating pain and suffering, replacing or restoring functions, and overall enhancing health and quality of life

⁷⁷⁵ EEG (electroencephalogram) / Mayo Clinic [Online]. Available at: <https://www.mayoclinic.org/tests-procedures/eeeg/about/pac-20393875>.

⁷⁷⁶ See, e.g., Chen, R. (2020) 'Precision biomarkers for mood disorders based on brain imaging', *The BMJ*, 371 [Online]. Available at: <https://doi.org/10.1136/bmj.m3618>.

⁷⁷⁷ See, generally, *Neurotechnologies: The Next Technology Frontier* / IEEE Brain [Online]. Available at: <https://brain.ieee.org/topics/neurotechnologies-the-next-technology-frontier/>.

⁷⁷⁸ See, e.g., Ning, S. et al. (2022) 'Neurotechnological Approaches to the Diagnosis and Treatment of Alzheimer's Disease', *Frontiers in Neuroscience*, 16 (854992). DOI:10.3389/fnins.2022.854992.

⁷⁷⁹ See, e.g., Habelt, B. (2020) 'Biomarkers and neuromodulation techniques in substance use disorders', *Bioelectrical Medicine*, 6(4). DOI: 10.1186/s42234-020-0040-0.

⁷⁸⁰ See, e.g., Erickson, M. (2021), *Experimental depression treatment is nearly 80% effective in controlled study* / Stanford Medicine News Center [Online]. Available at: <https://med.stanford.edu/news/all-news/2021/10/depression-treatment.html>.

⁷⁸¹ See, e.g., Wonders C. P. (2018) *Self-tuning brain implant could help treat patients with Parkinson's disease* / National Institutes of Health [Online]. Available at: <https://www.nih.gov/news-events/news-releases/self-tuning-brain-implant-could-help-treat-patients-parkinsons-disease>.

⁷⁸² See, e.g., Stix, G. (2021) *Experimental Brain Implant Could Personalize Depression Therapy* / Scientific American [Online]. Available at: <https://www.scientificamerican.com/article/experimental-brain-implant-could-personalize-depression-therapy/>.

⁷⁸³ See, e.g., Carlyon, R. and Goehring, T. (2021) 'Cochlear Implant Research and Development in the Twenty-first Century: A Critical Update', *Journal of the Association for Research in Otolaryngology*, 22. DOI: 10.1007/s10162-021-00811-5.

⁷⁸⁴ See, e.g., Fernandez, E., Alfaro, A., and Gonzalez-Lopez, P. (2020) 'Toward Long-Term Communication With the Brain in the Blind by Intracortical Stimulation: Challenges and Future Prospects', *Frontiers in Neuroscience*, 14. DOI: 10.3389/fnins.2020.00681.

⁷⁸⁵ See, e.g., Yildiz, K.A., Shin, A.Y., and Kaufman, K.R. (2020) 'Interfaces with the peripheral nervous system for the control of a neuroprosthetic limb: a review', *Journal of NeuroEngineering and Rehabilitation*, 17. DOI: 10.1186/s12984-020-00667-5.

⁷⁸⁶ See, e.g., Lazarou et al., supra note 752.

⁷⁸⁷ See, e.g., Lempriere, S. (2019) 'Brain-machine interaction improves mobility', *Nature Reviews Neurology*, 15 (685). Available at: <https://www.nature.com/articles/s41582-019-0285-y>.

⁷⁸⁸ See, e.g., Cannard, C. (2020) 'Self-health monitoring and wearable neurotechnologies' in Ramsey, N.F. and Millan, J.R. (eds). *Handbook of Clinical Neurology*. 3rd ed., vol. 168, Elsevier, pp. 207-33.

Neurotechnologies are subject to existing international human rights law on the right to health and States have an obligation to ensure that the use of neurotechnologies support realisation of the right. States must take all necessary steps possible to guarantee that neurotechnologies do not interfere with individual's right to control their own health and that everyone has equal opportunity to benefit from neurotechnologies if desired. In relation to right to health, further human rights guidance specific to neurotechnologies may be required to address concerns related to, among other issues, consent, obsolescence, neurodiscrimination and bias, inequality of access, and intentional misuse and abuse.

5.1.8 Right to education

Neurotechnologies have the potential to both enhance and undermine the right to education. Neurotechnologies already help provide insights into learning, which may be applied to make educational systems more effective, particularly for persons with disabilities. If realised, information 'downloads' directly into the brain would revolutionise education and improve access to information. However, concerns about the use of neurotechnologies in educational setting include the adoption of ineffective methods propped up on false or misleading claims, long-term harm to development and learning capacities, risk of cognitive overload, negative impacts from commercialisation and privatisation, and inequality of access to beneficial applications. While international human rights law on the right to education does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not interfere with the enjoyment of the right.

International law and policy

Under international law, everyone has the right to education.⁸⁰⁰ This right is also recognised in regional organisations, including the Council of Europe.⁸⁰¹

Education should be "directed to the full development of the human personality and the sense of its dignity".⁸⁰² States are obligated to provide free, compulsory primary education to children and ensure equal access to secondary and higher education without discrimination.⁸⁰³ All education should be available, accessible, acceptable, and adaptable within the specific context of the State.⁸⁰⁴ Particular care should be afforded to persons with disabilities; States are obligated to provide reasonable accommodation to ensure equal access to education.⁸⁰⁵

To address concerns about the privatisation and commodification of human rights, human rights experts adopted the Adibjan Principles in 2019 to provide guidance on regulating private actors' involvement in education.⁸⁰⁶ Under the States must established effective regulation of private actors

⁸⁰⁰ UDHR, Article 26; ICESCR, Article 13; ICERD, Article 5(e)(v); CEDAW, Article 10; CRC, Article 28; and CRPD, Annex I, Article 24.

⁸⁰¹ ECHR, Article 2.

⁸⁰² UDHR, Article 26; and ICESCR, Article 13.

⁸⁰³ Ibid.

⁸⁰⁴ Committee on Economic, Social and Cultural Rights. (1999) *General Comment No. 13: The Right to education (article 13 of the Covenant)*, E/C.12/1999/10, 8 December 1999, para.6.

⁸⁰⁵ Committee on the Rights of Persons with Disabilities. (2016) *General Comment No. 4 (2016) on the right to inclusive education*, CRPD/C/GC/4, 25 November 2016, paras.28-33; and Committee on the Rights of the Child. (2007) *General Comment No. 9 (2006) on the rights of children with disabilities*, CRC/C/GC/9, 27 February 2007, Section VIII(D).

⁸⁰⁶ Abidjan Principles (Guiding Principles on the human rights obligations of States to provide public education and to regulate private involvement in education), adopted 13 February 2019.

consistent with international rights and standards.⁸⁰⁷ The Adibjan Principles have been endorsed by the U.N. High Commission for Human Rights,⁸⁰⁸ U.N. Special Procedures (including the then U.N. Special Rapporteur on the right to education),⁸⁰⁹ and the U.N. Human Rights Council,⁸¹⁰ among others.

Goal 3 of the UN Sustainable Development Goals is to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”.⁸¹¹

EU law and policy

The EU Charter of Fundamental Rights includes the right to education, including free compulsory education.⁸¹² The European Pillar of Social Rights also includes a principle on education, training and life-long learning.⁸¹³

Potential enhancements

Neurotechnologies may enhance education and learning. Research on neuroscience and neurotechnologies is already providing information on how the brain works during the learning process.⁸¹⁴ Learnings from this field of research may be used to make educational methods more effective and improve learning at all ages. Neuroscience research related to issues like attention in digital environments,⁸¹⁵ spaced lessons over time,⁸¹⁶ or the impacts of periodic social activities⁸¹⁷ may help educators better develop curricula and learning environments to improve education.⁸¹⁸ Better understanding of an individual’s brain and learning functions could also help teachers develop personalised learning plans.⁸¹⁹ For these reasons, investments in neurotechnologies may help States fulfil their obligation to ensure education is available, accessible, acceptable, and adapted in their national context.

⁸⁰⁷ Ibid, para. 53.

⁸⁰⁸ U.N. High Commissioner for Human Rights (2019) *Statement by UN High Commissioner for Human Rights Michelle Bachelet at the Social Forum: The promotion and protection of the rights of children and youth through education*, 1 October 2019. Available at: <https://www.ohchr.org/en/statements/2019/10/social-forum-promotion-and-protection-rights-children-and-youth-through?LangID=E&NewsID=25085>.

⁸⁰⁹ U.N. Special Rapporteur on the right to education. (2019) *Right to education: the implementation of the right to education and Sustainable Development Goal 4 in the context of the growth of private actors in education*, A/HRC/41/37, 10 April 2019.

⁸¹⁰ U.N. Human Rights Council. (2021) *Resolution on the right to education*, A/HRC/4/L.26/Rev.1, 8 July 2021; U.N. Human Rights Council. (2019) *Resolution on the right to education: follow-up to Human Rights Council resolution 8/4*, A/HRC/4/L.26, 9 July 2019.

⁸¹¹ Sustainable Development Goals, Goal 4.

⁸¹² CFREU, Art. 14.

⁸¹³ European Pillar of Social Rights, Principle 1.

⁸¹⁴ See, e.g., McCandliss B. and Toomarian, E. (2020) ‘Putting Neuroscience in the Classroom: How the Brain Changes As We Learn’, *Trend*. Available at: <https://www.pewtrusts.org/en/trend/archive/spring-2020/putting-neuroscience-in-the-classroom-how-the-brain-changes-as-we-learn>.

⁸¹⁵ See, e.g., Lodge, J.M. and Harrison, W.H. (2019) ‘The Role of Attention in Learning in the Digital Age’, *Yale Journal of Biology and Medicine*, 92. Available at: <https://pubmed.ncbi.nlm.nih.gov/30923470/>.

⁸¹⁶ See, e.g., Sisti, H.M., Glass, A.L. and Shors, T.J. (2007) ‘Neurogenesis and the spacing effect: Learning over time enhances memory and the survival of new neurons’, *Learning and Memory*, 14(5). DOI: 10.1101/Lm.488707.

⁸¹⁷ See, e.g., Mazzoli et al. (2021) ‘Breaking up classroom sitting time with cognitively engaging physical activity; Behavioural and brain responses’, *PLoS ONE*, 16(7). DOI: 10.1371/journal.pone.0253733.

⁸¹⁸ See, e.g., Willis, J. and Willis, M. *Research-based Strategies to Ignite Student Learning: Insights from Neuroscience and the Classroom*. 2nd ed. Alexandria, VA: USCD.

⁸¹⁹ See, generally, Posey, A. (2020) *Leveraging Neuroscience in Lesson Design* / ASCD [Online]. Available at: <https://www.ascd.org/el/articles/leveraging-neuroscience-in-lesson-design>.

Students with disabilities may particularly benefit from the integration of neurotechnologies in educational contexts.⁸²⁰ Neurotechnologies might assist not only with diagnosing learning disabilities,⁸²¹ but may also offer interventions to help students with disabilities learn better. For example, research suggests that screen-based technologies may help students with ADHD⁸²² or neurofeedback treatment may help students with dyslexia.⁸²³ Neurotechnologies could, therefore, be used as a tool of reasonable accommodation to adapt learning methods to specific needs. Neuroscience research may also be used to address discrimination against persons with disabilities and promote acceptance of 'neurodiversity'.⁸²⁴

In the future, neurotechnologies, including neural implants, may also have the potential to directly improve learning and education. Current research suggests that learning for a particular skill can be improved through targeted neurostimulation to the brain⁸²⁵ and many claim that it may one day be possible to download information into the brain through a brain-computer interface as the technologies improve.⁸²⁶ Such technologies could drastically expand access to information and enhance education.

Potential interferences

The use of neurotechnologies may create or contribute to situations that negatively impact the right to education. For example, some argue that false claims and promises of neuroscience research in education have led to the emergence of myths about learning, which, when applied, may undermine the learning process and support ineffective educational policies in place of more effective methods and interventions.⁸²⁷ In some instances, these misconceptions could negatively impact decisions on

⁸²⁰ See, generally, Muller, E. (2011). *Neuroscience and Special Education*. in Forum Brief Policy Analysis [Online]. Available at: https://nasdse.org/docs/72_f2f7f9b7-ff92-4cda-a843-c817497e81e4.pdf.

⁸²¹ See, e.g., Prado, J. (2019) *Can neuroscience help predict learning difficulties in children* / International Brain Research Organisation [Online]. Available at: <https://solportal.ibe-unesco.org/articles/can-neuroscience-help-predict-learning-difficulties-in-children/>.

⁸²² See, e.g., Kulman, R. (2022) *Why Neurotechnology May Help Your Child with ADHD* / Psychology Today [Online]. Available at: <https://www.psychologytoday.com/us/blog/screen-play/202205/why-neurotechnologies-may-help-your-child-adhd>.

⁸²³ See, e.g., Coben et al. (2015) 'The Impact of Coherence Neurofeedback on Reading Delays in Learning Disabled Children: A Randomized Controlled Study', *NeuroRegulation*, 2(4). DOI: 10.15540/nr.2.4.168.

⁸²⁴ See, generally, Armstrong, T. (2017) *Neurodiversity: The Future of Special Education?* / ASCD [Online]. Available at: <https://www.ascd.org/el/articles/neurodiversity-the-future-of-special-education>. 'Neurodiversity' is a term coined in the 1990s by Judy Singer to the "virtually infinite neuro-cognitive variability within Earth's human population". Singer, J. (2020) *What is Neurodiversity?* / Reflections on Neurodiversity [Online]. Available at: <https://neurodiversity2.blogspot.com/p/what.html>.

⁸²⁵ See, e.g., Kurzweil, R. (2016) *Now you can learn to fly a plan from expert-pilot brainwave patterns* / Kurzweil [Online]. Available at: <https://www.kurzweilai.net/now-you-can-learn-to-fly-a-plane-from-expert-pilot-brainwave-patterns>; Choe et al. (2016) 'Transcranial Direct Current Stimulation Modulates Neural Activities and Learning in Pilot Training', *Frontiers in Human Neuroscience*, 10. DOI: 10.3389/fnhum.2016.00034).

⁸²⁶ See, e.g., Kolitz, D. (2021) *Will It Be Possible to Upload Information To My Brain?* / Gizmodo [Online]. Available at: <https://gizmodo.com/will-it-be-possible-to-upload-information-to-my-brain-1847698784>; Papadopoulos, L. (2019) 'Brain Implants' Will Make Learning Obsolete in 20 Years, AI Expert Says / Interesting Engineering [Online]. Available at: <https://interestingengineering.com/google-brain-implants-could-make-learning-obsolete-in-20-years-says-ai-expert>; Villarica, H. (2012) *Study of the Day: Soon, You May Download News Skills to Your Brain* / The Atlantic [Online]. Available at: <https://www.theatlantic.com/health/archive/2012/01/study-of-the-day-soon-you-may-download-new-skills-to-your-brain/250775/>.

⁸²⁷ See, e.g., Macdonald et al. (2017) 'Dispelling the Myth: Training in Education or Neuroscience Decreases but Does Not Eliminate Beliefs in Neuromyths', *Frontiers in Psychology*, 8. DOI: 10.3389/fpsyg.2017.01314; and Klemm, W.R. (2016) *Fables and Facts in Educational Neuroscience* / Psychology Today [Online]. Available at: <https://www.psychologytoday.com/us/blog/memory-medic/201601/fables-and-facts-in-educational-neuroscience> (questioning 'myths' on, for example, teaching to different learning styles and the special importance of pre-kindergarten education).

the distribution of limited resources in such a way that effective teaching measures are deprioritised or unfunded.

Additionally, as long-term risks and effects on brain development from neurotechnologies is still unknown,⁸²⁸ the use of neurotechnologies may result in impacts that impair the brain's ability to develop and learn, thereby negatively impacting enjoyment of the right to education.

It is also important to note that the promise of wide or even unlimited access to information through neurotechnologies does not necessarily equate to enhanced learning or knowledge comprehension. Research on information overload in the context of the internet and digital technologies⁸²⁹ should inform discussions on whether individuals learn more with neurotechnologies and whether they should be used in educational settings.

Other concerns include potential negative effects from the use of commercial neurotechnologies that are not adapted or appropriately integrated into the educational context,⁸³⁰ or that give private actors too much control over learning content and systems while benefitting financially.⁸³¹

Lastly, inequitable access to beneficial neurotechnologies in educational settings could exacerbate existing inequalities and frustrate a State's ability to fulfil their obligations to ensure equal access to education.⁸³²

States' obligations and areas for legal development

Neurotechnologies are subject to existing international human rights law on the right to education and States have an obligation to ensure that the use of neurotechnologies support realisation of the right. States must ensure that neurotechnologies do not interfere with their obligations to provide free primary education to all children and equal access to secondary and higher education without discrimination. States have a particular responsibility to ensure equal access and non-discrimination for students with disabilities. Furthermore, States must regulate commercial neurotechnologies so that they, too, are consistent with international standards. In relation to right to education, further human rights guidance specific to neurotechnologies may be required to address concerns related to, among other issues, policy based on false or misleading claims, equality for and accommodation of students with disabilities, regulation of private actors and inequality of access.

5.1.9 Access to justice and right to a fair trial

Neurotechnologies have the potential to both enhance and undermine access to justice. XR may increase access to proceedings and allow for novel ways to present evidence, and its use may reduce the risk of judge, jury, or prosecutorial bias. However, XR may also encourage inferior participation

⁸²⁸ International Bioethics Committee, supra note 791, para. 98; and Muller and Rotter, supra note 790:

⁸²⁹ See, e.g., Lehman, A. and Miller, S.J. (2020) 'A Theoretical Conversation about Responses to Information Overload', *Information*, 11(8). DOI: 10.3390/info11080379; and Kurelovic, E.K., Tomljanovic, J. and Davidovic, V. (2016) 'Information Overload, Information Literacy and Use of Technology by Students', *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 10(3).

⁸³⁰ See, e.g., Taherisadr et al. (2021) 'Future of Smart Classroom in the Era of Wearable Neurotechnology'. Available at: https://www.researchgate.net/publication/355495131_Future_of_Smart_Classroom_in_the_Era_of_Wearable_Neurotechnology.

⁸³¹ See, generally, Hogan, A. and Thompson, G. (eds) (2021). *Privatisation and commercialisation in public education: How the nature of public schooling is changing*. Abingdon, Oxon United Kingdom: Routledge; and Selwyn et al. (2020) 'What's next for Ed-Tech? Critical hopes and concerns for the 2020s', *Learning, Media and Technology*, 45:1, 1-6, DOI: 10.1080/17439884.2020.1694945.

⁸³² International Bioethics Committee, supra note 791, p.37.

and mask non-verbal cues, and it raises concerns about the accuracy and risk of image manipulation, inequalities of access to the technology, and privacy and data protection. All of these factors together may erode judicial legitimacy and undermine access to justice. While international human rights law on access to justice does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR does not violate enjoyment of the right.

International law and policy

Access to justice is a basic principle of law constituted by several related rights. These rights include equal access and treatment before the law, a “fair and public hearing by a competent, independent and impartial tribunal” in criminal cases,⁸³³ and the right to an effective remedy.⁸³⁴ Specific requirements include the right to be heard, the right to a defense, and the right to a public trial.⁸³⁵ In addition to specific guarantees, States have an obligation to ensure that access to courts and tribunals is not “systematically frustrated” by any *de jure* or *de facto* factors.⁸³⁶

Individuals also have the right to the presumption of innocence until proven guilty⁸³⁷ and the right “not to be compelled to testify against himself or to confess guilt.”⁸³⁸

These rights are also recognised in regional organisations, including the Council of Europe.⁸³⁹ While XR has not been the topic of guidance or jurisprudence in relation to international human rights law, the European Court of Human Rights has considered the use of videoconferencing and found no violation of a defendant’s right to a fair trial if certain conditions are met.⁸⁴⁰

EU law and policy

The EU Charter of Fundamental Rights includes the right “to an effective remedy” and “a fair and public hearing within a reasonable time by an independent and impartial tribunal.”⁸⁴¹

Potential enhancements

Neurotechnologies can be incorporated into the justice systems in ways that may help guarantee an individual’s right to a fair trial by enhancing fairness, limiting bias, and ensuring justice is served. For example, neuroimaging is already used in some jurisdictions to establish competency of individuals to stand trial,⁸⁴² establish an insanity defense,⁸⁴³ and assess a victim’s injury in personal injury cases.⁸⁴⁴ Findings on childhood brain development could also inform rules and standards on the age of criminal

⁸³³ UDHR, Article 10; ICCPR, Article 14.

⁸³⁴ ICCPR, Article 2(a).

⁸³⁵ Human Rights Committee. (2007) *General Comment No. 32: Article 14: Right to equality before courts and tribunals and to a fair trial*, CCPR/C/GC/32, adopted 23 August 2007, para.28, 32, and 37.

⁸³⁶ Ibid, para.9. Latin for “in law or in fact.”

⁸³⁷ UDHR, Article 11; ICCPR, Article 14(2).

⁸³⁸ ICCPR, Article 14(3)(g).

⁸³⁹ ECHR, Article 6.

⁸⁴⁰ European Court of Human Rights. (2006) *Marcello Viola v Italy (No. 1)*, 5 October 2006, No. 45106/04, CE:ECHR:2006:1005JUD004510604, para.76.

⁸⁴¹ CFREU, Article 47

⁸⁴² Kolla, N. J., Brodie, J.D. (2012) Application of Neuroimaging in Relationship to Competence to Stand Trial and Insanity In: Simpson, J.R. (ed) (2012) *Neuroimaging in Forensic Psychiatry: From the Clinic to the Courtroom*. Chichester, West Sussex: Wiley-Blackwell, p. 159.

⁸⁴³ Aono, D., Yaffe, G., Kober, H. (2019) ‘Neuroscientific Evidence in the Courtroom: A Review’, *Cognitive Research: Principles and Implications*, 4 (40), pp. 2-20.

⁸⁴⁴ Alces, P.A. (2018) *The Moral Conflict of Law and Neuroscience*. Chicago: The University of Chicago Press, p. 183.



responsibility.⁸⁴⁵ Research also suggests that neurotechnologies could be used in jury selection, assessing judge bias in sentencing, in memory elicitations, and determining guilt of an individual.⁸⁴⁶ If accurate and fair, these applications could enhance judicial proceedings.

Potential interferences

The use of neurotechnologies can also interfere with access to justice and the right to a fair trial, particularly if used in way that undermines the right to presumption of innocence or violates the right to not self-incriminate.

Regardless of how neurotechnologies come into the judicial system, a general concern is that the standards of evidence for law and science do not always align.⁸⁴⁷ The law requires proving an alleged set of facts at the individual level with specificity (a *specific* defendant did a *specific* thing at a *specific* time). Neuroscience, instead, often makes inferences about an individual based on group data (group to individual, or G2i, inference). Therefore, the tension between standards of proof from the two disciplines when neurodata is introduced to legal proceedings can undermine fairness and accuracy in the justice system.

Of particular concern is the potential use brain scans are introduced to show guilt, which poses many issues related accuracy, privacy, and mental integrity.⁸⁴⁸ If found guilty, a related concern is using neurotechnologies in criminal sentencing to assess risk of recidivism (*will the defendant commit the same crime again?*).⁸⁴⁹ While insights into the brain could used a mitigating factors that contribute to a lesser sentence, there is a significant risk of assessments based on a G2i inference, resulting in a non-personalised decision (i.e. other people would a similar brain may commit another crime, therefore the defendant will likely commit another crime and should have a longer sentence).

The use of neurotechnologies in detention and correctional facilities (e.g., for addiction or mental illness treatment) presents concerns related to efficacy, safety, and consent, especially when the treatment is court-ordered or involuntary.⁸⁵⁰

⁸⁴⁵ See, e.g., Wishart, H. (2018) 'Young Minds, Old Legal Problems: Can Neuroscience Fill the Void Young Offenders and the Age of Criminal Responsibility Bill – Promise and Peril', *The Journal of Criminal Law*, 82(3), pp. 311-320. DOI: [10.1177/0022018318779830](https://doi.org/10.1177/0022018318779830); and Mercurio et al. (2020). 'Adolescent Brain Development and Progressive Legal Responsibility in the Latin American Context', *Frontiers in Psychology*, 11. DOI: 10.3389/fpsyg.2020.00627.

⁸⁴⁶ Reese, B. (2009) 'Using fMRI as a Lie Detector- Are We Lying to Ourselves?', *Journal of Science and Technology*, 19 (1), 206-230. See also: Rusconi, E., Mitchener-Nissen, T. (2003) 'Prospects of Functional Magnetic Resonance Imaging as Lie Detector', *Frontiers in Human Neuroscience*, 7 (594), pp. 1-12; Pulice, E.B. (2010) 'The Right to Silence at Risk: Neuroscience-Based Lie Detection in The United Kingdom, India, and the United States', *The George Washington International Law Review*, 42 (4), pp. 865-896.

⁸⁴⁷ See, e.g., Faigman et al. (2014) 'Group to Individual (G2i) Inference in Scientific Expert Testimony', *University of Chicago Law Review*, 81 (2). Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2298909.

⁸⁴⁸ See, e.g., Aharoni et al. (2008) 'Can Neurological Evidence help Courts Assess Criminal Responsibility? Lessons from Law and Neuroscience', *Annals of the New York Academy of Sciences*, 1124. DOI: 10.1196/annals.1440.007; and Kraft, C.J. and Giordano, J. (2017) 'Integrating Brain Science and Law: Neuroscientific Evidence and Legal Perspectives on Protecting Individual Liberties', *Frontiers in Neuroscience*, 11. DOI: 10.3389/fnins.2017.00621.

⁸⁴⁹ See, e.g., Gertner, N. (2016) 'Neuroscience and Sentencing', *Fordham Law Review*, 85; and Ling, S. and Raine, A. (2017) 'The Neuroscience of Psychopathy and Forensic Implications', *Psychology, Crime & Law*. DOI: 10.1080/1068316X.2017.1419243.

⁸⁵⁰ See, e.g., Gkotsi, G.M. and Benaroyo, L. (2012) 'Neuroscience and the Treatment of Mentally Ill Criminal Offenders: Some Ethical Issues', *Journal of Ethics in Mental Health, Neuroethics Supplement*. Available at: http://www.antoniascasella.eu/dnlaw/Gkotsi_2012.pdf.

Lastly, neurotechnologies in judicial proceedings may also present privacy and data protection concerns, as many proceedings involve highly sensitive materials and neurodata is particularly sensitive.⁸⁵¹ This would be especially relevant to non-parties (e.g., jury members, witnesses) who have expectations of privacy but whose privacy rights are subservient to the parties rights; for example, a juror may not have the right to refrain from answering a question during jury selection if the answer to question is necessary to assess bias and ensure a defendants right to an impartial jury.⁸⁵²

States' obligations and areas for legal development

Neurotechnologies is subject to existing international human rights law on access to justice and the right to a fair trial, and States have an obligation to ensure that the use of neurotechnologies supports realisation of the rights. States must take all necessary steps possible to guarantee that the use of neurotechnologies does not create circumstances constituting a *de jure* or *de facto* interference with individual's right to equal access to justice, a fair trial, the presumption of innocence, and the right not to self-incriminate. In relation to right to a fair trial access to justice, further human rights guidance specific to neurotechnologies may be required to address concerns related to, among other issues, presumption of innocence and self-incrimination for defendants, standard of proof for neurodata, recidivism assessments in sentencing, and privacy and data protection for all parties.

5.1.10 Right to rest and leisure

Neurotechnologies have the potential to both enhance and undermine the right to rest and leisure. Neurotechnologies may unlock new creative outlets, free-up time for leisure, and improve access and enjoyment of certain activities for persons with disabilities. However, neurotechnologies can also interfere with rest and leisure, particularly when their use (and misuse) in workplace settings results in prolonged periods of work without sufficient rest. While international human rights law on the right to rest and leisure does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not violate enjoyment of the right. Furthermore, developments on 'right to disconnect' are directly relevant to neurotechnologies.

International law and policy

Under international law, everyone has the right to rest and leisure."⁸⁵³ This right is related to the right to work and labour protection, as it includes "reasonable limitation of working hours and periodic holidays with pay."⁸⁵⁴ Children are specifically entitled "to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts."⁸⁵⁵ All individuals have a right to equally participate in leisure activities, including persons with disabilities.⁸⁵⁶ The Council of Europe also recognises the right to rest, leisure and play for children.⁸⁵⁷

⁸⁵¹ See, e.g., Kraft, C.J. and Giordano, J. (2017) 'Integrating Brain Science and Law: Neuroscientific Evidence and Legal Perspectives on Protecting Individual Liberties', *Frontiers in Neuroscience*, 11. DOI: 10.3389/fnins.2017.00621.

⁸⁵² See, e.g., Suskin, Z.D. (2021) 'Lady Justice may be Blind, but is She Racist? Examining Brain, Biases and Behaviors Using Neuro-Voir Dire', *Cambridge Quarterly of Healthcare Ethics*, 30(2). DOI: [10.1017/S0963180121000177](https://doi.org/10.1017/S0963180121000177).

⁸⁵³ UDHR, Article 24; ICESCR, Article 7(d).

⁸⁵⁴ Ibid.

⁸⁵⁵ CRC, Article 31.

⁸⁵⁶ CRPD, Article 30.

⁸⁵⁷ Council of Europe. *Leisure time / Council of Europe* [Online]. Available at: <https://www.coe.int/en/web/childrens-voices/leisure-time>.

In some cases, the right to rest and leisure has been interpreted to include the 'right to disconnect' from work and associated digital technologies. While not codified in international law, the right to disconnect has been discussed by the World Health Organization and the International Labour Organization in a technical brief on telework.⁸⁵⁸

EU law and policy

In relation to fair and just working conditions, the EU Charter of Fundamental Rights includes the right "to daily and weekly rest periods."⁸⁵⁹ Member states are directed to take necessary measures to ensure restrictions on working hours.⁸⁶⁰ Work-life balance, particularly in the context of telework, is one of the European Pillars of Social Rights.⁸⁶¹

Potential enhancements

Neurotechnologies, and our understanding of the brain through neuroscience research, may enhance the enjoyment of leisure by 'unlocking' or enhancing an individual's creative abilities, thus fostering new leisure activities and outlets.⁸⁶² The use of neurotechnologies in non-leisure (a.k.a. work) activities may also improve efficiency, thus freeing time for more leisure activities. Neurotechnologies may offer particular benefits to persons with disabilities, for example smart glasses for children with autism that gives cues on facial expressions to help a child develop social skills and play with peers⁸⁶³ or neuro-prosthesis and mind-controlled exoskeletons that enable someone with mobility limitations to participate more fully in sport.⁸⁶⁴

Potential interferences

The use of neurotechnologies, particularly in the workplace setting, may negatively impact an individual's ability to enjoy the right to rest and leisure. For example, neurotechnologies to enhance productivity may have the inverse effects of increasing workload, thus maintaining the *status quo* or even further limiting time available for rest and leisure.⁸⁶⁵ Misuse and abuse of neurotechnologies could, in theory, be used to coerce or force individuals to perform activities or take actions. In the

⁸⁵⁸ World Health Organization and the International Labour Organization. (2021) *Healthy and Safe Telework*. Available at: <https://www.who.int/publications/i/item/9789240040977>.

⁸⁵⁹ CFREU, Art. 31(2).

⁸⁶⁰ Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time [2003] OJ L299/9.

⁸⁶¹ European Commission. (2021) European Pillar of Social Rights. Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en.

⁸⁶² See, e.g., Blaszczyk, C. (2019) *3Q: The interface between art and neuroscience* / MIT News [Online]. Available at: [https://www.fastcompany.com/90665894/this-is-how-to-truly-unlock-your-creativity](https://news.mit.edu/2019/3-questions-sarah-schwettmann-interface-between-art-and-neuroscience-0416#:~:text=Neuroscience%20and%20art%2C%20therefore%2C%20each,sense%20of%20incoming%20visual%20data; Ricker, E.R. (2021) <i>This is how to truly unlock your creativity</i> / Fast Company [Online]. Available at: <a href=); and Kirkwood, C. (2014) *Unlocking Creativity in the Brain* / BrainFacts.org [Online]. Available at: <https://www.brainfacts.org/Neuroscience-in-Society/The-Arts-and-the-Brain/2014/Unlocking-Creativity-in-the-Brain>; Nijholt A., et al. (2018) 'Brain-Computer Interfaces for Artistic Expression', CHI'18 Extended Abstracts, April 21–26, 2018, Montreal, QC, Canada. DOI: 10.1145/3170427.3170618.

⁸⁶³ See, e.g., Digitale, E. (2018) *Google Glass helps kids with autism read facial expressions* / Stanford Medicine News Center [Online]. Available at: <https://med.stanford.edu/news/all-news/2018/08/google-glass-helps-kids-with-autism-read-facial-expressions.html>.

⁸⁶⁴ See, e.g., Martins, A. and Rincon, P. (2014) *Paraplegic in robotics suit kicks off World Cup* / BBC [Online]. Available at: <https://www.bbc.com/news/science-environment-27812218>.

⁸⁶⁵ See, e.g., Hopkins, P.D. & Fiser, H.L. (2014) 'This Position Requires Some Alteration of your Brain': On the Moral and Legal Issues of Using Neurotechnology to Modify Employees', *Journal of Business Ethics*. DOI: 10.1007/s10551-016-3182-y.



context of work, this could manifest as prolonged periods of work without sufficient periods of rest, raising concerns related to the 'right to disconnect' and forced labour.

States' obligations and areas for legal development:

Neurotechnologies are subject to existing international human rights law on the right to rest and leisure and States have an obligation to ensure that the use of neurotechnologies support realisation of the right. Further human rights guidance specific to neurotechnologies may be required to address concerns related to, among other issues, the 'right to disconnect' and misuse and abuse in the workplace.

5.1.11 Right to benefit from science

Everyone has the right under international law to benefit from scientific progress, which includes neurotechnologies. States may not arbitrarily interfere with the ability to enjoy this right, which includes ensuring access to neurotechnologies without discrimination, particularly when the use of neurotechnologies is "instrumental" for enjoyment of other fundamental rights. States may not, however, force the use of technologies like neurotechnologies, excepted in limited situations.

International law and policy

Under international law, everyone has the right to "to share in scientific advancement and its benefits."⁸⁶⁶ Historically, this right is one of the least studied or applied in international human rights, but recent interest from UNESCO, the UN Special Rapporteur in the Field of Cultural Rights, and the UN Committee on Economic, Social and Cultural Rights as prompted new interest in the right.⁸⁶⁷

In this context, the definition of 'science' encompasses both process and the results of process⁸⁶⁸ and "the technology deriving from scientific research".⁸⁶⁹ The term 'benefits' refers to "the material results" and "the scientific knowledge and information directly deriving from scientific activity".⁸⁷⁰ States have obligations "to abstain from interfering in the freedom of individuals and institutions to develop science and diffuse its results" and to ensure individuals can enjoy the benefits of science without discrimination.⁸⁷¹ In particular, States must ensure "that everyone has equal access to the applications of science, particularly when they are instrumental for the enjoyment of other economic, social and cultural rights."⁸⁷² The U.N. Committee on Economic, Social and Cultural rights identifies that new emerging technologies present many risks and promises for the enjoyment of other rights, and calls on States to "adopt policies and measures that expand the benefits of these new technologies while at the same time reducing their risks."⁸⁷³

⁸⁶⁶ UDHR, Article 27. In the ICESCR, the right is articulated as the "right to benefit from scientific progress and its application". ICESCR, Article 15(b).

⁸⁶⁷ See Yotova, R. and Knoppers, B.M. (2020) 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing', *The European Journal of International Law*, 31(2).

⁸⁶⁸ Committee on Economic, Social and Cultural Rights. (2020) *General comment No. 25 (2020) on science and economic, social and cultural rights (article 15 (1) (b), (2), (3), and (4) of the International Covenant on Economic, Social and Cultural Rights*, E/C.12/GC/25, 20 April 2020, paras.4-5 (discussing United Nations Educational, Scientific and Cultural Organization. (2017) *Records of the General Conference, 39th session, Annex II – Recommendation on Science and Scientific Research*.

⁸⁶⁹ Ibid, para.7.

⁸⁷⁰ Ibid, para.8.

⁸⁷¹ Ibid, para.15.

⁸⁷² Ibid, para.17.

⁸⁷³ Ibid, para.74.



This right does not create an obligation on individuals to benefit from or use technologies. For example, in the context of medical treatment, States “must guarantee everyone has the right to choose or refuse the treatment they want with the full knowledge of the risks and benefits.”⁸⁷⁴ Anything contrary to this guarantee must be determined by law and “solely for the purpose of promoting the general welfare in a democratic society”.⁸⁷⁵

To address risks associated with some science and technologies and their applications, State may put limits on scientific research, but they must also be in law and promote “the general welfare in a democratic society”.⁸⁷⁶

In the specific context of biomedicine, the Council of Europe stresses “the need for international co-operation so that all humanity may enjoy the benefits of biology and medicine.”⁸⁷⁷

EU law and policy

The EU Charter of Fundamental Rights includes ‘freedom of the arts and sciences’ to ensure scientific research is “free of constraint”,⁸⁷⁸ but a similar right to benefit from scientific progress does not exist.

Key issues, gaps and challenges

Neurotechnologies itself would not potentially enhance or interfere with the right to benefit from scientific progress. Instead, enjoyment of the right is possible through the use of neurotechnologies, as the right extends to new and emerging technologies including neurotechnologies. States must ensure that individuals have access to neurotechnologies without discrimination, particularly when neurotechnologies are instrumental to the enjoyment of other rights like the right to health and education. To those individuals who choose, a State cannot arbitrarily interfere in the development, deployment, or enjoyment of neurotechnologies. On the other hand, except in certain circumstances determined by law, individuals cannot be forced to use neurotechnologies technologies. The use of neurotechnologies in justice systems presents a particular challenge if a compelled use of neurotechnologies interferes with the right to fair trial, presumption of innocence, and right to be free from self-incrimination.

States’ obligations and areas for legal development

States have an obligation to not arbitrarily interfere with the ability to enjoy the benefits of scientific progress, particularly when the use of neurotechnologies is “instrumental” for enjoyment of other fundamental rights. At the same time, States may not force the use of technologies like neurotechnologies, except in limited situations. To ensure that an individuals’ choice to ‘benefit from science’ is respected, there is an interest in a right of refusal to not use a technology or engage its use in a specific application.⁸⁷⁹ A right to refusal may enhance an individual’s ability to enjoy other rights

⁸⁷⁴ Ibid, para.44.

⁸⁷⁵ ICESCR, Article 4.

⁸⁷⁶ Committee on Economic, Social and Cultural Rights, supra note 868, para.21.

⁸⁷⁷ Oviedo Convention, supra note 667.

⁸⁷⁸ CFREU, Article 13.

⁸⁷⁹ This is distinct from involuntary limitations on access because of the ‘digital divide’. See Gangadharan, S.P. (2021) ‘Digital Exclusion: A Politics of Refusal’ in Bernholz, L., Landemore, H. and Reich, R. (eds) *Digital Technology and Democratic Theory*. University of Chicago Press: Chicago; Gangadharan, S.P. (2019) Video: ‘Technologies of control and our right of refusal’, TEDxLondon. Available at: https://www.ted.com/talks/dr_seeta_pena_gangadharan_technologies_of_control_and_our_right_of_refusal; and Benjamin, Ruha. (2016) ‘Informed Refusal: Toward a Justice- Based Bioethics.’ *Science, Technology, & Human Values* 41 (6), 967– 90. <https://doi.org/10.1177/0162243916656059>.

without the potential negative impacts of XR. However, the idea is not widely discussed or codified in any laws, though there is a proposal for a neuroright to ‘cognitive liberty’ to guarantee an individual’s freedom to use or refuse to use technologies that alter mental state (See Section 5.1.13).

5.1.12 Non-discrimination and vulnerable groups

Neurotechnologies have the potential to both enhance and interfere with the rights of vulnerable groups, including women, children and persons with disabilities. Beneficial applications in educational contexts may enhance the right to education for children, particularly those with disabilities, while the use of neurotechnologies, such as neurostimulation, may be used to treat a variety of neurological disorders and physical disabilities, which may enhance the right to health of persons with disabilities. However, the use of neurotechnologies also carries the risk of neurodiscrimination, particularly for neurodiverse individuals, the experiencing of which may negatively impact upon the enjoyment of other protected rights. Although international human rights law on the rights of vulnerable groups does not explicitly address the impacts of neurotechnologies, States have an obligation to ensure that the development and deployment of neurotechnologies does not interfere with the enjoyment of the protected rights of such groups, including to non-discrimination.

International law and policy

The rights of all persons to equality and non-discrimination are explicitly guaranteed under international law.⁸⁸⁰ The right to non-discrimination prohibits specific instances of discrimination, such as racial discrimination,⁸⁸¹ whilst also protecting particular groups against discriminatory treatment, including women,⁸⁸² children,⁸⁸³ migrant workers,⁸⁸⁴ and persons with disabilities,⁸⁸⁵ the particularised rights relating to whom are contained in specific international conventions. The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), for instance, is the most comprehensive of the treaties on the rights of women, requiring that State Parties, inter alia, ‘take all appropriate measures for the elimination of discrimination against women’ in the context of employment,⁸⁸⁶ healthcare,⁸⁸⁷ and other areas of economic and social life.⁸⁸⁸ In addition to the elimination of discrimination and the establishment of equality between men and women, the CEDAW also contains more targeted provisions, such as the imposition of an obligation on State Parties to “take all appropriate measures, including legislation, to suppress all forms of traffic in women and exploitation of prostitution of women.”⁸⁸⁹

In relation to children, meanwhile, the Convention on the Rights of the Child (CRC) establishes the Committee on the Rights of the Child (CRC Committee)⁸⁹⁰ and provides, inter alia, that State Parties “shall take all appropriate measures to ensure that the child is protected against all forms of discrimination”,⁸⁹¹ while also establishing “the best interests of the child” as a “primary consideration”

⁸⁸⁰ UDHR, Article 7; ICERD, Article 2; ICESCR, Articles 2 and 3; ICCPR, Articles 2(1), 3 and 26; CEDAW, Article 2; CRC, Article 2; CPRMW, Article 1; CRPD, Articles 1, 3, 4 and 5.

⁸⁸¹ ICERD, Article 2.

⁸⁸² CEDAW, Article 2.

⁸⁸³ CRC, Article 2.

⁸⁸⁴ CPRMW, Article 1.

⁸⁸⁵ CRPD, Articles 1, 3, 4 and 5.

⁸⁸⁶ CEDAW, Article 11.

⁸⁸⁷ Ibid, Article 12.

⁸⁸⁸ Ibid, Article 13.

⁸⁸⁹ Ibid, Article 6.

⁸⁹⁰ CRC, Article 43.

⁸⁹¹ Ibid, Article 2.

in actions taken by public and private sector bodies relating to children.⁸⁹² The rights of persons with disabilities under international law, meanwhile, are contained in the Convention on the Rights of Persons with Disabilities (CRPD), the primary purpose of which “is to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity.”⁸⁹³ Akin to the CEDAW and the CRC (see above), the CRPD requires that State Parties “promote equality and eliminate discrimination”,⁸⁹⁴ thereby permitting “specific measures which are necessary to accelerate or achieve de facto equality of persons with disabilities”,⁸⁹⁵ whilst also explicitly recognising the intersectionality between vulnerable groups through particular provisions relating to women and children with disabilities.⁸⁹⁶ Furthermore, the CRPD introduces various Convention-specific rights, such as the right of accessibility to, inter alia, “information and communications, including information and communications technologies and systems”,⁸⁹⁷ and the right to live independently and be included in the community.⁸⁹⁸

The rights of women, children and persons with disabilities are also recognised in regional organisations. For instance, the European Convention on Human Rights, a treaty of the Council of Europe providing for civil and political rights, contains a prohibition upon discrimination that is applicable to each of the identified vulnerable groups,⁸⁹⁹ meanwhile the corresponding European Social Charter guarantees various fundamental rights directly addressed to women, children and persons with disabilities.⁹⁰⁰ Pursuant to the latter, there is an obligation upon Contracting Parties to “recognise the right of men and women workers to equal pay for work of equal value”,⁹⁰¹ and moreover commit to taking measures consistent with “ensuring the effective exercise of the right of employed women to protection”, such as establishing provision for paid maternity leave.⁹⁰² Children and young persons are similarly entitled to specific protection under the European Social Charter, both alongside mothers in a joint right to social and economic protection,⁹⁰³ and as specific group; the protections in relation to which are primarily focused upon the age of, remuneration for, and general working conditions relevant to the employment context.⁹⁰⁴ Lastly, persons with a disability have a right to vocational training, rehabilitation and social resettlement under the European Social Charter, pursuant to which Contracting Parties have an obligation ‘to take adequate measures’ relating to the provision of training facilities and the placing of persons with disabilities in employment.⁹⁰⁵

EU law and policy

The Charter of Fundamental Rights guarantees that “[e]veryone is equal before the law”⁹⁰⁶ and prohibits “[a]ny discrimination based on any ground”.⁹⁰⁷ Alongside the rights to equality and non-discrimination, the specific rights of women, children and persons with disabilities under EU law are

⁸⁹² Ibid, Article 3.

⁸⁹³ CRPD, Article 1.

⁸⁹⁴ Ibid, Article 5(1)-(3).

⁸⁹⁵ Ibid, Article 5(4).

⁸⁹⁶ Ibid, Articles 6 and 7.

⁸⁹⁷ Ibid, Article 9(1).

⁸⁹⁸ Ibid, Article 19.

⁸⁹⁹ ECHR, Article 14.

⁹⁰⁰ European Social Charter, supra note 768.

⁹⁰¹ Ibid, Article 4(3).

⁹⁰² Ibid, Article 8(1).

⁹⁰³ Ibid, Article 17.

⁹⁰⁴ Ibid, Article 7(1)-(10).

⁹⁰⁵ Ibid, Article 15.

⁹⁰⁶ CFREU, Article 20.

⁹⁰⁷ Ibid, Article 21.



contained in Chapter III of the EU Charter of Fundamental Rights (CFREU), entitled Equality.⁹⁰⁸ In relation to the former, Article 23(1) ensures equality between men and women “in all areas, including employment, work and pay”, whilst not precluding “the maintenance or adoption of measures providing for specific advantages in favour of the under-represented sex.”⁹⁰⁹ The specific Article containing the rights of the child is based on the CRC (see above) and includes, inter alia, a right to “protection and care” as is necessary for wellbeing,⁹¹⁰ whilst the CFREU also lays down a requirement that the working conditions of young people be age-appropriate and protective against associated harms to health, safety and general development, in addition to establishing a prohibition upon child labour.⁹¹¹ Finally, building upon the equivalent provision under the European Social Charter (see above),⁹¹² persons with disabilities are entitled “to benefit from measures designed to ensure their independence, social and occupational integration and participation in the life of the community.”⁹¹³

Potential enhancements

Neurotechnologies may enhance the rights of vulnerable groups in various ways. Research into neuroscience and neurotechnologies, for instance, is enhancing understanding of how children’s brains develop during the learning process, the learnings from which may be used to improve educational performance (see Section...).⁹¹⁴ Children with disabilities may particularly benefit from the use of neurotechnologies in educational settings.⁹¹⁵ More generally, the use of neurotechnologies by persons with disabilities may lead to enhancements linked to the right to health. In addition to the role of neurotechnologies, such as electroencephalography (EEG), electrocorticography (ECoG), and brain computer interfaces (BCIs), in assisting communication for those with verbal communication impairments (see Section...), neurotechnologies can be used to study and treat the medical conditions underlying a range of disabilities. For instance, neurostimulation and neuromodulation techniques, such as deep brain stimulation (DBS), may be used to treat neurological disorders such as Alzheimer’s,⁹¹⁶ movement disorders such as Parkinson’s disease,⁹¹⁷ and neuropsychiatric disorders such as schizophrenia.⁹¹⁸ Further, the emerging field of neuroprosthesis may facilitate the treatment of spinal cord injuries,⁹¹⁹ while efforts are underway to develop neuroprosthetic interfaces enabling individuals to gain more intuitive control over prosthetic limbs.⁹²⁰ Each of these applications of

⁹⁰⁸ CFREU.

⁹⁰⁹ Ibid, Article 23(2).

⁹¹⁰ Ibid, Article 24(1)-(2).

⁹¹¹ Ibid, Article 32.

⁹¹² Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02), Explanations on Article 26.

⁹¹³ CFREU, Article 26.

⁹¹⁴ McCandliss B. and Toomarian E. (2020) *Putting Neuroscience in the Classroom: How the Brain Changes As We Learn / Trend* [Online]. Available at: <https://www.pewtrusts.org/en/trend/archive/spring-2020/putting-neuroscience-in-the-classroom-how-the-brain-changes-as-we-learn>.

⁹¹⁵ See, e.g., Simos P.G. et al. (2002) ‘Dyslexia-specific brain activation profile becomes normal following successful remedial training’, *Neurology*, 58 (8). DOI: <https://doi.org/10.1212/wnl.58.8.1203>.

⁹¹⁶ See, e.g., Ning S. et al. (2022) ‘Neurotechnological Approaches to the Diagnosis and Treatment of Alzheimer’s Disease’, *Frontiers in Neuroscience*, 16. DOI: <https://doi.org/10.3389/fnins.2022.854992>.

⁹¹⁷ See, e.g., Spagna S. Askari A. Patil P and Chou K. (2022) ‘Social Support and Clinical Outcomes in Patients with Parkinson Disease After Deep Brain Stimulation’, *Neurology*, 98. DOI: https://n.neurology.org/content/98/18_Supplement/1509.

⁹¹⁸ See, e.g., Sui Y. et al. (2021) ‘Deep Brain Stimulation Initiative: Toward Innovative Technology, New Disease Indications, and Approaches to Current and Future Clinical Challenges in Neuromodulation Therapy’, *Frontiers in Neurology*, 11. DOI: <https://doi.org/10.3389/fneur.2020.597451>.

⁹¹⁹ See, e.g., Nightingale T.E. et al (2019) ‘Ergogenic effects of an epidural neuroprosthesis in one individual with spinal cord injury’, *Neurology*, 92 (7). DOI: <https://n.neurology.org/content/92/7/338>.

⁹²⁰ See, e.g., Yildiz, Shin and Kaufman, supra note 785.

neurotechnologies has the potential to enhance the rights of persons with disabilities, specifically the right to health.⁹²¹

Potential interferences

The use of neurotechnologies may create or exacerbate situations that compromise the right of everyone under international law to non-discrimination. A particular concern is that the processing of brain data in neurotechnologies, particularly neuroimaging, may lead to “neurodiscrimination”, a phenomenon characterised by “discrimination based on a person’s neural signatures (indicating for example, a dementia predisposition), or mental health, personality traits, cognitive performance, intentions and emotional states.”⁹²² This is based on research which indicates that neurodiverse individuals, such as those with mental health problems, may suffer from both anticipated and experienced discrimination, one effect of which may be to create obstacles to receiving healthcare,⁹²³ and, moreover, that persons with disabilities may experience discrimination in employment settings, potentially receiving lower pay, job security and job flexibility in comparison to employees without disabilities.⁹²⁴ This raises the possibility that the use of neurotechnologies for clinical purposes may exacerbate existing or lead to increased *de facto* discrimination, particularly in employment and insurance contexts, the experiencing of which may compromise the right to non-discrimination and other protected rights, such as the right to health (see Section...) and the right to work and employment.⁹²⁵

States’ obligations and areas for legal development

Neurotechnologies are subject to existing human rights law on the rights of women, children and persons with disabilities, and States have an obligation to ensure that the use of such technologies supports realisation of these rights. States must ensure that neurotechnologies do not interfere with their obligations to guarantee the rights of vulnerable groups on the basis of non-discrimination. Further human rights guidance specific to neurotechnologies may be required to address concerns related to neurodiscrimination, in relation to which it has been suggested that the prohibition on genetic discrimination in the Oviedo Convention⁹²⁶ may serve as a reference point for comparable treatment.⁹²⁷

5.1.13 Trends and emerging rights

Neurotechnologies open the door to a new and previously unattainable set of possibilities to study the human brain and develop a better understanding of its functioning. The emergence of these technologies has prompted a scholarly debate around the possible negative impacts on one’s human rights and the suitability of the existing human rights law framework to provide adequate safeguards against intrusive applications of neurotechnologies. It has been argued that the emergence of

⁹²¹ CRPD, Article 25.

⁹²² Ienca, *supra* note 757, p.32.

⁹²³ See, e.g., Henderson C. et al. (2012) ‘A decision aid to assist decisions on disclosure of mental health status to an employer: protocol for the CORAL exploratory randomised controlled trial’, *BMC Psychiatry*, 12. DOI: <https://doi.org/10.1186/1471-244X-12-133>.

⁹²⁴ See, e.g., Schur L. (2017) ‘Disability at Work: A Look Back and Forward’, *Journal of Occupational Rehabilitation*, 27 (4), pp.482-497. DOI: <https://doi.org/10.1007/s10926-017-9739-5>.

⁹²⁵ CRPD, Article 27.

⁹²⁶ Oviedo Convention, *supra* note 667, Article 11.

⁹²⁷ Ienca, *supra* note 757, p. 32.

neuroscience and neurotechnologies has given rise to need for a new set of human rights, called **neurorights**.⁹²⁸

In particular, a set of four new human rights have been proposed Ienca and Andorno:

- Right to cognitive liberty
- Right to mental privacy
- Right to mental integrity
- Right to psychological continuity.⁹²⁹

Acknowledging the importance of avoiding rights inflation, Ienca and Andorno argue that neurotechnologies give a specific rise to the need for these neurorights, because existing human rights alone cannot offer adequate protection in some applications of neurotechnologies. In fact, it is argued that neurorights are essential for the protection of other human rights.⁹³⁰ The right to remain silent and the privilege against self-incrimination during criminal proceedings, for instance, would become redundant if one's decision to remain silent can easily be bypassed through mind-reading techniques. Furthermore, the advancement of pervasive neurotechnologies used for sub-conscious neuromarketing,⁹³¹ for instance, gives rise to new legal questions and the suitability of the existing human rights law framework to provide adequate safeguards. This section considers these four neurorights in short, and touches upon the ongoing scholarly debate around these rights.

Cognitive liberty By examining current and possible applications of neurotechnologies in the courtroom, a lot of attention is given to possible implications to constitutional rights of due process and equality before the law. Furthermore, application of neurotechnologies is considered against the protection of privacy and data retention. The former may be related to a more general right of privacy to one's mind against, while the latter may relate to privacy issues arising from neurodata retainment in a courtroom setting. At present, there seems to be no existing rights which may be specifically utilized to the application of neurotechnologies, although scholars have made proposals for such an introduction. Chile is an exception, as it recently initiated the introduction of "neurorights" as a constitutional amendment.

The concept of cognitive liberty may be defined as a right to mental self-determination⁹³². As a legal concept, the right can protect individuals against coercive use of neurotechnologies. An individual may accept or refuse the use of neurotechnologies in the context of their mind. Although such a right is currently not adopted in existing laws⁹³³, similar notions may be found when examining the right of bodily integrity. For instance, Article 3 of the EU Charter of Fundamental Rights outlines the rights of physical and mental integrity.⁹³⁴ However, creating a clear separation between the concept of the

⁹²⁸ Ienca and Andorno, *supra* note 757; see also Yuste, et al., *supra* note 709.

⁹²⁹ Ienca and Andorno, *supra* note 757.

⁹³⁰ *Ibid*, p. 9.

⁹³¹ *Ibid*, p. 4.

⁹³² Bublitz, C. (2013) 'My Mind is Mine!? Cognitive Liberty as a Legal Concept', in: Hildt, E., Franke, A. (eds) *Cognitive Enhancement: Trends in Augmentation of Human Performance*, vol 1. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6253-4_19.

⁹³³ *Ibid*, p. 9.

⁹³⁴ CFREU, Article 3 (1).



“mental” and “bodily” may be useful in the emerging application of neurotechnologies. The right to cognitive liberty and mental integrity could help safeguard existing due process rights in a legal setting. It goes beyond this as well, as neurotechnologies may be proposed for treatment purposes post-conviction⁹³⁵. Adopting a right to cognitive liberty may thus be a useful human rights development, as there is growing concern around the adoption of neurotechnologies and whether existing rights are enough to protect against possible misuse⁹³⁶.

One such recent development occurred in Chile, whose senate recently approved an amendment to their constitution to extend protection of brain rights and mental privacy⁹³⁷. Once signed into law by the president would be first of such developments, essentially creating a clear right for possible neurotechnological applications. This marks a movement towards the notion of “neurorights” which aim to address the human rights challenges neurotechnologies may present⁹³⁸.

There are obvious connections between the right to cognitive liberty and other human rights and fundamental freedoms. It would be difficult to imagine how the right to human dignity, or freedom of thought, speech or religion, for instance, would not be affected if one’s cognitive liberty is restricted due to the application of neurotechnologies. In fact, the freedom of thought is at the heart of other fundamental freedoms,⁹³⁹ and the right to cognitive liberty may be regarded as a necessary upgrade from the freedom of thought because it takes into account the technological ability to monitor and manipulate cognitive function, which previously was not held possible before the advancement of neurotechnologies.

However, pushback from some scholars argues that neurorights do not necessarily address the issue of evolving technological advancements which effect law, as they may overly emphasise the neuroscientific application⁹⁴⁰. The result of this may be that such a law would not be sufficient to address growing concern among other areas.

Nonetheless, the concept of cognitive liberty may be a useful tool in addressing the growing concern of the use of neurotechnologies in law and above the scope of law. Adopting such concepts in international jurisprudence may set a path by which individual States may interpret and form the law within their jurisdiction.

The right to mental privacy The application of neurotechnologies in certain scenarios, such as the use of brain-reading technologies in the criminal justice system, has given rise to the scholarly debate around the need to recognise the right to mental privacy.⁹⁴¹ This right has been defined as “the right

⁹³⁵ For instance, see discussion on bodily integrity in Neurotechnologies in Ireland, including Bestgen B. (2020) *Neurolaw – mental integrity and psychological continuity* / Irish Legal News [Online]. Available at <https://www.irishlegal.com/articles/benjamin-bestgen-neurolaw-mental-integrity-and-psychological-continuity>.

⁹³⁶ Yuste, et al., supra note 709; Zúñiga-Fajuri A., et al. (2021) ‘Neurorights in Chile: Between neuroscience and legal science’ in Hevia M. (ed), *Developments in Neuroethics and Bioethics*, Academic Press, 4, 165-179. Available at <https://doi.org/10.1016/bs.dnb.2021.06.001>; Bublitz J. (2022) ‘Novel Neurorights: From Nonsense to Substance’ *Neuroethics*, 15 (7) [Online]. Available at <https://doi.org/10.1007/s12152-022-09481-3> (accessed 2 June 2022).

⁹³⁷ Guzmán L. (2022) *Chile: Pioneering the protection of neurorights/Unesco* [Online]. Available at: <https://www.unesco.org/en/articles/chile-pioneering-protection-neurorights>.

⁹³⁸ Yuste, et al., supra note 709, p. 157.

⁹³⁹ Ienca M. (2021) ‘On Neurorights’, *Frontiers in Human Neuroscience*, 15 (701258) [online]. Available at: <https://doi.org/10.3389/fnhum.2021.701258>, p. 7; Ienca and Andorno, supra note 691, p.10; Sententia W. (2004) ‘Neuroethical considerations: cognitive liberty and converging technologies for improving human cognition’ *Ann N Y Acad Sci*, 1013 (1). Available at <https://doi.org/10.1196/annals.1305.014>.

⁹⁴⁰ Bublitz, supra note 936, p 7.

⁹⁴¹ Lighthart, et al., supra note 712.



against unconsented intrusion into brain data and the collection of that data.”⁹⁴² Unsurprisingly, the right to mental privacy is closely related to the general right to privacy. One might expect that privacy of the mind would be covered by one’s “reasonable expectation of privacy” and protected by the right to privacy.⁹⁴³ Yet, the right to mental privacy seeks to offer more enhanced protection to brain data specifically. Ienca and Andorno (2017) argue that the right to privacy by itself cannot offer the kind of protection that would be desired for brain data. Brain data would be exposed to the same level of exposure and intrusiveness of other personal information protected by the right to privacy.⁹⁴⁴ The highly sensitive nature of brain data, and their intrinsic connection with the individual’s “inner life and personhood” – the data source – give rise to the need for a specific right to mental privacy to provide additional safeguards.⁹⁴⁵

Related to mental privacy is the concept of neuroprivacy. Mental privacy relates to the protection of mental information regardless of how this information is collected, whilst neuroprivacy relates specifically to the protection of neural data.⁹⁴⁶ This distinction may become important, for example, when a criminal court is tasked with considering the admissibility of mental information as biological evidence and the protection of the principle against self-incrimination. In that context, questions like whether data gathered through neurotechnologies can be regarded as physical evidence which can be compelled in a similar vein to other biological evidence such as DNA or blood samples will need to be considered. Or does this data so closely relate to ‘testimony’ and the ‘will’ of the individual so that its use in court could constitute a violation of the individual’s privilege against self-incrimination.⁹⁴⁷ While this leads into a philosophical debate beyond the scope of this analysis around the distinction between neural processes and a person’s ‘will’, it is an important discussion when determining the suitability of existing right to privacy to protect mental information and neural data, or whether there is a need to recognise a novel right to mental privacy.

The scholarly debate around mental privacy has focused around two approaches. Some scholars, following the first approach, call for the recognition of a new right to mental privacy as part of the European human rights framework.⁹⁴⁸ This approach has also been suggested in the US legal context,⁹⁴⁹ as well as in the context of the Chile mentioned above with respect to the proposed

⁹⁴² Ienca, supra note 939, p. 7; Shen F. X. (2013) ‘Neuroscience, mental privacy, and the law’ *Harvard Journal of Law and Public Policy*, 36, 653-713; Ienca and Andorno 2017, ‘A New Category of Human Rights: Neurorights’ (*BMC Research in Progress Blog*, 26 April 2017) [online]. Available at: <https://blogs.biomedcentral.com/bmcblog/2017/04/26/new-category-human-rights-neurorights/>; Ienca and Andorno, supra note 691; Yuste, et al., supra note 709.

⁹⁴³ Ienca and Andorno, supra note 691, p. 13; Shen, supra note 942; *Katz v. United States* (1967) 389 U.S. 347.

⁹⁴⁴ Ienca and Andorno, supra note 691, p. 12.

⁹⁴⁵ *Ibid*, p. 14.

⁹⁴⁶ Ienca, supra note 939, p. 7; Hallinan D., et al. (2014) ‘Neurodata and neuroprivacy: data protection outdated?’ *Surveillance & Society*, 12, [Online]. Available at: <https://doi.org/10.24908/ss.v12i1.4500>; Ienca, supra note 799; Wolpe P. R. (2017) ‘Neuroprivacy and Cognitive Liberty’ in Johnson L. S. M. and Rommelfanger K. S. (eds) *The Routledge Handbook of Neuroethics* (New York: Routledge, Taylor & Francis Group), 214-224 [Online]. Available at: <https://doi.org/10.4324/9781315708652>.

⁹⁴⁷ Ienca and Andorno, supra note 691, p. 17; *Saunders v. United Kingdom*, ECtHR 1996-VI, para 69; US Supreme Court, *Miranda v. Arizona*, 384 U.S. 436 (1966).

⁹⁴⁸ Lighthart S. (2020) ‘Freedom of Thought in Europe: do advances in ‘brain-reading’ technology call for revision?’ *Journal of Law and the Biosciences*, 7 (1). Available at doi:10.1093/jlb/lcaa048, p. 3-4; Ienca and Andorno, supra note 691, p. 11-17. See also, Lavazza A. (2018) ‘Freedom of Thought and Mental Integrity: The Moral Requirements for Any Neural Prosthesis’, *Frontiers in Neuroscience*, 12 [online]. Available at DOI=10.3389/fnins.2018.00082 (accessed 1 June 2022), p. 1, 4.

⁹⁴⁹ Lighthart, supra note 948, p. 4; Farahany N. A. (2012) ‘Incriminating Thoughts’, *Stanford Law Review* 64 (351), 351-408, p. 406.



amendment to the constitution to include neurorights.⁹⁵⁰ The main argument for the adoption of a new right to mental privacy, is that the specific nature of brain data, deserves a higher degree of protection than other data covered by the general right to privacy.⁹⁵¹ Furthermore, brain data may be inseparable from the data source,⁹⁵² meaning that justified access to brain data alone would arguably also lay the source bare. The right to privacy has traditionally sought to protect 'external data' and therefore would fall short in an attempt to protect 'internal data' related to an individual's mental state and neural information.

The second approach, and this reasoning arguably applies to all considerations for existing human rights law and the need for novel neurorights, suggests that the general right to privacy can and should be interpreted to include the protection of the brain data and neural activity. To some extent, this approach may require a clarification of the right to privacy, a broadening of scope, or specification of the inclusion of brain data. In the context of criminal justice, Lighthart argues that the information gathered through brain-reading techniques, for instance, is not necessarily more sensitive than other personal information obtained through other (non-consensual) methods.⁹⁵³ Yet, a court of law may find that such use of brain-reading techniques would trigger stronger legal protection under other existing human rights, such as the freedom of thought.⁹⁵⁴ This would suggest that the existing human rights law framework is at least capable of providing adequate safeguards in the context of neurotechnologies.

Right to mental integrity The right to mental integrity refers to the idea that individuals should be protected from illicit and harmful manipulations of their mental activity.⁹⁵⁵ Whilst the right to physical and mental integrity is protected under EU human rights law,⁹⁵⁶ it is generally understood to relate to mental health.⁹⁵⁷ Ienca and Andorno argue, that the right to mental integrity should be reconceptualised to protect against mental harm, such as could occur from the unauthorised manipulation of neural activity resulting in harm.⁹⁵⁸ Neurostimulators and memory engineering methods are other examples of neurotechnologies which, despite their therapeutic benefit potential, may result in mental harm if applied in an illicit manner or for malevolent purposes.⁹⁵⁹

There is an ongoing debate as to the definition of the right to mental integrity. Whilst Ienca and Andorno define the right as the right to protection from mental harm through the use of neurotechnologies, Lavazza defines mental integrity as "the individual's mastery of his mental states and brain data".⁹⁶⁰ These mental states and brain data cannot be accessed or altered without the individual's consent.⁹⁶¹ This interpretation of mental privacy could be regarded as synonymous to cognitive liberty, meaning the right to mental integrity could be regarded as a substitute of the right

⁹⁵⁰ Guzmán, supra note 937; Lighthart, supra note 948, p. 4; Muñoz J. M. (2019) 'Chile-Right to Free will Needs Definition', 574 *Nature* 634, [Online]. Available at: <https://doi.org/10.1038/d41586-019-03295-9>. See also Yuste, et al., supra note 709.

⁹⁵¹ Ienca and Andorno, supra note 691, p. 14.

⁹⁵² Ibid, p 15.

⁹⁵³ Lighthart, et al., supra note 712, p. 200.

⁹⁵⁴ Ibid; ECHR, Article 9.

⁹⁵⁵ Ienca and Andorno, supra note 691, p. 18.

⁹⁵⁶ CFREU, Article 3.

⁹⁵⁷ Ienca and Andorno, supra note 691, p. 18.

⁹⁵⁸ Ibid.

⁹⁵⁹ Ibid, p. 19.

⁹⁶⁰ Lavazza, supra note 948, p. 4; Ienca, supra note 939, p. 8.

⁹⁶¹ Ibid.



to cognitive liberty.⁹⁶² Ienca and Andorno, however, draw an important distinction with the right to cognitive liberty, by stating that the right to mental integrity relates to the protection from harm related to an individual's mental domain.⁹⁶³

Arguably, violations of the right to mental integrity could have occurred before the advancement of the neurotechnologies seen today. Harsh interrogations, polygraph-based lie detection methods, and even psychological torture and manipulation may in some scenarios have constituted violations of these concepts of neurorights. The use of psychoactive drugs and hypnosis that cause harm to one's mental state may be regarded as threats to one's mental integrity. Yet, Ienca and Andorno argue that advanced "the degree of perturbation of advanced neurotechnology on the current ethical-legal framework is quantitatively higher than non-computational techniques",⁹⁶⁴ calling for the recognition of the right to mental integrity as a basic human right.⁹⁶⁵ Furthermore, Douglas and Forsberg argue that the right to bodily integrity necessitates the need to recognise a right to mental integrity, for justificatory consistency.⁹⁶⁶

Right to psychological continuity Psychological continuity is a key element of personal identity, and has been defined as "experiencing oneself as persisting through time as the same person."⁹⁶⁷ The right to psychological continuity seeks to preserve personal identity and protect against unconsented external interference.⁹⁶⁸ The right to identity is already recognised in the UDHR,⁹⁶⁹ and as part of the right to private life by the ECtHR.⁹⁷⁰ Ienca and Andorno distinguish personal identity from privacy by stating that the right to psychological continuity aims to protect against third party alterations of brain functioning, whereas the right to privacy is limited to protecting against unrestricted access to brain data.⁹⁷¹

Neurotechnologies such as memory engineering techniques may impact a person's identity if certain memories related to their experience of themselves as a particular individual are changed or otherwise affected.⁹⁷² Furthermore, neuromarketing techniques, such as unconscious neural advertising where an individual does not consciously register an intervention, may affect one's psychological continuity and therefore impact on their personal identity.⁹⁷³

Ienca and Andorno argue that psychological continuity may be impacted by neurotechnologies separately from mental privacy and integrity.⁹⁷⁴ The right to psychological continuity may be violated if an application of neurotechnologies results in the unconsented alteration of one's mental state despite not causing any harm.⁹⁷⁵ The absence of harm is an important as this scenario would otherwise

⁹⁶² Ibid.

⁹⁶³ Ienca, supra note 939, p. 8; Ienca and Andorno, supra note 691, p. 17-20.

⁹⁶⁴ Ienca and Andorno, supra note 691, p. 10.

⁹⁶⁵ Ibid.

⁹⁶⁶ Douglas T., Forsberg L. (2021) 'Three Rationales for a Legal Right to Mental Integrity' in Ligthart S., et al. (eds.) *Neurolaw*, Palgrave MacMillan Cham. [Online]. Available at: https://doi.org/10.1007/978-3-030-69277-3_8, p. 190.

⁹⁶⁷ Ienca and Andorno, supra note 691, p. 20; Klaming L. and Haselager P. (2013) 'Did My Brain Implant Make Me Do It? Questions Raised by DBS Regarding Psychological Continuity, Responsibility for Action and Mental Competence, *Neuroethics*, 6 [online]. Available at <https://doi.org/10.1007/s12152-010-9093-1>.

⁹⁶⁸ Ienca and Andorno, supra note 691, p. 21.

⁹⁶⁹ UDHR, Articles 22 and 29.

⁹⁷⁰ ECHR, Article 8 ECHR; *Goodwin v United Kingdom*, supra note 698, 18 at 90; Ienca and Andorno, supra note 691, p. 21.

⁹⁷¹ Ienca and Andorno, supra note 691, p. 21-22.

⁹⁷² Ibid, p. 20.

⁹⁷³ Ibid, p. 22.

⁹⁷⁴ Ibid, p. 21.

⁹⁷⁵ Ibid, p. 21.



trigger the right to mental integrity. An example in which the right to psychological continuity could be threatened is the use of unconscious neural advertising in neuromarketing.⁹⁷⁶ The ability of marketing companies to influence people's preferences through invasive yet undetectable advertising techniques calls for the protection of psychological continuity in order to adequately protect the right to identity. Yet, there is currently no consensus as to the exact meaning of the right to identity or psychological continuity in the context of neurorights. Yuste et al., for one, argue that the individual identify relates to one's physical and mental integrity,⁹⁷⁷ whereas Ienca and Andorno make a clear distinction between mental integrity and psychological continuity.⁹⁷⁸ The right to psychological continuity and the right to personal identity seek to promote freedom of the mind and protect against external manipulation.⁹⁷⁹ The right to cognitive liberty and freedom of thought arguably seek to do the same thing, meaning that these neurorights may constitute one and the same family of neurorights, sitting next to the right to mental privacy and the right to mental integrity.⁹⁸⁰

5.2 Privacy and Data Protection

Neurotechnologies offer the opportunity to gain unique insights into the workings of the human brain. Whilst initially intended for clinical and research purposes, increased commercialisation had led to various market-led efforts to develop consumer-grade neurotechnologies, from Neuralink seeking to produce "a scalable high-bandwidth brain-machine interface system",⁹⁸¹ to Facebook only recently discontinuing its development of a brain computer interface (BCI) that could be combined with virtual reality (VR).⁹⁸² Such consumer-based neurotechnologies are, moreover, being used in conjunction with big data and advanced machine learning techniques for the purposes of, inter alia, developing "more effective assistive neurotechnologies",⁹⁸³ and the prediction and analysis of neural recording data.⁹⁸⁴ The convergence of these "technological macrotrends" may, however, also lead to the collection and storage of personal brain data on a vast scale, thereby potentially exacerbating the risk of interference with rights to privacy and data protection of users.⁹⁸⁵ Against this background, this section analyses the key issue of the status of brain data obtained through the use of neurotechnologies, specifically assessing whether, and if so how, such data is protected under the relevant international and EU law.

⁹⁷⁶ Ibid, p. 22.

⁹⁷⁷ Ienca, supra note 939, p. 8; Yuste, et al., supra note 709, p. 162.

⁹⁷⁸ Ienca and Andorno, supra note 691, p. 22.

⁹⁷⁹ Ienca, supra note 939, p. 9.

⁹⁸⁰ Ibid, p. 9.

⁹⁸¹ Musk E and Neuralink. (2019) 'An Integrated Brain-Machine Interface Platform With Thousands of Channels', *Journal of Medical Internet Research*, 21 (10). DOI: <https://doi.org/10.2196/16194>.

⁹⁸² Regalado A. (2021) *Facebook is ditching plans to make an interface that reads the brain* / MIT Technology Review [Online]. Available at: <https://www.technologyreview.com/2021/07/14/1028447/facebook-brain-reading-interface-stops-funding/>.

⁹⁸³ Ienca M. and Ignatiadis K. (2020) 'Artificial Intelligence in Clinical Neuroscience: Methodological and Ethical Challenges', *AJOB Neuroscience*. DOI: <https://doi.org/10.1080/21507740.2020.1740352>.

⁹⁸⁴ Rainey S. and Erden Y.J. (2020) 'Correcting the Brain? The Convergence of Neuroscience, Neurotechnology, Psychiatry, and Artificial Intelligence', *Science and Engineering Ethics*, 26, pp. 2439-2454. DOI: <https://doi.org/10.1007/s11948-020-00240-2>.

⁹⁸⁵ Kellmeyer P. (2021) 'Big Brain Data: On the Responsible Use of Brain Data from Clinic and Consumer-Directed Neurotechnological Devices', *Neuroethics*, 14, pp. 83-98. DOI: <https://doi.org/10.1007/s12152-018-9371-x>.

5.2.1 International and EU law and policies

International law and policy

The right to privacy is applicable to everyone under international law.⁹⁸⁶ Whilst legal doctrine recognising the right does not expressly refer to neurotechnologies, in its non-binding recommendations relating to responsible innovation in neurotechnology, the OECD has identified the right to privacy as a relevant consideration in relation to the promotion of “responsible innovation in neurotechnology to address health challenges”,⁹⁸⁷ the safeguarding of “personal brain data and other information gained through neurotechnology”,⁹⁸⁸ and the anticipation and monitoring of “the potential unintended use and/or misuse of neurotechnology.”⁹⁸⁹

The right to privacy is, moreover, recognised in regional organisations, including the Council of Europe. The European Convention on Human Rights (ECHR), for instance, provides that “Everyone has the right to respect for his private and family life and his correspondence.”⁹⁹⁰ Alongside this, the Council of Europe’s *Strategic Action Plan on Human Rights and Technologies in Biomedicine* (2020-2025) explains how the organisation will address emerging challenges posed by new technologies, including neurotechnologies, and highlights privacy and data protection as relevant considerations in relation to, inter alia, the governance of emerging technologies and physical and mental integrity.⁹⁹¹ Also relevant to the right to privacy and neurotechnologies is the *Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine* (Oviedo Convention), according to which “Everyone has the right to respect for private life in relation to information about his or her health.”⁹⁹² The Oviedo Convention additionally provides that “Everyone is entitled to know any information collected about his or her health.”⁹⁹³

In contrast to the right to privacy, the right to data protection is not expressly protected under international law. The United Nations Human Rights Committee has nonetheless indicated that the protection of personal data is an integral aspect of the right to privacy, as evidenced by the explanation that “[i]n order to have the most effective protection of his private life, every individual should have the right to ascertain in an intelligible form, whether, and if so, what personal data is stored in automatic data files, and for what purposes.”⁹⁹⁴

EU law and policy

There are several EU laws applicable to privacy and data protection in neurotechnologies, including the Charter of Fundamental Rights of the European Union (CFREU) and the General Data Protection Regulation (GDPR), alongside legislative proposals such as the Artificial Intelligence Act, the Data

⁹⁸⁶ UDHR, Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14; CRPD, Article 22.

⁹⁸⁷ OECD (2019). *Recommendation of the Council on Responsible Innovation in Neurotechnology*, OECD/LEGAL/0457, principle 1(d).

⁹⁸⁸ Ibid, principle 7(f).

⁹⁸⁹ Ibid, principle 9(b).

⁹⁹⁰ ECHR, Article 8.

⁹⁹¹ Council of Europe. (2019) ‘Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025)’. Available at: <https://rm.coe.int/strategic-action-plan-final-e/1680a2c5d2>.

⁹⁹² Oviedo Convention, supra note 667, Article 10(1).

⁹⁹³ Ibid, Article 10(2).

⁹⁹⁴ CCPR General Comment No.16: Article 17 (Right to Privacy) The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation (8th April 1988), [10].

Governance Act and the Data Act. For a detailed discussion of the EU laws and draft legislation on privacy and data protection with application to neurotechnologies, see Section 3 above.

5.2.2 Privacy

The right to privacy is a core right within the international human rights law framework, pursuant to which it is conditionally guaranteed that no one shall be subjected to arbitrary interference with their “privacy, family, home, or correspondence nor to unlawful attacks on his or her reputation” and, moreover, that everyone shall be protected by law against such interference or attack.⁹⁹⁵ As indicated, the right to privacy is not absolute and may be restricted in certain specified circumstances, the threshold for which is tightly constrained. According to the ECHR, for instance, interferences with the right to privacy must be in accordance with the law and be “necessary in a democratic society in the interests of national security, public safety or the economic wellbeing of the country, for the prevention of crime or disorder, for the protection of health or morals, or for the protection of the rights and freedoms of others.”⁹⁹⁶ Similarly, though slightly revised to account for technological developments,⁹⁹⁷ the CFREU provides that “[e]veryone has the right to respect for his or her private and family life, home, and communications.”⁹⁹⁸ The explanatory notes to the Charter make clear that the meaning and scope of the right under Article 7 CFREU is, in accordance with Article 52(3), the same as the corresponding article of the ECHR,⁹⁹⁹ namely Article 8, pursuant to which it is instructive to consider the interpretation of this provision by the European Court of Human Rights (ECtHR). The Grand Chamber of the ECtHR has interpreted the meaning of “private life” within Article 8 ECHR as “a broad concept” encompassing, inter alia, the physical and psychological aspects of the personal autonomy, integrity, identity, and development of individuals.¹⁰⁰⁰

In the light of this interpretation of the right to privacy, a central question is whether brain data obtained through the use of neurotechnologies would be protected against intrusion, or whether a new “right to mental privacy” is required to offer protection against more specific interferences,¹⁰⁰¹ such as instances of so-called “brain-hacking”.¹⁰⁰² On this, some scholars have cited the link to notions of personhood to highlight “the special nature of brain data”, suggesting that “[t]he particularity of brain data is that the information to be protected is not easily distinguishable from the source itself that produced the data: the individual’s neural processing.”¹⁰⁰³ Whilst this forms the basis of an argument in favour of a novel right to mental privacy, this potentially overlooks the possibility that brain data may be protected within the existing human rights law framework on the right to privacy. The European Court of Human Rights (ECtHR), for instance, has interpreted the right to privacy under Article 8 of the ECHR as including dactyloscopic (fingerprint) data, DNA profiles and cellular samples, amongst other “means of personal identification”, on the basis that “[i]nformation about [a] person’s health is an important element of private life.”¹⁰⁰⁴ Since neurotechnologies, including neuroimaging, neurostimulation and brain computer interfaces (BCIs), engage directly with the brain, obtaining

⁹⁹⁵ UDHR, Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14; CRPD, Article 22.

⁹⁹⁶ ECHR, Article 8(2).

⁹⁹⁷ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

⁹⁹⁸ CFREU, Article 7.

⁹⁹⁹ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

¹⁰⁰⁰ *Case of A, B and C v Ireland* (Application no.25579/05), ECtHR Judgement 16th December 2010, para. 212.

¹⁰⁰¹ See, e.g., Ienca and Andorno, supra note 691; Paz, supra note 727.

¹⁰⁰² Ienca, supra note 799.

¹⁰⁰³ Ienca and Andorno, supra note 691.

¹⁰⁰⁴ *Case of S. and Marper v. The United Kingdom* (Application nos.30562/04 and 30566/04) (4 December 2008), para. 66.

information directly applicable to the physical and mental health of natural persons,¹⁰⁰⁵ this may mean that brain data is, in principle, within the purview of the right to privacy, pursuant to Article 8 ECHR, alongside Article 7 CFREU, in accordance with Article 52(3) CFREU.

This notwithstanding, some scholars have questioned the suitability of the existing human rights law framework to provide adequate protection against the specific threats posed by intrusive applications of neurotechnologies, such as “brain-hacking”,¹⁰⁰⁶ accordingly advocating the adoption of various so-called “neurorights”, included within which is a right to so-called mental privacy.¹⁰⁰⁷ The putative right to mental privacy expresses “the idea that we should have control over access to our neural data and to the information about our mental processes and states that can be obtained by analysing it”,¹⁰⁰⁸ and therefore, more substantively, refers to “people’s right against the uncontested intrusion by third parties into their brain data as well as against the unauthorized collection of those data.”¹⁰⁰⁹ For a more detailed discussion of the possibility that a new set of human rights is required to protect against possible interferences by neurotechnologies, including whether a specific right to mental privacy would provide additional safeguards, see Section 4.1.14.

5.2.3 Classification of data

The right of everyone to the protection of personal data concerning him or her is guaranteed under Article 8 CFREU.¹⁰¹⁰ The right entails that everyone shall have “the right of access to data which has been collected concerning him or her, and the right to have it rectified”, and moreover, that “data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by law.”¹⁰¹¹ Further strengthening the right to data protection under EU law, as well as the right to privacy, the GDPR is applicable “to the processing of personal data wholly or partly by automated means”.¹⁰¹² Expanding on the first of these two elements, data “processing” is defined as “any operation or set of operations which is performed on personal data or on sets of personal data, whether or not by automated means”.¹⁰¹³ The definition of personal data is similarly wide-ranging, specifically “any information relating to an identified or identifiable natural person (‘data subject’); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural, or social identity of that natural person”.¹⁰¹⁴

As the CJEU has observed, the use of the phrase “any information” reflects the aim of the EU legislature to assign a broad scope of meaning to the concept of personal data, “which is not restricted to information that is sensitive or private, but potentially encompasses all kinds of information, not only objective, but also subjective, in the form of opinions and assessments, provided

¹⁰⁰⁵ Ienca, supra note 757.

¹⁰⁰⁶ See, e.g., Ienca M., Haselager P., and Emanuel E.J. (2018) ‘Brain leaks and consumer neurotechnology’, *Nature Biotechnology*, 36 (9), pp. 805-811. DOI: <https://doi.org/10.1038/nbt.4240>.

¹⁰⁰⁷ See, e.g., Ienca and Andorno, supra note 691.

¹⁰⁰⁸ Paz, supra note 727.

¹⁰⁰⁹ Ienca M. (2017) *Preserving the Right to Cognitive Liberty* / Scientific American [Online]. Available at: <https://www.scientificamerican.com/article/preserving-the-right-to-cognitive-liberty/>.

¹⁰¹⁰ CFREU, Article 8(1).

¹⁰¹¹ Ibid, Article 8(2).

¹⁰¹² Regulation (EU) 2016/679 (General Data Protection Regulation) COM/2012/010 final (EU GDPR), Article 2(1).

¹⁰¹³ Ibid, Article 4(2).

¹⁰¹⁴ Ibid Article 4 (1),



that it ‘relates’ to the data subject.”¹⁰¹⁵ The condition of information relating to a data subject is “satisfied where the information, by reason of its content, purpose or effect, is linked to a particular person.”¹⁰¹⁶ Pursuant to this criterion of linking to a particular person, the CJEU has interpreted both dynamic IP addresses,¹⁰¹⁷ specifically when combined with additional information “likely reasonably to be used to identify the data subject”,¹⁰¹⁸ and written examination answers to constitute personal data.¹⁰¹⁹ This highlights the overall expansiveness of the categories of “personal data” included within the remit of the GDPR.

That the type of data processed by neurotechnologies may primarily be “personal” in nature is largely uncontested, not least because the core functionality of neurotechnologies typically requires responsiveness to the specific brain data of users,¹⁰²⁰ thereby effectively rendering useless “anonymous data”, understood as “information which does not relate to an identified or an identifiable natural person or to personal data rendered anonymous in such a manner that the data subject is not or no longer identifiable.”¹⁰²¹ The clinical application of BCIs, for instance, particularly those which use sensorimotor rhythms (SMRs), involves an iterative process whereby the user encodes intent in brain signals and the BCI recognises these signals and translates them into output commands, one effect of which may be to establish an inextricable link between the brain data and the data subject that cannot be anonymised.¹⁰²² The more pertinent issue, therefore, is whether for the purposes of the GDPR brain data processed in neurotechnologies constitutes personal data or special category sensitive data, the relevance of which is in determining the applicable rules of processing.

On this, whereas the processing of general category personal data is in principle permitted provided the conditions for lawfulness of processing are complied with,¹⁰²³ the processing of data classified as special category or sensitive data is in principle prohibited, unless, alongside the aforementioned conditions for lawful processing, one of the exhaustively listed exceptions to the rule is applicable,¹⁰²⁴ for instance “the data subject has given explicit consent”¹⁰²⁵ or “processing is necessary for reasons of substantial public interest”.¹⁰²⁶ The types of data classified as special category and therefore subject to the more restricted conditions for processing are listed as “personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person’s sex life or sexual orientation”.¹⁰²⁷ There are various applications of neurotechnologies that may involve the processing of personal data

¹⁰¹⁵ Case C-434/16 *Peter Nowak v. Data Protection Commissioner* [2017] EU:C: 2016:779, para.34.

¹⁰¹⁶ *Ibid*, para.35.

¹⁰¹⁷ Case C-582/14 *Patrick Breyer v. Bundesrepublik Deutschland* [2016] EU:C: 2017:994, para.49.

¹⁰¹⁸ *Ibid*, para.45.

¹⁰¹⁹ Case of *Peter Nowak v. Data Protection Commissioner*, supra note 1015, para.62.

¹⁰²⁰ Rainey S et al., (2020) ‘Is the European Data Protection Regulation sufficient to deal with emerging data concerns relating to neurotechnology?’, *Journal of Law and the Biosciences*, 7 (1). DOI: <https://doi.org/10.1093/jlb/l5aa051>.

¹⁰²¹ EU GDPR, Recital 26.

¹⁰²² See generally, Macfarland D.J. and Wolpaw J.R. (2018) ‘Brain-computer interface use is a skill that user and system acquire together’, *PLOS Biology*, 16 (7). DOI: <https://doi.org/10.1371/journal.pbio.2006719>.

¹⁰²³ EU GDPR, Article 6.

¹⁰²⁴ *Ibid*, Article 9(2)(a)-(j).

¹⁰²⁵ *Ibid*, Article 9(2)(a).

¹⁰²⁶ *Ibid*, Article 9(2)(g).

¹⁰²⁷ *Ibid*, Article 9(1).



properly classified as special category sensitive data according to the GDPR, from using electroencephalogram neurotechnologies (EEG) to make predictions about an individual's identity, including age¹⁰²⁸ and sexuality,¹⁰²⁹ to the emerging trend towards EEG-based biometric recognition.¹⁰³⁰ Yet, perhaps most likely to process data considered special category sensitive data for the purposes of the GDPR are the various clinical applications of neurotechnologies, from speech BCI technologies used to treat verbal communication impairments,¹⁰³¹ to neurostimulation and neuromodulation techniques, such as deep brain stimulation (DBS), used to treat neurological disorders such as Alzheimer's,¹⁰³² movement disorders such as Parkinson's disease,¹⁰³³ and neuropsychiatric disorders such as schizophrenia.¹⁰³⁴

However, a central theme in the scholarly debate is the suggestion that the current definition of special category sensitive data provides insufficient protection for users of neurotechnologies. On this, some scholars have argued that the definition of special category sensitive data "in terms of a recording purpose appears to be inadequate for brain recordings, especially in a consumer context", citing the possibility that the processing of brain data in consumer devices may not be required to comply with the more stringent conditions for data processing under the GDPR on the basis that the initial purpose of the application is non-health related.¹⁰³⁵ Others, meanwhile, have suggested that the lack of protection in the GDPR "stems from the fact that the list of sensitive data categories in the GDPR (health, biometric, genetic, political opinions, sexual orientations, etc.) is not comprehensive enough to include, e.g., 'emotions' or other 'thoughts' not related to health status, sexuality or political/religious beliefs."¹⁰³⁶ Overall, this indicates that the GDPR may require adapting to more comprehensively protect the rights to privacy and data protection of users of neurotechnologies.

5.2.4 Potential developments and future trends

This section has explored the relationship between privacy and data protection in relation to neurotechnologies, situating this analysis in the context of the relevant international and EU laws and draft legislation. Whilst it has been suggested that the call from some scholars for a novel "right to mental privacy" may overlook the protection supplied by the existing international and EU law framework, further guidance may be required to clarify the status of brain data, specifically whether such data is analogous to other forms of health-related data and therefore included within the right to privacy under the ECHR and CFREU, and moreover, whether such data should be characterised as special category sensitive data for the purposes of the GDPR, even if processed in consumer-grade devices, the primary application of which is non-medical.

¹⁰²⁸ Carrier J. et al. (2001) 'The effects of age and gender on sleep EEG power spectral density in the middle years of life (ages 20-60 years old)', *Psychophysiology*, 38 (2), pp. 232-242. DOI: <https://doi.org/10.1111/1469-8986.3820232>.

¹⁰²⁹ Alexander J.E. and Sufka K.J. (1993) 'Cerebral lateralization in homosexual males: a preliminary EEG investigation', *International Journal of Psychophysiology*, 15 (3), pp. 269-274. DOI: [https://doi.org/10.1016/0167-8760\(93\)90011-D](https://doi.org/10.1016/0167-8760(93)90011-D).

¹⁰³⁰ Campisi P. La Rocca D. and Scarano G. (2012) 'EEG for automatic person recognition', *Computer*, 45 (7). DOI: <https://doi.org/10.1109/MC.2012.233>.

¹⁰³¹ See, e.g., Bocquelet F. et al. (2016) 'Key considerations in designing a speech brain-computer interface', *Journal of Physiology-Paris*, 110 (4), pp. 392-401. DOI: <https://doi.org/10.1016/j.jphysparis.2017.07.002>.

¹⁰³² See, e.g., Ning, et al. supra note 916.

¹⁰³³ See, e.g., Spagna, et al., supra note 917.

¹⁰³⁴ See, e.g., Sui Y. et al. (2021) 'Deep Brain Stimulation Initiative: Toward Innovative Technology, New Disease Indications, and Approaches to Current and Future Clinical Challenges in Neuromodulation Therapy', *Frontiers in Neurology*, 11. DOI: <https://doi.org/10.3389/fneur.2020.597451>.

¹⁰³⁵ Rainey S et al., supra note 1020.

¹⁰³⁶ Ienca M. and Malgieri G. (2022) 'Mental data protection and the GDPR', *Journal of Law and the Biosciences*, 9 (1), pp.1-19 [Online]. Available at: <https://doi.org/10.1093/jlb/lbac006>.

6. Digital Extended Reality (XR)

XR technologies are subject to international and EU laws and policies on human rights, privacy and data protection and consumer rights, and may be subject to forthcoming rules on artificial intelligence, data and digital services.

The following sections discuss some ways that digital extended reality (XR) is or may be governed by international and EU law and policy within the legal frameworks for human rights, privacy and data protection, consumer rights, artificial intelligence, and digital services. Each section begins with a brief introduction to the relevant legal issues and a summary of the international and EU legal framework (for more details on the legal frameworks, see Section 3). Specific legal issues within the legal framework are then presented in more detail; each discussion includes specific references to existing (and proposed) law and an explanation of how the law may apply to climate engineering.

While no international or EU law directly addresses or explicitly mentions XR, many aspects are subject to international and EU law.

6.1 Human rights

XR has the potential to impact human rights in many ways, both positive and negative. In relation to some rights in particular context, XR has the potential to enhance enjoyment of rights, such as when XR provides safer workplace training modules that help support the right to just and favourable conditions of work. Yet in other ways, the use of XR interferes with and may even violate human rights.

The human rights discussed in this section are:

- Right to dignity
- Right to autonomy
- Right to privacy
- Freedom of expression
- Right to health
- Right to education
- Access to justice and right to a fair trial
- Right to just and favourable conditions of work
- Right to rest and leisure
- Right to benefit from science

○ Non-discrimination and vulnerable groups

All sections outline the relevant international and EU laws and policies, then move to a discussion of key issues, gaps and challenges. For many rights, this discussion is organised into the positive and negative impacts that XR have on realisation of a right ('potential enhancements' and 'potential interferences'); the impacts discussed include both current examples and potential future impacts, sometimes drawn from science fiction.¹⁰³⁷ Some rights do not have distinct positive and negative impacts, and therefore the key legal issues are discussed more generally. All sections conclude with remarks on States' current obligations under the law and identifies where the law may be updated to address gaps and challenges.

The final subsection presents a summary of three trends in human rights law that have relevance to XR: the right to a healthy environment, the right to disconnect, and the right to online access.

6.1.1 International and EU law on human rights

In the context of XR, the most frequently referenced international legal documents are the Universal Declaration of Human Rights, International Covenant on Civil and Political Rights (ICCPR), International Covenant on Economic, Social and Cultural Rights (ICESCR), International Convention on the Elimination of All Forms of Racial Discrimination (CERD); Committee on the Elimination of Discrimination Against Women (CEDAW), Convention on the Rights of the Child (CRC), and the European Convention on Human Rights (ECHR). General Comments and General Recommendations from U.N. treaty bodies and reports from Special Procedures provide interpretative guidance explaining how the rights apply in specific contexts. Where relevant, specific reference is made to the U.N. Sustainable Development Goals and the jurisprudence of the European Court of Human Rights. At the EU level, the primary legal document is the Charter of Fundamental Rights of the European Union (CFREU). Where relevant, specific reference is made to jurisprudence of the European Court of Justice and the EU Pillar of Social Rights.

XR is not explicitly referenced in international or EU human rights law, nor is it the explicit topic of any guidance or reference documents. However, States' obligation to respect, protect and fulfil human rights apply in the context of XR.

6.1.2 Right to dignity

XR technologies have the potential to both enhance and interfere with the right to dignity. The use of XR technologies in certain contexts, such as criminal justice (see the paragraph below on potential enhancements of the right to dignity), may enhance the right to dignity of victims, offenders, and psychiatric patients alike. However, such technologies also carry the potential to interfere with the right to dignity, either directly through harmful graphic content in VR, for instance, or in conjunction with another protected right (see the paragraph below on potential interferences). Whilst international and EU human rights law does not speak directly to the impacts of XR technologies on the right to dignity, States have an obligation to ensure that the development and deployment of such technologies does not interfere with the enjoyment of the right, as will be discussed below.

¹⁰³⁷ "By highlighting possible futures, science fiction enables law to consider different strategies for dealing with new events and scenarios." In Mitchell, T. (2014) 'Making Space: Law and Science Fiction', *Law and Literature*, 32(2), pp241-261, 248.

International law and policy

Although not recognised as a freestanding legal right, dignity is subject to specific references within legal doctrine pertaining to international human rights law. The Universal Declaration of Human Rights (UDHR), the foundational document of the International Bill of Human Rights, provides that “all human beings are born free and equal in dignity and rights.”¹⁰³⁸ Although primarily symbolic and not formally binding upon State parties to the United Nations (UN), this provides the normative basis for the various civil, political, economic, social, and cultural rights contained within the International Covenant on Civil and Political Rights (ICCPR)¹⁰³⁹ and the International Covenant on Economic, Social and Cultural Rights (ICESCR),¹⁰⁴⁰ both of which assert within the preamble to the text that the rights contained therein “derive from the inherent dignity of the human person”. It follows from this that explicit reference to dignity can be found in the text of several Articles, for instance the right to education under the ICESCR¹⁰⁴¹ and the rights of persons deprived of their liberty through imprisonment or detention under the ICCPR.¹⁰⁴² Various other major conventions, for instance on the Rights of the Child,¹⁰⁴³ the Rights of Migrant Workers,¹⁰⁴⁴ and the Rights of Persons with Disabilities,¹⁰⁴⁵ have also since included specific references to dignity. Similarly, in international humanitarian law Common Article 3 of the Geneva Conventions protects wounded, sick and shipwrecked soldiers on (i) land and (ii) sea, (iii) prisoners of war and (iv) civilians against “outrages upon personal dignity, in particular humiliating and degrading treatment”.¹⁰⁴⁶

Within the legal framework of the Council of Europe, the most relevant legal instruments are the European Convention on Human Rights (ECHR)¹⁰⁴⁷, the Convention on Human Rights and Biomedicine (Oviedo Convention),¹⁰⁴⁸ and the Convention on Action against Trafficking in Human Beings.¹⁰⁴⁹ The former eschews establishing a codified right and instead, analogous to the formulation of the two Covenants (see above), conceptualises dignity as an overarching principle. On this, the European Court of Human Rights (ECtHR) has observed that “[t]he very essence of the Convention is respect for human dignity and human freedom.”¹⁰⁵⁰ The Oviedo Convention, meanwhile, whilst not defining dignity explicitly, refers within the preamble to “the importance of ensuring the dignity of the human being”, and moreover, imposes an obligation on State Parties to “protect the dignity and identity of all human beings”, specifically within the context of biology and medicine. Finally, the Council of Europe

¹⁰³⁸ Universal Declaration of Human Rights (8 December 1948), G.A. Res. 217(A) III, Article 1.

¹⁰³⁹ International Covenant on Civil and Political Rights (entry into force 23 March 1976) G.A. Res 2200A (XXI) (ICCPR).

¹⁰⁴⁰ International Covenant on Economic, Social and Cultural Rights (entry into force 3 January 1976) G.A. Res 2200A (XXI) (ICESCR).

¹⁰⁴¹ ICESCR, Article 13.

¹⁰⁴² ICCPR, Article 10(1).

¹⁰⁴³ Convention on the Rights of the Child (entry into force 2 September 1990) GA Res. 44/25 (CRC), Preamble, Articles 23, 28, 37 and 39.

¹⁰⁴⁴ Convention for the Protection of the Rights of All Migrant Workers and Members of their Families (entry into force 1 July 2003) GA Res.45/158 (CPRMW), Articles 17 and 70.

¹⁰⁴⁵ Convention on the Rights of Persons with Disabilities (entry into force 3 May 2008) GA Res. A/61/611 (CRPD), Preamble, Articles 1, 3, 8, 16, 24 and 25.

¹⁰⁴⁶ See, for example, Geneva Convention relative to the Protection of Civilian Persons in Time of War (entry into force 21 October 1950) 75 UNTS 287 (Fourth Geneva Convention).

¹⁰⁴⁷ European Convention on Human Rights (as amended by Protocols 11, 14 and 15) (entry into force 3 September 1953), E.T.S. 5, 4. XI. 1950 (ECHR).

¹⁰⁴⁸ Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine: Convention on Human Rights and Biomedicine (entry into force 1 December 1999), E.T.S 164 4.IV.1997 (Oviedo Convention).

¹⁰⁴⁹ Convention on Action against Trafficking in Human Beings (entry into force 1 February 2008), E.T.S No 197 16.V.2005.

¹⁰⁵⁰ *Case of Pretty v the United Kingdom* (Application no. 2346/02) (2002), [65].

adopted the Convention on Action against Trafficking in Human Beings in 2005, the preamble of which asserts “that trafficking in human beings constitutes a violation of human rights and an offence to the dignity and the integrity of the human being”. Further reference to dignity is provided in relation to measures to discourage demand for trafficking of human beings,¹⁰⁵¹ and repatriation and return of victims.¹⁰⁵²

EU law and policy

Mirroring the international human rights law approach to human dignity, the Treaty on European Union (TEU)¹⁰⁵³ establishes dignity as the first of the EU’s foundational values.¹⁰⁵⁴ In a clear separation from the former, however, EU law also codifies a substantive and enforceable right to human dignity in primary law under the terms of the Charter of Fundamental Rights (CFREU), specifically within Chapter 1 entitled “Dignity”, wherein it is asserted that “Human dignity is inviolable. It must be respected and protected.”¹⁰⁵⁵ Whilst judicial interpretation of this provision is limited, with the Court of Justice of the EU (CJEU) often referring to dignity in conjunction with other protected rights,¹⁰⁵⁶ such as the prohibition of torture and inhuman or degrading treatment or punishment,¹⁰⁵⁷ and the right to privacy,¹⁰⁵⁸ an indication of the European Commission’s understanding of the right to dignity can be obtained from the 2018 Annual Report on the Application of the EU Charter of Fundamental Rights, according to which human dignity “guarantees the right of human beings to be protected from being treated as mere objects by the state or by their fellow citizens.”¹⁰⁵⁹ The prominence of the positioning of the right, coupled with the eponymous title of the Chapter, is indicative of the fundamental importance of dignity in the CFREU.¹⁰⁶⁰ Furthermore, the inclusion of, *inter alia*, the right to the integrity of the person,¹⁰⁶¹ the prohibition of torture, inhuman and degrading treatment or punishment,¹⁰⁶² and the prohibition of slavery, forced labour and human trafficking¹⁰⁶³ within the Title of Dignity is a reflection of the interrelationship between dignity and other protected rights,¹⁰⁶⁴ as constituted by the former being, according to the Explanations Relating to the Charter, “the real basis of fundamental rights.”¹⁰⁶⁵ Finally, dignity is explicitly referred to within the rights of the elderly “to lead a life of dignity”¹⁰⁶⁶ and the right of workers to fair and just working conditions “which respect to his or her health, safety and dignity.”¹⁰⁶⁷

¹⁰⁵¹ Convention on Action against Trafficking in Human Beings (entry into force 1 February 2008), E.T.S No 197 16.V.2005, Article 6.

¹⁰⁵² *Ibid*, Article 16.

¹⁰⁵³ Consolidated Version of the Treaty on European Union, C 326/15 (TEU).

¹⁰⁵⁴ Alongside freedom, democracy, equality, the rule of law and respect for human rights, including the rights of persons belonging to minorities.

¹⁰⁵⁵ Charter of Fundamental Rights of the European Union (entry into force 18 December 2009), 2000/C 364/01(CFREU), Article 1.

¹⁰⁵⁶ Dupré, C. (2021) ‘Article 1’ in Peers S., Hervey T., Kenner J., and Ward A., (eds) *The EU Charter of Fundamental Rights: A Commentary* (Hart Publishing) pp. 3-24.

¹⁰⁵⁷ CFREU, Article 4.

¹⁰⁵⁸ *Ibid*, Article 7.

¹⁰⁵⁹ 2018 Report on the Application of the EU Charter of Fundamental Rights COM (2019) 257 final.

¹⁰⁶⁰ <https://data.europa.eu/doi/10.2838/44400>

¹⁰⁶¹ Jones J. (2012) ‘Human Dignity in the EU Charter of Fundamental Rights and Its Interpretation Before the European Court of Justice’, *Liverpool Law Review*, vol.33, pp.281-300.

¹⁰⁶² CFREU, Article 3.

¹⁰⁶³ *Ibid*, Article 4.

¹⁰⁶⁴ *Ibid*, Article 5.

¹⁰⁶⁵ Dupré, *supra* note 1056, pp. 3-24.

¹⁰⁶⁶ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

¹⁰⁶⁷ CFREU, Article 25.

¹⁰⁶⁸ *Ibid*, Article 31.



At the level of EU policy, and consistent with the drafting of the Ethics Guidelines for Trustworthy AI in accordance with the fundamental rights established in the treaties, the CFREU and international human rights law,¹⁰⁶⁸ the High-Level Expert Group on Artificial Intelligence (AI HLEG) calls for the development of AI systems “in a manner that respects, serves and protects humans’ physical and mental integrity, personal and cultural sense of identity, and satisfaction of their essential needs.”¹⁰⁶⁹

Potential enhancements

A potentially dignity-enhancing application of XR is in the context of criminal justice for the purposes of, inter alia, conducting risk assessments, rehabilitating and re-integrating offenders, and treating victims of criminal offences, the latter of which may enhance the right to dignity of such persons by alleviating psychological trauma.¹⁰⁷⁰ The use of XR technologies in this context may, inter alia, be used to gain greater insights into offender decision-making in order to provide more targeted treatment by simulating a burglary in virtual reality,¹⁰⁷¹ enable exposure of sexual offenders to virtual environments for the purposes of training coping skills and conducting risk assessments without posing a risk to others,¹⁰⁷² provide a different form of psychiatric treatment for regulating aggressive behaviours,¹⁰⁷³ and even virtually embody perpetrators of domestic abuse in user avatars of female victims in order to modify emotion recognition patterns associated with this specific form of aggressive behaviour.¹⁰⁷⁴ Each of these use cases may enhance the right to dignity, specifically by assisting in the process of resocialisation and increasing criminal offenders’ “autonomy and moral agency, enabling them to take control over their own lives.”¹⁰⁷⁵ The use of XR for such purposes is, moreover, consistent with the objective of rehabilitating offenders, in relation to which State Parties to the Council of Europe may, in principle, be subject to “a positive obligation” to facilitate “progress towards”,¹⁰⁷⁶ based on the requirement under the ECHR of “respect for human dignity.”¹⁰⁷⁷

Potential interferences

Whilst potentially enhancing the right to dignity, the use of XR technologies for treatment purposes (see above) may also create or exacerbate situations that negatively impact and interfere with the right to dignity, typically in conjunction with another fundamental right. One such right, as explicitly protected under the CFREU,¹⁰⁷⁸ and as considered an aspect of the right to respect for private life

¹⁰⁶⁸ European Commission, Directorate-General for Communications Networks, Content and Technology (2019) ‘Ethics Guidelines for Trustworthy AI’. Available at: <https://data.europa.eu/doi/10.2759/346720>.

¹⁰⁶⁹ Ibid.

¹⁰⁷⁰ Cornet L.J.M and Van Gelder J-L. (2020) ‘Virtual reality: a use case for criminal justice practice’, *Psychology, Crime & Law*, vol.26:7, pp.631-647. Available at: <https://doi.org/10.1080/1068316X.2019.1708357>.

¹⁰⁷¹ Nee C., et al. (2019) ‘Learning on the job: Studying expertise in residential burglars using virtual environments’, *Criminology*, vol.57:3, pp. 481-511.

¹⁰⁷² Fromberger P., Jordan K., and Müller J L. (2018) ‘Virtual reality applications for diagnosis, risk assessment and therapy of child abusers’, *Behavioural Sciences & the Law*, vol.36:2, pp.235-244. Available at: <https://doi.org/10.1002/bsl.2332>.

¹⁰⁷³ Klein Tunte S et al. (2020) ‘Virtual Reality Aggression Prevention Therapy (VRAPT) versus Waiting List Control for Forensic Psychiatric Inpatients: A Multicentre Randomized Controlled Trial’, *Journal of Clinical Medicine*, vol.9:7, pp.2258. Available at: <https://www.mdpi.com/2077-0383/9/7/2258>.

¹⁰⁷⁴ Seinfeld S et al. (2018) ‘Offenders become the victim in virtual reality: impact of changing perspective in domestic violence’, *Scientific Reports*, vol.8 [Online]. Available at: <https://doi.org/10.1038/s41598-018-19987-7>.

¹⁰⁷⁵ Ligthart S., et al. (2021) ‘Is Virtually Everything Possible? The Relevance of Ethics and Human Rights for Introducing Extended Reality in Forensic Psychiatry’, *AJOB Neuroscience*. Available at: <https://doi.org/10.1080/21507740.2021.1898489>.

¹⁰⁷⁶ *Case of Murray v. The Netherlands* (Application no.10511/10) (2016), [104].

¹⁰⁷⁷ *Case of Vinter and Others v. The United Kingdom* (Applications nos. 66069/09, 130/10 and 3896/10) (2013), [113].

¹⁰⁷⁸ CFREU, Article 3(1): “Everyone has the right to respect for his or her physical and mental integrity.”

under Article 8 ECHR,¹⁰⁷⁹ is the right to mental integrity, understood by the Committee of Bioethics of the Council of Europe to mean “the ability of individuals to exercise control over what happens to...their mental state, and the related personal data.”¹⁰⁸⁰ Notwithstanding the general prohibition on compulsory medical treatment under international law,¹⁰⁸¹ with the exception of treating “a mental disorder of a serious nature” under the Oviedo Convention,¹⁰⁸² the failure to obtain consent where required or the intentional misuse and abuse of XR technologies may adversely affect the right to mental integrity, in conjunction with the right to dignity, by inducing unwanted and/or harmful emotional, cognitive, and/or behavioural changes in affected persons.¹⁰⁸³

A more direct potential interference with the right to dignity by XR technologies is the playing of VR games involving the depiction of extreme violence. Whilst such content is not unique to gaming in VR, there is the potential for a heightened risk of interference based on the user experiencing such content from a fully immersed first-person perspective.¹⁰⁸⁴ It has, moreover, been recognised by the CJEU that, in relation to the potentially analogous game of laser tag, EU law “does not preclude an economic activity consisting of the commercial exploitation of games simulating acts of homicide from being made subject to a national prohibition measure adopted on grounds of protecting public policy by reason of the fact that activity is an affront to human dignity.”¹⁰⁸⁵ This is indicative of the potential for violent games to infringe upon the right to human dignity in a way that contravenes EU law; a risk that is potentially heightened in the context of VR.

States’ obligations and areas for legal development

XR technologies are subject to existing international and EU human rights law on the right to dignity and States have a positive obligation to ensure that the use of such technologies supports realisation of this right. Further guidance specific to XR technologies may be required to address concerns related to, inter alia, the use of XR in criminal justice settings for therapeutic purposes, intentional misuse and abuse, and the potential for, and effect of, depicting harmful graphic content.

6.1.3 Right to autonomy

XR technologies have the potential to both enhance and interfere with the right to autonomy. Whilst international and European Union human rights law and policy on the right to autonomy does not explicitly refer to XR, the right operates in the context of such technologies and the relevant provisions under international and EU law are directly applicable.

¹⁰⁷⁹ *Case of Bédat v Switzerland* (Application no.56925/08) (29 March 2016), [72]: “The concept of “private life” is a broad term which is not susceptible to exhaustive definition. It covers the physical and psychological integrity of a person”.

¹⁰⁸⁰ Council of Europe, (2019) ‘Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025)’, [22]. Available at: <https://rm.coe.int/strategic-action-plan-final-e/1680a2c5d2> (accessed 27 June 2022).

¹⁰⁸¹ See, for example, ECHR, Article 3 (right to freedom from cruel, inhuman, or degrading treatment); Article 5 (right to liberty) and Article 8 (right to privacy).

¹⁰⁸² Oviedo Convention, Article 7. See also, Council of Europe, Committee of Ministers. (2004) ‘Recommendations concerning the protection of the human rights and dignity of persons with mental disorder and its Explanatory Memorandum’, REC(2004)10, Article 12.

¹⁰⁸³ Slater M et al. (2020) ‘The Ethics of Realism in Virtual and Augmented Reality’, *Frontiers of Virtual Reality*, vol.1:1 [Online]. Available at: <https://doi.org/10.3389/frvir.2020.00001> (accessed 27 June 2022).

¹⁰⁸⁴ Ibid.

¹⁰⁸⁵ Case C-36/02 *Omega Spielhallen-und Automatenaufstellungs-GmbH v Oberbürgermeisterin der Bundesstadt Bonn* (14 October 2004), [41].

International law and policy

Although not expressly provided for within any of the major conventions under international human rights law, the right to “autonomy” is nonetheless listed as one of the general principles of the Convention on the Rights of Persons with Disabilities (CRPD),¹⁰⁸⁶ finding specific reference in Articles pertaining to freedom from exploitation, violence and abuse,¹⁰⁸⁷ and health.¹⁰⁸⁸ The right, alongside associated variations,¹⁰⁸⁹ has also been recognised in regional organisations, including the Council of Europe. In relation to the latter, the European Court of Human Rights (ECtHR) has recognised the right to autonomy as derivative of, and therefore protected by, the right to respect for private and family life, conceptualised as “the personal sphere of each individual”.¹⁰⁹⁰ In *Pretty v UK*, for instance, the ECtHR observed that “[a]lthough no previous case has established as such any right to self-determination as being contained in Article 8 of the Convention, the Court considers that the notion of personal autonomy is an important principle underlying the interpretation of its guarantees.”¹⁰⁹¹ Further, the ECtHR has strengthened this position by recognising that protecting “the right to personal autonomy” imposes positive obligations on States,¹⁰⁹² in addition to the classical formulation of a negative obligation of non-interference.¹⁰⁹³ The factual elements of these cases highlights the primary basis upon which the right to autonomy is given legal effect, namely healthcare decision-making and, more specifically, “the requirement for consent to treatment and a corresponding right to refuse treatment.”¹⁰⁹⁴

EU law and policy

The right to “autonomy” is not directly protected within the Charter of Fundamental Rights of the European Union (CFREU); however, it can be construed as an aspect of several protected fundamental rights. In accordance with Article 52(3) CFREU, pursuant to which the rights in the CFREU which correspond with the European Convention of Human Rights (ECHR) are to have the same “meaning and scope”, there are three potential bases of protection for the right to autonomy. The first potential source, for the reasons outlined above, is Article 7 CFREU corresponding to Article 8 ECHR. A further potential source of protection, derived from reference the ECtHR’s reference to “a person’s physical and psychological integrity” in conjunction with “the right to personal autonomy”,¹⁰⁹⁵ is the right to integrity of the person.¹⁰⁹⁶ A final potential basis for protection of the right to “autonomy” is Article 1 CFREU, with legal scholars having highlighted the conceptual overlap with the right to human dignity.¹⁰⁹⁷

¹⁰⁸⁶ CRPD, Article 3.

¹⁰⁸⁷ CRPD, Article 16(4).

¹⁰⁸⁸ CRPD, Article 25(d).

¹⁰⁸⁹ See, e.g., African Charter on Human and Peoples’ Rights (Banjul Charter) (entry into force 21 October 1986) CAB/LEG/67/3 rev.5, 21 I.L.M. 58, Article 20 on the “unquestionable and inalienable right to self-determination.”

¹⁰⁹⁰ See, e.g., *Case of Christine Goodwin v. The United Kingdom* (Application no.28957/95) (11 July 2002), para.90.

¹⁰⁹¹ *Case of Pretty v. The United Kingdom* (Application no.2346/02) (29 April 2002), para. 61.

¹⁰⁹² *Case of Tysiąc v. Poland* (Application no.5410/03) (20 March 2007), para. 107.

¹⁰⁹³ Donnelly M., (2011) *Healthcare Decision-Making and the Law: Autonomy, Capacity and the Limits of Liberalism* (Cambridge University Press), p. 78.

¹⁰⁹⁴ *Ibid*, p. 52.

¹⁰⁹⁵ *Case of Tysiąc v. Poland*, supra note 1092, para.107.

¹⁰⁹⁶ CFREU, Article 3.

¹⁰⁹⁷ See, e.g., Dupré, C., (2021) ‘Article 1’ in Peers, S., Hervey T., Kenner J., and Ward A., (eds) *The EU Charter of Fundamental Rights: A Commentary* (Hart Publishing) pp.3-24. Available at: <http://dx.doi.org/10.5040/9781849468350.ch-001>.



Potential enhancements

The use of XR may enhance the right to autonomy of certain persons with disabilities by improving the accessibility of experiences otherwise unattainable in the physical world, such as driving a car or riding a horse.¹⁰⁹⁸ The use of XR in a clinical context, meanwhile, may enhance an individual's right to autonomy, in combination with the right to health, by enabling clinical practitioners to communicate critical but often complex information regarding particular treatments, thereby improving healthcare literacy and ultimately enabling patients to make more educated and informed decisions regarding their healthcare.¹⁰⁹⁹

Potential interferences

Whilst the use of XR in a clinical context may, for reasons outlined above, enhance the right to autonomy, the use of VR, in particular, may also undermine the right to autonomy by causing interferences, such as motion sickness symptoms and technological difficulties, which distract from patient learning and thereby compromise patient decision-making.¹¹⁰⁰ Additionally, the use of XR may create or exacerbate situations that negatively impact the right to autonomy, in conjunction with the right to health and the right to privacy, by, inter alia, cultivating addictive behaviour, enabling emotional manipulation, and presenting opportunities for surveillance of users.¹¹⁰¹

States' obligations and areas for legal development

XR technologies are subject to existing, albeit limited, international human rights law on the right to autonomy, and States have an obligation to ensure that the use of such technologies supports realisation of this right. States must take all necessary steps to guarantee that XR technologies do not interfere with an individual's right to autonomy. In addition, States have a particular responsibility to ensure that the right to autonomy of persons with disabilities is not infringed upon, in accordance with their obligations under the CRPD (see above). Further human rights guidance specific to XR may be required to address concerns related to the potential for addiction, emotional manipulation and surveillance.

6.1.4 Right to privacy

XR technologies have the potential to undermine the right to privacy of users and bystanders alike in several ways, as discussed in section 6.2 and below. Although international and EU human rights law on the right to privacy does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR technologies does not interfere with the enjoyment of the protected right to privacy. Furthermore, developments on the putative rights to mental privacy and cognitive liberty are directly relevant to XR technologies.

¹⁰⁹⁸ Heilemann F, Zimmermann G and Münster P., (2021) 'Accessibility Guidelines for VR Games – A Comparison and Synthesis of a Comprehensive Set', *Frontiers in Virtual Reality*, vol.2, Available at: <https://doi.org/10.3389/frvir.2021.697504>.

¹⁰⁹⁹ Adapa K et al., (2020) 'Augmented reality in patient education and health literacy: a scoping review protocol', *British Medical Journal Open*, vol.10. Available at: <https://bmjopen.bmj.com/content/10/9/e038416>.

¹¹⁰⁰ Ibid.

¹¹⁰¹ O'Brolcháin F et al., (2016) 'The Convergence of Virtual Reality and Social Networks: Threats to Privacy and Autonomy', *Science and Engineering Ethics*, vol.22, pp.1-29. Available at: <https://doi.org/10.1007/s11948-014-9621-1>.

International law and policy

Everyone has the right to privacy under international law.¹¹⁰² This right entails that “No one shall be subjected to arbitrary or unlawful interference with his privacy, family, correspondence, nor to unlawful attacks on his honour and reputation.”¹¹⁰³ It follows that States are under an obligation “to adopt legislative and other measures to give effect to the prohibition against such interferences and attacks as well as to the protection of this right.”¹¹⁰⁴ The right to privacy is also recognised in regional organisations, including the Council of Europe.¹¹⁰⁵

EU law and policy

The EU Charter of Fundamental Rights similarly provides that under EU law everyone has the “right to respect for his or her private and family life, home, and communications.”¹¹⁰⁶ The right to privacy is closely related to the right to data protection, pursuant to which “data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by law.”¹¹⁰⁷

Potential interferences

The use of XR technologies may create or exacerbate situations that negatively impact the right to privacy. XR technologies may interfere with the right to privacy of users and bystanders alike, both in the conventional sense of intruding upon physical privacy, as well as in ways that pertain to the emerging ideas of mental privacy and cognitive liberty; intrusions in relation to which may be facilitated by the emergence of new categories of data processing, such as “biometric psychography”.¹¹⁰⁸ Further potential interferences with the right to privacy stem from the opportunity for cybersurveillance in VR,¹¹⁰⁹ the ability to personally identify users of XR technologies,¹¹¹⁰ and the potential for trivial observation and tracking of bystanders who may not be aware of nor have given consent for such processing of their personal data.¹¹¹¹

States’ obligations and areas for legal development

XR technologies are subject to existing human rights laws on the right to privacy and States have an obligation to ensure that the use of such technologies supports realisation of this right. States must take all necessary steps to guarantee that the use of XR does not create circumstances in which an individual may be subject to arbitrary or unlawful interference with their privacy. Further human rights guidance specific to XR technologies may be required to address concerns related to, inter alia, new

¹¹⁰² Universal Declaration of Human Rights (8 December 1948) G.A. Res 217(A) III (UDHR), Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14; CRPD, Article 22.

¹¹⁰³ UDHR, Article 12; ICCPR, Article 17.

¹¹⁰⁴ ICCPR General Comment No.16: Article 17 (Right to Privacy) The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation (8 April 1988) [1].

¹¹⁰⁵ ECHR, Article 8.

¹¹⁰⁶ CFREU, Article 7.

¹¹⁰⁷ CFREU, Article 8(2).

¹¹⁰⁸ Heller, B., (2021) ‘Watching Androids Dream of Electric Sheep: Immersive Technology, Biometric Psychography, and the Law’, *Vanderbilt Journal of Entertainment & Technology Law*, vol.23(1), pp. 1-51.

¹¹⁰⁹ See, e.g., Yadin G., (2017) ‘Virtual Reality Surveillance’, *Cardozo Arts & Entertainment Law Journal*, vol.35:3, Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3043922.

¹¹¹⁰ See, e.g., Miller M.R. et al, (2020) ‘Personal identifiability of user tracking data during observation of 360-degree VR video’, *Scientific Reports*, vol.10. Available at: <https://www.nature.com/articles/s41598-020-74486-y>.

¹¹¹¹ McGill M. (2021) ‘Extended Reality (XR) and the Erosion of Anonymity and Privacy’, *The IEEE Global Initiative on Ethics of Extended Reality (XR) Report*. Available at: <https://ieeexplore.ieee.org/document/9619999>.



categories of data processing, the potential for cybersurveillance and the ability to personally identify both users and bystanders. For further analysis of the relationship between XR technologies and the right to privacy, see Section 6.2.

6.1.5 Right to freedom of expression

XR technologies have the potential both to enhance and interfere with the right to freedom of expression. This right applies equally to content created by XR developers and the content generated by XR users. States cannot arbitrarily restrict the right to freedom of expression, and they have an obligation to ensure private actors do not interfere with the right. In balancing between unrestricted freedom and legitimate limitations, particularly salient issues for freedom of expression in the context of XR include, inter alia, violence, pornography, hate speech, and mis/disinformation. Whilst international and European Union (EU) human rights law and policy on the right to freedom of expression does not explicitly refer to XR, the right operates in the context of such technologies and many of the provisions under international and EU law are directly applicable.

International law and policy

The right to freedom of expression is enshrined in international law in various human rights instruments, including the Universal Declaration of Human Rights (UDHR),¹¹¹² the International Covenant on Civil and Political Rights (ICCPR),¹¹¹³ the International Convention on the Elimination of All Forms of Racial Discrimination (CERD),¹¹¹⁴ the Convention on the Rights of the Child (CRC),¹¹¹⁵ the Convention on the Rights of Persons with Disabilities (CRPD),¹¹¹⁶ and the International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families.¹¹¹⁷ State parties have an obligation to guarantee the right, which includes the “freedom to seek, receive and impart information of all kinds, regardless of frontiers, either orally, in writing or in print, in the form of art, or through any other media”.¹¹¹⁸ The right “protects all forms of expression and the means of their dissemination”, including spoken, written and non-verbal expression, in addition to all forms of audio-visual, “electronic and internet-based modes of expression.”¹¹¹⁹ Included within the broad remit of protection are expressions considered “deeply offensive”,¹¹²⁰ as well as “expressions of an erroneous opinion or an incorrect interpretation of past events.”¹¹²¹ However, exercising of the right to freedom of expression entails “special duties and responsibilities”, consistent with which enjoyment of the right may be limited in exceptional circumstances if provided by law for the protection of an enumerated purpose and the restriction is necessary to achieve that purpose.¹¹²² Further, based on its fundamental importance to the enjoyment of all other human rights, any such limitation to the right

¹¹¹² UDHR, Article 17.

¹¹¹³ ICCPR, Article 19.

¹¹¹⁴ International Convention on the Elimination of All Forms of Racial Discrimination (entry into force 4 January 1969) G.A. Res. 2106 (XX) (ICERD), Article 5.

¹¹¹⁵ CRC, Article 13.

¹¹¹⁶ CRPD, Article 21.

¹¹¹⁷ CPMW, Article 13(2).

¹¹¹⁸ ICCPR, Article 19(2).

¹¹¹⁹ Human Rights Committee, *General comment No.34, Article 19: Freedom of opinion and expression*. CCPR/C/GC/34. 12 September 2011, para.12.

¹¹²⁰ Ibid, para. 11.

¹¹²¹ Ibid, para. 49.

¹¹²² The enumerated purposes are: “(a) For respect of the rights or reputation of others; (b) For the protection of national security or of public order (*ordre public*), or of public health or morals.” ICCPR, Article 19(3).

to freedom of expression must satisfy the conditions of legality, legitimacy, necessity, and proportionality.¹¹²³

The right to freedom of expression is also recognised in regional organisations, including the Council of Europe.¹¹²⁴ The enjoyment of this right is not absolute and can be restricted where such interferences are “prescribed by law and are necessary in a democratic society”, for the purposes of, inter alia, preventing crime or disorder, or the protection of health or morals.¹¹²⁵ However, based on the right to freedom of expression being “one of the essential foundations of a democratic society and one of the basic conditions for its progress and for each individual’s self-fulfilment”,¹¹²⁶ the European Court of Human Rights (ECtHR) has established a high threshold for legitimate interference, observing that “the adjective “necessary” in Article 10(2) implies the existence of a pressing social need...[which]...must be convincingly established.”¹¹²⁷ Domestic legislators and judicial bodies are, in principle, conferred a margin of appreciation to make such determinations, subject to the ECtHR’s overall supervisory function and ability “to give the final ruling” on whether an interference has occurred and, if so, whether it is permitted.¹¹²⁸

EU law and policy

The EU Charter of Fundamental Rights (CFREU) also protects “the right to freedom of expression and information”, corresponding to Article 10 of the ECHR (see above) in accordance with Article 52(3) of the CFREU, included within which is the right “to receive and impart information and ideas without interference by public authority and regardless of frontiers.”¹¹²⁹ The right to freedom of expression under EU law is not absolute, however, any limitation “must be provided for by law and respect the essence” of the right, in addition to being “necessary” and genuinely meeting “objectives of general interest recognised by the Union or the need to protect the rights and freedoms of others”, pursuant to the principle of proportionality.¹¹³⁰

Potential enhancements

XR technologies can potentially enhance the right to freedom of expression, primarily by facilitating new forms of creative expression. XR technologies may enhance musical expression, for instance by, inter alia, providing the medium for the expression of novel forms of musical creativity and distinctive forms of music,¹¹³¹ creating opportunities for the pairing of immersive virtual music instruments with 3D interaction techniques such as navigation, selection and manipulation to enhance musical control,¹¹³² and developing virtual environments wherein creative musical collaboration can be facilitated by enhanced feelings of togetherness or copresence between performers.¹¹³³ The use of

¹¹²³ Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, A/74/486, 9 October 2019, para.6. Available at:

https://www.ohchr.org/sites/default/files/Documents/Issues/Opinion/A_74_486.pdf.

¹¹²⁴ See, e.g., ECHR, Article 10.

¹¹²⁵ ECHR, Article 10(2).

¹¹²⁶ *Case of Sanchez v. France* (Application no.45581/15) (2 September 2021), para.76.

¹¹²⁷ *Ibid*, para.77.

¹¹²⁸ *Case of Handyside v. The United Kingdom* (Application no.5493/72) (7 December 1976), para.49.

¹¹²⁹ CFREU, Article 11.

¹¹³⁰ CFREU, Article 52(1).

¹¹³¹ Barrass S. and Barrass T., (2006) ‘Musical creativity in collaborative virtual environments’, *Virtual Reality*, vol.10, pp.149-157. DOI: <https://doi.org/10.1007/s10055-006-0043-5>.

¹¹³² Berthaut F., (2020) ‘3D interaction techniques for musical expression’, *Journal of New Music*, vol.49:1, pp.60-72. DOI: <https://doi.org/10.1080/09298215.2019.1706584>.

¹¹³³ Schober M.F. (2006) ‘Virtual environments for creative work in collaborative music-making’, *Virtual Reality*, vol.10, pp.85-94. DOI: <https://doi.org/10.1007/s10055-006-0049-z>.



AR technologies, specifically, may enhance the right to freedom of expression by developing narrative skill and creativity in storytelling.¹¹³⁴ The use of VR technologies for filmmaking, meanwhile, can enable recording from a 360-degree perspective and empower individuals to choose the sequencing of scenes which may enhance the right to freedom of expression for filmmakers, actors, and viewers alike.¹¹³⁵ VR can also provide a medium for creative expression through 3D immersive painting applications, such as Tilt Brush.¹¹³⁶

Key issues and challenges

There are several issues that raise concerns related to freedom of expression in XR. Whilst not constituting interferences per se, these issues (and any corresponding regulation) could impact the right to freedom of expression. The issues are as follows: violence, pornography, hate speech and mis/disinformation.

Violence: Possible issues in the context of violent content in XR include, inter alia, whether the law would distinguish between violence included in the XR experience, violence witnessed by users, and violence generated and enacted by users through their actions, both against the XR experience and other users. Underpinning each of these issues is the purported link between playing violent videogames and engaging in violent behavior(s),¹¹³⁷ and the associated possibility that the unique effects of XR technologies on users may heighten this risk and necessitate restricting experiences of violent content. Such concerns are the product of research comparing the experiences of users playing violent videogames in VR and non-VR, which suggests that immersion and elicitation of “illusions of presence and body ownership” in the former context may result in users feeling “more personally involved in receiving and enacting the in-game violence” in comparison to non-VR users.¹¹³⁸ This raises the possibility that the law might treat violent content in XR differently in comparison to traditional media and videogames, yet it has been suggested that Media Ratings Bodies (MRBs), such as Pan European Game Information (PEGI), do not currently distinguish between gameplay experiences in XR and non-XR contexts, supplying the same rating and content descriptors for games irrespective of the mode in which it is played.¹¹³⁹

In relation to the legal framework, depictions of violence in media and videogames are generally permitted by law, but there are often age restrictions in place to ensure content is age appropriate. In the U.S., for instance, there are age classifications and limits on sale of certain videogames, but the playing of violent and sexual videogames, even by minors, constitutes a form of expression protected by the First Amendment.¹¹⁴⁰ If the regulation of violent content in XR follows the approach of videogame law, creators may have the unrestricted freedom of expression to develop XR experiences

¹¹³⁴ Yilmaz R.M. and Gotkas Y., (2017) ‘Using augmented reality technology in storytelling activities: examining elementary students’ narrative skill and creativity’, *Virtual Reality*, vol.21, pp.75-89. DOI: <https://doi.org/10.1007/s10055-016-0300-1>.

¹¹³⁵ Forchetti M., (2020) *What You Need to Know About Acting + Virtual Reality / Backstage* [Online]. Available at: <https://www.backstage.com/magazine/article/acting-world-virtual-reality-1555/>.

¹¹³⁶ See, e.g., *Tilt Brush / Tilt Brush by Google* [Online]. Available at: <https://www.tiltbrush.com/>.

¹¹³⁷ See, e.g., Gunter B., (2016) *Does Playing Video Games Make Players More Violent?* (Palgrave Macmillan). DOI: <https://link.springer.com/book/10.1057/978-1-137-57985-0>.

¹¹³⁸ Wilson G., and McGill M., (2018) ‘Violent games in virtual reality: re-evaluating the impact and rating of interactive experiences.’, *Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play*, pp.535-548. DOI: <https://doi.org/10.1145/3242671.3242684>.

¹¹³⁹ Ibid.

¹¹⁴⁰ See, e.g., *Brown v. Entertainment Merchants Association* 564 U.S. 786, 790 (2011).



with extreme violence.¹¹⁴¹ This is also indicated by case law from the ECtHR, which has interpreted the right to freedom of expression expansively, observing that the right guaranteed under the ECHR “is applicable not only to “information” or “ideas” that are favourably received or regarded as inoffensive or as a matter of indifference, but also to those that offend, shock or disturb the State or any sector of the population.”¹¹⁴² Whilst this appears to indicate that violent content in XR may be subject to the protection of the right to freedom of expression for the purposes of the ECHR, it is important to recall that the Convention confers a margin of appreciation which may lead to variation between State Parties. Depictions of violence in Germany, for example, are subject to regulation by the criminal code,¹¹⁴³ based on which violent videogames such as *Mortal Kombat* and *Manhunt* have been banned from sale to the public.¹¹⁴⁴

An additional consideration, alongside age rating and access regulations, is the treatment of incidences of harassment, stalking and assault in XR. As discussed in relation to the right to non-discrimination and the rights of vulnerable groups (see Section 6.1.12), incidences of users experiencing harassment and violence in XR have been widely reported,¹¹⁴⁵ particularly by women encountering sexual misconduct.¹¹⁴⁶ Yet, whilst the immersiveness of VR, specifically, may render the psychological and emotional harm suffered by victims of “virtual assault” comparable to that which occurs in the physical world,¹¹⁴⁷ incidences of this nature may not be treated equivalently for the purposes of the law. Instead, XR developers may seek to regulate such harmful content through game design alteration, for instance by introducing invisible safety bubbles and blocking and muting functions.¹¹⁴⁸

Pornography: In considering the issue of pornography and freedom of expression in XR, it is necessary to distinguish between adults and children as (i) users of, and (ii) persons depicted by, virtual pornography. Whilst children are entitled to the right to freedom of expression,¹¹⁴⁹ the use of virtual pornography by such persons may be restricted on the basis of protecting “public health or morals.”¹¹⁵⁰ Contrastingly, the use by and depiction of (consenting) adults in VR pornography, alongside alternatives such as adult VR games,¹¹⁵¹ may in certain circumstances be seen as protected by the right to freedom of expression. The central and most contentious issue in this context, therefore, relates to virtual pornography depicting children, potentially including so-called “virtual

¹¹⁴¹ See, e.g., *Blood Trail*, described as “the most violent game in VR” at Steam. *Blood Trail / Steam* [Online]. Available at: https://store.steampowered.com/app/1032430/Blood_Trail/.

¹¹⁴² *Case of Handyside v. The United Kingdom*, supra note 1128, para.49.

¹¹⁴³ Criminal Code in the version published on 13 November 1998, as last amended by Article 2 of the Act of 19 June 2019 [Germany], s.131.

¹¹⁴⁴ Osborne Clarke, *Will virtual reality video game content be protected by the Freedom of Speech?* / Osborne Clarke [Online]. Available at: <https://connectedconsumer.osborneclarke.com/digital-entertainment/will-virtual-reality-video-game-content-be-protected-by-the-freedom-of-speech/>.

¹¹⁴⁵ See, e.g., Sum of Us. (2022) *Metaverse: another cesspool of toxic content*, p. 6. Available at: https://www.sumofus.org/images/Metaverse_report_May_2022.pdf.

¹¹⁴⁶ See, e.g., Basu T. (2021) *The metaverse has a groping problem already* / MIT Technology Review [Online]. Available at: <https://www.technologyreview.com/2021/12/16/1042516/the-metaverse-has-a-groping-problem/>.

¹¹⁴⁷ Petter O. (2022) *Why Is No One Taking Sexual Assault In the Metaverse Seriously?* / Vogue [Online]. Available at: <https://www.vogue.co.uk/arts-and-lifestyle/article/sexual-assault-in-the-metaverse>.

¹¹⁴⁸ Metz R. (2022) *Harassment is a problem in VR, and its likely to get worse* / CNN Business [Online]. Available at: https://edition.cnn.com/2022/05/05/tech/virtual-reality-harassment/index.html?utm_source=optzlynewmarketribbon.

¹¹⁴⁹ CRC, Article 13.

¹¹⁵⁰ Ibid, Article 13(2)(b).

¹¹⁵¹ See, e.g., Joho J., (2021) *The best virtual reality porn games, and how to play adult VR* / Mashable [Online]. Available at: <https://mashable.com/article/best-vr-porn-games>.

ageplay”,¹¹⁵² in relation to which it has been suggested that, on the one hand, there is no direct harm, and any indirect harm is contained in the virtual environment, yet, on the other hand, concern remains that permitting such practices “might normalise deviant sexual preferences” and provide a gateway for sexual contact offences to be committed in the real world.¹¹⁵³ Furthermore, the potential for reputational harm and psychological damage to victims rendered in VR child pornography may be comparable to pornographic deepfakes,¹¹⁵⁴ with relevant provisions in the proposed AI¹¹⁵⁵ and Digital Services Acts¹¹⁵⁶ highlighting the tentative steps taken by EU legislators towards stricter regulation of such content.

Whilst it has been suggested that the term fails to adequately capture the associated harms and should be replaced,¹¹⁵⁷ the issue of “child pornography” is addressed in various provisions under EU¹¹⁵⁸ and international law, including the Optional Protocol to the Convention on the Rights of the Child on the sale of children, child prostitution and child pornography (OPSC),¹¹⁵⁹ and the Council of Europe Conventions on Cybercrime (Budapest Convention)¹¹⁶⁰ and the Protection of Children against Sexual Exploitation and Sexual Abuse (Lanzarote Convention).¹¹⁶¹ It is apparent from the definitions of “child pornography”¹¹⁶² contained in each of these provisions that the issue of virtual child pornography is only explicitly contemplated within the framework of the Budapest Convention, wherein State Parties are required to criminalise a range of “child pornography” offences, the definition for which includes “realistic images representing a minor engaged in sexually explicit conduct.”¹¹⁶³ This phrasing restricts the scope of the provision, yet in the light of the trend towards increasingly human-realistic virtual avatars,¹¹⁶⁴ it may nonetheless be applicable to instances of virtual child pornography in XR. States Parties to the Lanzarote and Budapest Conventions, however, “may reserve the right not to apply” the identified provisions.¹¹⁶⁵ Under the Lanzarote Convention, for instance, this entails that State Parties exercising the reservation mechanism will not be required to criminalise the production and

¹¹⁵² See, e.g., Esposito L., (2019) ‘Sexual Ageplay in Virtual Reality: Practicing Free Speech or Producing Child Pornography’, *Cardoza Law Review*, vol.40:4, pp.1913-1951. Available at: <http://cardozolawreview.com/wp-content/uploads/2019/05/8-Esposito.40.4.8.pdf>.

¹¹⁵³ Witting S.K., (2018) ‘The “greyscale” of “child pornography”: Of mangas, avatars and schoolgirls: Part 1’, *Computer and Telecommunications Law Review*, vol.24:3, pp.61-66.

¹¹⁵⁴ See, e.g., Chesney B and Citron DK. (2019) ‘Deep Fakes: A Looming Challenge for Privacy, Democracy, and National Security’, *California Law Review*, vol.107, pp.1753-1820. Available at: https://scholarship.law.bu.edu/faculty_scholarship/640/.

¹¹⁵⁵ Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) And Amending Certain Union Legislative Acts COM/2021/206 final, Article 52.

¹¹⁵⁶ Amendments adopted by the European Parliament on 20 January 2022 on the proposal for the regulation of the European Parliament and of the Council on a Single Market for Digital Services (Digital Services Act) and amending Directive 2000/31/EC (COM(2020)0825-C9-0418/2020-2020/0361(COD)), Article 30a. Available at: https://www.europarl.europa.eu/doceo/document/TA-9-2022-0014_EN.pdf.

¹¹⁵⁷ See, e.g., Guidelines regarding the implementation of the Optional Protocol to the Convention on the Rights of the Child on the sale of children, child prostitution and child pornography (10 September 2019) CRC/C/156, para.5.

¹¹⁵⁸ See, e.g., Directive 2011/92 of the European Parliament and of the Council of 13 December 2011 on combating the sexual abuse and sexual exploitation of children and child pornography and replacing Council Framework Decision 2004/68/JHA. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0093&from=EN>.

¹¹⁵⁹ The Optional Protocol to the Convention on the Rights of the Child on the sale of children, child prostitution and child pornography (entry into force 18 January 2002) A/RES/54/263 (Optional Protocol to CRC).

¹¹⁶⁰ Convention on Cybercrime (Budapest Convention) (entry into force 1 July 2004) 23.XI.2001.

¹¹⁶¹ Convention on the Protection of Children against Sexual Exploitation and Sexual Abuse (Lanzarote Convention) (entry into force 1 July 2010) 25.X.2007.

¹¹⁶² Optional Protocol to CRC, Article 2(c); Budapest Convention, Article 9(2); Lanzarote Convention, Article 20(2).

¹¹⁶³ Budapest Convention, Article 9(2)(c).

¹¹⁶⁴ See, e.g., ServReality, *Virtual Avatars. From Toons to Hyper-Realistic Digital Man/HABR*. [Online]. Available at: <https://servreality.com/news/virtual-avatars-from-toons-to-hyper-realistic-digital-man-habr/>.

¹¹⁶⁵ Budapest Convention, Article 9(4); Lanzarote Convention, Article 20(3) and Article 20(4).

possession of child pornographic material “consisting exclusively of simulated representations or realistic images of a non-existent child”.¹¹⁶⁶ It has been suggested that the basis for this derogation is concern related to, inter alia, the right to freedom of expression, particularly artistic expression,¹¹⁶⁷ and a possible effect of this may be that some forms of virtual child pornography in XR are not criminalised.

However, the Explanatory Report to the Lanzarote Convention appears to pre-empt this possibility and highlights the risk that rapid developments in technology will enable the production of “extremely lifelike images of child pornography where in reality no child was involved”, and accordingly recommends that State Parties “should avoid covering such productions by their reservation.”¹¹⁶⁸ Furthermore, this does not exclude the possibility that State Parties may exercise the reservation mechanism, whilst offering similar and perhaps more enhanced protections under national law. Bulgaria, for instance, has exercised the reservation mechanism in relation to Article 20(1)(f) of the Lanzarote Convention, pertaining to “knowingly obtaining access, through information and communication technologies, to child pornography”,¹¹⁶⁹ yet criminalises such offences pursuant to Article 159(7) of the Criminal Code.¹¹⁷⁰

Hate speech: As mentioned above, States can restrict freedom of expression if certain conditions are met, and there are, moreover, certain circumstances where States are obligated to prohibit some forms of expression. For example, the Convention on the Prevention and Punishment of the Crime of Genocide requires States to criminalise expression that incites genocide.¹¹⁷¹ States are also obligated under international law to prohibit by law “[a]ny advocacy of national, racial or religious hatred that constitutes incitement to discrimination, hostility or violence”.¹¹⁷² This prohibition applies to (i) advocacy of hatred, (ii) advocacy which constitutes incitement, and (iii) the likelihood of incitement leading to one of the identified outcomes, specifically discrimination, hostility or violence.¹¹⁷³ Guidance in the Rabat Plan of Action, prepared by a Working Group under the U.N. High Commissioner for Human Rights, defines key terms like “hatred”, “hostility”, “advocacy” and “incitement”,¹¹⁷⁴ whilst also establishing “a six-part threshold test” to determine the severity necessary for expressions to be considered criminal offences.¹¹⁷⁵ The potential for hate speech in XR which may satisfy these criteria is highlighted by recent research which found that users have reported “observing hate speech that is discriminatory, homophobic, racist, and sexual in nature”, the harm resulting from which is particularly acute for women, children, members of the LGBTQ+ community, people of colour and persons with

¹¹⁶⁶ Lanzarote Convention, Article 20(3).

¹¹⁶⁷ See, e.g., Witting, *supra* note 1153, pp. 61-66.

¹¹⁶⁸ Council of Europe (2007). *Explanatory Report to the Council of Europe Convention on the Protection of Children against Sexual Exploitation and Sexual Abuse* CETS 201, para.144.

¹¹⁶⁹ See, e.g., Reservations and Declarations for Treaty No.201 – Council of Europe Convention on the Protection of Children against Sexual Exploitation and Sexual Abuse (CETS No.201). Available at: <https://www.coe.int/en/web/conventions/by-member-states-of-the-council-of-europe?module=declarations-by-treaty&numSte=201&codeNature=0>.

¹¹⁷⁰ Council of Europe (2018). *Replies to the thematic questionnaire: Bulgaria* T-ES(2017)ICT-BG. Available at: <https://rm.coe.int/bulgaria-replies-to-the-thematic-questionnaire/168077fa9b>.

¹¹⁷¹ Convention on the Prevention and Punishment of the Crime of Genocide (entry into force 12 January 1951) G.A. Res 260 A (III) (Genocide Convention), Article 3(c).

¹¹⁷² ICCPR, Article 19(3); See also, e.g., ICERD, Article 4.

¹¹⁷³ Report of the Special Rapporteur on the promotion and protection of the right to freedom of opinion and expression, A/67/357 (7 September 2012), para.43.

¹¹⁷⁴ Rabat Plan of Action on the prohibition of advocacy of national, racial or religious hatred that constitutes incitement to discrimination, hostility or violence, Annual report of the United Nations High Commissioner for Human Rights, Addendum, A/HRC/22/17/Add.4, 11 January 2013, Annex, footnote 5.

¹¹⁷⁵ *Ibid*, Annex, para. 29.



disabilities.¹¹⁷⁶ In seeking to moderate such content, the Special Rapporteur has suggested that penalties for prohibited expression should be the same online and offline.¹¹⁷⁷ It follows that the penalties for prohibited hate speech should be enforced in XR environments just as they are enforced offline and in other online contexts.

A more challenging issue is that of “hate speech” which does not constitute advocacy or incitement to discrimination, hostility and violence.¹¹⁷⁸ Under international human rights law, some legal restrictions on non-incitement expression, such as anti-blasphemy laws, are “specifically disfavoured” because such expression is protected.¹¹⁷⁹ Instead, States are encouraged to “take robust steps”, such as education, training and “government condemnation of prejudice” to counter such instances of hate.¹¹⁸⁰ States may not use private companies, including XR developers and deployers, “as tools to limit expression that they themselves would be precluded from limiting under international human rights law.”¹¹⁸¹ This is particularly relevant when considering the introduction of strict liability measures purporting to hold ICT companies and other online intermediaries directly responsible for failure to remove hate speech.¹¹⁸² Any State which establishes a restriction to the freedom of expression by law must ensure that the exceptional conditions provided by international human rights law, specifically those listed under Article 20(2) ICCPR (see above), are complied with.

Mis/disinformation: XR technologies are among the various digital technologies seen to represent a new frontier in the rise of mis/disinformation in the online environment.¹¹⁸³ As closely related but distinct phenomena, both misinformation and disinformation entail the sharing of false information yet are typically distinguished on the basis that misinformation does not embody an intention to cause harm, whereas disinformation does.¹¹⁸⁴ The potential for content in XR which may constitute mis/disinformation has been highlighted in recent research, with reporters from BuzzFeed, for instance, having created an experimental private VR world called “Qniverse”, complete with

¹¹⁷⁶ Sum of Us, supra note 1145.

¹¹⁷⁷ Report of the Special Rapporteur, supra note 1173, para. 29: “Penalties on individuals for engaging in unlawful hate speech should not be enhanced merely because the speech occurred online.”

¹¹⁷⁸ See, e.g., United Nations Strategy and Plan of Action on Hate Speech (2019). Available at: https://www.un.org/en/genocideprevention/documents/advising-and-mobilizing/Action_plan_on_hate_speech_EN.pdf - “There is no international legal definition of hate speech, and the characterization of what is ‘hateful’ is controversial and disputed. In the context of this document, the term hate speech is understood as any kind of communication in speech, writing or behaviour, that attacks or uses pejorative or discriminatory language with reference to a person or a group on the basis of who they are, in other words, based on their religion, ethnicity, nationality, race, colour, descent, gender or other identity factor.”

¹¹⁷⁹ Report of the Special Rapporteur, supra note 1173, para.21.

¹¹⁸⁰ Ibid, para.24. See also, e.g., Human Rights Council Resolution 16/18 A/HRC/RES/16/18 (12 April 2011). Available at: <https://documents-dds-ny.un.org/doc/RESOLUTION/GEN/G11/127/27/PDF/G1112727.pdf?OpenElement>.

¹¹⁸¹ Report of the Special Rapporteur, supra note 1173), para.29.

¹¹⁸² See, e.g., *Delfi AS v Estonia* (Application no.64569/09) (ECtHR, 16 June 2015), para.159: “the rights and interests of others and of society as a whole may entitle Contracting States to impose liability on Internet news portals, without contravening Article 10 of the Convention, if they fail to take measures to remove clearly unlawful comments without delay, even without notice from the alleged victim or from third parties.”

¹¹⁸³ See, e.g., European Commission, Directorate-General for Communications Networks, Content and Technology, (2018) ‘A multi-dimensional approach to disinformation: report of the independent High Level Group on fake news and online disinformation’, *Publications Office*. Available at: <https://data.europa.eu/doi/10.2759/739290>

¹¹⁸⁴ See, e.g., Wardle C., and Derakhshan H., (2017) ‘Information Disorder: Toward an interdisciplinary framework for research and policymaking’, Council of Europe report DGI (2017) 09. Available at: <https://rm.coe.int/information-disorder-toward-an-interdisciplinary-framework-for-research/168076277c>.

misinformation slogans pertaining to electoral fraud, vaccines, and the Covid-19 pandemic, the content of which was only removed after being reported by one of the journalists.¹¹⁸⁵

Whilst there are “certain restrictions” on the right to freedom of expression under international law,¹¹⁸⁶ including any propaganda for war and where such expression is hatred constituting incitement to discrimination, hostility or violence (see above),¹¹⁸⁷ States are not permitted to impose a general prohibition on “expressions of an erroneous opinion or an incorrect interpretation of past events.”¹¹⁸⁸ Similarly, the ECtHR has observed that the right to freedom of expression under the ECHR “does not prohibit discussion or dissemination of information received even if it is strongly suspected that this information might not be truthful.”¹¹⁸⁹ This indicates that the right to freedom of expression entails the right to disseminate false information, yet this may not be an unrestricted right based on the potential for harm to various human rights, including the right to free elections,¹¹⁹⁰ the right to health (see Section...) and the right to non-discrimination (see Section ...). Furthermore, whilst this right may be guaranteed *de jure*, XR developers may require that users sign up to terms of service agreements through which such expression can be restricted on a *de facto* basis.

States’ obligations and areas for legal development

XR technologies are subject to existing international human rights law on the right to freedom of expression and States have an obligation to ensure that the use of XR supports the realisation of this right. States must ensure that any restrictions to the enjoyment of the right to freedom of expression in XR are lawful, legitimate, necessary and proportionate for the attainment of a specified and recognised purpose. Furthermore, based on the duty to protect individuals against human rights abuses by third parties, including private corporations, States must regulate commercial XR developers so that their content moderation policies are consistent with international standards. In seeking to strike a balance between the right to freedom of expression and the avoidance of harm to other protected rights, XR developers may consider adopting specific content moderation policies. The Santa Clara Principles 2.0, for instance, contain a series of foundational and operational principles intended to assist companies in complying with their responsibilities to respect human rights, as directed by the UN Guiding Principles on Business and Human Rights,¹¹⁹¹ and have been endorsed by various companies involved in the development of XR, including Facebook (Meta) and Google.¹¹⁹²

6.1.6 Right to health

XR has the potential to both enhance and undermine the right to health. XR may be used for training of medical professions, in treatment and care, and as a platform for telemedicine. However, XR may also cause direct or indirect harm to health. Additionally, there are concerns related to telemedicine,

¹¹⁸⁵ Baker-White E. (2022) *Meta Wouldn't Tell Us How It Enforces Its Rules in VR, So We Ran A Test To Find Out / BuzzFeed* [Online]. Available at: <https://www.buzzfeednews.com/article/emilybakerwhite/meta-facebook-horizon-vr-content-rules-test>.

¹¹⁸⁶ ICCPR, Article 19(3).

¹¹⁸⁷ Ibid, Article 20.

¹¹⁸⁸ Human Rights Committee, *General comment No.34, Article 19: Freedom of opinion and expression*. CCPR/C/GC/34. 12 September 2011, para. 49.

¹¹⁸⁹ *Case of Salov v. Ukraine* (Application no.65518/01) (6 September 2005), para. [113].

¹¹⁹⁰ See, e.g., ECHR, Article 3.

¹¹⁹¹ United Nations, (2011) *Guiding principles on business and human rights: implementing the United Nations “Protect, Respect and Remedy” framework*. Available at: https://www.ohchr.org/sites/default/files/documents/publications/guidingprinciplesbusinesshr_en.pdf.

¹¹⁹² *The Santa Clara Principles On Transparency and Accountability in Content Moderation* [Online]. Available at: <https://santaclaraprinciples.org>.



including inequality of access, limited capabilities for quality care, and cybersecurity risks with health-related data. While international or EU human rights law on the right to health does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR does not violate enjoyment of the right.

International law and policy

Under international law, everyone has the right “to the enjoyment of the highest attainable standard of physical and mental health.”¹¹⁹³ This right is also recognised in regional organisations, including the Council of Europe.¹¹⁹⁴

It is not a right to be *healthy*, but rather a right to certain freedoms (right to control one’s health and be freed from interference) and entitlements (equal opportunity to enjoy the highest attainable level of health).¹¹⁹⁵ States have an obligation to “take the necessary steps to the maximum of its available resources” to ensure access to timely, acceptable, and affordable healthcare.¹¹⁹⁶

Also relevant to the right to health and XR is the *Convention for the Protection of Human Rights and Dignity of the Human Being with regard to the Application of Biology and Medicine (Oviedo Convention)*.¹¹⁹⁷ It is the only international binding legal instrument on human rights and biomedicine and includes provisions on relevant topics including equitable access and informed consent.

The Council of Europe’s Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025) elaborates how the international organisation will address emerging challenges posed by new technologies, including telemedicine.¹¹⁹⁸ For example, its Committee on Bioethics intends to prepare a Recommendation ‘on equitable and timely access to innovative treatments and technologies in healthcare systems’.¹¹⁹⁹

Three of the UN Sustainable Development Goals relate to the right to the right to health: good health and well-being, zero hunger, and clean water and sanitation.¹²⁰⁰

EU law and policy

The EU Charter of Fundamental Rights includes the right “of access to preventative health care and the right to benefit from medical treatment under the conditions established by national laws and practices.”¹²⁰¹ The European Pillar of Social Rights also includes a principle on health care and “the right to timely access to affordable, preventive and curative health care of good quality.”¹²⁰²

¹¹⁹³ ICESCR, Article 12. See, also, UDHR, Article 25(1); ICERD, Article 5(e)(iv); Convention on the Elimination of All Forms of Discrimination against Women (entry into force 3 September 1981), 1249 U.N.T.S. 13 (CEDAW), Article 12; CRC, Article 24; and CRPD, Annex I, Article 25.

¹¹⁹⁴ European Social Charter (entered into force 26 February 1965), E.T.S. 35 – Social Charter, 18.X.1961, Part I, para. 11.

¹¹⁹⁵ Committee on Economic, Social and Cultural Rights. (2000) *General Comment No. 14: The Right to the Highest Attainable Standard of Health (Art. 12)*, adopted 11 August 2000, para. 8.

¹¹⁹⁶ *Ibid*, paras. 11-12, 47.

¹¹⁹⁷ Oviedo Convention; Convention on Human Rights and Biomedicine, 4.IV.1997.

¹¹⁹⁸ Council of Europe. (2019) ‘Strategic Action Plan on Human Rights and Technologies in Biomedicine (2020-2025)’. Available at: <https://rm.coe.int/strategic-action-plan-final-e/1680a2c5d2>.

¹¹⁹⁹ *Ibid*.

¹²⁰⁰ Sustainable Development Goals, Goals 2, 3, and 6.

¹²⁰¹ ECHR, Article. 35.

¹²⁰² European Pillar of Social Rights, Principle 16.



Potential enhancements

XR may enhance an individual's right to enjoy the highest attainable standard of health. For example, XR may enhance the education of health care professionals by providing low-risk, realistic training experiences, thus improving overall healthcare provision.¹²⁰³ XR may also be used by medical providers in, for example, clinical care or surgery, as a tool to provide quality care.¹²⁰⁴ Telemedicine via XR may also improve access to healthcare, particularly for persons with disabilities and those unable to visit a medical provider in person.¹²⁰⁵

Potential interferences

The use of XR may negatively impact both an individual's health and ability to access the highest attainable standard of healthcare. Research has already documented many negative health-related harms associated with the use of XR, including motion sickness and nausea, physical injuries from contact with physical setting, and bodily neglect.¹²⁰⁶ Other potential harms include depersonalisation and derealisation dissociative disorders and addiction.¹²⁰⁷ Research on the impacts on children specifically suggest that XR technologies may interfere with brain and neurological development,¹²⁰⁸ raises issues about children's development that could have negative and life-long health effects.

Other concerns related to the use of XR in telemedicine, including high costs, limited accessibility especially in low socio-economic areas, privacy concerns for sensitive health data, and the inherent difficulty to adequately diagnose and effectively treat some health conditions remotely.¹²⁰⁹

States' obligations and areas for legal development

XR is subject to existing international human rights law on the right to health and States have an obligation to ensure that the use of XR supports realisation of the right. States must take all necessary steps possible to guarantee that XR does not interfere with individual's right to control their own health and that everyone has equal opportunity to benefit from XR if desired. In relation to the right to health, further human rights guidance specific to XR may be required to address concerns related to, among other issues, impacts on child brain development, inequality of access, and privacy and data protection.

¹²⁰³ See, e.g., Logeswaran et al. (2021) 'The role of extended reality technology in healthcare education: Towards a learner-centred approach', *Future Healthcare Journal*, 8(1). DOI: 10.7861/fhj.2020-0112.

¹²⁰⁴ See, e.g., Marr, B. (2021) *Extended Reality in Healthcare: 3 Reasons The Industry Must Get Ready for AI and VR / FORBES* [Online]. Available at: <https://www.forbes.com/sites/bernardmarr/2021/06/14/extended-reality-in-healthcare-3-reasons-the-industry-must-get-ready-for-ar-and-vr/?sh=18b747fe73a4> (Accessed: 17 May 2022); and Andrews et al. (2019) 'Extended Reality in Medical Practice', *Current Treatment Options in Cardiovascular Medicine*, 21(4). DOI: 10.1007/s11936-019-0722-7.

¹²⁰⁵ See, e.g., Ong et al. (2021) 'Extended Reality for Enhanced Telehealth During and Beyond COVID-19: Viewpoint', *JMIR Serious Games*, 9(3). DOI: 10.2196/26520.

¹²⁰⁶ See, e.g., Spiegel, J.S. (2017) 'The Ethics of Virtual Reality Technology: Social Hazards and Public Policy Recommendations', *Science and Engineering Ethics*. DOI: 10.1007/s11948-017-9979-y; Snijders et al. (2020) *Responsible VR. Protect consumer in virtual reality*. The Hague: Rathenau Instituut; and Bagheri, R. (2017) 'Virtual reality, The real life consequences', *UC Davis Business Law Journal*, 17.

¹²⁰⁷ See, e.g., Spiegel, supra note 1206.

¹²⁰⁸ See, e.g., Miehlsbradt et al. (2021) 'Immersive virtual reality interferes with default head-trunk coordination strategies in young children', *Scientific Reports*, 11. DOI: 10.1038/s41598-021-96866-8.

¹²⁰⁹ See, e.g., Ong et al., supra note 1205; and Evans, J. (2022) 'Extended Reality (XR) Ethics in Medicine, IEEE Global Initiative on Ethics of Extended Reality. Available at: <https://standards.ieee.org/wp-content/uploads/2022/02/whitepaper-ethics-in-medicine.pdf> (Accessed: 17 May 2022).

6.1.7 Right to education

XR has the potential to both enhance and undermine the right to education. The use of XR technologies may improve learning outcomes, provide reasonable accommodation for students with disabilities, and enhance accessibility. However, concerns about XR include physical and mental harm from extended periods of use, undue influence of private and commercial actors, and compounded inequalities of access. While international or EU human rights law on the right to education does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR does not interfere with the enjoyment of the right.

International law and policy

Under international law, everyone has the right to education.¹²¹⁰ This right is also recognised in regional organisations, including the Council of Europe.¹²¹¹

Education should be “directed to the full development of the human personality and the sense of its dignity” and “enable all persons to participate effectively in a free society, promote understanding, tolerance and friendship among all nations and all racial, ethnic or religious groups”.¹²¹² States are obligated to provide free, compulsory primary education to children and ensure equal access to secondary and higher education without discrimination.¹²¹³ All education should be available, accessible, acceptable, and adaptable within the specific context of the State.¹²¹⁴ Particular care should be afforded to persons with disabilities; States are obligated to provide reasonable accommodation to ensure equal access to education.¹²¹⁵

To address concerns about the privatisation and commodification of human rights, human rights experts adopted the Adibjan Principles in 2019 to provide guidance on regulating private actors’ involvement in education.¹²¹⁶ The Adibjan Principles call on States to establish effective regulation of private actors consistent with international rights and standards.¹²¹⁷ The Adibjan Principles have been endorsed by the U.N. High Commission for Human Rights,¹²¹⁸ U.N. Special Procedures (including the then U.N. Special Rapporteur on the right to education),¹²¹⁹ and the U.N. Human Rights Council,¹²²⁰ among others.

¹²¹⁰ UDHR, Article 26; ICCPR, Article 13; ICERD, Article 5(e)(v); CEDAW, Article 10; CRC, Article 28; and CRPD, Article 24.

¹²¹¹ ECHR, Art. 2.

¹²¹² UDHR, Article 26; and ICCPR, Article 13.

¹²¹³ UDHR, Article 26; and ICESCR, Article 13.

¹²¹⁴ Committee on Economic, Social and Cultural Rights. (1999) *General Comment No. 13: The Right to education (article 13 of the Covenant)*, E/C.12/1999/10, 8 December 1999, para.6.

¹²¹⁵ Committee on the Rights of Persons with Disabilities. (2016) *General Comment No. 4 (2016) on the right to inclusive education*, CRPD/C/GC/4, 25 November 2016, paras.28-33; and Committee on the Rights of the Child. (2007) *General Comment No. 9 (2006) on the rights of children with disabilities*, CRC/C/GC/9, 27 February 2007, Section VIII(D).

¹²¹⁶ Guiding Principles on the human rights obligations of States to provide public education and to regulate private involvement in education, adopted 13 February 2019 (Abidjan Principles).

¹²¹⁷ Ibid, para. 53.

¹²¹⁸ U.N. High Commissioner for Human Rights (2019) *Statement by UN High Commissioner for Human Rights Michelle Bachelet at the Social Forum: The promotion and protection of the rights of children and youth through education*, 1 October 2019. Available at: <https://www.ohchr.org/en/statements/2019/10/social-forum-promotion-and-protection-rights-children-and-youth-through?LangID=E&NewsID=25085>.

¹²¹⁹ U.N. Special Rapporteur on the right to education. (2019) *Right to education: the implementation of the right to education and Sustainable Development Goal 4 in the context of the growth of private actors in education*, A/HRC/41/37, 10 April 2019.

¹²²⁰ U.N. Human Rights Council. (2021) *Resolution on the right to education*, A/HRC/4/L.26/Rev.1, 8 July 2021; U.N. Human Rights Council. (2019) *Resolution on the right to education: follow-up to Human Rights Council resolution 8/4*, A/HRC/4/L.26, 9 July 2019.

Goal 3 of the UN Sustainable Development Goals is to “ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”.¹²²¹

EU law and policy

The EU Charter of Fundamental Rights includes the right to education, including free compulsory education.¹²²² The European Pillar of Social Rights also includes a principle on education, training and life-long learning.¹²²³

Potential enhancements

XR technologies may enhance education and learning in a number of ways.¹²²⁴ One, XR exposes students to information in engaging, interactive ways, which research suggests may improve overall learning outcomes,¹²²⁵ particularly for students with disabilities and special learning needs.¹²²⁶ XR can be used to deliver personalized approaches and lessons for students, which may also improve learning outcomes.¹²²⁷ XR technologies could, therefore, be used as a tool of reasonable accommodation to adapt learning methods to specific needs. Other benefits may include minimising distractions and improving focus,¹²²⁸ teaching empathy,¹²²⁹ and enhancing collaboration, particularly when in-person learning is limited (e.g., COVID-19 pandemic).¹²³⁰

For these reasons, XR technologies may augment efforts to ensure education promotes understanding, tolerance and friendship, and may help States fulfil their obligation to ensure education is available, accessible, acceptable, and adapted in their national context.

¹²²¹ Sustainable Development Goals, Goal 4.

¹²²² CFREU, Art. 14.

¹²²³ European Pillar of Social Rights, Principle 1.

¹²²⁴ See, e.g., Oyelere et al. (2020) ‘Exploring the trends of educational virtual reality games: a systematic review of empirical studies’, *Smart Learning Environments*, 7. DOI: 10.1186/s40561-020-00142-7.

¹²²⁵ See, e.g., Dick, E. (2021) ‘The Promise of Immersive Learning: Augmented and Virtual Reality’s Potential in Education’, *Information Technology and Innovation Foundation*. Available at: <https://itif.org/sites/default/files/2021-ar-vr-education.pdf>.

¹²²⁶ See, e.g., Zitter, L. (2020) *How VR and AR Can Be Used to Support Students with Special Needs / Tech & Learning* [Online]. Available at: <https://www.techlearning.com/how-to/how-vr-and-ar-can-be-used-to-support-students-with-special-needs>; Educators in VR. (2019) *Accessibility, Disabilities and Virtual Reality Solutions / Educators in VR* [Online]. Available at: <https://educatorsinvr.com/2019/05/31/accessibility-disabilities-and-virtual-reality-solutions/>.

¹²²⁷ See, e.g., Horvath, I. (2021) ‘An Analysis of Personalized Learning Opportunities in 3D VR’, *Frontiers in Computer Science*, 3. DOI: 10.3389/fcomp.2021.673826.

¹²²⁸ See, e.g., Zimmerman, E. (2019) *AR/VR in K-12: Schools Use Immersive Technology for Assistive Learning / EDTECH* [Online]. Available at: <https://edtechmagazine.com/k12/article/2019/08/arvr-k-12-schools-use-immersive-technology-assistive-learning-perfcon>.

¹²²⁹ See, e.g., Bertrand et al. (2018) ‘Learning Empathy Through Virtual Reality: Multiple Strategies for Training Empathy-Related Abilities Using Body Ownership Illusions in Embodied Virtual Reality’, *Frontiers in Robotics and AI*, 5. DOI: 10.3389/frobt.2018.00026; Rueda, J and Lara, F. (2020) ‘Virtual Reality and Empathy Enhancement: Ethical Aspects’, *Frontiers in Robotics and AI*, 7. DOI: 10.3389/frobt.2020.506984. Film-maker Chris Milk made the claim that virtual reality could be the ultimate empathy machine” in 2015 in regard to the short film *Clouds Over Sidra*, which is used to educate about the refugee experience in a camp in Jordan. Milk, C. (2015) *How virtual reality can create the ultimate empathy machine / TED*. Transcript available at: https://www.ted.com/talks/chris_milk_how_virtual_reality_can_create_the_ultimate_empathy_machine/transcript?language=en.

¹²³⁰ See, e.g., Dick, supra note 1225, p. 3; and Zhou, M. and Kalota, F. (2020) ‘Promoting Collaborative Learning through VR Technologies in the Era of COVID-19’, *2020 Seventh International Conference on Information Technology Trends (ITT)*, 22-26 November 2020. DOI: 10.1109/ITT51279.2020.9320886.



Potential interferences

The use of XR may create or contribute to situations that negatively impact the right to education. Firstly, XR technologies may pose physical and mental health risks, particularly if used for extended periods of time.¹²³¹ There are particular concerns around the impacts of immersive technologies on children's brain, particularly potential interferences with brain and neurological development in children,¹²³² which could have impacts on an individual's ability to learn and enjoy the right to education.

It is also important to note lessons facilitated through XR does not necessarily equate to enhanced learning or knowledge comprehension.¹²³³ Research on information overload in the context of the internet and digital technologies¹²³⁴ should inform discussions on whether individuals learn more with XR and whether they should be used in educational settings. Without further research, misconceptions about the benefits of XR in education could negatively impact decisions on the distribution of limited resources in such a way that effective teaching measures are deprioritised or unfunded.

Other concerns include potential negative effects from the use of commercial XR technologies that are not adapted or appropriately integrated into the educational context, or that give private actors too much control over learning content and systems while benefiting financially. A particular concern is the integration of advertising into XR learning tools.¹²³⁵

Lastly, inequitable access to XR technologies and their requisite infrastructure (especially reliable, fast internet connections) could exacerbate existing socioeconomic inequalities and frustrate a State's ability to fulfil their obligations to ensure equal access to education.¹²³⁶

States' obligations and areas for legal development

XR technologies are subject to existing international human rights law on the right to education and States have an obligation to ensure that the use of XR supports the realisation of this right. States

¹²³¹ See, e.g., Lavoie et al. (2021) 'Virtual experience, real consequences: the potential negative emotional consequences of virtual reality gameplay', *Virtual Reality*, 25. DOI: 10.1007/s10055-020-00440-y; and Rosbach, M. (2020) *Virtual reality, real injuries: OSU study shows how to reduce physical risk in VR* / Oregon State University [Online]. Available at: <https://today.oregonstate.edu/news/virtual-reality-real-injuries-osu-study-shows-how-reduce-physical-risk-vr>.

¹²³² See, e.g., Sanctuary, H. (2021) *Virtual Reality Affects Children Differently Than Adults* / NeuroscienceNews.com [Online]. Available at: <https://neurosciencenews.com/virtual-reality-children-19370/>; and Gent, E. (2016) *Are Virtual Reality Headsets Safe for Children* / Scientific American [Online]. Available at: <https://www.scientificamerican.com/article/are-virtual-reality-headsets-safe-for-children/>; Kaimara, P., Oikonomou, A. and Deliyannis, I. (2021) 'Could virtual reality applications pose real risks to children and adolescents? A systematic review of ethical issues and concerns', *Virtual Reality*. DOI: 10.1007/s10055-021-00563-w.

¹²³³ See, e.g., Mado et al. (2022) 'Accessibility of Educational Virtual Reality for Children during the COVID-19 Pandemic', *Technology, Mind and Behavior*, 3(1), p.3. DOI: 10.1037/tmb0000066; Mulders, M., Buchner, J. and Kerres, M. (2020) 'A Framework for the Use of Immersive Virtual Reality in Learning Environments', *International Journal of Emerging Technology in Learning*, 15(24). DOI: 10.3991/ijet.v15i24.16615.

¹²³⁴ See, e.g., Lehman, A. and Miller, S.J. (2020) 'A Theoretical Conversation about Responses to Information Overload', *Information*, 11(8). DOI: 10.3390/info11080379; Kurelovic, E.K., Tomljanovic, J. and Davidovic, V. (2016) 'Information Overload, Information Literacy and Use of Technology by Students', *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 10(3), pp. 917-921.

¹²³⁵ See, e.g., Herold, B. (2018) *Virtual Reality for Learning Raises High Hopes and Serious Concerns* / EdWeek [Online]. Available at: <https://www.edweek.org/technology/virtual-reality-for-learning-raises-high-hopes-and-serious-concerns/2018/02>.

¹²³⁶ See, e.g., Southgate et al. (2018) 'Embedding immersive virtual reality in classrooms: Ethical, organisational and educational lessons in bridging research and practice', *International Journal of Child-computer Interaction*. DOI: 10.1016/j.ijcci.2018.10.002.



must ensure that XR technologies do not interfere with their obligations to provide free primary education to all children and equal access to secondary and higher education without discrimination. States have a particular responsibility to ensure equal access and non-discrimination for students with disabilities. Furthermore, States must regulate commercial XR technologies so that they, too, are consistent with international standards. In relation to right to education, further human rights guidance specific to XR may be required to address concerns related to, among other issues, physical and mental harms, especially to child development, equality for and accommodation of students with disabilities, regulation of private actors and inequality of access.

6.1.8 Access to justice and right to a fair trial

XR has the potential to both enhance and undermine access to justice. XR may increase access to proceedings and allow for novel ways to present evidence, and its use may reduce the risk of judge, jury, or prosecutorial bias. However, XR may also encourage inferior participation and mask non-verbal cues, and it raises concerns about the accuracy and risk of image manipulation, inequalities of access to the technology, and privacy and data protection. All of these factors together may erode judicial legitimacy and undermine access to justice. While international and EU human rights law on access to justice does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR does not violate enjoyment of the right.

International law and policy

Access to justice is a basic principle of law constituted by several related rights. These rights include equal access and treatment before the law, a “fair and public hearing by a competent, independent and impartial tribunal” in criminal cases,¹²³⁷ and the right to an effective remedy.¹²³⁸ Specific requirements include the right to be heard, the right to a defence, and the right to a public trial.¹²³⁹ In addition to specific guarantees, States have an obligation to ensure that access to courts and tribunals is not “systematically frustrated” by any *de jure* or *de facto* factors.¹²⁴⁰

These rights are also recognised in regional organisations, including the Council of Europe.¹²⁴¹ While XR has not been the topic of guidance or jurisprudence in relation to international human rights law, the European Court of Human Rights has considered the use of videoconferencing and found no violation of a defendant’s right to a fair trial if certain conditions are met.¹²⁴²

Furthermore, Goal 16 of the UN Sustainable Development Goals relates to access to justice.¹²⁴³

¹²³⁷ UDHR, Article 10; ICCPR, Article 14.

¹²³⁸ ICCPR, Article 2(a).

¹²³⁹ Human Rights Committee. (2007) *General Comment No. 32: Article 14: Right to equality before courts and tribunals and to a fair trial*, CCPR/C/GC/32, adopted 23 August 2007, para.28, 32, and 37.

¹²⁴⁰ Latin for “in law or in fact.” Human Rights Committee. (2007) *General Comment No. 32: Article 14: Right to equality before courts and tribunals and to a fair trial*, CCPR/C/GC/32, adopted 23 August 2007, para. 9.

¹²⁴¹ ECHR, Article 6.

¹²⁴² European Court of Human Rights. (2006) *Marcello Viola v Italy (No. 1)*, 5 October 2006, No. 45106/04, CE:ECHR:2006:1005JUD004510604, para.76.

¹²⁴³ Sustainable Development Goals, Goal 16.



EU law and policy

The EU Charter of Fundamental Rights includes the right “to an effective remedy” and “a fair and public hearing within a reasonable time by an independent and impartial tribunal.”¹²⁴⁴

Potential enhancements

XR can be incorporated into the justice systems in ways that may enhance an individual’s right to a fair trial. XR can be used to enable access to courtrooms for parties and witnesses otherwise limited due to distance, travel cost, or language barriers,¹²⁴⁵ providing a timely option for increasing accessibility. Additionally, XR could be used to present evidence to the court, for example to recreate an accident, represent an important scene or bring to life a physical item that cannot be brought into a courtroom.¹²⁴⁶ Images and video collected through devices equipped with XR technology, for example first-person recordings from smart glasses, could also be introduced as evidence.¹²⁴⁷

Research also suggests that virtual reality training for judges and juries may reduce bias that may undermine the fairness of a judicial system,¹²⁴⁸ and immersive virtual experiences may help minimise prosecutorial bias and reduce prosecutorial misconduct.¹²⁴⁹

Potential interferences

The use of XR can also interfere with access to justice and the right to a fair trial. For example, XR may undermine access to justice if it encourages a type or quality of participation that is inferior to in-person participation, and thus results in an unsatisfactory or unfair result.¹²⁵⁰ XR may also undermine accuracy or fairness, such as when witness testimony fails to capture non-verbal cues,¹²⁵¹ or when avatars or digital representations of evidence are manipulated.¹²⁵²

Additionally, as access to justice does not refer to mere access or convenience to physical spaces, XR alone is not sufficient to guarantee access and fairness in the delivery of justice. Furthermore,

¹²⁴⁴ CFREU, Article 47

¹²⁴⁵ See, e.g., Donoghue, J. (2017) ‘The Rise of Digital Justice: Courtroom Technology, Public Participation and Access to Justice’, *The Modern Law Review*, 80(6); and Long, V. (2021) ‘Online Courts: Re-Assessing Inequality in the ‘Remote’ Courtroom’, *(re)connect*, 11(1). Available at: <https://excursions-journal.sussex.ac.uk/index.php/excursions/article/view/283.4>.

¹²⁴⁶ See, e.g., Olmeda, R. (2022) *Is Virtual Reality the Future of Expert Testimony in Court? / Government Technology* [Online]. Available at: <https://www.govtech.com/public-safety/is-virtual-reality-the-future-of-expert-testimony-in-court>; Elizaroff, N. (2020) *One Step Away from the Matrix: The New Normal of Virtual Reality / @theBar The Chicago Bar Association* [Online]. Available at: <https://cbaatthebar.chicagobar.org/2020/09/24/one-step-away-from-the-matrix-the-new-normal-of-virtual-reality/>.

¹²⁴⁷ See, e.g., Bergman, K. (2014) ‘Cyborgs in the Courtroom: The Use of Google Glass Recordings in Litigation’, *Richmond Journal of Law and Technology*, 20(3). Available at: <http://jolt.richmond.edu/v20i3/article11.pdf>.

¹²⁴⁸ See, e.g., Salmanowitz, N. (2016) ‘Unconventional Methods for a Traditional Setting: The Use of Virtual Reality to Reduce Implicit Racial Bias in the Courtroom’, *The University of New Hampshire Law Review*, 15(1). Available at: http://scholars.unh.edu/unh_lr/vol15/iss1/2.

¹²⁴⁹ See, e.g., Bloch, K.E. (2019) ‘Harnessing Virtual Reality to Prevent Prosecutorial Misconduct’, *The Georgetown Journal of Legal Ethics*, 32(1). Available at: <https://www.law.georgetown.edu/legal-ethics-journal/in-print/volume-32-issue-1-winter-2019/harnessing-virtual-reality-to-prevent-prosecutorial-misconduct/>.

¹²⁵⁰ Donoghue, supra note 1245; and Long, V. (2021) ‘Online Courts: Re-Assessing Inequality in the ‘Remote’ Courtroom’, *(re)connect*, 11(1). Available at: <https://excursions-journal.sussex.ac.uk/index.php/excursions/article/view/283>.

¹²⁵¹ Legg, M. and Song, A. (2021) ‘The Courts, the remote hearing and the pandemic: From action to reflection’, *New South Wales Law Journal*, 44(1). DOI: [10.53637/ZATE4122](https://doi.org/10.53637/ZATE4122), p.138.

¹²⁵² See, e.g., Smith, R. (2020) *Remote Courts and the consequences of ending ‘practical obscurity’ / Law, Technology and Access to Justice* [Online]. Available at: <https://law-tech-a2i.org/remote-courts/remote-courts-and-the-consequences-of-ending-practical-obscurity/>.



disadvantaged parties may find existing inequalities compounded when they have limited access to the technologies to remotely connect or cannot afford the technology to use XR.¹²⁵³

Lastly, XR in judicial proceedings may also present privacy and data protection concerns, particularly as many proceedings involve highly sensitive materials.¹²⁵⁴ For example, attendees may retain unauthorized copies of confidential information (e.g., by screenshot or recording device), including information that is stricken from the official record.¹²⁵⁵ Access breaches may also result in unauthorized attendance or viewing.¹²⁵⁶

In light of the collective concerns, the use of XR in judicial systems “may erode judicial legitimacy and the court’s authority”.¹²⁵⁷

States’ obligations and areas for legal development

XR is subject to existing international human rights law on access to justice and the right to a fair trial, and States have an obligation to ensure that the use of XR supports realisation of the rights. States must take all necessary steps possible to guarantee that the use of XR does not create circumstances constituting a *de jure* or *de facto* interference with individual’s right to equal access to justice and a fair trial. In relation to the right to a fair trial and access to justice, further human rights guidance specific to XR may be required to address concerns related to, among other issues, accuracy of digital representations and evidence, inequality of access, and privacy and data protection.

6.1.9 Right to just and favourable conditions of work

XR has the potential to both enhance and undermine the right to work and associated rights. XR may be used to make work more accessible and training safer and to address discrimination in the workplace. However, for end-users in the workplace, XR may cause harm to physical and mental health from extended use and increased workload, interfere with rest and leisure, raise privacy and data protection concerns, and compound existing inequalities of access. In the supply chain for XR devices, other labour rights concerns include forced and child labour, workplace health and safety, and fair wages. While international and EU human rights law on the right to work and related rights do not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR do not interfere with these rights.

¹²⁵³ See, e.g., Rossner, M., Tait, D. and McCurdy, M. (2021) ‘Justice reimagined: challenges and opportunities with implementing virtual courts’, *Current Issues in Criminal Justice*, 33(1). DOI: [10.1080/10345329.2020.1859968](https://doi.org/10.1080/10345329.2020.1859968); Legg, M. and Song, A. (2021) ‘The Courts, the remote hearing and the [10.53637/ZATE4122](https://www.justice.org.uk/our-work/justice-covid-19-response/)’; Mulcahy, L. (2020) *Exploring the case for Virtual Jury Trials during the COVID-19 crisis: An evaluation of a pilot study conducted by JUSTICE*. Available at: <https://justice.org.uk/our-work/justice-covid-19-response/>.

¹²⁵⁴ See, e.g., Karp, J. (2021) *Virtual Courts Lead to Tension Between Access and Privacy / Law 360* [Online]. Available at: <https://www.law360.com/pulse/articles/1348795/virtual-courts-lead-to-tension-between-access-and-privacy>.

¹²⁵⁵ See, e.g., Gori, P and Pahladsingh, A. (2021) ‘Fundamental rights under COVID-19: an European perspective on videoconferencing in court’, *ERA Forum*, 21, p576. DOI: [10.1007/s12027-020-00643-5](https://doi.org/10.1007/s12027-020-00643-5).

¹²⁵⁶ This type of breach would be akin to a ‘zoom bomb’, a term coined during the COVID-19 pandemic to refer to an unauthorized and unwanted intrusion into a virtual meeting, commonly held on Zoom, an online meeting platform. See, e.g., Lorenz, T. and Alba, D. (2020) ‘Zoombombing’ Becomes a Dangerous Organized Effort / *The New York Times* [Online]. Available at: <https://www.nytimes.com/2020/04/03/technology/zoom-harassment-abuse-racism-fbi-warning.html>.

¹²⁵⁷ Rossner, M., Tait, D. and McCurdy, M. (2021) ‘Justice reimagined: challenges and opportunities with implementing virtual courts’, *Current Issues in Criminal Justice*, 33(1). DOI: [10.1080/10345329.2020.1859968](https://doi.org/10.1080/10345329.2020.1859968), p. 97.



International law and policy

Under international law, everyone has the right to work in “just and favourable conditions.”¹²⁵⁸ Children can perform work activities, but must be “protected from economic exploitation and from performing any work that is likely to be hazardous or to interfere with the child’s education, or to be harmful to the child’s health or physical, mental, spiritual, moral or social development.”¹²⁵⁹

To fulfil the right to work, States have an obligation to ensure that individuals can freely choose and accept work.¹²⁶⁰ This relates to the general prohibition in international human rights on slavery and forced labour.¹²⁶¹ States must also ensure that work is accessible (including both physical accessibility and non-discrimination) and acceptable, which means guaranteeing the conditions of just and favourable work are met.¹²⁶² Those conditions include fair wages and equal remuneration, safe and healthy working conditions, and provision of rest and leisure.¹²⁶³

This right to just conditions of work and the prohibition on slavery is also recognised in regional organisations, including the Council of Europe.¹²⁶⁴

Goal 8 of the Sustainable Development Goals relates to “decent work for all”.¹²⁶⁵

EU law and policy

The EU Charter of Fundamental Rights includes the right to engage in work and “working conditions which respect his or her health, safety and dignity.”¹²⁶⁶ The European Pillar of Social Rights also includes a chapter on fair working conditions, which include a principle for a “healthy, safe and well-adapted work environment.”¹²⁶⁷ In January 2021, the European Parliament adopted a resolution on work-life balance and a ‘right to disconnect’ and called on the European Commission to put forward a “legislative framework with a view to establishing minimum requirements for remote work across the Union”¹²⁶⁸. For more on the emerging ‘right to disconnect’, see Section 6.1.13.

Potential enhancements

XR may enhance an individual’s right to work and related protections. For example, XR may enable some work environments to be more accessible, whether it be through the use of remote access or augmented applications within the physical workplace.¹²⁶⁹ XR may be used to make training safer,

¹²⁵⁸ UDHR, Article 23; ICESCR, Articles 6-7; ICERD, Article 5(e)(i); CEDAW, Article 11; and CRPD, Annex I, Article 27.

¹²⁵⁹ CRC, Article 32.

¹²⁶⁰ Committee on Economic, Social and Cultural Rights. (2006) *General Comment No. 18: The right to work*, adopted 6 February 2006, paras. 4,6.

¹²⁶¹ UDHR, Article 4; and ICCPR, Articles 8.

¹²⁶² Committee on Economic, Social and Cultural Rights. (2006) *General Comment No. 18: The right to work*, adopted 6 February 2006.

¹²⁶³ Committee on Economic, Social and Cultural Rights. (2006) *General Comment No. 23 (2016) on the right to just and favourable conditions of work (article 7 of the International Covenant on Economic, Social and Cultural Rights)*, 27 April 2016, E/C.12/GC/23.

¹²⁶⁴ European Social Charter, Part I; ECHR, Article 4.

¹²⁶⁵ Sustainable Development Goals, Goal 8.

¹²⁶⁶ CFREU, Art. 15 and 31.

¹²⁶⁷ European Pillar of Social Rights.

¹²⁶⁸ European Parliament. (2021) *Resolution of 21 January 2021 with recommendations to the Commission on the right to disconnect*, P9_TA(2021)0021, adopted 21 January 2021.

¹²⁶⁹ See, e.g., PEAT and XR Association (2022) *Inclusive XR in the Workplace*. Available at: <https://www.peatworks.org/futureofwork/xr/inclusiveworkplacexr/>.



particularly for high-risk occupations¹²⁷⁰ and to conduct anti-bias training to address workplace discrimination.¹²⁷¹

Potential interferences

The use of XR may negatively impact the right to work and related rights. For users of XR, long periods of time within XR may result in physical and/or mental health harm (See section on right on health for more information). Earlier research also suggested that XR use may contribute to higher workloads (including mental and physical demand),¹²⁷² which may cause exhaustion and other harms to health. Concerns about 'disconnecting' and work-life balance in extended (See Section on right to rest and leisure and emerging rights) also impact whether work conditions are considered just and favourable, as do privacy and data protection concerns related to the constant surveillance and recording capabilities within XR.¹²⁷³ Additionally, inequality of access to XR technologies that become *de facto* required to participate in the workforce may undermine the ability to secure work and lead to workplace discrimination.¹²⁷⁴

A distinct set of concerns relates to the working conditions of individuals who enable the creation of XR devices. While not a risk unique to XR, concerns include child and forced labour in the mining of rare minerals,¹²⁷⁵ labour violations in overseas manufacturing centres,¹²⁷⁶ and the harmful health effects associated with e-waste disposal.¹²⁷⁷

States' obligations and areas for legal development

XR is subject to existing international human rights law on the rights related to work and States have an obligation to ensure that the use of extended support realisation of the rights. States must take all necessary steps possible to guarantee that XR technologies do not interfere with individual's right to work, right to just and favourable conditions of work, and the prohibition on slavery and forced labour.

¹²⁷⁰ See, e.g., Kaplan et al. (2021) 'The Effects of Virtual Reality Augmented Reality, and Mixed Reality as Training Enhancement Methods: A Meta-Analysis', *Human Factors*, 63(4). DOI: 10.1177/0018720820904229; and Fade, L. (2020) *Training for Dangerous Jobs With Virtual Reality / FORBES* [Online]. Available at:

<https://www.forbes.com/sites/theyec/2020/07/28/training-for-dangerous-jobs-with-virtual-reality/?sh=15b4547c1c37>.

¹²⁷¹ See, e.g., Ascott, E. (2021) *How Can Virtual Reality Be Used to Conduct Anti-Bias Training For Workers? / AllWork* [Online]. Available at: <https://allwork.space/2021/12/how-can-virtual-reality-be-used-to-conduct-anti-bias-training-for-workers>.

¹²⁷² Xi et al. (2022) 'The challenges of entering the metaverse: An experiment on the effect of extended reality on workload', *Information Systems Frontiers*. DOI: 10.1007/s10796-022-10244-x.

¹²⁷³ See, e.g., Schuir, J. and Teuteberg, F. (2021) 'Understanding augmented reality adoption trade-offs in production environments from the perspective of future employees: A chose-based conjoint study', *Information Systems and e-Business Management*, 19. DOI: 10.1007/s10257-021-00529-0.

¹²⁷⁴ See, e.g., Seifert, A. and Schlomann, A. (2021) 'The Use of Virtual and Augmented Reality by Older Adults: Potentials and Challenges', *Frontiers in Virtual Reality*. DOI: 10.3389/frvir.2021.639718; and Amano-Smerling, T. (2021) *The Inequality of Virtual Reality / USC Viterbi School of Engineering* [Online]. Available at: <https://vce.usc.edu/weekly-news-profile/the-inequality-of-virtual-reality/>.

¹²⁷⁵ See, e.g., Kelly, A. (2019) 'Apple and Google named in a US lawsuit over Congolese child cobalt mining deaths', *The Guardian* [Online]. Available at: <https://www.theguardian.com/global-development/2019/dec/16/apple-and-google-named-in-us-lawsuit-over-congolese-child-cobalt-mining-deaths>.

¹²⁷⁶ See, e.g., Wong, J.C. (2021) 'Revealed: Google illegally underpaid thousands of workers across dozens of countries', *The Guardian* [Online]. Available at: <https://www.theguardian.com/technology/2021/sep/10/google-underpaid-workers-illegal-pay-disparity-documents>; U.N. Special Procedures (2018) Press release: *Vietnam: UN Experts concerned by threats against factory workers and labour activities*, U.N. Office of the High Commissioner for Human Rights, 20 March 2018. Available at: <https://www.ohchr.org/en/press-releases/2018/03/vietnam-un-experts-concerned-threats-against-factory-workers-and-labour>.

¹²⁷⁷ See, e.g., World Health Organization (2021) *Soaring e-waste affects the health of millions of children, WHO warns*. Available at: <https://www.who.int/news/item/15-06-2021-soaring-e-waste-affects-the-health-of-millions-of-children-who-warns>.

Further human rights guidance specific to XR may be required to address concerns related to, among other issues, health and safety impacts, privacy of employees, inequality of access, and labour abuses within the supply chain for XR devices.

6.1.10 Right to rest and leisure

XR technologies have the potential to both enhance and undermine the right to rest and leisure. XR technologies may be used for leisure activities, and some claim that the use of XR for non-leisure activities will afford more time for leisure. Persons with disabilities may particularly benefit from leisure activities enjoyed through XR. However, XR technologies may undermine enjoyment of the right to leisure due to the digitalised commercialisation of leisure activities in XR and challenges of work-life balance. While international human rights law on the right to rest and leisure does not explicitly address the impacts of XR, States have an obligation to ensure that the development and deployment of XR technologies do not violate enjoyment of the right.

International law and policy

Under international law, everyone has the right to rest and leisure.”¹²⁷⁸ This right is related to the right to work and labour protection, as it includes “reasonable limitation of working hours and periodic holidays with pay.”¹²⁷⁹ Children are specifically entitled “to engage in play and recreational activities appropriate to the age of the child and to participate freely in cultural life and the arts.”¹²⁸⁰ All individuals have a right to equally participate in leisure activities, including persons with disabilities.¹²⁸¹ The Council of Europe also recognises the right to rest, leisure and play for children.¹²⁸²

EU law and policy

In relation to fair and just working conditions, the EU Charter of Fundamental Rights includes the right “to daily and weekly rest periods.”¹²⁸³ Member states are directed to take necessary measures to ensure restrictions on working hours.¹²⁸⁴ Work-life balance, particularly in the context of telework, is one of the European Pillars of Social Rights.¹²⁸⁵ The 2021 European Parliament resolution on a ‘right to disconnect’ (mentioned above in Section 6.1.13) calls for a legal framework to limit remote work to protect rest and leisure”.¹²⁸⁶

¹²⁷⁸ UDHR, Article 24; ICCPR, Article 7(d).

¹²⁷⁹ Ibid.

¹²⁸⁰ CRC, Article 31.

¹²⁸¹ CRPD, Article 30.

¹²⁸² Council of Europe. *Leisure time / Council of Europe* [Online]. Available at: <https://www.coe.int/en/web/childrens-voices/leisure-time> (Accessed: 17 May 2022).

¹²⁸³ CFREU, Art. 31(2).

¹²⁸⁴ European Parliament and European Council. (2003) *Directive 2003/88/EC of the European Parliament and of the Council of 4 November 2003 concerning certain aspects of the organisation of working time*, 4 November 2003.

¹²⁸⁵ European Commission. (2021) European Pillar of Social Rights. Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/economy-works-people/jobs-growth-and-investment/european-pillar-social-rights_en.

¹²⁸⁶ European Parliament. (2021) *Resolution of 21 January 2021 with recommendations to the Commission on the right to disconnect*, P9_TA(2021)0021, adopted 21 January 2021.



Potential enhancements

XR may enhance the enjoyment of leisure because many leisure activities can involve XR (e.g., games, social interaction platforms, cultural activities, virtual travel).¹²⁸⁷ Furthermore, some believe that increased uptake of digital technologies, like XR, may allow individuals more time to engage in rest and leisure activities¹²⁸⁸. For persons with disabilities in particular, XR may offer a particular benefit in facilitating leisure experiences that would otherwise be limited in the physical world.

Potential interferences

Extended realities may create or contribute to negative impacts on an individual's ability to enjoy the right to rest and leisure. Some concerns relate specifically to the digitalisation and commercialisation of leisure activities, such as power imbalances from intensified political and economic interests, surveillance and control, privacy of the data collected, and inequalities of access.¹²⁸⁹ Other concerns relate to the use of XR technologies for work and work-life balance.¹²⁹⁰

States' obligations and areas for legal development

XR is subject to existing international human rights law on the right to rest and leisure and States have an obligation to ensure that the use of XR support realisation of the right. Further human rights guidance specific to XR technologies may be required to address concerns related to, among other issues, the influence of private and commercial actors, privacy and data protection, and the work-life balance.

6.1.11 Right to benefit from science

Everyone has the right under international law to benefit from scientific progress, which includes XR technologies. States may not arbitrarily interfere with the ability to enjoy this right, which includes ensuring access to XR without discrimination, particularly when the use of XR is "instrumental" for enjoyment of other fundamental rights. States may not, however, force the use of technologies like XR, excepted in limited situations.

International law and policy

Under international law, everyone has the right to "to share in scientific advancement and its benefits."¹²⁹¹ Historically, this right is one of the least studied or applied in international human rights,

¹²⁸⁷ See, e.g., Dhar, P. (2021) 'The future of 'extended reality' tourism is now, thanks to the pandemic', *The Washington Post*, 8 July 2021; Margetis et al. (2021) 'X-Reality Museums: Unifying the Virtual and Real World Towards Realistic Virtual Museums', *Applied Sciences*, 11. DOI: [10.3390/app11010338](https://doi.org/10.3390/app11010338); and Marr, B. (2022) *The 5 Biggest Virtual, Augmented and Mixed reality Trends in 2022 / FORBES* [Online]. Available at: <https://www.forbes.com/sites/bernardmarr/2022/01/07/the-5-biggest-virtual-augmented-and-mixed-reality-trends-in-2022/?sh=6fdebd324542>.

¹²⁸⁸ See, e.g., Stansberry, K., Anderson, J. and Rainie, L. (2019) 4. *The internet will continue to make life better / Pew Research Center* [Online]. Available at: <https://www.pewresearch.org/internet/2019/10/28/4-the-internet-will-continue-to-make-life-better/>.

¹²⁸⁹ Silk et al. (2016) '(Re-)thinking digital leisure', *Leisure Studies*, 35(6) [Online]. Available at: <https://doi.org/10.1080/02614367.2016.1240223>.

¹²⁹⁰ Plitt, D., Scapoli, J and Farrell-Thomas, A. (2022) *Work in the metaverse will pose novel employment law questions / Lexology* [Online]. Available at <https://www.osborneclarke.com/insights/work-metaverse-will-pose-novel-employment-law-questions>; and Henshall, A. (2021) *Can the 'right to disconnect' exist in a remote-work world? / BBC* [Online]. Available at: <https://www.bbc.com/worklife/article/20210517-can-the-right-to-disconnect-exist-in-a-remote-work-world>.

¹²⁹¹ UDHR, Article 27. In the ICESCR, the right is articulated as the "right to benefit from scientific progress and its application". International Covenant on Economic, Social and Cultural Rights, Article 15(b).



but recent interest from UNESCO, the UN Special Rapporteur in the Field of Cultural Rights, and the UN Committee on Economic, Social and Cultural Rights as prompted new interest in the right.¹²⁹²

In this context, the definition of 'science' encompasses both process and the results of process¹²⁹³ and "the technology deriving from scientific research".¹²⁹⁴ The term 'benefits' refers to "the material results" and "the scientific knowledge and information directly deriving from scientific activity".¹²⁹⁵ States have obligations "to abstain from interfering in the freedom of individuals and institutions to develop science and diffuse its results" and to ensure individuals can enjoy the benefits of science without discrimination.¹²⁹⁶ In particular, States must ensure "that everyone has equal access to the applications of science, particularly when they are instrumental for the enjoyment of other economic, social and cultural rights."¹²⁹⁷ The U.N. Committee on Economic, Social and Cultural rights identifies that new emerging technologies present many risks and promises for the enjoyment of other rights, and calls on States to "adopt policies and measures that expand the benefits of these new technologies while at the same time reducing their risks."¹²⁹⁸

This right does not create an obligation on individuals to benefit from or use technologies. For example, in the context of medical treatment, States "must guarantee everyone has the right to choose or refuse the treatment they want with the full knowledge of the risks and benefits."¹²⁹⁹ Anything contrary to this guarantee must be determined by law and "solely for the purpose of promoting the general welfare in a democratic society".¹³⁰⁰

To address risks associated with some science and technologies and their applications, State may put limits on scientific research, but they must also be in law and promote "the general welfare in a democratic society".¹³⁰¹

In the specific context of biomedicine, the Council of Europe stresses "the need for international co-operation so that all humanity may enjoy the benefits of biology and medicine."¹³⁰²

EU law and policy

The EU Charter of Fundamental Rights includes 'freedom of the arts and sciences' to ensure scientific research is "free of constraint,"¹³⁰³ but a similar right to benefit from scientific progress does not exist.

XR and the right to benefit from scientific progress

The enjoyment of the right to benefit from scientific progress is possible and may be enhanced through the use of XR, as the right extends to new and emerging technologies, including XR. States must ensure that individuals have access to XR without discrimination, particularly when XR

¹²⁹² See Yotova, R. and Knoppers, B.M. (2020) 'The Right to Benefit from Science and Its Implications for Genomic Data Sharing', *The European Journal of International Law*, 31(2).

¹²⁹³ Committee on Economic, Social and Cultural Rights. (2020) *General comment No. 25 (2020) on science and economic, social and cultural rights (article 15 (1) (b), (2), (3), and (4) of the International Covenant on Economic, Social and Cultural Rights*, E/C.12/GC/25, 20 April 2020, paras.4-5.

¹²⁹⁴ Ibid, para.7.

¹²⁹⁵ Ibid, para.8.

¹²⁹⁶ Ibid, para.15.

¹²⁹⁷ Ibid, para.17.

¹²⁹⁸ Ibid, para.74.

¹²⁹⁹ Ibid, para.44.

¹³⁰⁰ ICESCR, Article 4.

¹³⁰¹ Committee on Economic, Social and Cultural Rights, supra note 1293, para.21.

¹³⁰² Oviedo Convention.

¹³⁰³ CFREU, Art. 13.



technologies are instrumental to the enjoyment of other rights like the right to health and education. To those individuals who choose, a State cannot arbitrarily interfere in the development, deployment, or enjoyment of XR. On the other hand, except in certain circumstances determined by law, individuals cannot be forced to use XR technologies.

States' obligations and areas for legal development

States have an obligation to not arbitrarily interfere with the ability to enjoy the benefits of scientific progress, particularly when the use of XR is "instrumental" for enjoyment of other fundamental rights. At the same time, States may not force the use of technologies like XR, except in limited situations. To ensure that an individuals' choice to 'benefit from science' is respected, there is an interest in a right of refusal to not use a technology or engage its use in a specific application.¹³⁰⁴ A right to refusal may enhance an individual's ability to enjoy other rights without the potential negative impacts of XR. However, the idea is not widely discussed or codified in any laws.

6.1.12 Non-discrimination and vulnerable groups

XR has the potential to both enhance and undermine the rights of vulnerable groups, including women, children, and persons with disabilities. The use of XR technologies may lead to improved health, education, and leisure experiences amongst children. Such potential benefits of the use of XR technologies may also apply to persons with disabilities, in addition to assisting in establishing *de facto* non-discrimination between disabled and non-disabled persons. However, the use of XR technologies may undermine the rights of women, children, and persons with disabilities through incidences of harassment, physical and mental harms, especially to child development, and accessibility challenges, all of which may contravene the right of such persons to non-discrimination. Whilst international and EU law on the rights of vulnerable groups does not explicitly refer to XR, the rights of such groups are relevant in the context of XR technologies and many of the specific provisions under international and EU law are directly applicable.

International law and policy

The rights of all persons to equality and non-discrimination are explicitly guaranteed under international law.¹³⁰⁵ The right to non-discrimination prohibits specific instances of discrimination, such as racial discrimination,¹³⁰⁶ whilst also protecting particular groups against discriminatory treatment, including women,¹³⁰⁷ children,¹³⁰⁸ migrant workers,¹³⁰⁹ and persons with disabilities,¹³¹⁰ the particularised rights relating to whom are contained in specific international conventions. The Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), for instance, is

¹³⁰⁴ This is distinct from involuntary limitations on access because of the 'digital divide'. See Gangadharan, S.P. (2021) 'Digital Exclusion: A Politics of Refusal' in Bernholz, L., Landemore, H. and Reich, R. (eds) *Digital Technology and Democratic Theory*. University of Chicago Press: Chicago; Gangadharan, S.P. (2019) Video: 'Technologies of control and our right of refusal', TEDxLondon. Available at: https://www.ted.com/talks/dr_seeta_pena_gangadharan_technologies_of_control_and_our_right_of_refusal; and Benjamin, Ruha. 2016. "Informed Refusal: Toward a Justice- Based Bioethics." *Science, Technology, & Human Values* 41 (6): 967– 90. <https://doi.org/10.1177/0162243916656059>.

¹³⁰⁵ UDHR, Article 7; ICERD, Article 2; ICESCR, Articles 2 and 3; ICCPR, Articles 2(1), 3 and 26; CEDAW, Article 2; CRC, Article 2; CPRMW, Article 1; CRPD, Articles 1, 3, 4 and 5.

¹³⁰⁶ ICERD, Article 2.

¹³⁰⁷ CEDAW, Article 2.

¹³⁰⁸ CRC, Article 2.

¹³⁰⁹ CPRMW, Article 1.

¹³¹⁰ CRPD, Articles 1, 3, 4 and 5.

the most comprehensive of the treaties on the rights of women, requiring that State Parties, inter alia, 'take all appropriate measures for the elimination of discrimination against women' in the context of employment,¹³¹¹ healthcare,¹³¹² and other areas of economic and social life.¹³¹³ In addition to the elimination of discrimination and the establishment of equality between men and women, the CEDAW also contains more targeted provisions, such as the imposition of an obligation on State Parties to 'take all appropriate measures, including legislation, to suppress all forms of traffic in women and exploitation of prostitution of women.'¹³¹⁴

In relation to children, meanwhile, the Convention on the Rights of the Child (CRC) establishes the Committee on the Rights of the Child (CRC Committee)¹³¹⁵ and provides, inter alia, that State Parties "shall take all appropriate measures to ensure that the child is protected against all forms of discrimination",¹³¹⁶ while also establishing "the best interests of the child" as a "primary consideration" in actions taken by public and private sector bodies relating to children.¹³¹⁷ The application of the right to non-discrimination in the digital environment entails that "State parties should take all measures necessary to overcome digital exclusion",¹³¹⁸ while in order to comply with the assessment of the best interests of the child, the CRC Committee recommends that State parties ensure national and local bodies have regard "for all children's rights, including their rights to seek, receive and impart information, to be protected from harm and to have their views given due weight".¹³¹⁹ Further non-binding recommendations are advanced by the OECD, which provides several principles for "a safe and beneficial digital environment for children", in accordance with which it is recommended that members and non-members alike promote and implement (i) fundamental values, (ii) empowerment and resilience, (iii) proportionality and respect for human rights, (iv) appropriateness and inclusion, and (v) shared responsibility, cooperation and positive engagement.¹³²⁰

The rights of persons with disabilities under international law are contained in the Convention on the Rights of Persons with Disabilities (CRPD), the primary purpose of which "is to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity."¹³²¹ Akin to the CEDAW and the CRC (see above), the CRPD requires that State Parties "promote equality and eliminate discrimination",¹³²² thereby permitting "specific measures which are necessary to accelerate or achieve de facto equality of persons with disabilities",¹³²³ whilst also explicitly recognising the intersectionality between vulnerable groups through particular provisions relating to women and children with disabilities.¹³²⁴ Furthermore, the CRPD introduces various Convention-specific rights, such as the right of accessibility

¹³¹¹ CEDAW, Article 11.

¹³¹² Ibid, Article 12.

¹³¹³ Ibid, Article 13.

¹³¹⁴ Ibid, Article 6.

¹³¹⁵ CRC, Article 43.

¹³¹⁶ Ibid, Article 2.

¹³¹⁷ Ibid, Article 3.

¹³¹⁸ Committee on the Rights of the Child, (2021) *General comment No.25 (2021) on children's rights in relation to the digital environment*, CRC/C/GC/25, 2 March 2021, [9].

¹³¹⁹ Ibid, [13].

¹³²⁰ OECD, (2022) *Recommendation of the Council on Children in the Digital Environment*, OECD/LEGAL/0389. Available at: <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0389>.

¹³²¹ CRPD, Article 1.

¹³²² Ibid, Article 5(1)-(3).

¹³²³ Ibid, Article 5(4).

¹³²⁴ Ibid, Articles 6 and 7.



to, inter alia, 'information and communications, including information and communications technologies and systems',¹³²⁵ and the right to live independently and be included in the community.¹³²⁶

The rights of women, children and persons with disabilities are also recognised in regional organisations. For instance, the European Convention on Human Rights, a treaty of the Council of Europe providing for civil and political rights, contains a prohibition upon discrimination that is applicable to each of the identified vulnerable groups,¹³²⁷ meanwhile the corresponding European Social Charter guarantees various fundamental social and economic rights directly addressed to women, children and persons with disabilities.¹³²⁸ Pursuant to the latter, there is an obligation upon Contracting Parties to 'recognise the right of men and women workers to equal pay for work of equal value',¹³²⁹ and moreover commit to taking measures consistent with 'ensuring the effective exercise of the right of employed women to protection', such as establishing provision for paid maternity leave.¹³³⁰ Children and young persons are similarly entitled to specific protection under the European Social Charter, both alongside mothers in a joint right to social and economic protection,¹³³¹ and as specific group; the protections in relation to which are primarily focused upon the age of, remuneration for, and general working conditions relevant to the employment context.¹³³² Lastly, persons with disabilities have a right to vocational training, rehabilitation and social resettlement under the European Social Charter, pursuant to which Contracting Parties have an obligation 'to take adequate measures' relating to the provision of training facilities and the placing of persons with disabilities in employment.¹³³³

EU law and policy

The Charter of Fundamental Rights guarantees that "[e]veryone is equal before the law"¹³³⁴ and prohibits "[a]ny discrimination based on any ground".¹³³⁵ Alongside the rights to equality and non-discrimination, the specific rights of women, children and persons with disabilities under EU law are contained in Chapter III entitled Equality of the EU Charter of Fundamental Rights (CFREU).¹³³⁶ In relation to the former, the CFREU ensures equality between men and women "in all areas, including employment, work and pay", whilst not precluding "the maintenance or adoption of measures providing for specific advantages in favour of the under-represented sex."¹³³⁷ The specific Article containing the rights of the child is based on the CRC (see above) and includes, inter alia, a right to "protection and care" as is necessary for wellbeing,¹³³⁸ whilst the CFREU also lays down a requirement that the working conditions of young people be age-appropriate and protective against associated harms to health, safety and general development, in addition to establishing a prohibition upon child labour.¹³³⁹ Finally, building upon the equivalent provision under the European Social Charter (see

¹³²⁵ Ibid, Article 9(1).

¹³²⁶ Ibid, Article 19.

¹³²⁷ ECHR, Article 14.

¹³²⁸ European Social Charter.

¹³²⁹ Ibid, Article 4(3).

¹³³⁰ Ibid, Article 8(1).

¹³³¹ Ibid, Article 17.

¹³³² Ibid, Article 7(1)-(10).

¹³³³ Ibid, Article 15.

¹³³⁴ CFREU, Article 20.

¹³³⁵ Ibid, Article 21.

¹³³⁶ CFREU.

¹³³⁷ Ibid, Article 23.

¹³³⁸ Ibid, Article 24(1)-(2).

¹³³⁹ Ibid, Article 32.



above),¹³⁴⁰ persons with disabilities are entitled “to benefit from measures designed to ensure their independence, social and occupational integration and participation in the life of the community.”¹³⁴¹

At the level of EU policy, meanwhile, the European Commission has proposed signing a joint declaration with the European Parliament and the Council entitled the “European Declaration on Digital Rights and Principles”, an aspect of which refers to the need “to ensure inclusiveness and support of vulnerable people, elderly, children and people with disabilities, so that they can benefit fully from the digital transformation.”¹³⁴² Consistent with this, the Commission has also recently updated its better internet for kids strategy (BIK+), as initially established in 2012, pursuant to which actions are proposed in relation to three key pillars, namely: firstly, ensuring “safe digital experiences to protect children from harmful illegal online content, conduct, contact and consumer risks” and improving “their well-being online through a safe, age-appropriate digital environment, created in a way that respects children’s best interests”; secondly, increasing “digital empowerment” and; thirdly, creating opportunities for children to actively participate in the shaping of the digital environment.¹³⁴³

Potential enhancements

XR technologies may enhance the rights of vulnerable groups in several ways. In relation to children, the use of VR has been linked to various potential enhancements, including physical rehabilitation and pain management, the creation of engaging learning environments and the improvement of learning outcomes, and the cultivation of desirable prosocial behaviours and emotions, such as empathy.¹³⁴⁴ The use of XR technologies generally, and VR applications specifically, may also improve cognitive and psychosocial development in children, for instance by improving attention span and facilitating collaboration.¹³⁴⁵ Such potential enhancements are linked to the right to health,¹³⁴⁶ the right to education,¹³⁴⁷ and the right to rest and leisure of children.¹³⁴⁸ Furthermore, XR technologies can be useful tools for supporting the education of students with disabilities¹³⁴⁹ and special learning needs, for instance by facilitating interaction for autistic students and improving communication skills in students with hearing loss.¹³⁵⁰ Expanding on the latter, the pairing of traditional hearing aids with AR,

¹³⁴⁰ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02), Explanations on Article 26.

¹³⁴¹ CFREU, Article 26.

¹³⁴² Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *Establishing a European Declaration on Digital rights and principles for the Digital Decade* COM/2022/27 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0027&qid=1643363406727>.

¹³⁴³ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Digital Decade for children and youth: the new European strategy for a better internet for kids (BIK+)* COM/2022/212 final. Available at: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13160-Better-internet-for-children-strategy-update_en.

¹³⁴⁴ See, e.g., Bailey J.O., and Bailenson J.N., (2017) ‘Considering virtual reality in children’s lives’, *Journal of Children and Media*, vol.11:1, pp107-113. DOI: <https://doi.org/10.1080/17482798.2016.1268779>; Aubrey J.S., Robb M.B., Bailey J., and Bailenson J., (2018) ‘Virtual Reality 101: What You Need to Know About Kids and VR’, *Common Sense*. Available at: https://www.common sense media.org/sites/default/files/research/report/csm_vr101_final_under5mb.pdf.

¹³⁴⁵ Kamara P., Oikonomou A., and Deliyannis I., (2022) ‘Could virtual reality applications pose real risks to children and adolescents? A systematic review of ethical issues and concerns’, *Virtual Reality*, vol.26, pp.697-735. Available at: <https://doi.org/10.1007/s10055-021-00563-w>.

¹³⁴⁶ CRC, Article 24.

¹³⁴⁷ Ibid, Article 28.

¹³⁴⁸ Ibid, Article 31.

¹³⁴⁹ See, e.g., Educators in VR, supra note 1226.

¹³⁵⁰ See, e.g., Zitter, L. (2020) *How VR and AR Can Be Used to Support Students with Special Needs* / Tech & Learning [Online]. Available at: <https://www.techlearning.com/how-to/how-vr-and-ar-can-be-used-to-support-students-with-special-needs>.



for instance, may enable enhanced auditory experiences,¹³⁵¹ thereby highlighting how XR technologies can also be used to improve aspects of the right to health for persons with disabilities.¹³⁵² Finally, research indicates that embodiment in VR entails a “heightened sense of realism” for users, one effect of which may be to elicit greater “self-other merging, favourable attitudes, and helping towards persons with disabilities”,¹³⁵³ of which the potential benefits relate to the principle of respect for and acceptance of persons with disabilities under the CRPD.¹³⁵⁴

Potential interferences

The use of XR technologies may create or exacerbate situations that negatively impact the rights of women, children and persons with disabilities. Firstly, XR technologies may create accessibility challenges for persons with disabilities, particularly in the context of VR, wherein the interactive and visual aspects of the medium may lead to difficulties for those with motor or sensory impairments.¹³⁵⁵ A further concern relates to the potential for, and effect of, vulnerable groups experiencing harassment whilst using XR technologies. On this, whilst the difficulties associated with parental monitoring may lead to children experiencing harassment and cyberbullying whilst using XR technologies,¹³⁵⁶ it is women in relation to whom the highest incidence of harassment is recorded,¹³⁵⁷ with up to 49% of women having reported experiencing at least one instance of sexual harassment whilst using VR.¹³⁵⁸ Such harassment takes multiple forms, ranging from flirting and lack of respect for personal boundaries,¹³⁵⁹ to VR groping,¹³⁶⁰ masturbatory gestures, and sexist comments,¹³⁶¹ and is most prevalent in social VR applications where the focus is upon “general social interaction between users rather than on a shared game or experience”.¹³⁶² Whilst the introduction of new user control measures, such as a “space bubble” feature enabling users to prevent others from entering their personal space,¹³⁶³ may help to protect women against such harassment, concern remains that the immersiveness of VR may lead to greater feelings of presence, one consequence of which is that

¹³⁵¹ Mehra R., Brimijoin O., Robinson P., Lunner T., ‘Potential of Augmented Reality Platforms to Improve Individual Hearing Aids and to Support More Ecologically Valid Research’, *Ear and Hearing*, vol.41, pp.140-146. Available at: https://journals.lww.com/ear-hearing/fulltext/2020/11001/potential_of_augmented_reality_platforms_to.15.aspx.

¹³⁵² CRPD, Article 25.

¹³⁵³ Ahn S.J., Tran Le A.M., and Bailenson J., (2013) ‘The Effect of Embodied Experiences on Self-Other Merging, Attitude, and Helping Behaviour’, *Media Psychology*, vol.16:7, pp.7-38. Available at: <https://doi.org/10.1080/15213269.2012.755877>.

¹³⁵⁴ CRPD, Article 3(d).

¹³⁵⁵ Heilemann F, Zimmermann G, and Münster P., supra note 1098.

¹³⁵⁶ Jerome J., (2021) ‘Safe and Secure VR: Policy Issues Impacting Kids’ Use of Immersive Tech’, *Common Sense*. Available at: https://www.common SenseMedia.org/sites/default/files/featured-content/files/safe_and_secure_vr_policy_issues_impacting_kids_final.pdf.

¹³⁵⁷ Shiram K and Schwartz R., (2017) ‘All are welcome: Using VR ethnography to explore harassment behaviour in immersive social virtual reality’, *2017 IEEE Virtual Reality*. Available at: <https://ieeexplore.ieee.org/abstract/document/7892258>.

¹³⁵⁸ Outlaw J. (2021) *Virtual Harassment: The Social Experience of 600+ Regular Virtual Reality (VR) Users* / The Extended Mind [Online]. Available at: <https://www.extendedmind.io/the-extended-mind-blog/2018/04/04/2018-4-4-virtual-harassment-the-social-experience-of-600-regular-virtual-reality-vrusers>.

¹³⁵⁹ Outlaw J and Duckles B., (2017) *Why Women Don't Like Social Virtual Reality* / The Extended Mind [Online]. Available at: <https://www.extendedmind.io/why-women-dont-like-social-virtual-reality>.

¹³⁶⁰ Belamire J. (2016) My First Virtual Reality Groping / Medium [Online]. Available at: <https://medium.com/athena-talks/my-first-virtual-reality-sexual-assault-2330410b62ee#.lwtpcaxzk>.

¹³⁶¹ Buchleitner J. (2018) *When virtual reality feels real, so does the sexual harassment* / Reveal [Online]. Available at: <https://revealnews.org/article/when-virtual-reality-feels-real-so-does-the-sexual-harassment/>.

¹³⁶² Blackwell L et al., (2018) ‘Harassment in Social Virtual Reality: Challenges for Platform Governance’, *Proceedings of the ACM on Human-Computer Interaction*, vol.3, pp.1-25. Available at: <https://doi.org/10.1145/3359202>.

¹³⁶³ Kelly K. (2016), *Introducing space bubble* / AltspaceVR [Online]. Available at: <https://altvr.com/introducing-space-bubble/>.



incidences of harassment in VR may be experienced more intensely by victims in comparison to other forms of digital harassment.¹³⁶⁴

Furthermore, whilst there is a paucity of scientific research on the impact of XR technologies on the sensorimotor abilities of children,¹³⁶⁵ and much depends on the device used, the time spent using it and the type of content engaged with, there is concern in relation to the impact of such technologies on vision and brain development.¹³⁶⁶ On this, research indicates that immersion in VR can, inter alia, lead to short-term “simulator sickness”¹³⁶⁷ or “cybersickness” (terms attributed to the nauseas symptoms experienced by users either during or after immersion in VR),¹³⁶⁸ disruptions to distance perception and balance,¹³⁶⁹ as well as symptoms of depersonalisation and derealisation,¹³⁷⁰ with further research required to assess the potential for long-term effects. Related to this are longstanding concerns regarding the possible link between violent videogames and increased aggressive behaviour,¹³⁷¹ which, whilst lacking consensus,¹³⁷² may be exacerbated by the increased feeling of psychological presence in XR, with resultant implications for child behavioural development.¹³⁷³ Finally, inequitable access to XR technologies and associated infrastructure (such as a reliable internet connection) may deepen and reinforce the “digital divide”,¹³⁷⁴ with resultant implications for child development.

¹³⁶⁴ See, e.g., Lemley M.A., and Volokh E., (2018) ‘Law, Virtual Reality, and Augmented Reality’, *University of Pennsylvania Law Review*, vol.166:5, pp.1051-1138. Available at: https://scholarship.law.upenn.edu/cgi/viewcontent.cgi?article=9622&context=penn_law_review; Reinhard R et al.,

(2019) ‘Acting your avatar’s age: effects of virtual reality avatar embodiment on real life walking speed’, *Media Psychology*. Available at: <https://doi.org/10.1080/15213269.2019.1598435>; Blackwell L et al., supra note 1362; Cortese M., and Outlaw J. (2021) ‘The IEEE Global Initiative on Ethics and Extended Reality (XR) Report – Social and Multi-User Spaces in VR: Trolling, Harassment, and Online Safety’, IEEE. Available at: <https://ieeexplore.ieee.org/document/9650825/authors#authors>; Bailey J.O., and Bailenson J.N., supra note 1344.

¹³⁶⁵ Sanctuary H. (2021) *Virtual Reality Affects Children Differently Than Adults* / Neurosciencenews.com [Online]. Available at: <https://neurosciencenews.com/virtual-reality-children-19370/>.

¹³⁶⁶ Gent, E. (2016) *Are Virtual Reality Headsets Safe for Children* / Scientific American [Online]. Available at: <https://www.scientificamerican.com/article/are-virtual-reality-headsets-safe-for-children/>.

¹³⁶⁷ Ferguson C.J. et al, (2022) ‘Video games, frustration, violence, and virtual reality: Two studies’, *British Journal of Social Psychology*, vol.61, pp.83-99. Available at: <https://bpspsychub.onlinelibrary.wiley.com/doi/epdf/10.1111/bjso.12471>.

¹³⁶⁸ Caserman P., et al., (2021) ‘Cybersickness in current-generation virtual reality head-mounted displays: systematic review and outlook’, *Virtual Reality*, vol.25, pp.1153-1170.

¹³⁶⁹ McKie R. (2017) *Virtual reality headsets could put children’s health at risk* / The Guardian [Online]. Available at: <https://www.theguardian.com/technology/2017/oct/28/virtual-reality-headset-children-cognitive-problems>.

¹³⁷⁰ Peckman C. et al, (2022) ‘Virtual reality induces symptoms of depersonalisation and derealisation: A longitudinal randomised control trial’, *Computers in Human Behaviour*, vol.131. Available at: <https://doi.org/10.1016/j.chb.2022.107233>.

¹³⁷¹ Wilson G., and McGill M., supra note 1138.

¹³⁷² Bushman, B. J., Gollwitzer, M., & Cruz, C. (2015). ‘There is broad consensus: Media researchers agree that violent media increase aggression in children, and paediatricians and parents concur.’ *Psychology of Popular Media Culture*, 4(3), pp.200–214. Available at: <https://doi.apa.org/doi/10.1037/ppm0000046>; Cf. Ferguson C.J., and Coldwell J., (2017) ‘Understanding Why Scholars Hold Different Views on the Influences of Video Games on Public Health’, *Journal of Communication*, vol.67:3, pp.305-327. Available at: <https://doi.org/10.1111/jcom.12293>.

¹³⁷³ Lull R.B., and Bushman B.J., (2016) ‘Immersed in violence: Presence mediates the effect of 3D violent video gameplay on angry feelings’, *Psychology of Popular Media Culture*, vol.5:2, pp.113-144. DOI: <https://psycnet.apa.org/doi/10.1037/ppm0000062>; Cf. Ferguson C.J. et al, supra note 1367.

¹³⁷⁴ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, *A Digital Decade for children and youth: the new European strategy for a better internet for kids (BIK+)* COM/2022/212 final. Available at: https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13160-Better-internet-for-children-strategy-update_en.

States' obligation and areas for legal development

XR technologies are subject to existing human rights laws on the rights of women, children and persons with disabilities, and States have an obligation to ensure that the use of such technologies supports realisation of these rights. States must ensure that XR technologies do not interfere with their obligations to guarantee the rights of such vulnerable groups on the basis of non-discrimination. Further human rights guidance specific to XR technologies may be required to address concerns related to, inter alia, incidences of harassment, potential long-term impacts to vision and brain development in children, inequality of access, particularly amongst children, and accessibility issues faced by persons with disabilities.

6.1.13 Trends and emerging rights

Human rights law is constantly evolving to address new challenges and trends, whether it be through expanded interpretations of currently recognised rights or the introduction of new rights. The following three proposals for development of the human rights law would impact States' obligations vis-à-vis XR technologies.

Right to a healthy environment

XR technologies may have an impact on the environment and may therefore impact the right to enjoy a health environment. While international human rights law on the right to a healthy environment does not explicitly address XR, States have an obligation to ensure individuals can enjoy a healthy environment in the context of XR.

The right to healthy environment is very new, recognised by the U.N. Human Rights Council in a 2021 resolution.¹³⁷⁵ The right includes substantive elements like "healthy ecosystems, clean air and water, a safe and stable climate, adequate and nutritious food, and a non-toxic environment."¹³⁷⁶

Some issues about the environment and XR technologies relate their production components, contribution to e-waste, and energy usage. A common concern with all electronics is the use of rare earth and precious metals, whose extraction causes significant environmental destruction, including habitat destruction and toxic waste contamination.¹³⁷⁷ A related concern is the use of plastics (made with non-renewable fossil fuels) in XR devices,¹³⁷⁸ leading some developers to consider other production materials like cardboard.¹³⁷⁹ At the other end of the use-cycle are concerns around disposal and recycling of e-waste including XR devices, particularly given that planned obsolescence in

¹³⁷⁵ Human Rights Council. (2021) *Resolution 48/13 The human rights to a clean, health and sustainable environment*, A/HRC/RES/48/13, 18 October 2021.

¹³⁷⁶ Bachelet, M. (2022) *"The right to a clean, healthy, and sustainable environment – what does it mean for States, for rights-holders and for nature?"*, Speech by UN High Commissioner for Human Rights, 16 May 2022. Transcript available at: <https://www.ohchr.org/en/statements/2022/05/right-clean-healthy-and-sustainable-environment-what-does-it-mean-states-rights>.

¹³⁷⁷ See, e.g., Nayar, J. (2021) 'Not So "Green" Technology: The Complicated Legacy of Rare Earth Mining', *Harvard International Review*. Available at: <https://hir.harvard.edu/not-so-green-technology-the-complicated-legacy-of-rare-earth-mining/>.

¹³⁷⁸ See, e.g., Joehning, J. (2018) *Is Virtual Reality Technology Bad for the Environment* / *AR Post* [Online]. Available at: <https://arpost.co/2018/07/12/virtual-reality-technology-bad-environment/>.

¹³⁷⁹ "Eco-friendly, environmentally safe, sustainably sources Google cardboard VR headsets." Maxbox VR. Available at: <https://www.maxboxvr.com/>.

many devices leads to frequent disposal.¹³⁸⁰ A final concern is the significant energy consumption needed for data processing and storage, particularly for XR systems using AI.¹³⁸¹

However, some argue that XR has the potential to spur beneficial environmental benefits for example by reminding children to recycle with gamification in AR¹³⁸², raising awareness of climate change impacts through immersive experiences,¹³⁸³ decreasing GHG emission by reducing need for transportation to physical places,¹³⁸⁴ and enhancing water management¹³⁸⁵ or waste management¹³⁸⁶ with AR.

Right to disconnect

Some scholars and policymakers have interpreted the right to rest and leisure to include the 'right to disconnect' from work and associate digital technologies. While not codified in international law, the right to disconnect has been discussed by the World Health Organization and the International Labour Organization in a technical brief on telework,¹³⁸⁷ explaining that the right means "that the worker has the right to disengage from work and refrain from engaging in work-related electronic communications (e.g. emails and text messages) during non-workhours."¹³⁸⁸ Furthermore, in January 2021, the European Parliament adopted a resolution on the right to disconnect and called on the European Commission to put forward a "legislative framework with a view to establishing minimum requirements for remote work across the Union".¹³⁸⁹ The European Commission notes in particular that "the ever greater use of digital tools for work purposes has resulted in an 'ever-connected', 'always on', or 'constantly on-call' culture, which can have detrimental effect on workers' fundamental rights".¹³⁹⁰

As discussed in Sections 6.1.9 and 6.1.10, the use of XR technologies may pose challenges to work-life balance and interfere with the enjoyment of the right to just and favourable conditions of work and the right to rest and leisure. This may be especially difficult when the 'space' for work and leisure is shared, and workers are 'ever-connected' to employers; traditional physical boundaries between work and home are blurred when the activities take place in a virtual environment. The trend towards

¹³⁸⁰ Harris, J. (2020) *Planned obsolescence: the outrage of our electronic waste mountain* / *The Guardian* [Online]. Available at: <https://www.theguardian.com/technology/2020/apr/15/the-right-to-repair-planned-obsolescence-electronic-waste-mountain>.

¹³⁸¹ See, e.g., Labbe, M. (2021) 'Energy consumption of AI poses environmental problems' / *TechTarget* [Online]. Available at: <https://www.techtarget.com/searchenterpriseai/feature/Energy-consumption-of-AI-poses-environmental-problems>; and Knight, W. (2020) *AI Can Do Great Things – if It Doesn't Burn the Planet* / *WIRED* [Online]. Available at: <https://www.wired.com/story/ai-great-things-burn-planet/>.

¹³⁸² Aco Recycling. (2022) *AR and VR Implementation for Recycling Habits*. Available at: <https://www.acorecycling.com/blog/ar-and-vr-implementation-for-recycling-habits/>.

¹³⁸³ See, e.g., National Geographic. (2020). *Nat Geo's Instagram interactive shows what the world will feel like in 2070* [Online]. Available at: <https://www.nationalgeographic.com/pages/article/earth-day-instagram-ar-experience>.

¹³⁸⁴ Miller, A. (2021) *4 Ways AR and VR Can Help Save the Planet* / *AR Insider* [Online]. Available at: <https://arinsider.co/2021/10/27/4-ways-ar-and-vr-can-help-save-the-planet/#:~:text=AR%20and%20VR%20can%20directly,significantly%20contributes%20to%20atmospheric%20pollution.>

¹³⁸⁵ See, e.g., Acciona. *Augmented Reality to Address the Challenges of the Water Cycle*. Available at: https://www.imnovation-hub.com/water/augmented-reality-address-challenges-water-cycle/?_adin=02021864894.

¹³⁸⁶ See, e.g., Simpson, W. (2016) *Augmented Reality Comes to Waste Management* / *RESOURCE* [Online]. Available at: <https://resource.co/article/augmented-reality-comes-waste-management-11342>.

¹³⁸⁷ World Health Organization and the International Labour Organization. (2021) *Healthy and Safe Telework*. Available at: <https://www.who.int/publications/i/item/9789240040977>.

¹³⁸⁸ Ibid, p. 13.

¹³⁸⁹ European Parliament. (2021) *Resolution of 21 January 2021 with recommendations to the Commission on the right to disconnect*, P9_TA(2021)0021, adopted 21 January 2021.

¹³⁹⁰ Ibid, para. B.

recognising a 'right to disconnect', either as part of these rights or a stand-alone right, creates obligations on States to ensure that limits are in place to ensure individuals can disengage from virtual workspaces.

Right to be online

In light of the ubiquity and importance of internet access, some legal scholars have proposed the need to recognize a human right to internet access or the 'right to be online'.¹³⁹¹ Many States and organisations already acknowledge the role that the internet plays in promoting human rights,¹³⁹² and a small number have given legal recognition to the right.¹³⁹³ Whether as a corollary to the right to benefit from scientific progress or a stand-alone right, it would obligate States to ensure equal access to the internet and perhaps provision of free access.¹³⁹⁴ The use of XR applications could, therefore, be bolstered by increased or improved internet access.

A related concept is the rights of digital avatars, proposed specifically in the context of the intellectual property right of publicity.¹³⁹⁵ In the future, if XR becomes more integrated into daily life and necessary for securing basic services, there may be a need to articulate a 'right to XR' or 'right to digital identity' in the XR environment to ensure that individual's human rights are guaranteed.

6.2 Privacy and Data Protection

XR technologies collect and process a variety of different data in order to create an interactive and/or immersive experience for users. The gathering of such data, however, raises concerns relating to privacy and data protection. On this, it has been suggested that there are three factors in relation to XR technologies generally and VR/AR devices specifically which, in combination, present potentially serious privacy and data protection challenges, namely: (i) the range of different information-gathering technologies utilised in XR, each presenting specific privacy risks; (ii) the extensive gathering of data which is sensitive in nature, as distinct from the majority of other consumer technologies; and (iii) the comprehensive gathering of such data being an essential aspect of the core functions of XR technologies.¹³⁹⁶ Collectively, these factors highlight the ongoing tension between the necessity of collecting intimate data to enable the optimal immersive or interactive experience in XR, balanced against the requirement to uphold rights to privacy and data protection under international and EU law. While these legal frameworks do not specifically address or explicitly refer to XR technologies, many of the relevant provisions are directly applicable.

¹³⁹¹ See, Tully, S. (2014) 'A Human Right to Access the Internet? Problems and Prospects', *Human Right Law Review*. Available at: <https://doi.org/10.1093/hrlr/nqu011>.

¹³⁹² Ibid, pp. 3-7.

¹³⁹³ See, Pollicino, O. (2019) 'Right to Internet Access: Quid Iuris?' in von Arnould, A, von der Decken, K. and Susi, M. (eds), *The Cambridge Handbook on New Human Rights. Recognition, Novelty, Rhetoric*. Cambridge University Press.

¹³⁹⁴ University of Birmingham. (2019) *Free internet access should be a basic human right – study* [Online]. Available at: <https://www.birmingham.ac.uk/news/2019/free-internet-access-should-be-a-basic-human-right-study>; U.N. Special Rapporteur on the promotion of the right to freedom of opinion and expression, Frank Law Rue. (2011) Report of the Special Rapporteur on the promotion of the right to freedom of opinion and expression, A/66/150, Section IV.

¹³⁹⁵ See, Khan, O.A. (2010) 'My, Myself, and My Avatar: The Right to the Likeness of Our Digital Selves', *Journal of Law and Policy for the Information Society*, 5(2). Available at: https://kb.osu.edu/bitstream/handle/1811/72946/ISJLP_V5N3_447.pdf;sequence=1.

¹³⁹⁶ Dick E., (2021) 'Balancing User Privacy and Innovation in Augmented Reality and Virtual Reality', *Information Technology & Innovation Foundation*, pp.1-27, pp.1.

6.2.1 International and EU laws and policies

International law and policy

The right to privacy is applicable to everyone under international law.¹³⁹⁷ The right to privacy is, moreover, recognised in regional organisations, including the Council of Europe. The European Convention on Human Rights (ECHR), for instance, provides that “Everyone has the right to respect for his private and family life and his correspondence.”¹³⁹⁸ Conversely, the right to data protection is not explicitly protected under international law. However, the United Nations Human Rights Committee (CCPR) has suggested that the protection of personal data is an integral aspect of the right to privacy, as indicated by the explanation that “[i]n order to have the most effective protection of his private life, every individual should have the right to ascertain in an intelligible form, whether, and if so, what personal data is stored in automatic data files, and for what purposes.”¹³⁹⁹

EU law and policies

EU laws and draft legislation applicable to privacy and data protection in XR technologies include the Charter of Fundamental Rights of the European Union (CFREU)¹⁴⁰⁰, the General Data Protection Regulation (GDPR)¹⁴⁰¹, and legislative proposals, including the Regulation on Privacy and Electronic Communications (e-Privacy Regulation)¹⁴⁰², the Artificial Intelligence Act (AIA), the Digital Services Act (DSA), the Data Governance Act (DGA) and the Data Act (DA). For a detailed discussion of the EU laws and draft legislation applicable to privacy and data protection in XR, see Sections 3.7 and 3.9 above.

6.2.2 Privacy

The right to privacy is a core right within the international human rights law framework, pursuant to which it is conditionally guaranteed that no one shall be subjected to arbitrary interference with their “privacy, family, home, or correspondence nor to unlawful attacks on his or her reputation” and, moreover, that everyone shall be protected by law against such interference or attack.¹⁴⁰³ As indicated, the right to privacy is not absolute and may be restricted in certain specified circumstances, yet the threshold for permitted interferences is tightly constrained. According to the ECHR, for instance, interferences with the right to privacy must be in accordance with the law and be “necessary in a democratic society in the interests of national security, public safety or the economic wellbeing of the country, for the prevention of crime or disorder, for the protection of health or morals, or for the protection of the rights and freedoms of others.”¹⁴⁰⁴ Similarly, though slightly revised to account for

¹³⁹⁷ UDHR, Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14; CRPD, Article 22.

¹³⁹⁸ ECHR, Article 8.

¹³⁹⁹ CCPR General Comment No.16: Article 17 (Right to Privacy) The Right to Respect of Privacy, Family, Home and Correspondence, and Protection of Honour and Reputation (8th April 1988), [10].

¹⁴⁰⁰ CFREU.

¹⁴⁰¹ Regulation (EU) 2016/679 (General Data Protection Regulation) COM/2012/010 final (EU GDPR). Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679>.

¹⁴⁰² Proposal for a Regulation of the European Parliament and the Council concerning the respect for private life and the protection of personal data in electronic communications and repealing Directive 2002/58/EC (Regulation on Privacy and Electronic Communications) COM/2017/010 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52017PC0010>.

¹⁴⁰³ UDHR, Article 12; ICCPR, Article 17; CRC, Article 16; CPRMW, Article 14; CRPD, Article 22.

¹⁴⁰⁴ ECHR, Article 8(2).

technological developments,¹⁴⁰⁵ the CFREU provides that “[e]veryone has the right to respect for his or her private and family life, home, and communications.”¹⁴⁰⁶ The explanatory notes to the Charter make clear that the meaning and scope of the right under Article 7 CFREU is, in accordance with Article 52(3), the same as the corresponding article of the ECHR,¹⁴⁰⁷ namely Article 8, pursuant to which it is instructive to consider the interpretation of this provision by the European Court of Human Rights (ECtHR).

The Grand Chamber of the ECtHR has interpreted the meaning of “private life” as “a broad concept” encompassing, inter alia, the physical and psychological aspects of the personal autonomy, integrity, identity, and development of individuals.¹⁴⁰⁸ Although it has been suggested that Article 7 CFREU is not as broadly construed,¹⁴⁰⁹ this is nonetheless indicative of the coverage of the right to privacy and of the specific aspects included within the remit of it. Perhaps most relevant to XR is the inclusion of personal identity as an aspect of the right to privacy, particularly as the CJEU has observed that an aspect of personal identity relates to a person’s image.¹⁴¹⁰ It follows that the processing of various forms of biometric data by XR devices and applications, as is considered “fundamentally necessary” to “core functionality” of such technologies,¹⁴¹¹ could lead to the capturing of real and true likenesses in user avatars, for instance by using body scanning technologies to create a virtual 3D replica,¹⁴¹² infringements in relation to which may contravene the right to privacy. Further potential interferences with the right to privacy relate to the potential for cybersurveillance in VR,¹⁴¹³ the ability to personally identify users of XR technologies,¹⁴¹⁴ and the potential for trivial observation and tracking of bystanders.¹⁴¹⁵

6.2.3 Classification of data

The right of everyone to the protection of personal data concerning him or her is guaranteed under the CFREU.¹⁴¹⁶ The right entails that everyone shall have “the right of access to data which has been collected concerning him or her, and the right to have it rectified”, and moreover, that “data must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis laid down by law.”¹⁴¹⁷ Against this background, one of the key data protection issues in relation to XR is the classification of the various forms of data processed by such technologies. It has been suggested that the types of data collected in AR/VR technologies can be categorised as follows: (a) “observable data” in the form of digital communications or virtual personas (i.e., avatars) which enables users to create a virtual presence; (b) “observed data”, as provided or generated by the user, such as geolocation or biographical information; (c) “computed data” in the

¹⁴⁰⁵ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

¹⁴⁰⁶ CFREU, Article 7.

¹⁴⁰⁷ Explanations Relating to the Charter of Fundamental Rights (2007/C 303/02).

¹⁴⁰⁸ *Case of A, B and C v Ireland* (Application no.25579/05), ECtHR Judgement 16th December 2010, para. 212.

¹⁴⁰⁹ Mangan D. (2021) ‘Article 7 (Private Life, Home, and Communications)’ in Peers S., Hervey T., Kenner J., and Ward A., (eds), *The EU Charter of Fundamental Rights: A Commentary* (Hart Publishing) pp. 151-194, pp.154.

¹⁴¹⁰ *Case T-168/14 Gutiérrez v European Commission* [2015] EU: T: 2015:607, para. 30.

¹⁴¹¹ McGill, *supra* note 1111, pp.7.

¹⁴¹² Henriksson, E.A., (2018) ‘Data protection challenges for virtual reality applications.’, *Interactive Entertainment Law Review*, vol.1(1), pp.57-61.

¹⁴¹³ See, e.g., Yadin G., (2017) ‘Virtual Reality Surveillance’, *Cardozo Arts & Entertainment Law Journal*, vol.35:3, Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3043922.

¹⁴¹⁴ See, e.g., Miller, *supra* note 1110.

¹⁴¹⁵ McGill, *supra* note 1111.

¹⁴¹⁶ CFREU, Article 8(1).

¹⁴¹⁷ *Ibid*, Article 8(2).



form of new information inferred by AR/VR technologies through the manipulation of observable and observed data, for example biometric identification; and (d) “associated data”, meaning information not directly related to an individual, for instance a username or IP address.¹⁴¹⁸ Whilst providing a useful framework for the various types of data collected and processed in XR, this differs from the types of data identified in the GDPR, which instead refers, *inter alia*, to “anonymous data”,¹⁴¹⁹ “personal data”¹⁴²⁰ and “special category”¹⁴²¹ or “sensitive” data.¹⁴²² Further analysis is therefore required to assess the relationship between these respective frameworks, though for clarity the forms of data identified in the subheadings below correspond with the terms used in the GDPR, wherein the process of classifying data type determines whether and, if so, which provisions are applicable.

Anonymous data

Within the context of the GDPR, “anonymous data” is understood as “information which does not relate to an identified or identifiable natural person or to personal data rendered anonymous in such a manner that the data subject is not or no longer identifiable.”¹⁴²³ On the basis that a data subject cannot be identified, the processing of this type of data in XR technologies is not regulated by the GDPR. Such data is the opposite of “personal data”, the protection of which is guaranteed by Article 7 CFREU and the processing of which falls directly within the purview of the GDPR.

Personal data

As indicated above, and consistent with the legislative intention to strike a balance between the protection of fundamental rights and the free movement of data, the terms of the GDPR are applicable when the type of data processed by the data controller or processor is “personal data”.¹⁴²⁴ As the converse of anonymous data (see above), personal data is defined as “any information relating to an identified or identifiable natural person (‘data subject’); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural, or social identity of that natural person”.¹⁴²⁵ As the Second Chamber of the CJEU has observed, the use of the phrase “any information” reflects the aim of the EU legislature to assign a broad scope of meaning to the concept of personal data, “which is not restricted to information that is sensitive or private, but potentially encompasses all kinds of information, not only objective, but also subjective, in the form of opinions and assessments, provided that it ‘relates’ to the data subject.”¹⁴²⁶

The condition of information relating to a data subject is “satisfied where the information, by reason of its content, purpose or effect, is linked to a particular person.”¹⁴²⁷ Pursuant to this criterion of linking to a particular person, the CJEU has interpreted both dynamic IP addresses,¹⁴²⁸ specifically, when combined with additional information “likely reasonably to be used to identify the data

¹⁴¹⁸ Dick, *supra* note 1396, p. 3.

¹⁴¹⁹ EU GDPR, Recital 26.

¹⁴²⁰ *Ibid*, Article 4(1).

¹⁴²¹ *Ibid*, Article 9(1).

¹⁴²² *Ibid*, Recital 51.

¹⁴²³ *Ibid*, Recital 26.

¹⁴²⁴ *Ibid*, Article 2(1).

¹⁴²⁵ *Ibid*, Article 4(1).

¹⁴²⁶ Case C-434/16 *Peter Nowak v. Data Protection Commissioner* [2017] EU:C: 2016:779, para.34.

¹⁴²⁷ *Ibid*, para.35.

¹⁴²⁸ Case C-582/14 *Patrick Breyer v. Bundesrepublik Deutschland* [2016] EU:C: 2017:994, para.49.



subject”,¹⁴²⁹ and written examination answers to constitute personal data.¹⁴³⁰ This highlights the overall expansiveness of the categories of “personal data” included within the remit of the GDPR, one effect of which may be that a greater volume of data processing in XR is required to comply with the various requirements under the GDPR. More specifically, since IP addresses are an example of ‘associated data’ according to the taxonomy outlined above, this indicates that the collection and processing of such data in XR technologies, as is considered “necessary to associate users with their unique accounts, user preferences, and virtual assets”,¹⁴³¹ may be required to comply, inter alia, with the various principles relating to the processing of personal data,¹⁴³² in addition to the conditions for lawfulness of processing.¹⁴³³

Special category or sensitive data

In addition to distinguishing between anonymous and personal data (see above), the GDPR also differentiates between general category personal data and “special category” or “sensitive” data. It is explained in the preamble to the GDPR that “[p]ersonal data which are, by their nature, particularly sensitive in relation to fundamental rights and freedoms merit specific protection as the context of their processing could create significant risks to the fundamental rights and freedoms.”¹⁴³⁴ It follows that whereas the processing of personal data characterised as special category or sensitive data is in principle prohibited, unless, alongside the aforementioned conditions for lawful processing, one of the exhaustively listed exceptions to the rule is applicable,¹⁴³⁵ for instance, “the data subject has given explicit consent”,¹⁴³⁶ or “processing is necessary for reasons of substantial public interest”,¹⁴³⁷ the processing of all other personal data is in principle permitted provided the conditions for lawfulness of processing are complied with.¹⁴³⁸

The types of data included in the special categories of personal data, and therefore subject to compliance with these conditions, are listed as “personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person’s sex life or sexual orientation”.¹⁴³⁹ There are various use cases of XR which may involve the processing of personal data properly classified as special category sensitive data, with biometric data, for instance, being captured in XR technologies “by means of eye-tracking systems, facial recognition systems, and advanced sensors (e.g., fingerprints, voiceprints, hand and face geometry, electrical muscle activity, heart-rate, skin response, eye movement detection, head position, etc.) in order to provide an immersive and comfortable experience for users.”¹⁴⁴⁰ The processing of biometric data is particularly ubiquitous in the context of VR, where the complete immersion of users into a computer-generated virtual environment is enabled through the capturing of assorted intimate data by various biometric sensors in order to track users and fully immerse them

¹⁴²⁹ Ibid, para.45.

¹⁴³⁰ *Peter Nowak v. Data Protection Commissioner*, supra note 1426, para.62.

¹⁴³¹ Dick, supra note 1396, p.13.

¹⁴³² EU GDPR, Article 5.

¹⁴³³ Ibid, Article 6.

¹⁴³⁴ Ibid, Recital 51.

¹⁴³⁵ Ibid, Article 9(2)(a)-(j).

¹⁴³⁶ Ibid, Article 9(2)(a).

¹⁴³⁷ Ibid, Article 9(2)(g).

¹⁴³⁸ Ibid, Article 6.

¹⁴³⁹ Ibid, Article 9(1).

¹⁴⁴⁰ Olivi G., Anselmi N., and Miele C.O., (2020) ‘Virtual Reality: Top Data Protection Issues to Consider’, *The Journal of Robotics, Artificial Intelligence & Law*, vol.3(2), pp141-147, pp.142.

in a personalised virtual world.¹⁴⁴¹ It is, moreover, because of the widespread use of such sensors that VR is perhaps the most suitable medium for gaining additional insights via the processing of biometric data, with the newly coined term “biometric psychography” denoting the inference of user preferences through predictive behavioural analytics of traditional biometric data, such as eye positioning.¹⁴⁴²

Whilst the processing of biometric data, as an example of personal data, falls squarely within the purview of the GDPR, which defines such data as “personal data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of a natural person, which allow or confirm the unique identification of that natural person, such as facial images or dactyloscopic data”,¹⁴⁴³ a distinction is drawn between biometric data that is used “for the purpose of uniquely identifying a natural person”,¹⁴⁴⁴ and other biometric data.¹⁴⁴⁵ It follows that whereas AR wearables utilising facial recognition technology,¹⁴⁴⁶ for instance, may be subject to the prohibition on and exceptions relating to the processing of special category sensitive data, other XR applications using biometric data may instead be required to comply with the general requirements relating to the processing of personal data.

Alongside biometric data, health data is an additional source of data processed by XR technologies which may be characterised as special category sensitive data for the purposes of the GDPR. There are various clinical applications of XR (see Section 6.1.6), including inter alia, the use of AR for visualising medical information, such as anatomical data, and the use of VR for therapeutic treatment, for instance by immersing patients in a virtual world to distract from the experiencing of pain.¹⁴⁴⁷ Since “data concerning health” is listed as special category sensitive data, this indicates that the more restrictive conditions for data processing will be applicable.¹⁴⁴⁸ A possible exception to this, however, is consumer-grade XR applications, such as healthcare wearables, which, like some consumer-based neurotechnologies (see Section 5.2.3) process health data on a non-clinical basis.¹⁴⁴⁹ Clarification is required to determine the applicable conditions for lawful data processing in such applications, with much depending on whether special category sensitive data is characterised according to the purpose¹⁴⁵⁰ or context¹⁴⁵¹ of processing, on which there is a lack of consensus amongst legal scholars.

¹⁴⁴¹ Snijders et al., supra note 1206, p. 12.

¹⁴⁴² Heller, supra note 1108.

¹⁴⁴³ EU GDPR, Article 4(14). N.B., under Amendment 9 of the Draft Report by the EP, this definition of biometric data is also applicable to the proposed AI Act.

¹⁴⁴⁴ Ibid, Article 9(1).

¹⁴⁴⁵ Blodgett-Ford S.J., and Supponen M., (2018) ‘Data privacy legal issues in virtual and augmented reality advertising’ in Barfield W., and Blitz M.J., (eds), *Research Handbook on the Law of Virtual and Augmented Reality* (Edward Elgar), pp471-512, pp.508.

¹⁴⁴⁶ Lemley M., and Volokh E., (2018) ‘Law, Virtual Reality and Augmented Reality’, *University of Pennsylvania Law Review*, vol.166(5), pp.1051-1138, pp.1062.

¹⁴⁴⁷ See e.g., Marr, B. (2021) *Extended Reality in Healthcare: 3 Reasons The Industry Must Get Ready for AI and VR / FORBES* [Online]. Available at: <https://www.forbes.com/sites/bernardmarr/2021/06/14/extended-reality-in-healthcare-3-reasons-the-industry-must-get-ready-for-ar-and-vr/?sh=18b747fe73a4>.

¹⁴⁴⁸ EU GDPR, Article 9(2).

¹⁴⁴⁹ Rainey S et al., (2020) ‘Is the European Data Protection Regulation sufficient to deal with emerging data concerns relating to neurotechnology?’, *Journal of Law and the Biosciences*, vol.7:1. Available at: <https://doi.org/10.1093/jlb/lsaa051>.

¹⁴⁵⁰ See, e.g., *ibid*.

¹⁴⁵¹ See, e.g., Ienca et al., supra note 1036.



6.2.4 Consent

In accordance with the requirement that personal data “must be processed fairly for specified purposes and on the basis of the consent of the person concerned or some other legitimate basis”,¹⁴⁵² the GDPR establishes various conditions under which the processing of personal data is lawful,¹⁴⁵³ most pertinent of which is that “the data subject has given consent to the processing of his or her personal data for one or more specific purposes”.¹⁴⁵⁴ Corresponding to the various types of data identified above (see 6.2.3), however, there are different requirements for the consent of a data subject depending on the type of data processed. This subsection analyses the definition of and conditions for consent under the GDPR, alongside the role of consent as a basis for lawful processing, highlighting the associated challenges arising in the context of XR.

The definition of consent

According to the GDPR, consent is defined as “any freely given, specific, informed and unambiguous indication of the data subject’s wishes by which he or she, by a statement or by a clear affirmative action, signifies agreement to the processing of personal data relating to him or her”.¹⁴⁵⁵ The CJEU has interpreted the requirement that consent be “informed” as an obligation on behalf of data controllers “to provide the data subject with information relating to all the circumstances surrounding the data processing”, such that the data subject is “able to determine easily the consequences of any consent he or she might give and ensure that the consent given is well informed.”¹⁴⁵⁶ Furthermore, in relation to the requirement that consent be “unambiguous”, the CJEU has held that “[o]nly active behaviour on the part of the data subject with a view to giving his or her consent may fulfil that requirement.”¹⁴⁵⁷ It follows that the consent of the data subject is not “validly constituted” if access to the relevant information “is permitted by way of a pre-ticked checkbox which the user must deselect to refuse his or her consent.”¹⁴⁵⁸

The analogous application of these requirements to the context of XR technologies entails that end-user, either before or whilst operating VR/AR/MR applications, are given the entirety of information relating to all identifiable purposes of data processing, in addition to being required to demonstrate in a non-passive way their consent to such processing. An unresolved challenge here, however, is how the providers of XR devices and applications, in relation to whom, as the data controllers for the purposes of the GDPR, there is a requirement “to demonstrate” compliance,¹⁴⁵⁹ will ensure observance of these requirements for the characteristics of consent without impinging on end-user experience. This is essential to enable consent to serve as a basis for lawful processing of personal data, the requirements in relation to which are analysed in the following section.

¹⁴⁵² CFREU, Article 8(2).

¹⁴⁵³ Ibid, Article 6(1).

¹⁴⁵⁴ Ibid, Article 6(1)(a).

¹⁴⁵⁵ EU GDPR, Article 4(11).

¹⁴⁵⁶ Case C-61/19 *Orange România SA v Autoritatea Nationala de Supraveghere a Prelucrării Datelor cu Caracter Personal (ANSPDCP)* [2020] ECLI:EU:C: 2020:90, para. 40.

¹⁴⁵⁷ Case C-673/17 *Bundesverband der Verbraucherzentralen und Verbraucherverbände – Verbraucherzentrale Bundesverband eV v Planet49 GmbH* [2019] ECLI:EU:C: 2019:801, para. 54.

¹⁴⁵⁸ Ibid, para. 63.

¹⁴⁵⁹ *Orange România SA v Autoritatea Nationala de Supraveghere a Prelucrării Datelor cu Caracter Personal*, supra note 1456, para. 52.



As a basis for lawful processing

As noted above, consent is one of the six bases upon which the processing of personal data is lawful,¹⁴⁶⁰ with the GDPR providing that processing shall be lawful if “the data subject has given consent to the processing of his or her personal data for one or more specific purposes”.¹⁴⁶¹ In this context, however, it is pertinent to recall (see Section 6.3.2) that the GDPR draws a distinction between personal data and sensitive data, the relevant point of differentiation between which being that the processing of sensitive data is prohibited unless one of the limited exceptions to the rule applies, most applicably that “the data subject has given explicit consent to the processing of those personal data for one or more specified purposes”.¹⁴⁶² Whilst a significant proportion of the processed in XR technologies, particularly observed and observable data, may, for reasons outlined above, appropriately be classified as sensitive under the terms of the GDPR, and therefore subject to the in principle more rigorous requirement for “explicit consent”, further guidance may be required to determine the practical effect of the premodifier “explicit”,¹⁴⁶³ particularly in comparison to the general conditions for consent.¹⁴⁶⁴

The conditions for consent

The various conditions under which the consent of a user of XR technologies is valid and constitutes a lawful basis for the processing of personal data are listed under Article 8 GDPR for children (see below) and Article 7 GDPR for other natural persons. In relation to the latter, Article 7 imposes, inter alia, a requirement for the data controller to demonstrate that the data subject has consented to the processing of his or her personal data,¹⁴⁶⁵ and moreover, for the data subject to be informed prior to giving consent that such consent is withdrawable “at any time”.¹⁴⁶⁶ The consent of the data subject is not subject to particular requirements regarding its form and could be provided via electronic means or an oral statement,¹⁴⁶⁷ yet it is stipulated that “[i]f the data subject’s consent is given in the context of a written declaration which also concerns other matters, the request for consent shall be presented in a manner which is clearly distinguishable from the other matters, in an intelligible and easily accessible form, using clear and plain language.”¹⁴⁶⁸ These requirements are consistent with the principle of transparency underpinning the GDPR (see 6.2.5 below) and are intended to ensure that a data subject is truly agreeing to a particular use of their data.¹⁴⁶⁹

Furthermore, in “assessing whether consent is freely given, utmost account shall be taken of whether, inter alia, the performance of a contract, including the provision of a service is conditional on consent to the processing of personal data that is not necessary for the performance of that contract.”¹⁴⁷⁰ It is unclear exactly how this provision applies to immersive XR technologies, in relation to which scholars

¹⁴⁶⁰ Alongside necessity for contractual performance, compliance with a legal obligation, protection of vital interests, performance of a task in the public interest, and legitimate interests, EU GDPR Article 6(1)(a)-(f).

¹⁴⁶¹ Ibid, Article 6(1)(a).

¹⁴⁶² Ibid, Article 9(2)(a).

¹⁴⁶³ Kranenborg H., (2021) ‘Article 8’ in Peers S., Hervey T., Kenner J., and Ward A., (eds), *The EU Charter of Fundamental Rights: A Commentary* (Oxford, Hart Publishing), pp231-290, p. 267.

¹⁴⁶⁴ EU GDPR, Article 7.

¹⁴⁶⁵ Ibid, Article 7(1).

¹⁴⁶⁶ Ibid, Article 7(3).

¹⁴⁶⁷ Ibid, Recital 32.

¹⁴⁶⁸ Ibid, Article 7(2).

¹⁴⁶⁹ European Union Agency for Fundamental Rights, (2018) *Handbook on European data protection law*, pp.1-400, p. 112.

¹⁴⁷⁰ EU GDPR, Article 7(4).



widely agree that the processing of personal data is necessary to enable core functions.¹⁴⁷¹ A possible effect of this requirement, however, is to mitigate against the risk of “consensual erosion” of users’ rights to privacy and data protection, whereby the interests of such users in gaining access to the latest XR technologies is leveraged by companies in making access conditional upon agreement to “terms of service or privacy policies that permit extensive capture and processing activities.”¹⁴⁷² It follows that the linking of “freely given” consent to necessity for contractual performance may enhance the protection of data subjects against possible exploitation through catch-all privacy notices.

6.2.5 Transparency

The principle of transparency is central to the ethical and legal regulation of new and emerging technologies, including XR. In the context of human-machine interactions facilitated by XR “chatbots” using AI-based natural language processing (NLP) approaches, for instance, it has been suggested that the principle of transparency requires that such systems are designed in a way that “is not opaque or incomprehensible to humans.”¹⁴⁷³ In the context of the GDPR, meanwhile, transparency forms one of the various principles relating to the legitimate processing of personal data,¹⁴⁷⁴ establishing an obligation for which the data controller is required to be able to demonstrate compliance with under the principle of “accountability”.¹⁴⁷⁵ Although not defined specifically, the Recitals to the GDPR are instructive as to the meaning and effect of the principle of transparency in the context of data protection,¹⁴⁷⁶ specifically, by providing that it should be clear “to natural persons that personal data concerning them are collected, used, consulted or otherwise processed and to what extent”, and moreover by asserting “that any information and communication relating to the processing of those personal data be easily accessible and easy to understand, and that clear and plain language be used.”¹⁴⁷⁷ This understanding of transparency in the GDPR forms the basis of specific practical requirements on behalf of data processors and controllers, and, concomitantly, specific rights of the data subject.¹⁴⁷⁸

A central consideration relating to XR is the requirement for information relating to data processing to be provided by the data controller “in writing, or by other means, including, where appropriate, by electronic means.”¹⁴⁷⁹ Such “other means” are not exhaustively listed, but it is specified that “information may be provided orally”,¹⁴⁸⁰ if measures are taken to verify the identity of the data subject for information relating to the exercise by a data subject of their various rights under the GDPR.¹⁴⁸¹ It follows that the controllers of data processed in XR technologies are required to provide the information to users via a means that is appropriate to the particular circumstances of processing, for instance whilst the provision of information in an electronic form may be suitable for AR

¹⁴⁷¹ Dick, *supra* note 1396; Heller, *supra* note 1108.

¹⁴⁷² McGill, *supra* note 1111, p. 17.

¹⁴⁷³ Comité National Pilote D’Éthique Du Numérique, (2021) ‘Opinion No.3 Ethical Issues of Conversational Agents’, pp. 1-38, p. 36.

¹⁴⁷⁴ EU GDPR, Article 5(1).

¹⁴⁷⁵ *Ibid*, Article 5(2).

¹⁴⁷⁶ Article 29 Data Protection Working Party, (2018) ‘Guidelines on transparency under Regulation 2016/679’, 17/EN WP260, para. 6. Available at: <https://ec.europa.eu/newsroom/article29/items/622227>

¹⁴⁷⁷ EU GDPR, Recital 39.

¹⁴⁷⁸ See, e.g., *ibid*, Articles 12-14.

¹⁴⁷⁹ *Ibid*, Article 12(1).

¹⁴⁸⁰ *Ibid*, Article 12(1).

¹⁴⁸¹ Article 29 Data Protection Working Party, *supra* note 1476.

applications accessed via a smartphone,¹⁴⁸² it may be more suitable for alternative means, such as a hard copy instruction manual, to be used for supplying the relevant information in VR applications.¹⁴⁸³

The draft AI Act, meanwhile, lays down a requirement, as unamended by the EP Draft Report,¹⁴⁸⁴ for AI systems classified as “high risk”¹⁴⁸⁵ to “be designed and developed in such a way to ensure that their operation is sufficiently transparent to enable users to interpret the system’s output and use it appropriately.”¹⁴⁸⁶ The classification of AI systems as high risk is based on the “function performed” and the “specific purpose and modalities for which that system is used”,¹⁴⁸⁷ with the draft AI Act identifying several high-risk AI systems, including, perhaps most applicably to XR applications, “AI systems intended to be used for the ‘real-time’ and ‘post’ remote biometric identification of natural persons”.¹⁴⁸⁸ Whilst much depends on whether, as per the definition of an AI system, an XR application has been developed with one or more of machine learning, statistical, logic or knowledge-based techniques,¹⁴⁸⁹ there are multiple use-cases of XR applications involving biometric identification, the design and development of which may be required to comply with the transparency obligations applicable to high-risk AI systems. For instance, AR and VR devices may use biometric identification to, inter alia, “replicate a user’s actions in virtual space” and improve security by authenticating users.¹⁴⁹⁰

Alongside imposing specific transparency obligations in relation to AI systems classified as high risk, the draft AI Act seeks to introduce “harmonised transparency rules for AI systems intended to interact with natural persons, emotion recognition systems and biometric categorisation systems, and AI systems used to generate or manipulate image, audio or video content”.¹⁴⁹¹ The imposition of transparency obligations to this effect,¹⁴⁹² as similarly unamended by the EP after first reading, are intended to address the specific risks of manipulation posed by the identified AI systems. Perhaps most relevant to XR applications using AI systems, under the terms of Title IV there is an obligation on providers of low-risk AI systems to design and develop such systems so “that natural persons are informed that they are interacting with an AI system, unless this is obvious from the circumstances and the context of use”.¹⁴⁹³ To this end, whilst there may be certain circumstances and contexts in which it will be “obvious” to natural persons that they are engaging with an XR application using AI, for instance while socialising, gaming, or exercising in the Metaverse,¹⁴⁹⁴ it is possible to contemplate situations in which this will not necessarily be as “obvious”, for instance in the use of VR for practical

¹⁴⁸² For instance, Pokémon Go is accessed via a smartphone app. Available at: <https://www.pokemon.com/uk/app/pokemon-go/>.

¹⁴⁸³ Article 29 Data Protection Working Party, *supra* note 1476.

¹⁴⁸⁴ Committee on the Internal Market and Consumer Protection Committee on Civil Liberties, Justice, and Home Affairs, (2022) ‘Draft Report on the proposal for a regulation of the European Parliament and of the Council on harmonised rules on Artificial Intelligence (Artificial Intelligence Act) and amending certain Union Legislative Acts’ 2021/0106(COD). Available at: https://iapp.org/media/pdf/publications/CJ40_PR_731563_EN.pdf.

¹⁴⁸⁵ Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) And Amending Certain Union Legislative Acts COM/2021/206 final (draft AI Act), Article 6.

¹⁴⁸⁶ *Ibid*, Article 13.

¹⁴⁸⁷ *Ibid*, p.12.

¹⁴⁸⁸ *Ibid*, Annex III (1).

¹⁴⁸⁹ Per the definition of AI under *ibid*, Article 3(1).

¹⁴⁹⁰ Dick, *supra* note 1396, p.8.

¹⁴⁹¹ Draft AI Act, *supra* note 1485, Article 1(1)(c).

¹⁴⁹² *Ibid*, Article 52(1)-(3).

¹⁴⁹³ *Ibid*, Article 52(1).

¹⁴⁹⁴ The Oculus Quest 2 VR headset, for instance, offers each of these use cases. Available at: <https://www.oculus.com/quest-2/>.



healthcare applications, such as diagnosis and pre-procedural planning.¹⁴⁹⁵ In this context, there are also multiple mental health risks associated with the therapeutic use of VR, for instance depersonalisation and difficulty readjusting to the material world,¹⁴⁹⁶ thereby requiring that providers, and vicariously medical professionals, ensure patients are informed and can choose to step back from the situation if desired. Furthermore, the draft AI Act also imposes a requirement on users of emotion recognition and biometric categorisation systems to inform exposed natural persons of the operation of such systems, except where the use of such systems is permitted by law for the purposes of crime prevention.¹⁴⁹⁷ It follows that users of XR wearables enabled with facial recognition technology,¹⁴⁹⁸ for instance, may be required to inform affected persons (bystanders) that they have been the subject of biometric categorisation.

At the level of EU policy, meanwhile, transparency is listed under Chapter II of the 'Ethics Guidelines for Trustworthy AI' as one of the seven key requirements for trustworthy AI, as devised by the High-Level Expert Group on Artificial Intelligence (AI HLEG). In this context, the requirement for transparency is closely associated with the principle of explicability and is comprised of three overlapping elements, namely: traceability, explainability and communication.¹⁴⁹⁹ While only voluntarily opted-into by stakeholders, and therefore not legally binding, this policy document serves to contextualise and complement the provisions of the proposed AI Act, specifically by offering practical guidance on the operationalisation and implementation of ethical principles in socio-technical systems, potentially including some XR applications.¹⁵⁰⁰

6.2.6 Vulnerable users

A key privacy and data protection challenge in relation to XR technologies is to ensure the adequate protection of vulnerable users, particularly children, the processing of whose data has the potential to be disproportionately harmful when compared with non-vulnerable users.¹⁵⁰¹ This is so because "they may be less aware of the risks, consequences and safeguards concerned and their rights in relation to the processing of personal data."¹⁵⁰²

The right to data protection is construed as an aspect of a child's right to privacy under international law,¹⁵⁰³ in accordance with which the Committee on the Rights of the Child has advocated the prohibition by law of practices which seek to engage directly or indirectly with children those practices to promote products, applications, and services through immersive advertising in VR and AR environments.¹⁵⁰⁴ Whilst not binding, this reflects an acknowledgement of the ease with which

¹⁴⁹⁵ Andrews C., Southworth, M.K., Silva, J.N.A., and Silva, J.R., (2019) 'Extended Reality in Medical Practice', *Current Treatment Options in Cardiovascular Medicine*, vol.21:4, pp. 1-12.

¹⁴⁹⁶ Spiegel, supra note 1206.

¹⁴⁹⁷ Draft AI Act, supra note 1485, Article 52(2).

¹⁴⁹⁸ For instance, the Vuzix M400 smart glasses enable the mobile deployment of the NeoFace Kaoato facial recognition system offered by NEC Solution Innovators. Available at: <https://www.biometricupdate.com/202201/new-worldwide-deals-facial-recognition-integration-for-vuzix-smart-glasses>.

¹⁴⁹⁹ High-Level Expert Group on Artificial Intelligence, (2019) 'Ethics Guidelines for Trustworthy AI', pp.1-39. Available at: <https://ec.europa.eu/futurium/en/ai-alliance-consultation.1.html>.

¹⁵⁰⁰ Ibid.

¹⁵⁰¹ Dick, supra note 1396, p.17.

¹⁵⁰² EU GDPR, Recital 38.

¹⁵⁰³ CRC, Article 16.

¹⁵⁰⁴ General comment No.25 (2021) on children's rights in relation to the digital environment, para. 42.

children may be targeted with advertisements in XR,¹⁵⁰⁵ and identifies a potential regulatory solution to avoid children suffering associated harms.

Expanding on the protection of children under international human rights law, the GDPR asserts that children “merit special protection with regard to their personal data”,¹⁵⁰⁶ consistent with which the European Data Protection Board, as constituted by the GDPR,¹⁵⁰⁷ has included as an aspect of its Work Programme for 2021/2022 the establishment of guidelines relating to children’s personal data.¹⁵⁰⁸ Such guidelines are intended to complement the various provisions within the GDPR relating to children, most specifically the conditions applicable to child’s consent in relation to information society services.¹⁵⁰⁹ Pursuant to this provision, there is an age restriction of 16, or between 13 and 16 if provided for under Member State law, in order for consent to act as a lawful basis for processing of personal data,¹⁵¹⁰ the alternative to which being “that consent is given or authorised by the holder of parental responsibility over the child.”¹⁵¹¹ In relation to the latter, there is a requirement on the behalf of data controllers to “make reasonable efforts to verify in such cases that consent is given or authorised by the holder of parental responsibility over the child, taking into consideration available technology.”¹⁵¹² For instances in which processing is addressed to a child, the principle of transparency (see above) requires that any information and/or communication is provided in clear and plain language that a child can easily understand.¹⁵¹³ Such provisions may serve to mitigate the risks posed to child users of XR, which include, inter alia, physical harm, exposure to harmful content, bullying, and harassment.¹⁵¹⁴

Finally, whereas there exist specific provisions for the protection of children under the terms of the GDPR, there is no explicit protection for other “vulnerable natural persons”,¹⁵¹⁵ with the exception of the assertion in the Recitals to the GDPR that consent does not provide a valid legal ground for the processing of personal data in situations “where there is a clear imbalance between the data subject and the controller”.¹⁵¹⁶ It follows that protections for other vulnerable users of XR, such as older people or those with disabilities, are not explicitly contemplated within the framework of the GDPR.

6.2.7 Potential developments and future trends

This section has explored the relationship between privacy and data protection in relation to XR technologies, situating this analysis in the context of the relevant international and EU laws and draft legislation. Whilst the precise effect of certain provisions in relation to XR awaits further clarification, for instance the requirements for obtaining user consent pursuant to Article 6 GDPR (see section 6.2.4), the relevant international and EU laws may be sufficiently comprehensive and technologically

¹⁵⁰⁵ Blodgett-Ford S.J., and Supponen M., (2018) ‘Data privacy legal issues in virtual and augmented reality advertising’ in Barfield W., and Blitz M.J., (eds), *Research Handbook on the Law of Virtual and Augmented Reality* (Edward Elgar), pp471-512, p. 490.

¹⁵⁰⁶ EU GDPR, Recital 38.

¹⁵⁰⁷ Ibid, Article 68.

¹⁵⁰⁸ European Data Protection Board, (2021) ‘Working Programme 2021/2022’. Available at: https://edpb.europa.eu/system/files/2021-03/edpb_workprogramme_2021-2022_en.pdf.

¹⁵⁰⁹ EU GDPR, Article 8.

¹⁵¹⁰ Ibid, Article 6(1)(a).

¹⁵¹¹ Ibid, Article 8(1).

¹⁵¹² Ibid, Article 8(2).

¹⁵¹³ Ibid, Recital 58.

¹⁵¹⁴ Dick E., (2020) ‘How to Address Privacy Questions Raised by the Expansion of Augmented Reality in Public Spaces’, *Information Technology & Innovation Foundation*, pp.1-24.

¹⁵¹⁵ EU GDPR, Recital 75.

¹⁵¹⁶ Ibid, Recital 43.

neutral to effectively protect the rights to privacy and data protection of users against the various challenges posed by XR technologies, notwithstanding the calls from certain scholars for more specific and particularised laws, such as the putative Extended Reality Privacy Rights Framework.¹⁵¹⁷

6.3 Consumer protection

Consumer rights and consumer protection law are designed to hold sellers of goods and services accountable when they seek to profit, for example by taking advantage of a consumer's lack of information or bargaining power. Some conduct addressed by consumer rights laws is simply unfair, while other conduct might be fraudulent, deceptive, and/or misleading. Consumer rights are particularly important in the XR context, as the AR/VR market share is expected to increase by USD 162.71 billion from 2020 to 2025, and the market's growth momentum to accelerate at a CAGR of 46% (with growth being driven by increasing demand).¹⁵¹⁸ The use of XR is already transforming diverse industries (healthcare, manufacturing) and at the same time changing culture, travel, retail/ecommerce, education, training, gaming and entertainment (the latter two being the most significant).

All consumer rights could potentially be affected in XR in some manner or the other, but for the purpose of this report we have focused on the right to be informed, the right to safety, the right to choose, the right to redress, the right to consumer education and the right to healthy environment.

Risks for consumers in XR can be grouped into four categories¹⁵¹⁹:

- Physical and mental risks (e.g., emotional involvement, long-term damage, blurring of boundaries, alienation and addiction);
- Social risks (damage to social values, slander and intimidation, social disassociation, virtual violence, sexualisation);
- Abuse of power (manipulation, lack of transparency, curtailing autonomy, political autonomy, political influence, use of data without permission);
- Legal risks (invasion of privacy, identity abuse, property issues and uncertain status of legal actions).

While some of the issues are not unique to XR, the persuasive, illusionist, invasive, immersive, and/or intimate nature of XR products exacerbates the challenges and impacts on consumers. Furthermore, different XR applications have different target groups of consumers (e.g., children, elderly, other vulnerable groups) who might be impacted dissimilarly by their use.

¹⁵¹⁷ McGill, *supra* note 1111, p.18.

¹⁵¹⁸ Technavio, *Augmented Reality and Virtual Reality Market by Technology and Geography - Forecast and Analysis 2021-2025*, June 2021. SKU: IRTNTR43509. Available at: https://www.technavio.com/report/augmented-reality-and-virtual-reality-market-industry-analysis?utm_source=prnewswire&utm_medium=pressrelease&utm_campaign=T47_RVO_report_wk1_003_2022&utm_content=IRTNTR43509&nowebp.

¹⁵¹⁹ Drawn from four cluster of risks in VR identified by: Snijders et al., *supra* note 1206.



6.3.1 International and EU law and policies

International law and policy

At the international level, there are several instruments related to consumer protection. From the UN, the United Nations Guidelines for Consumer Protection (UNGCP) is a non-binding guidance document that sets out elements of effective consumer protection law. From the Organisation for Economic Co-operation and Development (OECD) are the OECD Recommendation on Consumer Protection in E-commerce (2016)¹⁵²⁰, the Consumer Policy Guidance on Intangible Digital Content Products (2014), the OECD Recommendation of the Council Concerning Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices Across Borders (2003) and the Recommendation of the Council on Consumer Dispute Resolution and Redress (2007). While OECD Recommendations are not legally binding, they represent a political commitment and an expectation that adherents will do their best to implement them.¹⁵²¹ Lastly, there is the legally binding Convention on the Law Applicable to Products Liability, but it only has 11 Member State parties (all within Europe).

The United Nations Guidelines for Consumer Protection (UNGCP) The UNGCP (revised by the General Assembly in resolution 70/186 of 22 December 2015)¹⁵²² set out the main characteristics of effective consumer protection legislation, enforcement institutions and redress systems. The Guidelines (not legally binding but have been widely used globally¹⁵²³) help Member States formulate and enforce domestic and regional laws, rules and regulations that are suitable to their economic, social and environmental circumstances and promote international enforcement cooperation among Member States along with encouraging the sharing of experiences in consumer protection. The Guidelines address e-commerce aspects and provide that Member States should work towards enhancing consumer confidence in electronic commerce by the continued development of transparent and effective consumer protection policies. They also state that Member States should, where appropriate, review existing consumer protection policies to accommodate the special features of electronic commerce and ensure that consumers and businesses are aware of their rights and obligations in the digital marketplace. The UN Conference on Trade and Development (UNCTAD) promotes the guidelines and encourages interested member States to create awareness of the ways in which Member States, businesses and civil society can promote consumer protection in the provision of public and private goods and services.¹⁵²⁴ The Intergovernmental Group of Experts on consumer protection law and policy was established to monitor the implementation of the guidelines, provide a forum for consultations, produce

¹⁵²⁰ OECD (2016), *Consumer Protection in E-commerce: OECD Recommendation*, OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/9789264255258-en>.

¹⁵²¹ OECD, *Legal Instruments / OECD*. Available at: <https://www.oecd.org/legal/legal-instruments.htm>.

¹⁵²² United Nations Conference on Trade and Development (UNCTAD), *United Nations Guidelines for Consumer Protection*, 2016. UNCT AD/DITC/CPLP/MISC/2016/1. Available at: https://unctad.org/system/files/official-document/ditccplpmisc2016d1_en.pdf.

¹⁵²³ United Nations. (2013). *Implementation report on the United Nations Guidelines on Consumer Protection (1985–2013)* (E/1999/INF/2/Add.2). Geneva: United Nations Conference on Trade and Development. Available at: http://unctad.org/meetings/en/SessionalDocuments/ciclpd23_en.pdf.

¹⁵²⁴ United Nations. *United Nations guidelines for consumer protection / UNCTAD* [Online]. Available at: <https://unctad.org/topic/competition-and-consumer-protection/un-guidelines-for-consumer-protection>.

research and studies, provide technical assistance, undertake voluntary peer reviews, and periodically update the UNGCP.¹⁵²⁵

The **OECD Recommendation on Consumer Protection in E-commerce (2016)**¹⁵²⁶ applies to business-to-consumer e-commerce, including commercial practices through which businesses enable and facilitate consumer-to-consumer transactions and covers commercial practices related to both monetary and non-monetary transactions for goods and services, which include digital content products. It, inter alia, recognises the need to address consumer challenges related to information disclosure, misleading or unfair commercial practices, confirmation and payment, fraud and identity theft, and dispute resolution and redress. It sets out general principles related to transparent and effective protection, fair business, advertising and marketing practices, online disclosures (clarity accuracy accessibility and conspicuousness), confirmation process, payment, dispute resolution and redress, privacy and security and education, awareness and digital competence.

The OECD Consumer Policy Guidance on Intangible Digital Content Products (2014)¹⁵²⁷ covers a broad range of digital content products, including media and entertainment items (such as film, music, games, virtual world items, literature, e-books, magazines, journals, images, news and IP TV services), apps and personalisation services/add-ons, including ringtones and screensavers. It addresses issues concerning a) digital content product access and usage conditions, b) privacy and security, c) fraudulent, misleading and unfair commercial practices, d) children, e) dispute resolution and redress, and f) digital competence.

The OECD Recommendation of the Council concerning Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices across Borders¹⁵²⁸ addresses fraudulent and deceptive commercial practices occurring in connection with business-to-consumer transactions.

The OECD Recommendation on Consumer Dispute Resolution and Redress (2007)¹⁵²⁹ sets out common principles for Member countries on mechanisms for consumers to resolve disputes and obtain redress for economic harm resulting from transactions with businesses involving goods or services, including transactions across borders.

The Convention on the Law Applicable to Products Liability¹⁵³⁰ determines the law applicable to the liability of the manufacturers and other persons specified for damage caused by a product, including damage in consequence of a misdescription of the product or of a failure to give adequate notice of its qualities, its characteristics or its method of use. Products here include natural and industrial products, whether raw or manufactured and whether movable or immovable. The States signatory to

¹⁵²⁵ United Nations, *Intergovernmental Group of Experts on Consumer Protection Law and Policy / UNCTAD* [Online]. Available at: <https://unctad.org/topic/competition-and-consumer-protection/intergovernmental-group-of-experts-on-consumer-protection>.

¹⁵²⁶ OECD (2016), *Consumer Protection in E-commerce: OECD Recommendation*, OECD Publishing, Paris, <http://dx.doi.org/10.1787/9789264255258-en>.

¹⁵²⁷ OECD (2014), 'Consumer Policy Guidance on Intangible Digital Content Products', *OECD Digital Economy Papers*, No. 241, OECD Publishing, Paris. Available at: <http://dx.doi.org/10.1787/5jxvbrjq3gg6-en>.

¹⁵²⁸ OECD, *Recommendation of the Council concerning Guidelines for Protecting Consumers from Fraudulent and Deceptive Commercial Practices across Borders*, OECD/LEGAL/0317. Available at: <https://legalinstruments.oecd.org/public/doc/184/184.en.pdf>.

¹⁵²⁹ OECD (2007) *OECD Recommendation on Consumer Dispute Resolution and Redress*. OECD Publishing [Online]. Available at: <https://www.oecd.org/sti/consumer/38960101.pdf>. This applies to solely to complaints initiated by or on behalf of consumers, and not to complaints initiated by businesses against consumers or another business.

¹⁵³⁰ Convention of 2 October 1973 on the Law Applicable to Products Liability (entry into force 1977). Available at: <https://www.hcch.net/en/instruments/conventions/full-text/?cid=84>.

the Convention are bound to apply it, but it does not preclude consideration being given to the rules of conduct and safety prevailing in the State where the product was introduced into the market.

EU law and policy

At the European Union level, there are many laws, policies, and reports with direct relevance to consumer rights in the context of XR. The European Commission Communication on the *2030 Digital Compass: the European way for the Digital Decade*¹⁵³¹, highlights that “augmented reality will be at the core of new products, new manufacturing processes and new business models based on fair sharing of data in the data economy, digitalisation of public services”.

The EU regulatory framework includes the Consumer Rights Directive (CRD)¹⁵³² and its Guidance, Unfair Commercial Practices Directive (UCPD)¹⁵³³, Digital Content Directive (DCD)¹⁵³⁴, and Product Liability Directive.¹⁵³⁵ Additionally, the following proposed pieces of EU law would have bearing on consumer rights in the EU: Digital Services Act (DSA)¹⁵³⁶, Digital Markets Act (DMA)¹⁵³⁷, Data Governance Act (DGA)¹⁵³⁸, and Artificial Intelligence Act (AIA).¹⁵³⁹

Collectively, EU consumer laws provide consumers with the following specific rights: right to truthful advertising, right to have faulty goods repaired or replaced, right to contracts without unfair clauses, right to return most goods purchased online within 14 days, right to access goods and services on the same terms as local customers, and the right to free assistance from European Consumer Centres for problems with a trader based within the EU/EEA.¹⁵⁴⁰

Consumer Rights Directive (CRD)¹⁵⁴¹ and CRD Guidance: The CRD provides consumers with strong rights across the EU and harmonises national consumer rules. It is applicable to all contracts between a

¹⁵³¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the 2030 Digital Compass: The European way for the Digital Decade. Brussels, 9.3.2021 COM(2021) 118 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52021DC0118&rid=4>.

¹⁵³² European Parliament and the Council, Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC of the European Parliament and of the Council *OJ L* 304, 22.11.2011, p. 64–88.

¹⁵³³ European Parliament and the Council, Directive 2005/29/EC of the European Parliament and of the Council of 11 May 2005 concerning unfair business-to-consumer commercial practices in the internal market and amending Council Directive 84/450/EEC; Directives 97/7/EC, 98/27/EC and 2002/65/EC of the European Parliament and of the Council and Regulation (EC) No 2006/2004 of the European Parliament and of the Council ('Unfair Commercial Practices Directive') *OJ L* 149, 11.6.2005, p. 22–39.

¹⁵³⁴ Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services *PE/26/2019/REV/1 OJ L* 136, 22.5.2019, p. 1–27.

¹⁵³⁵ Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products *OJ L* 210, 7.8.1985, p. 29–33.

¹⁵³⁶ Proposal for a Regulation of the European Parliament and of the Council on a Single Market for Digital Services (Digital Services Act) and amending Directive 2000/31/EC COM/2020/825 final. Available at: <https://eur-lex.europa.eu/legal-content/en/TXT/?uri=COM%3A2020%3A825%3AFIN>.

¹⁵³⁷ *Ibid.*

¹⁵³⁸ *Ibid.*

¹⁵³⁹ Draft AI Act, *supra* note 1485.

¹⁵⁴⁰ Citizens Information, *Consumer Rights in the EU / Citizens Information* [Online]. Available at: https://www.citizensinformation.ie/en/consumer/consumer_laws/consumer_rights_in_eu.html.

¹⁵⁴¹ European Parliament and the Council, Directive 2011/83/EU of the European Parliament and of the Council of 25 October 2011 on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC of the European Parliament and of the Council *OJ L* 304, 22.11.2011, p. 64–88.



consumer and trader.¹⁵⁴² It defines a consumer as “any natural person who, in contracts covered by this Directive, is acting for purposes which are outside his trade, business, craft or profession”.¹⁵⁴³ The CRD Guidance¹⁵⁴⁴ facilitates the effective application of the CRD for consumers, businesses, the authorities of the Member States, including national courts, and legal practitioners, across the EU. Important in the context of XR, the guidance clarifies ‘goods’ includes digital content supplied on a tangible medium.¹⁵⁴⁵ Therefore, providers offering goods with digital elements, digital content and digital services must fulfil certain obligations, including informing the consumer also about products functionality, compatibility and interoperability.

The Unfair Commercial Practices Directive (UCPD)¹⁵⁴⁶ The UCPD approximates the laws of the EU Member States on unfair commercial practices (business-to-consumer commercial practices), including unfair advertising, which directly harm consumers’ economic interests and thereby indirectly harm the economic interests of legitimate competitors. It protects consumers from the consequences of such practices and addresses commercial practices directly related to influencing consumers’ transactional decisions in relation to products. A ‘product’ is defined as any goods or service including immovable property, rights and obligations – this would capture XR products. The UCPD prohibits unfair commercial practices i.e., practices that are contrary to the requirements of professional diligence, and materially distort or are likely to materially distort the economic behaviour with regard to the product of the average consumer whom it reaches or to whom it is addressed, or of the average member of the group when a commercial practice is directed to a particular group of consumers. EU Member States must ensure that adequate and effective means (via legal provisions) exist to combat unfair commercial practices to enforce compliance with the provisions of the UCPD in the interest of consumers. Persons or organisations regarded under national law as having a legitimate interest in combating unfair commercial practices, including competitors, may take legal action against such unfair commercial practices; and/or bring such unfair commercial practices before an administrative authority competent either to decide on complaints or to initiate appropriate legal proceedings.

Digital Content Directive (DCD) The Digital Content Directive (DCD)¹⁵⁴⁷ aims to provide a high level of consumer protection by laying down common rules on certain requirements concerning contracts between traders and consumers for the supply of digital content (data which are produced and

¹⁵⁴² Any natural person or any legal person, irrespective of whether privately or publicly owned, who is acting, including through any other person acting in his name or on his behalf, for purposes relating to his trade, business, craft or profession in relation to contracts covered by this Directive.

¹⁵⁴³ Directive 2011/83/EU, supra note of the European Parliament and of the Council of 25 October 2011 on consumer rights, amending Council Directive 93/13/EEC and Directive 1999/44/EC of the European Parliament and of the Council and repealing Council Directive 85/577/EEC and Directive 97/7/EC of the European Parliament and of the Council. Available at: <https://eur-lex.europa.eu/eli/dir/2011/83/2018-07-01>, amended by Directive (EU) 2019/2161 of the European Parliament and of the Council of 27 November 2019 amending Council Directive 93/13/EEC and Directives 98/6/EC, 2005/29/EC and 2011/83/EU of the European Parliament and of the Council as regards the better enforcement and modernisation of Union consumer protection rules PE/83/2019/REV/1 OJ L 328, 18.12.2019, p. 7–28

¹⁵⁴⁴ European Commission, Commission notice Guidance on the interpretation and application of Directive 2011/83/EU of the European Parliament and of the Council on consumer rights (CRD Guidance) 2021/C 525/01 C/2021/9314 OJ C 525, 29.12.2021, p. 1–85.

¹⁵⁴⁵ Ibid, p. 1–85.

¹⁵⁴⁶ European Parliament and the Council, Directive 2005/29/EC of the European Parliament and of the Council of 11 May 2005 concerning unfair business-to-consumer commercial practices in the internal market and amending Council Directive 84/450/EEC, Directives 97/7/EC, 98/27/EC and 2002/65/EC of the European Parliament and of the Council and Regulation (EC) No 2006/2004 of the European Parliament and of the Council (‘Unfair Commercial Practices Directive’) OJ L 149, 11.6.2005, p. 22–39.

¹⁵⁴⁷ Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services PE/26/2019/REV/1 OJ L 136, 22.5.2019, p. 1–27.



supplied in digital form) or digital services (services that allows the consumer to create, process, store or access data in digital form or allows the sharing of or any other interaction with data in digital form uploaded or created by the consumer or other users of that service). Goods with digital elements' means any tangible movable items that incorporate, or are inter-connected with, digital content or a digital service in such a way that the absence of that digital content or digital service would prevent the goods from performing their functions. The Directive covers inter alia, computer programmes, applications, video files, audio files, music files, digital games, e-books or other e-publications, and digital services which allow the creation of, processing of, accessing or storage of data in digital form, including software-as-a-service, such as video and audio sharing and other file hosting, word processing or games offered in the cloud computing environment and social media.

Product Liability Directive In the EU, consumers can claim compensation for damage caused by defective products.¹⁵⁴⁸ The key piece of legislation in force is Directive 85/374/EEC which provides strict liability for damage from defective products.¹⁵⁴⁹ 'Products' here mean all movables, with the exception of primary agricultural products and game, even though incorporated into another movable or into an immovable. A producer is liable for damage caused by defects in their products. A product is defective, per the Directive, when it does not provide the safety which a person is entitled to expect, taking all circumstances into account, including: (a) the presentation of the product; (b) the use to which it could reasonably be expected that the product would be put; (c) the time when the product was put into circulation. The European Commission evaluated the Directive and set up an expert group on liability and new technologies¹⁵⁵⁰ that will assist the Commission in drawing up guidance on the directive and assess the implications of emerging digital technologies for the wider liability frameworks at EU and national level. In 2020, the Commission published a report on the broader implications for, potential gaps in and orientations for, the liability and safety frameworks for artificial intelligence, the Internet of Things and robotics.¹⁵⁵¹ The report itself does not mention XR but confirms that the Product Liability Directive's definition of product is broad, its scope could be further clarified to better reflect the complexity of emerging technologies and ensure that compensation is always available for damage caused by products that are defective because of software or other digital features. National non-harmonised regimes provide fault-based liability rules.

Proposed Digital Services Act (DSA) The DSA proposes harmonised rules on the provision of intermediary services in the EU internal market for a safe, predictable, and trusted online environment.¹⁵⁵² It lays down a framework for the conditional exemption from liability of providers of intermediary services; rules on specific due diligence obligations tailored to certain specific categories of providers of intermediary services; rules on the implementation and enforcement of this Regulation, including as regards the cooperation of and coordination between the competent

¹⁵⁴⁸ European Commission, *Liability of defective products / European Commission* [Online]. Available at: https://ec.europa.eu/growth/single-market/goods/free-movement-sectors/liability-defective-products_en.

¹⁵⁴⁹ Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products *OJ L 210*, 7.8.1985, p. 29–33.

¹⁵⁵⁰ European Commission, *Register of Commission Expert Groups and Other Similar Entities: Expert Group on liability and new technologies (E03592) / European Commission* [Online]. Available at: <https://ec.europa.eu/transparency/expert-groups-register/screen/expert-groups/consult?do=groupDetail.groupDetail&groupID=3592&NewSearch=1&NewSearch=1>.

¹⁵⁵¹ Report From the Commission to the European Parliament, The Council and the European Economic and Social Committee, Report on the safety and liability implications of Artificial Intelligence, the Internet of Things and robotics COM/2020/64 final. Available at: <https://eur-lex.europa.eu/legal-content/en/TXT/?qid=1593079180383&uri=CELEX%3A52020DC0064>.

¹⁵⁵² Draft Digital Services Act, supra note 1536.

authorities. With regards to consumers, it aims to ensure users are more informed and can contest content, have access to dispute resolution, have transparent terms and conditions and greater safety and better knowledge of the real sellers of products bought. Illegal content under the DSA would include or activities involving infringements of consumer protection law.

Proposed Digital Markets Act (DMA) The DMA proposes harmonised rules ensuring contestable and fair markets in the digital sector across the Union where gatekeepers are present, to prevent them from imposing unfair conditions on businesses and consumers.¹⁵⁵³ Gatekeepers include companies that have a strong economic position, significant impact on the internal market and is active in multiple EU countries, has a strong intermediation position (meaning that it links a large user base to a large number of businesses), or has (or is about to have) an entrenched and durable position in the market, meaning that it is stable over time. The DMA specifies practices of gatekeepers that limit contestability or are unfair, market investigation conditions and rules and investigative, enforcement and monitoring powers for the European Commission.

Proposed Data Governance Act (DGA) The DGA lays down conditions for the re-use, within the Union, of certain categories of data held by public sector bodies; a notification and supervisory framework for the provision of data sharing services; a framework for voluntary registration of entities which collect, and process data made available for altruistic purposes.¹⁵⁵⁴

Proposed Artificial Intelligence Act (AIA) The AIA is intended to improve the protection of fundamental rights and providing legal certainty for operators and consumers in the specific context of AI.¹⁵⁵⁵ The AIA introduces a harmonised set of core requirements with regard to AI systems classified as high-risk and obligations for providers and users of those systems. Article 13 (Transparency and provision of information to users), Article 16 (Obligations of providers of high-risk AI systems) and Article 28 (Obligations of distributors, importers, users or any other third-party) are examples of some provisions that would support consumer rights. Helberger, Micklitz and Rott outline that the “AIA only indirectly addresses the consumer” and that “consumer concerns can only be channelled into the AIA if they enjoy ‘constitutional status’ under Article 38 of the Charter or be subsumed under one of the more outspoken rights. In short, the consumer acquis matters only as far as it can be ‘constitutionalised’ and ‘individualised’.”¹⁵⁵⁶

6.3.2 Right to safety

One of the key consumer rights implicated by XR is the right to safety. The consumer right to safety means entails protection from marketing of hazardous products; it means safe enjoyment/use (intended or foreseeable).

¹⁵⁵³ Proposal for a Regulation of the European Parliament and of the Council on contestable and fair markets in the digital sector (Digital Markets Act) COM/2020/842 final. Available at: <https://eur-lex.europa.eu/legal-content/en/TXT/?qid=1608116887159&uri=COM%3A2020%3A842%3AFIN>.

¹⁵⁵⁴ Proposal for a Regulation of the European Parliament and of the Council on European data governance (Data Governance Act) COM/2020/767 final. Available at: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020PC0767>.

¹⁵⁵⁵ Draft AI Act, supra note 1485.

¹⁵⁵⁶ Natali Helberger, Hans-W. Micklitz, Peter Rott, EU Consumer Protection 2.0 The Regulatory Gap: Consumer Protection in the Digital Economy Addendum to the report ‘Structural asymmetries in digital consumer markets’, BEUC, December 2021. Available at: https://www.beuc.eu/publications/beuc-x-2021-116_the_regulatory_gap_consumer_protection_in_the_digital_economy.pdf.

Safety concerns related to XR are wide-ranging,¹⁵⁵⁷ and may include physical injury caused by distraction¹⁵⁵⁸, injury/harm caused by misidentification or mistakes,¹⁵⁵⁹ exposure to pornography, violence and assault,¹⁵⁶⁰ headaches, eyestrain/vision issues and trauma, seizures, motion sickness,¹⁵⁶¹ psychological harm and well-being issues (addiction, desensitisation).¹⁵⁶² Product liability claims could arise where XR products are found to be defective (manufacture, design) or where no safety warnings or instructions are provided or found lacking giving rise to strict liability.¹⁵⁶³ Furthermore, negligence claims/actions for damages or claims for breach of warranties might arise where technical issues or errors are found. Claims might arise against application developers, hardware makers, or the platforms selling the products.¹⁵⁶⁴

XR consumer safety concerns could be addressed via regulations, standards, policies, market entry requirements, consumer warranties and information (health and safety risk warnings), technical measures, education and awareness and product recalls/withdrawals.

6.3.3 Right to be informed

The right to be informed means consumers having sufficient information to weigh alternatives and make an informed choice. It also includes the ability to protect themselves from false and misleading claims in advertising and labeling practices.

The OECD Recommendation¹⁵⁶⁵ clearly states, “Businesses should not make any representation, or omission, or engage in any practice that is likely to be deceptive, misleading, fraudulent or unfair. This includes the general impression likely conveyed to consumers by the representation or practice as well as implied factual misrepresentations conveyed through features such as the good or the service’s name, words, pictures, audio and/or video and the use of disclaimers that are hidden, hard to notice or to understand. Businesses should take special care in advertising or marketing that is targeted to children, vulnerable or disadvantaged consumers, and others who may not have the capacity to fully understand the information with which they are presented.”

¹⁵⁵⁷ BEIS, The safety of domestic virtual reality systems A literature review BEIS Research Paper Number 2020/038, RPN 4527. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/923616/safety-domestic-vr-systems.pdf.

¹⁵⁵⁸ Ayers, J.W., et al., “Pokémon GO—A New Distraction for Drivers and Pedestrians,” *JAMA Internal Medicine*, Sept. 16, 2016. Available at: <http://archinte.jamanetwork.com/article.aspx?articleid=2553331>.

¹⁵⁵⁹ Hobson A., *Reality Check: the Regulatory Landscape for Virtual and Augmented Reality*. R Street Policy Study No. 69 September 2016 [Online]. Available at: <https://www.rstreet.org/wp-content/uploads/2016/09/69.pdf>.

¹⁵⁶⁰ Slater et al., supra note 1083.

¹⁵⁶¹ Behr, K.-M., et al. (2005) ‘Some practical considerations of ethical issues in VR research’ *Presence*, 14, 668–676.

Available at: <https://doi.org/10.1162/105474605775196535>; Kirk Hamilton (2016) *One Wild, Occasionally Nauseating Week Of virtual reality With The Oculus Rift / KOTAKU* [Online]. Available at: <http://kotaku.com/one-wild-occasionally-nauseating-week-of-virtual-reality-1767442615>.

¹⁵⁶² Slater et al., supra note 1083.

¹⁵⁶³ Simmons + Simmons (2020) *TechNotes – Top 10 issues for AR/VR / Simmons + Simmons* [Online]. Available at: <https://www.simmons-simmons.com/en/publications/ck9o6smekb1q009003dpy4aqe/technotes-top-10-issues-for-ar-vr>.

¹⁵⁶⁴ Hoppe, D. (2016) *Collateral Damage: Real Legal Risks for Virtual Reality Companies / Gamma Law: Media, Technology, Innovation* [Online]. Available at: <https://gammalaw.com/collateral-damage-real-legal-risks-for-virtual-reality-companies/>.

¹⁵⁶⁵ OECD (2016). *Recommendation of the Council on Consumer Protection in E-commerce*. Paris: OECD Publishing. Available at: <http://dx.doi.org/10.1787/9789264255258-en>.

Mhaidli & Schaub,¹⁵⁶⁶ using scenarios, identified five key mechanisms of manipulative XR advertising: misleading experience marketing; inducing artificial emotions in consumers; sensing and targeting people when they are vulnerable; emotional manipulation through hyperpersonalization; and distortion of reality. The scenarios all show how consumers can be tricked or deceived through XR advertising in their ability to rationally evaluate the claims of an ad and make an informed decision of whether to purchase a product. The listed practices could fall foul of the UCPD, for example, coming within its ambit as unfair commercial practices (contrary to professional diligence, material distortions, misleading, aggressive).

Remedies against unfair commercial practices include use of legal provisions, legal action, bringing such practices before competent administrative authority. Courts or administrative authorities can order the cessation of, or to institute appropriate legal proceedings for an order for the cessation of, unfair commercial practices; if the unfair commercial practice has not yet been carried out but is imminent, to order the prohibition of the practice, or to institute appropriate legal proceedings for an order for the prohibition of the practice, even without proof of actual loss or damage or of intention or negligence on the part of the trader.

6.3.4 Right to choose

The right to choose is an important consumer right that entails consumers can select from a range of products and services, offered at competitive prices with an assurance of satisfactory quality. The monopolisation of the market by BigTech companies is detrimental to the consumer right to choose and frustrates its enjoyment due to the elimination of competition. One example is Meta's VR increasing acquisitions in this space for VR games and headsets, including Oculus in 2014. The US FTC has launched antitrust investigations¹⁵⁶⁷ along with some other states in the US.¹⁵⁶⁸ With regard to quality, a pertinent matter is whether consumers have a choice about who (especially third parties) gains access to their information processed in XR and how that will be used further.¹⁵⁶⁹

The right to choose is underpinned by the ability of consumers to access adequate information enable them to make informed choices according to their individual wishes and needs (UNGCP). The right to choose in the XR consumer context is/could be protected by legislation that promotes an environment where solutions providers can compete and eliminating anti-competitive practices, limitations on concept ownership through patent law, prevention of development of monopolies and sanctions using anti-trust or anti-merger legislation¹⁵⁷⁰ and regulations and prohibitions.

¹⁵⁶⁶ Mhaidli, A.H., and Schaub F. (2021). *Identifying manipulative advertising techniques in xr through scenario construction*. Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. Available at: https://mhaidli.github.io/papers/CHI_2021_XR_Advertising_Manipulation.pdf.

¹⁵⁶⁷ Sisco J. (2021) *FTC Slows Meta Platforms' Metaverse Strategy By Extending Antitrust Probe of VR Deal / The Information* [Online]. Available at: <https://www.bloomberg.com/news/articles/2022-01-14/meta-s-oculus-unit-faces-ftc-led-probe-of-competition-practices?srnd=technology-vp>.

¹⁵⁶⁸ Ibid.

¹⁵⁶⁹ Reed Smith LLP (2017). *Augmented and virtual reality: emerging legal implications of the "final platform"* [Online]. Available at: <https://www.reedsmith.com/-/media/files/perspectives/2017/06/augmented-virtual-reality-emerging-legal-implications-of-final-platform.pdf>.

¹⁵⁷⁰ E.g., Council Regulation (EC) No 139/2004 of 20 January 2004 on the control of concentrations between undertakings (the EC Merger Regulation). Available at: <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex%3A32004R0139>.

6.3.5 Right to redress

The right to redress entails consumers must receive fair settlements of just claims made and compensation for misrepresentation, shoddy goods or unsatisfactory services.¹⁵⁷¹

Terms of use XR products and services govern user disputes. Users are invited to contact the product manufacturer/service provider and resolve the dispute informally by sending written notice of their claim (via registered letter or email with confirmation of receipt) including their personal details and type and reason for the claim, and the specific compensation sought. If the provider and the complainant cannot agree on a solution within specified period, legal proceedings could be initiated. Where claims are under a certain limit, they could be resolved via binding non-appearance-based arbitration (a right to refrain or waive might also be provided).¹⁵⁷² Jurisdiction for disputes is as specified in the terms of service unless law excludes the specified jurisdiction from being applicable.¹⁵⁷³

The UNCPG outline businesses should make available complaints-handling mechanisms that provide consumers with expeditious, fair, transparent, inexpensive, accessible, speedy and effective dispute resolution without unnecessary cost or burden. They should consider subscribing to domestic and international standards pertaining to internal complaints handling, alternative dispute resolution services and customer satisfaction code. The CRD iterates consumers should have recourse to out-of-court complaints and redress mechanisms, to which the trader is subject, and the methods for consumers to have access to it.

6.3.6 Right to consumer education

The right to consumer education is more than a right to information¹⁵⁷⁴ and means consumers can “acquire knowledge and skills needed to make informed, confident choices about goods and services, while being aware of basic consumer rights and responsibilities and how to act on them”.¹⁵⁷⁵

The lack of consumer education in the XR market has been clearly highlighted (what the technologies are, what they can do).¹⁵⁷⁶ A lack of transparency further complicates matters (especially related to defective XR products as claims are quietly settled).

Consumer education measures (responsibility of both governments and businesses) would include programmes to provide adequate information on XR products and their rights, organisation of public campaigns, fora, meetings, seminars, debates. Education programmes

¹⁵⁷¹ National Consumer Federation, *The 8 Consumer Rights / National Consumer Federation* [Online]. Available at: <https://www.nationalconsumer.org.uk/consumer-voice/consumer-rights/>.

¹⁵⁷² See e.g., Resolution Games (2020) *Terms of Use / Resolution* [Online]. Available at: <https://www.resolutiongames.com/terms-of-use>; Meta (2022) *Oculus Terms of Service / Meta* [Online]. Available at: https://www.oculus.com/legal/terms-for-oculus-account-users/?locale=en_GB.

¹⁵⁷³ Google (2014) *Glass Explorer Edition Terms of Use / Google* [Online]. Available at: <https://www.google.co.uk/intl/en/glass/termsfuse/>.

¹⁵⁷⁴ Paul N. Bloom (1976) ‘How Will Consumer Education Affect Consumer Behavior?’, in Beverlee B. Anderson, Cincinnati, (eds) *NA - Advances in Consumer Research*, Volume 03, Association for Consumer Research, Pages: 208-212.

¹⁵⁷⁵ National Consumer Federation, *supra* note 1571; also, United Nations, *United Nations guidelines for consumer protection / UNCTAD* [Online]. Available at: <https://unctad.org/topic/competition-and-consumer-protection/un-guidelines-for-consumer-protection>.

¹⁵⁷⁶ PwC. *Growing VR/AR companies in the UK: a business and legal handbook*. Digital Catapult in association with PwC [Online]. Available at: <https://www.pwc.co.uk/intelligent-digital/vr/growing-vr-ar-companies-in-the-uk.pdf>.

should cover health concerns, product hazards, product labelling, relevant legislation, access to dispute resolution and redress mechanisms and agencies, information on prices, quality, availability, impact on environment.

6.3.7 Right to a healthy environment

The consumer right to a healthy environment means being able to live and work in an environment that is non-threatening to the well-being of present and future generations.¹⁵⁷⁷

As indicated before, for example, XR has the potential to seriously undermine this right both when an individual is in and has left the XR environment (e.g., extended immersion leading to loss of hand-eye coordination and associated safety risks).¹⁵⁷⁸

One important consideration is that for the right to healthy environment to be able to be maintained, exercised, and enforced, as Radulescu & Radulescu point out, “individuals must be educated and have access to information, take part in decisions and to access to justice in environmental matters.”¹⁵⁷⁹

6.3.8 Potential developments and future trends

This section explored the relation of consumer law/rights and XR; it presented an overview of the international and EU laws and policies. It also examined the application of key impacted core consumer rights.

Overall, despite the expanding XR market and accessibility of such products to consumers and their wider availability and integration in daily life, compared to before, legislative/policy examination has not kept the same pace. Protections for vulnerable categories of consumers such as children¹⁵⁸⁰ and individuals with mental vulnerability (e.g., proneness to psychosis) should be reviewed.

6.4 AI governance

As many XR applications integrate AI systems, any laws governing AI would apply to those XR applications.¹⁵⁸¹ While there are no international laws governing AI specifically, the EU has proposed a regulatory framework dedicated to AI governance. This framework, which includes a proposed AI Act, does not mention XR, but would apply (if adopted as written) to any XR technology using AI.

It should be noted that not all XR technologies utilise AI technologies and would, therefore, not be subject to any proposed AI regulation. For example, chatbots can be developed using AI-based NLP approaches or using an extensive word database (not AI-based). The former would be subject to the

¹⁵⁷⁷ National Consumer Federation, *supra* note 1571.

¹⁵⁷⁸ BEIS, *The safety of domestic virtual reality systems A literature review BEIS Research Paper Number 2020/038*, RPN 4527. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/923616/safety-domestic-vr-systems.pdf.

¹⁵⁷⁹ Radulescu, D. M. and Radulescu V. (2011) ‘Educating the consumer about his right to a healthy environment.’ *Procedia-Social and Behavioral Sciences* 15, 466-470.

¹⁵⁸⁰ Jerome, *supra* note 1356.

¹⁵⁸¹ See Reiners et al. (2021) ‘The Combination of Artificial Intelligence and Extended Reality: A Systematic Review’, *Frontiers in Virtual Reality*, 2 [Online]. Available at: <https://doi.org/10.3389/frvir.2021.721933>.

proposed AI Act, the latter not. Thus, a case-by-case analysis of the different XR applications would be required to understand if the proposed AI Act is applicable.

6.4.1 International and EU law and policy

International law and policy

There are no international laws or policies dedicated to the governance of AI.

EU law and policy

At the EU level, the European Commission proposed a regulatory framework for the governance of AI in April 2021, which includes a draft regulation on the governance of AI (proposed AI Act).¹⁵⁸² The primary objective of the proposed AI Act is to ensure the proper functioning of the internal EU market by setting harmonised rules for developing, placing and using AI systems in the EU, as well as pursuing “high level of protection of health, safety and fundamental rights” in the context of AI.¹⁵⁸³ The proposed AI Act sets out specific requirements for AI systems¹⁵⁸⁴ and obligations for all value chain participants.

The proposed AI Act follows a risk-based approach, where different legal obligations would be imposed depending on the level of risk posed to safety and fundamental rights. The risk-based approach provides a “risk scale” methodology that differentiates between uses of AI that create classifying into unacceptable risk, high risk and low or minimal risk. AI systems with an ‘unacceptable’ level of risk would be prohibited.¹⁵⁸⁵ ‘High’ risk AI systems would be subject to mandatory *ex ante* and *ex post* requirements in order to be placed on the EU market; those requirements would relate to high-quality data, documentation and traceability, transparency, human oversight, accuracy and robustness.¹⁵⁸⁶ For ‘low’ risk AI systems, there would be limited transparency obligations.¹⁵⁸⁷ Minimal risk AI systems would not be subject to any requirements.¹⁵⁸⁸

6.4.2 Risk classification of XR technologies with AI

Within the EU, XR technologies with AI systems would be subject to the requirements in the proposed AI Act (if adopted) depending on the level of risk posed by the AI system.

Unacceptable risk

XR with AI that poses an unacceptable risk would be prohibited. The proposal identifies four types of prohibited AI systems:

Uses subliminal techniques to manipulate a person’s behaviour in a manner that may cause psychological or physical harm for themselves or another person.

¹⁵⁸² Draft AI Act, *supra* note 1485.

¹⁵⁸³ *Ibid*, Preamble.

¹⁵⁸⁴ In the proposed AI Act, artificial intelligence is defined as: “software that is developed with one or more of the techniques and approaches listed in Annex I and can, for a given set of human-defined objectives, generate outputs such as content, predictions, recommendations, or decisions influencing the environments they interact with”. *Ibid*, Article 3.

¹⁵⁸⁵ *Ibid*, Article 5.

¹⁵⁸⁶ *Ibid*, Chapter 2.

¹⁵⁸⁷ *Ibid*, Article 52.

¹⁵⁸⁸ *Ibid*, Preamble, para. 81.



Exploits vulnerabilities of any group of people due to their age, physical, or mental disability in a manner that may cause psychological or physical harm.

Enables governments to use general-purpose “social credit scoring.”

Provides real-time remote biometric identification in publicly accessible spaces by law enforcement except in certain time-limited public safety scenarios.¹⁵⁸⁹

The fourth category is unlikely to apply to XR, as it includes the element of “publicly accessible spaces”, which refers to physical (not digital or virtual) public spaces.¹⁵⁹⁰ It is possible, in theory, that the remaining three types of AI systems may be part of an XR system and may therefore be subject to prohibition.

High risk

XR applications with AI that poses a high risk would be subject to mandatory requirements in order to enter the EU marketplace. The classification of high risk would be based on the function and specific purpose of the AI system; specific high-risk domains identified in the proposal include education, employment, and justice systems.¹⁵⁹¹ Therefore, any XR that uses AI in high risk domains would need to meet the mandatory requirements. In general, any XR application that is designed to determine and decide the access of a natural person to essential private services, public services, financial benefits, education, training, jobs, migration, asylum, and border control, including verifying the authenticity of travel documents, would fall within the scope of the AI proposal. As there are already many existing XR applications deployed in these domains (see Sections 6.1.7, 6.1.8 and 6.1.9), it is likely they would likely be classified as high-risk and subject to the mandatory requirements under the proposed AI Act.

Low and minimal risk

XR technologies with AI classified as low risk would only be subject to transparency requirements.¹⁵⁹² For example, in the case of AI-based XR systems created to interact with people (e.g., AI-based chatbots), users should be made aware that they are interacting with an AI machine.

XR applications with minimal risk AI would not be subject to any requirements but would be encourage subscribe to voluntary codes of conduct.¹⁵⁹³ The EC has stated that “vast majority of AI systems fall into this category” and that the category includes AI-enabled video games.¹⁵⁹⁴ As many current XR systems are deployed for gaming and other entertainment,¹⁵⁹⁵ a significant portion of XR with AI would likely fall in the ‘minimal’ risk category. Therefore, it is possible – and perhaps likely –

¹⁵⁸⁹ Ibid, Article 5.

¹⁵⁹⁰ Ibid, Article 3(39).

¹⁵⁹¹ Ibid, Article 6-7, Annex III.

¹⁵⁹² Ibid, Article 52.

¹⁵⁹³ Ibid, Article 69.

¹⁵⁹⁴ European Commission. (2021) *Press release: Europe fit for the Digital Age: Commission proposes new rules and actions for excellence and trust in Artificial Intelligence* [Online]. Available at: https://ec.europa.eu/commission/presscorner/detail/en/IP_21_1682.

¹⁵⁹⁵ Grand View Research. (2021) *Report Overview - Virtual Reality Market Size, Share & Trends Analysis Report By Technology (Semi & Fully Immersive, Non-immersive), By Device (HMD, GTD, PDW), By Component (Hardware, Software), By Application, By Region, And Segment Forecasts, 2022 – 2030* [Online]. Available at: <https://www.grandviewresearch.com/industry-analysis/virtual-reality-vr-market/methodology#>.

that the 'vast majority' of XR with AI would not be subject to any mandatory obligations under the proposed AI Act.

6.4.3 Environmental impacts of AI in XR

AI systems, and the XR technologies that utilise them, may have significant environmental and energy impacts, including carbon footprints.¹⁵⁹⁶ The proposed AI Act does not address this issue with any mandatory requirements. However, individual AI providers and organisations are encouraged to develop voluntary codes of conduct which may include, among other issues, 'environmental sustainability'.¹⁵⁹⁷

6.5 Digital services governance

Since many XR applications provide services in the online environment, any laws governing the provision of digital services would apply to those XR systems. While there are no international laws governing digital services specifically, the EU has proposed a regulatory framework dedicated to the governance of digital services. This framework, which includes a proposed Digital Services Act, does not mention XR explicitly but would apply (if adopted as written) to providers of XR offering services in the digital environment.

6.5.1 International and EU law and policy

International law and policy

There are no international laws or policies dedicated to the governance of digital services, however it has been suggested that the legal framework applicable to trade in services under international trade law is additionally inclusive of digital services.¹⁵⁹⁸

EU law and policy

At the EU level, the European Commission proposed a regulatory framework for the governance of digital services in December 2020, an aspect of which includes a draft regulation on the governance of digital services (proposed Digital Services Act).¹⁵⁹⁹ The draft Digital Services Act (DSA), on which a political agreement was reached in April 2022, sets out a horizontal framework to ensure transparency, accountability and regulatory oversight of the EU online space.¹⁶⁰⁰ The primary purpose of the proposed DSA is to protect internet users and their fundamental rights by establishing new standards and rules for online platforms regarding illegal and harmful content. The potential implications of the proposed DSA for citizens, business users and providers of digital services, alongside society at large, are summarised in the table below.

¹⁵⁹⁶ See, Andrews, E.L. (2020) *AI's Carbon Footprint Problem* / *Stanford University Human-Centered Artificial Intelligence (HAI)* [Online]. Available at: <https://hai.stanford.edu/news/ais-carbon-footprint-problem>.

¹⁵⁹⁷ Draft AI Act, supra note 1485, Article 69.

¹⁵⁹⁸ See, e.g., Willemyns I. (2021) *Digital Services in International Trade Law* (Cambridge University Press) Available at: <https://doi.org/10.1017/9781108946353>.

¹⁵⁹⁹ Draft Digital Services Act, supra note 1536.

¹⁶⁰⁰ Madiega T. (2021) *Digital Services Act [EU Legislation in Progress]* / European Parliamentary Research Services [Online]. Available at: <https://epthinktank.eu/2021/03/05/digital-services-act-eu-legislation-in-progress/>.

Table 11: Potential implications of the proposed DSA

Citizens	<ul style="list-style-type: none"> • Better protection of fundamental rights • More choice, lower prices • Less exposure to harmful and/or illegal content
For providers of digital services	<ul style="list-style-type: none"> • Legal certainty, harmonisation of rules • Easier to start up and scale up in Europe
For business users of digital services	<ul style="list-style-type: none"> • More choice, lower prices • Access to EU-wide markets through platforms • Level playing field against providers of illegal content
For society at large	<ul style="list-style-type: none"> • Greater democratic control and oversight over systemic platforms • Mitigation of systemic risks, such as manipulation or disinformation

6.5.2 Obligations for a safe and transparent online environment

The proposed DSA imposes different sets of obligations for distinct categories of online intermediaries according to their role, size and socio-economic impact on the online environment.

- **Intermediary services:** Providers of network infrastructure services, including ‘mere conduit’ services (e.g., internet access), ‘caching’ services (e.g., automatic, intermediate and temporary storage of information) and ‘hosting’ services (e.g., storage of information supplied by a recipient of the service).¹⁶⁰¹
- **Online platform:** Providers of hosting services which store and disseminate information to the public at the request of the recipient of the service.¹⁶⁰²
- **Very large online platforms (VLOPs):** Providers of hosting services that pose a particular risk of societal harm in disseminating harmful content. Specific rules are applicable to such platforms, defined as those which reach more than 45 million active recipients in the EU every month,¹⁶⁰³ therefore likely including some XR developers, such as Meta.

The draft DSA stipulates various basic obligations applicable to all providers of XR intermediary services falling within the scope of the regulation, including those established outside of the EU,¹⁶⁰⁴ such as establishing a point of contact,¹⁶⁰⁵ appointing a legal representative if based outside the EU,¹⁶⁰⁶ and publishing annual reports on content moderation pursuant to the principle of transparency.¹⁶⁰⁷ Alongside these basic obligations, there are specific obligations applicable to XR hosting services, such as establishing notice and action mechanisms,¹⁶⁰⁸ and additional obligations applicable to all XR online platforms, except for micro and small enterprises,¹⁶⁰⁹ including to establish

¹⁶⁰¹ Draft Digital Services Act, supra note 1536, Article 2(f).

¹⁶⁰² Ibid, Article 2(h).

¹⁶⁰³ Ibid, Article 25.

¹⁶⁰⁴ Ibid, Article 1(3).

¹⁶⁰⁵ Ibid, Article 10.

¹⁶⁰⁶ Ibid, Article 11.

¹⁶⁰⁷ Ibid, Article 13.

¹⁶⁰⁸ Ibid, Article 14.

¹⁶⁰⁹ Ibid, Article 16.

an internal complaint-handling system¹⁶¹⁰ and protective measures against misuse,¹⁶¹¹ and to ensure the traceability of traders.¹⁶¹² Micro and small enterprises will have obligations proportionate to their size and ability while ensuring they remain accountable. The same principle applies to XR providers properly classified as VLOPs which, in recognition of their potentially significant economic and societal impact, are subject to certain substantive obligations in addition to the basic obligations outlined above, including conducting annual risk assessments¹⁶¹³ and independent audits,¹⁶¹⁴ alongside appointing compliance officers.¹⁶¹⁵

6.5.3 Discrimination

As highlighted above (see Section 6.1.12), the use of XR platforms may lead to users, particularly vulnerable users, suffering discrimination. In recognition of this risk, it is stated within the preamble to the draft text of the DSA that the proposal seeks, inter alia, to ensure that users can exercise their right to non-discrimination.¹⁶¹⁶ Building on this commitment to the protection of individuals against discrimination, the proposed DSA requires, more substantively, that VLOPs explicitly consider the risk of discrimination in their yearly systemic risk assessments,¹⁶¹⁷ and, moreover, provides that the European Board for Digital Services, as constituted by the DSA,¹⁶¹⁸ can recommend the Commission draws up crisis protocols which, inter alia, clearly set out the relevant measures to safeguard against any negative effects to the right to non-discrimination.¹⁶¹⁹

7. Conclusions and future outlook

As shown in this report, the three technology families of climate engineering, neurotechnologies, and digital extended reality present various legal issues and challenges with wide-ranging socio-economic and human rights implications. There are no comprehensive, dedicated legal frameworks at the international or EU level for any of the three families. However, they are nonetheless subject to various existing domain-specific international and EU law frameworks.

The analysis of legal issues and gaps in the legal frameworks contained in this report will serve as the basis for future work in the TechEthos project to develop recommendations for policy and legal reform.

7.1 Climate engineering

As shown in Section 4, climate engineering technologies present multiple and complex legal issues and challenges with wide-ranging socio-economic and human rights implications. A survey of the international and EU law landscape has revealed that there is no comprehensive legal framework for the governance of climate engineering, other than general climate obligations and environmental

¹⁶¹⁰ Ibid, Article 17.

¹⁶¹¹ Ibid, Article 20.

¹⁶¹² Ibid, Article 22.

¹⁶¹³ Ibid, Article 26.

¹⁶¹⁴ Ibid, Article 28.

¹⁶¹⁵ Ibid, Article 32.

¹⁶¹⁶ Ibid, preamble, p. 12.

¹⁶¹⁷ Ibid, Article 26.

¹⁶¹⁸ Ibid, Article 47.

¹⁶¹⁹ Ibid, Article 37(4)(e).



protection. However, specific types of climate engineering are subject to dedicated governing mechanisms:

- **Ocean iron fertilisation** is subject to a non-binding ban under international environmental law and law of the seas.
- **CCS in transboundary deep seabeds** is governed under international law of the seas.
- **CCS generally** is governed by the CCS Directive under EU law.

Furthermore, climate engineering technologies – particularly CDR approaches – are expressly contemplated in international and EU climate law and in EU law on corporate disclosure and sustainable finance. However, climate engineering technologies are never required by law and are not regulated (with the exception of CCS).

Such technologies are nonetheless subject to various domain-specific international and EU law frameworks, including human rights law (see Section 4.1), rules on state responsibility (see Section 4.2) environmental law (see Section 4.3), climate law (see Section 4.4), space law (see Section 4.5), and law of the seas (see Section 4.6).

Analysis of these frameworks reveal four key points about the governance of climate technologies. One, the specific approach and type of climate engineering proposal is very important. As each type of climate engineering involves very different elements, activities, and physical spaces, even a slight difference in the technology triggers different concerns and legal frameworks. Two, despite the existence of accountability frameworks, it would likely be very difficult to hold an actor – public or private – responsible for harm caused directly or indirectly by climate engineering. In addition to a lack of effective redress mechanisms, the challenges of establishing legal liability include defining ‘harm’, assessing causation, identifying the responsible party, and weighing mitigating circumstances. Third, there is a unique tension between competing interests in the legal frameworks, particularly environmental law and climate law. It is arguably impossible to achieve the goals of climate law without climate engineering, but climate engineering activities may frustrate the purpose or directly violate environmental protection objectives. At present, this significant tension in the objectives of the different legal frameworks may be irreconcilable. Four, policy and legal developments have often contemplated whether a specific technology should be subject to prohibition. With the exception of CCS, conversations about the governance of climate engineering do not focus on how the technology should be regulated, but rather whether the technology should be permitted at all.

At the time, there is no initiative towards the comprehensive regulation of climate engineering at the international or EU level. If the past is any indication, further development of any legal frameworks will continue to address specific types of climate engineering individually. Given the inherently global impacts and scale of climate engineering, regulation of this technology family may require governance at the international and EU level. The possibility of national level governance will be analysed in a forthcoming TechEthos report on national legal frameworks.

7.2 Neurotechnologies

As outlined in Section 5, neurotechnologies present multiple and complex legal issues and challenges with wide-ranging socio-economic and human rights implications. A survey of the legal landscape, specifically the applicable international and EU law, has shown that there is no dedicated legislation with direct application to neurotechnologies. Such technologies are nonetheless subject to various domain-specific legal frameworks, including human rights law (see Section 5.1) and privacy and data protection law (see Section 5.2), and further regulatory measures with potential application to

neurotechnologies are expected, particularly under EU law such as the proposed AI Act, DGA and DSA (see Section 3.9).

In the absence of more targeted regulatory measures, human rights-based frameworks are designed to be adaptable to the issues raised by new and emerging technologies in order to better protect the rights of individuals against interference. The “living instrument” doctrine applicable to the ECHR and the CFREU,¹⁶²⁰ for instance, ensures that the relevant human rights law can be updated to address new challenges, whether it be through expanded interpretations of existing rights or through the introduction of new rights. The introduction of so-called “neurorights” to supplement the existing international and EU human rights frameworks would impact States’ obligations vis-à-vis neurotechnologies, potentially requiring that States strengthen the protection of individuals against intrusions by neurotechnologies into, inter alia, notions of mental privacy, cognitive liberty, mental integrity and psychological continuity (see Section 5.1.13). The necessity of such additional rights may depend on the effectiveness of existing human rights law to respond to the specific challenges posed by neurotechnologies, which include, inter alia, neurodiscrimination, instances of so-called “brain-hacking” and the status of brain data. The latter is a key challenge in relation to neurotechnologies, with ambiguity surrounding the applicable regulatory basis for the processing of brain data and the comprehensiveness of such regulation, particularly in the light of the emergence of consumer-based neurotechnologies, in addition to the ongoing debate regarding whether brain data is adequately protected by the existing right to privacy or whether a novel right to mental privacy would better protect against potential interferences (see Section 5.1.13). In practice, these unresolved issues may lead to a gap in the protection of the human rights of users.

Overall, this analysis of international and EU law and policy in relation to neurotechnologies has highlighted how the relevant legal and policy developments have focused on *how* such technologies should be regulated, not *whether* such technologies should be permitted. However, without clear initiative to regulate at the international or EU level, it is possible that further governance of this technology family will occur at the national level, the possibility for which will be analysed in a forthcoming TechEthos report on legal frameworks at the national level.

7.3 Digital Extended Reality (XR)

As shown in Section 6, XR technologies present multiple and complex legal issues and challenges with wide-ranging socio-economic and human rights implications. A survey of the international and EU law landscape has revealed that there is no dedicated legislation with direct application to XR. Such technologies are nonetheless subject to various domain-specific international and EU law frameworks, including human rights law (see Section 6.1) privacy and data protection law (see Section 6.2), and consumer rights law (see Section 6.3). Further legislative measures at the EU level are also expected, with each of the e-Privacy Regulation, the AI Act, the Digital Services Act, the Data Act and the Data Governance Act at varying stages of the legislative schedule (see Sections 3.9, 6.4 and 6.5) and all likely to impact upon the regulation of XR technologies.

Even in the absence of additional regulatory measures, a key advantage of rights-based legal frameworks is the built-in flexibility to adapt to the challenges posed by new and emerging technologies, including XR, in order to better protect the rights of individuals against interference.

¹⁶²⁰ See, e.g., *Case of Tyrer v. The United Kingdom* (Application no.5856/72) (25 April 1978) at para.31: “The Court must also recall that the Convention is a living instrument which, as the Commission rightly stressed, must be interpreted in the light of present-day conditions.”

Certain human rights frameworks, for instance, are treated as “living instruments”,¹⁶²¹ in accordance with which they are constantly evolving to address new challenges, whether it be through expanded judicial interpretations of existing rights, or the introduction of new rights to supplement existing protections. A more expansive interpretation of the right to a healthy environment, for instance, may require that States place restrictions on the use of materials for XR development which cause environmental harms, such as habitat destruction and toxic waste contamination. Meanwhile, the formal recognition at the international or EU level of a right to be online and a right to disconnect, either as an aspect of the right to benefit from scientific progress and the right to rest and leisure, or as standalone rights, may require that States take measures to ensure equal access to engaging with and clear limits upon the use of digital environments, particularly those configured as virtual workspaces (see Section 6.1.13). Such mechanisms could significantly impact States’ obligations in relation to both individuals and the development of XR.

A future challenge, however, concerns the definition to be attributed to XR technologies, the significance of which is in determining the applicable basis for legal regulation. In the context of consumer protection, for instance, the definition of XR may determine the applicable recourse mechanism in the event of a breach of a consumer right, such as the right to safety (see Section 6.3.2). Bearing in mind some of the issues associated with the definition of Artificial Intelligence (AI) for the purposes of the proposed AI Act, particularly the potentially underinclusive definition based on approaches and techniques used to create an AI system rather than any other metric, legislators and policymakers at the international and EU level will be required to carefully consider the question of the most suitable and comprehensive definition for XR technologies in the context of legal regulation.

An additional future challenge relates to the regulation of data collected and processed in XR technologies. The issue is not simply the sheer volume of data used by XR technologies to enable core functionality, but also that this data is often of varying type and collected from multiple sources, in relation to which there will be different privacy and data protection considerations and variation in the specific legal provision to be complied with (see Section 6.2.3). In practice, this may impose a significant regulatory burden on XR developers and create gaps in the protection of the fundamental rights of XR users.

Overall, this analysis of international and EU law and policy in relation to XR has highlighted how the discussion is primarily framed as a question of *how best* to regulate such technologies, rather than a question of *whether* such technologies should be developed. This contrasts with AI, another emerging technology with application to XR, in relation to which regulators are increasingly seeking to restrict certain AI systems and/or uses of AI systems which may infringe upon protected rights.¹⁶²²

At present, there is no proposal to comprehensively regulate XR at the international or EU level. Further governance of this technology family may occur at the national level, the possibility for which will be analysed in a forthcoming TechEthos report on legal frameworks at the national level.

¹⁶²¹ Ibid.

¹⁶²² Proposal for a Regulation of the European Parliament and of the Council Laying Down Harmonised Rules on Artificial Intelligence (Artificial Intelligence Act) And Amending Certain Union Legislative Acts COM/2021/206 final (draft AI Act), Article 5.

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