



TECHETHOS

FUTURE ○ TECHNOLOGY ○ ETHICS



D4.1 Analysis of international and EU law and policy Part I: Climate Engineering



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D4.1 Analysis of international and EU law and policies – Part I: Climate Engineering

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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
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
Solar radiation management (SRM)	A type of climate engineering that aims to reflect some sunlight and heat back into space.

Table 2: List of Abbreviations

Term	Explanation
BECCS	Bioenergy with carbon capture and storage
CAT	Convention Against Torture
CBD	Convention on Biological Diversity
CCPR	United Nation Human Rights Committee
CCS	Carbon capture and storage

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>.

CCU	Carbon capture and utilisation
CDR	Carbon dioxide removal
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
CO2	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
DAC	Direct Air Capture
DoA	Description of Action
DOALAW	United Nations Division for Ocean Affairs and the Law of the Seas
EC	European Commission
ECHR	European Convention on Human Rights (CoE)
ECtHR	European Court of Human Rights (CoE)
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
FRA	Fundamental Rights Agency (EU)
GHG	Greenhouse gas
HRC	Human Rights Council (UN)
ICCPR	International Covenant on Civil and Political Rights
ICESCR	International Covenant on Economic, Social and Cultural Rights
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
ITRE	Committee for Industry, Research and Energy
LC/LP	London Convention / London Protocol
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
SDGs	U.N. Sustainable Development Goals
SRM	Solar radiation management
TEU	Treaty on European Union
TFEU	Treaty on the Functioning of the European Union
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
WMO	World Meteorological Organisation

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Executive Summary

This Deliverable 4.1, involving an analysis of international and EU law and policies, 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).

TechEthos Deliverable 4.1 explores and analyses relevant international and EU laws and policies for their relevance and applicability to each of the technology families. Based on the analysis of the characteristics, applications, ethics and socio-economic impacts of these technologies, as emerged in previous phases of the TechEthos project, Deliverable 4.1 serves 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.

TechEthos Deliverable 4.1 is divided into three parts. Part I focuses on climate engineering and the significant legal issues such technologies present. Part II and III focus on neurotechnologies and digital extended reality (XR), respectively.

For the purpose of this report, climate engineering is 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."²

There is no comprehensive or dedicated international or EU law governing climate engineering. 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 climate engineering are analysed, and cover human rights law, rules on state responsibility, environmental law, climate law, space law, and law of the seas.

TechEthos Deliverable 4.1 presents the obligations of States (for international law) and/or Member States (for EU law) and the rights of private individuals under those laws for each technology family. Discussion of the obligations of private individuals and entities will be the focus on a report (TechEthos Deliverable 4.2) 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).

² 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>.



Part I: Climate engineering

Part I 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	<ul style="list-style-type: none"> 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 CO₂
Space law	<ul style="list-style-type: none"> State responsibilities in outer space Environmental protection and liability for environmental harm in space Exploitation and mining of space resources
Law of the seas	<ul style="list-style-type: none"> 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 impact 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 (TechEthos Deliverable 4.2).



1. Introduction

Climate engineering presents many significant legal issues that impact socio-economic equality and fundamental rights. There is no comprehensive or dedicated international and EU law governing this technology family, though many elements of the technology are subject to existing laws and policies.

Part I of TechEthos Deliverable 4.1 explores and analyses relevant international and EU laws and policies in relation to climate engineering. Parts II and III focus on neurotechnologies and digital extended reality (XR) respectively. 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 Part I.

Table 4: International and EU legal frameworks

Climate engineering
<ul style="list-style-type: none">• Human rights law• Rules of state responsibility• Environmental law• Climate law• Space law• Law of the Seas

1.1 Defining the technology family

For the purpose of the TechEthos project and this report, we have used the following definition of climate engineering:

- **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."³

For more information about the technology families and their innovation ecosystems, visit:

<https://www.techethos.eu/resources/>.

1.2 Key legal issues

As TechEthos Deliverable 4.1 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).

³ 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>.



While some of the legal issues considered in Deliverable 4.1 are cross-cutting (e.g., privacy, safety) across the three 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.

The legal issues considered in relation to climate engineering are identified in the table below.

Table 5: Legal issues in climate engineering

Legal issues in international and EU law: Climate engineering
<ul style="list-style-type: none">○ 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○ Management of deep-seabed drilling and storage

1.3 Structure of report

Following this introduction, **Section 2** describes the methodology for developing the analysis report. **Section 3** provides a high-level summary of the legal frameworks discussed in relation to climate engineering. **Section 4** presents the international and European Union law frameworks with application to climate engineering. The report concludes with a high-level discussion of gaps, challenges and trends in **Section 5**. A reference list is included at the end.

2. Methodology and scope

TechEthos Deliverable 4.1 is part of the policy, legal and regulatory analysis conducted in accordance with 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.⁴ 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?)⁵

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 Deliverable 4.1 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 (Deliverable 4.2).

⁴ 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/>.

⁵ See, Danner, R.A. (1987) ‘From the Editor: Working with Facts’, *Law Library Journal*, 79.



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 climate engineering is a new and emerging technology, the legal scholarship does not always use the same terminology. For climate engineering, we also used the search terms 'geoengineering' and the specific types of climate engineering (e.g., solar radiation management, marine cloud brightening).

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).

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 Part I of the report are human rights law, rules on state responsibility, environmental law, climate law, space law, law of the seas.

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.⁶

⁶ 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>.



Subsequent treaties are legally binding on contracting States.⁷ There are seven core international human rights treaties, each with a committee of experts (treaty body) responsible for monitoring treaty implementation.⁸ The UDHR and two of those treaties – International Covenant on Civil and Political Rights (ICCPR) and International Covenant on Economic, Social and Cultural Rights (ICESCR) – are collectively known as the International Bill of Human Rights.⁹ To assist States with interpreting treaty language, the treaty bodies publish non-binding guidance in the form of *General Comments* or *General Recommendations*.¹⁰ 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.¹¹ 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’.¹² These experts take the form of Working Groups, Independent Experts and Special Rapporteur; collectively, they are known as the OHCHR ‘Special Procedures’.¹³ Also relevant is the U.N. Human Rights Council, an inter-governmental body responsible for addressing human rights violations.¹⁴ 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.¹⁵ 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.¹⁶ 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.¹⁷

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.

⁷ Vienna Convention Law of Treaties, Article 2(1).

⁸ 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 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).

⁹ U.N. General Assembly. (1948) *Resolution 217 (III) international Bill of Human Rights*, adopted 10 December 1948.

¹⁰ U.N. Office of the High Commissioner for Human Rights. *General Comments* / [Online]. Available at: <https://www.ohchr.org/en/treaty-bodies/general-comments>.

¹¹ U.N. Office of the High Commissioner for Human Rights. *High Commissioner* / [Online]. Available at: <https://www.ohchr.org/en/about-us/high-commissioner>.

¹² 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>.

¹³ Ibid.

¹⁴ 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>.

¹⁵ 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>.

¹⁶ United Nations. *Main Bodies* / [Online]. Available at: <https://www.un.org/en/about-us/main-bodies>.

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



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.¹⁸ 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.¹⁹ The European Court of Human Rights (ECtHR) is the body of the CoE responsible for hearing cases under the ECHR.²⁰ Decisions of the ECtHR are binding on Member States of the CoE.²¹

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).²² The European Court of Justice (CJEU), the supreme court of the EU, is responsible for interpreting EU law, including the Charter of Fundamental Rights.²³ 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.²⁴ The Fundamental Rights Agency (FRA) is the EU agency that supports the promotion and protection of human rights within the EU.²⁵ 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.²⁶

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.²⁷ 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.

¹⁸ Council of Europe. *Values: Human rights, Democracy, Rule of Law* / [Online]. Available at: <https://www.coe.int/en/web/about-us/values>.

¹⁹ 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.

²⁰ Council of Europe. *European Court of Human Rights* / [Online]. Available at: <https://echr.coe.int/Pages/home.aspx?p=home>.

²¹ ECHR, Article 46.

²² Charter of Fundamental Rights of the European Union (entry into force 18 December 2009), 2000/C 364/01 (CFREU).

²³ E.U. Court of Justice. *Presentation* [Online] Available at: https://curia.europa.eu/jcms/jcms/Jo2_7024/en/.

²⁴ Council of the European Union. (2020) *EU Action Plan on Human Rights and Democracy 2020-2024*, 18 November 2020, 12848/20

²⁵ E.U. Fundamental Rights Agency. *FRA – Promoting and protecting your fundamental rights across the EU* / [Online]. Available at: <https://fra.europa.eu/en>.

²⁶ 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.

²⁷ 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].



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 1992.²⁸ The Rio Declaration that was adopted at the UNCED is the most significant universally endorsed statement of the rights and obligations of States relating to the environment.²⁹ Whilst the Declaration itself is not legally binding, it is in many places a restatement of existing customary international law and environmental law principles.³⁰

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.³¹

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.³² Today, 197 countries are Party to the Framework Convention and meet annually to discuss climate matters during the Conference of the Parties (COP).³³ 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

²⁸ Birnie P., Boyle A., and Redgwell C. (2021). *International Law and the Environment*. 4th ed, Oxford: Oxford University Press, p. 2.

²⁹ Ibid, p. 112.

³⁰ Ibid.

³¹ 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).

³² 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 28, p. 357.

³³ 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>.



determining their national contributions to combatting climate change, and to pursuing domestic measures to achieve their objectives.³⁴

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 1984.³⁵ 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.³⁶ 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.³⁷ In comparison to the 1984 Moon Agreement, which only has 18 State parties,³⁸ the barely two-year old *Artemis Accords* has 19 signatories.³⁹

'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.⁴⁰

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

³⁴ Paris Agreement, Article 4 (2).

³⁵ 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.

³⁶ 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>.

³⁷ 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>.

³⁸ 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.

³⁹ 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").

⁴⁰ 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.



includes territorial waters and an Exclusive Economic Zone (EEZ),⁴¹ and any activity within the 200 nautical miles is governed mostly by domestic law. Beyond that point, the high seas (or international waters) are considered “the common heritage of mankind”⁴² 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.⁴³ 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.⁴⁴ 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.

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.

⁴¹ 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.

⁴² Ibid, Article 136.

⁴³ 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).

⁴⁴ See, U.N. Environmental Programme. Regional Seas Programme. Available at: <https://www.unep.org/explore-topics/oceans-seas/what-we-do/regional-seas-programme>.



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.⁴⁵ 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.⁴⁶

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.⁴⁷

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 in relation to climate engineering are identified in the table below.

Table 6: 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 ⁴⁸ human rights	Right to life

⁴⁵ 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.

⁴⁶ Adelman, S. (2017) ‘Geoengineering: Rights, risks and ethics’, *Journal of Human Rights and the Environment*, 8(1), pp. 119-138.

⁴⁷ 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.”

⁴⁸ 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 a healthy environment
	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 to 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.”⁴⁹ 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.⁵⁰ States may set limits on scientific research, but only if they are established in law, promote “the general welfare in a

⁴⁹ International Covenant on Economic, Social and Cultural Rights (entry into force 3 January 1976) G.A. Res 2200A (XXI), Article 15(3).

⁵⁰ 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.



democratic society”, and are “compatible with the nature of the right restricted.”⁵¹ Furthermore, “any limitation on the content of scientific research implies a strict burden of justification by States, in order to avoid infringing freedom of research.”⁵²

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.”⁵³

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 (...)”,⁵⁴ which may include establishing mechanisms for cooperation and sharing of scientific knowledge.⁵⁵

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.⁵⁶ 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.

⁵¹ Ibid, para.21; ICESCR, Article 4.

⁵² Committee on Economic, Social and Cultural Rights. (2020), supra note 50, para. 22.

⁵³ Charter of Fundamental Rights of the European Union (entry into force 18 December 2009) 2000/C 364/01 (CFREU), Article 13.

⁵⁴ 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.

⁵⁵ Reynolds, J.L. (2020), supra note 48, pp. 323-342; Reynolds, J.L. (2019) *Governance of Solar Geo-engineering and Human Rights*, Cambridge: Cambridge University Press.

⁵⁶ Reynolds, J.L. (2020), supra note 48, 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.”⁵⁷ 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.⁵⁸

In this context, the definition of ‘science’ encompasses both process and the results of process,⁵⁹ and “the technology deriving from scientific research”.⁶⁰ The term ‘benefits’ refers to “the material results” and “the scientific knowledge and information directly deriving from scientific activity”.⁶¹ 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.⁶² 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.”⁶³ 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.”⁶⁴ 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”.⁶⁵

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.”

⁵⁷ 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”.

⁵⁸ 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>.

⁵⁹ Committee on Economic, Social and Cultural Rights. (2020), supra note 50, 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*).

⁶⁰ Ibid, para.7.

⁶¹ Ibid, para.8.

⁶² Ibid, para.15.

⁶³ Ibid, para.17.

⁶⁴ Ibid, para.74.

⁶⁵ 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.”⁶⁶ The right refers to “creations of the human mind”, including scientific publications and innovations.⁶⁷ ‘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.”⁶⁸ ‘Material interests’ are those that “contribute to the enjoyment of the right to an adequate standard of living.”⁶⁹ The human right does not prescribe specific intellectual property (IP) but obligates States to take necessary steps to ensure effective protection of the interests.⁷⁰

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.⁷¹

At the EU level, the CFREU also protects intellectual property.⁷²

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 inventions⁷³. 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.⁷⁴

⁶⁶ UDHR, Article 27(2); ICESCR, Article 15(1)(c).

⁶⁷ 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.

⁶⁸ *Ibid.*, para. 12.

⁶⁹ *Ibid.*, para. 15.

⁷⁰ *Ibid.*

⁷¹ 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.

⁷² CFREU, Article 17(2).

⁷³ 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/njitip/vol13/iss1/1/>.

⁷⁴ 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”⁷⁵ 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.⁷⁶ The prohibition is absolute, meaning that there are no legally permissible reasons for a State to derogate.⁷⁷ Part of that prohibition is that “no one shall be subjected without his free consent to medical or scientific experimentation.”⁷⁸ 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.⁷⁹

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

⁷⁵ Ibid.

⁷⁶ 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 53, Article 19(2).

⁷⁷ 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.

⁷⁸ ICCPR, Article 7.

⁷⁹ 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,⁸⁰ 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.⁸¹ This right includes a general right of access to information held by public bodies,⁸² 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.⁸³ 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 and Egan v. The United Kingdom*, 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.⁸⁴ In *Roche v. the United Kingdom*, meanwhile, 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.⁸⁵ Furthermore, 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

⁸⁰ 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.

⁸¹ UDHR, supra note 57, Article 19; ICCPR, supra note 76, Article 19(2); ECHR, supra note 76, 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>.

⁸² Committee on Civil and Political Rights. (2011) *General comment No. 34 Article 19: Freedoms of opinion and expression*, CCPR/C/GC/34, para. 18.

⁸³ CFREU, Article 42.

⁸⁴ European Court of Human Rights. (1998) *McGinley and Egan v. The United Kingdom*, 9 June 1998, No 10/1997/794/995-996, CE:ECHR:1998:0609JUD002182593.

⁸⁵ European Court of Human Rights. (2005) *Roche v. The United Kingdom*, 19 October 2005, No.32555/96, CE:ECHR:2005:1019JUD003255596.



under certain conditions, guarantee a right of that nature and could require the authorities to communicate information.⁸⁶ The same principle also applies to access to information concerning projects whose implementation is liable to have an impact on the environment.⁸⁷ 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).⁸⁸

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.⁸⁹ 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.”⁹⁰ 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.⁹¹ 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.⁹²

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 Parliament⁹³ and at municipal elections.⁹⁴ The right to participation in public affairs for EU citizens is protected by the TEU,⁹⁵ 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

⁸⁶ European Court of Human Rights. (2021) *Association BURESTOP 55 and Others v. France*, 1 July 2021, No.56176/18, CE:ECHR:2021:0701JUD005617618. See also, European Court of Human Rights. (2016) *Magyar Helsinki Bizottság v. Hungary*, 8 November 2016, No.18030/11, CE:ECHR:2016:1108JUD001803011.

⁸⁷ European Court of Human Rights. (2019) *Cangi v. Turkey*, 29 January 2019, No.24973/15, CE:ECHR:2019:0129JUD002497315.

⁸⁸ McDonagh, M. (2013), supra note 81, p. 41.

⁸⁹ ICCPR, Article 25; McDonagh, M. (2013), supra note 81, p. 38.

⁹⁰ 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.

⁹¹ Ibid.

⁹² Ibid.

⁹³ CFREU, Article 39.

⁹⁴ Ibid, Article 40.

⁹⁵ Consolidated Version of the Treaty on European Union (TEU) C 326/15, Article 10(3).



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.⁹⁶

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”.⁹⁷ States have an obligation to ensure that “any person whose rights or freedoms as herein recognized are violated shall have an effective remedy”.⁹⁸

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.⁹⁹

The CFREU also guarantees the right to a fair trial and an effective remedy.¹⁰⁰

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.

⁹⁶ Ibid, Article 11(1)-(2).

⁹⁷ UDHR, Article 8; ICCPR, Article 2(3); ECHR, Articles 6, 13.

⁹⁸ Ibid.

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

¹⁰⁰ CFREU, Article 47.



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 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.”¹⁰¹ This right is also recognised in regional organisations, including the Council of Europe.¹⁰²

The right includes both a prohibition against arbitrary deprivation of life and a positive duty to protect life.¹⁰³ States have a “duty to refrain from engaging in conduct resulting in arbitrary deprivation of life”¹⁰⁴ and “must establish a legal framework to ensure the full enjoyment of the right to life,”¹⁰⁵ which should include taking appropriate measures to address conditions in society that interfere with “enjoying the right to life with dignity.”¹⁰⁶ The right is non-derogable¹⁰⁷ and must be ensured without discrimination.¹⁰⁸ The EU Charter of Fundamental Rights also includes the “right to life.”¹⁰⁹

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.¹¹⁰ 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.¹¹¹

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

¹⁰¹ 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.

¹⁰² ECHR, Article 2.

¹⁰³ 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.”

¹⁰⁴ *Ibid*, para. 7.

¹⁰⁵ *Ibid*, para. 18.

¹⁰⁶ *Ibid*, para. 26.

¹⁰⁷ *Ibid*, para. 2.

¹⁰⁸ *Ibid*, para. 61.

¹⁰⁹ CFREU, Art. 2.

¹¹⁰ Human Rights Committee. (2019), *supra* note 103, para. 62.

¹¹¹ 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>.



have an obligation to ensure individuals can enjoy a healthy environment in the context of climate engineering.

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.¹¹² 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.”¹¹³ It also encompasses the procedural rights to participation, of access to information and access to justice.¹¹⁴ 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.¹¹⁵ Additionally, States have special obligations towards vulnerable populations, including indigenous communities and communities in poverty.¹¹⁶ The CFREU calls for “a high level of environment protection”.¹¹⁷

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.”¹¹⁸ This right is also recognised in regional organisations, including the

¹¹² 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.

¹¹³ 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>.

¹¹⁴ 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.

¹¹⁵ 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.

¹¹⁶ 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 114, Section G.

¹¹⁷ CFREU, Article 37.

¹¹⁸ 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



Council of Europe.¹¹⁹ 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.¹²⁰ The CFREU provides the specific right "of access to preventative health care" and right "to benefit from medical treatment."¹²¹

Sustainable Development Goal 3 is to "ensure healthy lives and promote well-being for all at all ages."¹²²

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 malaria¹²³ or higher risk of skin cancer and pollution-related illness.¹²⁴ Moreover, to the extent that food production might be adversely impacted by deployment of SRM or CDR approaches,¹²⁵ this would undermine one of the "underlying determinants of health."¹²⁶ 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".¹²⁷ Furthermore, "an adequate supply of safe food" is an underlying determinant of health necessary to enjoy the right to health.¹²⁸ No similar rights exist in the ECHR or CFREU.

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 101, 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.

¹¹⁹ European Social Charter (entered into force 26 February 1965), E.T.S. 35 – Social Charter, 18.X.1961, Part I, para. 11.

¹²⁰ 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.

¹²¹ CFREU, Article 35.

¹²² Sustainable Development Goal, Goal 3.

¹²³ 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).

¹²⁴ 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>.

¹²⁵ 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/>.

¹²⁶ Burns, W.C.G. (2016), supra note 111.

¹²⁷ UDHR, Article 25; ICESCR, Article 11.

¹²⁸ Committee on Economic, Social and Cultural Rights. (2000), supra note 120, para. 11.



Sustainable Development Goal 2 is to “end hunger, achieve food security and improved nutrition and promote sustainable agriculture.”¹²⁹

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’¹³⁰ occurs, the rapid spikes in temperature might undermine food production.¹³¹ 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.¹³²

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 2010.¹³³ 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.”¹³⁴

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.¹³⁵

¹²⁹ Sustainable Development Goals, Goal 2.

¹³⁰ 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](https://doi.org/10.1002/2017EF000735).

¹³¹ Burns, W.C.G. (2016), supra note 111.

¹³² 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.

¹³³ U.N. General Assembly. (2010) *Resolution 64/292 The Human Right to Water and Sanitation, A/RES/64/292*.

¹³⁴ Sustainable Development Goals, Goal 3.

¹³⁵ Burns, W.C.G. (2016), supra note 111.



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.

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.”¹³⁶ 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.”¹³⁷

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.¹³⁸ States can also be liable for harm within the framework of the ILC Draft Articles on Prevention of Transboundary Harm from Hazardous Activities.¹³⁹ 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,”¹⁴⁰ the international judgments nevertheless provide important insights and interpretations.¹⁴¹

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.”¹⁴² The obligation applies to the direct activities of State and private actors within the state’s jurisdiction and control.¹⁴³ 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.¹⁴⁴ The prohibition includes harm to the global commons (e.g., high seas, outer space,

¹³⁶ 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.

¹³⁷ 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.

¹³⁸ 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).

¹³⁹ International Law Commission. (2001), Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities A/56/10.

¹⁴⁰ 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>.

¹⁴¹ 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>.

¹⁴² *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.”

¹⁴³ Jervan, M. (2014), supra note 141, pp.57-8.

¹⁴⁴ 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.”



atmosphere, Polar Regions).¹⁴⁵ To be prohibited, the harm must be ‘significant’,¹⁴⁶ which is “something more than ‘detectable’ but need not be at the level of ‘serious’ or ‘substantial’.”¹⁴⁷ While ‘harm’ is not 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.”¹⁴⁸ The state alleging harm has the burden to prove the attribution and harm.¹⁴⁹

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.¹⁵⁰ The duty to conduct an EIA, enshrined in international law¹⁵¹ and recognised by the ICJ,¹⁵² is discussed further in Section 4.3.2. Obligations to cooperate, notify, consult, and negotiate are enshrined in international environmental conventions and soft law,¹⁵³ 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,¹⁵⁴ 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.¹⁵⁵ 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.’¹⁵⁶

A state found in violation of the prohibition on transboundary environmental harm has a duty to stop the activity causing harm¹⁵⁷ and is liable for reparations for the harm caused.¹⁵⁸ 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.”¹⁵⁹

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

¹⁴⁵ Jervan, M. (2014), supra note 141, p. 5.

¹⁴⁶ International Law Commission. (2001), supra note 139.

¹⁴⁷ Commentaries on The Articles on Prevention of Transboundary Harms, A/56/10, 2001, Article 2, para. 4.

¹⁴⁸ OECD, Recommendation C(74)224 of 14 November 1974, Principles Concerning Transfrontier Pollution, Part A (Introduction).

¹⁴⁹ Jervan, M. (2014), supra note 141, p.39.

¹⁵⁰ Jervan, M. (2014), supra note 141, p.76.

¹⁵¹ 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”;

¹⁵² Jervan, M. (2014), supra note 141, pp78-88. (discussion of *Nuclear Test*, *Gabčíkovo-Nagymaros*, and *Pulp Mills* cases).

¹⁵³ 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 139, Articles 4, 8-9.

¹⁵⁴ Commentaries on The Articles on Prevention of Transboundary Harms. (2001), supra note 147, paragraph 7.

¹⁵⁵ Hubert, A. (2020), supra note 137, p.51; and Bodle, R. (2010), supra note 140, p.307.

¹⁵⁶ Bodle, R. (2010), supra note 140, p.307.

¹⁵⁷ Resolution 56/83, Articles 30.

¹⁵⁸ Ibid, Articles 31, 36-9.

¹⁵⁹ 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”.



violation of its obligations under EU law is subject to the judgment of the Court of Justice of the European Union (CJEU).¹⁶⁰ 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.¹⁶¹

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."¹⁶²

While the duty to prevent transboundary environmental harm prohibits "unrestrained and uncontrolled" activity "where there is a risk of significant environmental harm"¹⁶³ there are many limitations to its practical application.¹⁶⁴ 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,¹⁶⁵ particularly as states are only required to take reasonable efforts and capacities in environmental protection to achieve "best possible efforts" varies widely across states.¹⁶⁶ 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).¹⁶⁷ 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 injunction) to stop an activity that may cause harm, but they are rarely granted.¹⁶⁸ Therefore, it would

¹⁶⁰ *Treaties of Rome (1958), Article 258.*

¹⁶¹ 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>.

¹⁶² Hubert, A. (2020), supra note 137, p.51.

¹⁶³ Ibid.

¹⁶⁴ See, e.g., Bodle, R. (2010), supra note 140; 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 137, p.51.

¹⁶⁵ Hubert, A. (2020), supra note 137, p.51.

¹⁶⁶ Brunnée, J. (2005), supra note 164, pp. 9 and Ellis, J. (2018), supra note 164.

¹⁶⁷ Bodle, R. (2010), supra note 140, p.307.

¹⁶⁸ Ibid, p. 308.



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.¹⁶⁹

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.”¹⁷⁰ As such, there is a general obligation on States to ensure that activities within their jurisdiction respect the environment of other States.¹⁷¹

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.¹⁷² 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.

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.”¹⁷³ It seeks to inform decision-

¹⁶⁹ 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 46, pp. 119-138.

¹⁷⁰ ICJ Reports (1996) *Nuclear Weapons Advisory Opinion*, para 29.

¹⁷¹ Ibid.

¹⁷² See generally, Birnie P., Boyle A., and Redgwell C. (2021). *International Law and the Environment*. 4th ed, Oxford: Oxford University Press.

¹⁷³ 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)



makers about possible environmental impacts when authorising potentially harmful activities.¹⁷⁴ At an international level, the EIA seeks to inform other states and international organisations of the potentially transboundary environmental impacts of certain activities.¹⁷⁵

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.¹⁷⁶

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.¹⁷⁷ 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.¹⁷⁸ 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.¹⁷⁹ 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.¹⁸⁰ States also have an obligation to assess activities and report potential environmental impacts in relation to the marine environment.¹⁸¹

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.

¹⁷⁴ Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, p. 216.

¹⁷⁵ Ibid.

¹⁷⁶ 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.

¹⁷⁷ Rio Declaration, Principle 17.

¹⁷⁸ Espoo Convention, Article 2(1).

¹⁷⁹ Ibid, Article 2(1)-(2).

¹⁸⁰ Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, 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.

¹⁸¹ 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 172, p. 220.



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.¹⁸² 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.¹⁸³ 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.¹⁸⁴

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.¹⁸⁵ 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.¹⁸⁶ “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.¹⁸⁷ 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.”¹⁸⁸ 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.¹⁸⁹

The SEA Directive provides that SEAs must be carried out in the preparation phase, before adoption on or submission of plans or programmes.¹⁹⁰ Assessments must prepare an environmental report¹⁹¹ on likely significant effects on the environment, and evaluation of reasonable alternatives based on objectives and geography.¹⁹² 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

¹⁸² Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, pp. 228-229.

¹⁸³ Ibid, pp. 225-226.

¹⁸⁴ Ibid; Espoo Convention, Article 6.

¹⁸⁵ 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).

¹⁸⁶ 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).

¹⁸⁷ Ibid, Article 2(a).

¹⁸⁸ Ibid, Article 3.

¹⁸⁹ Ibid, Article 3 (8).

¹⁹⁰ Ibid, Article 4.

¹⁹¹ Ibid, Annex I.

¹⁹² Ibid, Article 5.



opinion.¹⁹³ 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.¹⁹⁴ All of the aforementioned forms of consultation must be taken into account in final preparation of plans or programmes.¹⁹⁵

Environmental Impact Assessment Directive: Directive 2011/92/EU establishes environmental assessment of the effects of public and private projects in Europe.¹⁹⁶ 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.¹⁹⁷ 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.¹⁹⁸ Member States are required to consider results of assessment information and consultations, together, in developing decisions.¹⁹⁹ 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.²⁰⁰

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;²⁰¹ species and habitat protection;²⁰² and environmental liability.²⁰³ 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 to be relevant to the development and use of climate engineering technologies.²⁰⁴ 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

¹⁹³ Ibid, Article 6.

¹⁹⁴ Ibid, Article 7.

¹⁹⁵ Ibid, Article 8.

¹⁹⁶ 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).

¹⁹⁷ Ibid, Article 5.

¹⁹⁸ Ibid, Articles 6 and 7.

¹⁹⁹ Ibid, Article 8.

²⁰⁰ Ibid, Article 11.

²⁰¹ 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).

²⁰² Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L206/7).

²⁰³ 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).

²⁰⁴ 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).



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 investment²⁰⁵ 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.²⁰⁶

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.²⁰⁷ 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 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.²⁰⁸ 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

²⁰⁵ 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).

²⁰⁶ 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.

²⁰⁷ Directive 2011/92/EU, Annex I.

²⁰⁸ Ibid, Annex III.



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.²⁰⁹ Economic actors possess key knowledge, resources, and information pertaining to environmental regulations (vis-à-vis implementation and compliance).²¹⁰ However, the involvement of economic actors creates issues with legitimacy, accountability, and conflicts of interest in EU environmental law.²¹¹ 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 between different areas of law concerning enforcement of common obligations”²¹², 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

²⁰⁹ Abbot, C., and Lee, M. (2015) ‘Economic Actors in EU Environmental Law’, *Yearbook of European Law*. DOI: 10.1093/yel/ye002.

²¹⁰ Ibid.

²¹¹ Ibid.

²¹² 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.



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,²¹³ there are no binding international laws on corporate disclosure.

EU law and policy

In the European Green Deal,²¹⁴ 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.²¹⁵ The **SFDR** lays down harmonised rules for financial market participants and financial advisers in regard to sustainability of financial processes and products.²¹⁶ Financial market participants include insurance, investment management, pension, venture capital, social entrepreneurship, credit, and financial companies or advisers.²¹⁷ The rules requires transparency and disclosure related to financial market risk policies,²¹⁸ potential adverse impacts of investment decisions and degree of alignment with Paris Agreement objectives.²¹⁹ The Regulation directs the European Environment Agency and Joint Research Centre of 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.²²⁰ 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,²²¹ and not

²¹³ White, A. (2006) 'Why we need global standards for corporate disclosure', *Law and Contemporary Problems*, 69. Available at: <https://scholarship.law.duke.edu/cqi/viewcontent.cgi?referer=&httpsredir=1&article=1392&context=lcp>.

²¹⁴ 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.

²¹⁵ 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.

²¹⁶ 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).

²¹⁷ Ibid, Article 2.

²¹⁸ Ibid, Article 3.

²¹⁹ Ibid, Article 4.

²²⁰ Ibid, Article 6-11.

²²¹ Ibid, Article 12.



contradict disclosed information in marketing communications.²²² Member States are delegated authority of monitoring compliance and cooperate in supervision and investigation.²²³

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.²²⁴ 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.²²⁵ Qualifying for “environmentally sustainable” means an economic activity: a) substantially contributes to one or more environmental objectives²²⁶; b) does not significantly harm any environmental objectives²²⁷; c) complies with minimum safeguards with respect human and labour rights²²⁸; d) complies with technical screening criteria²²⁹. 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”.²³⁰

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”.²³¹ 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 activities²³²—those claiming to be environmentally sustainable; those promoting environmental characteristics, and other financial products.²³³ 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.²³⁴ “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

²²² Ibid, Article 13.

²²³ Ibid, Article 14.

²²⁴ 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.

²²⁵ Ibid, Recital 34.

²²⁶ Ibid, Article 9-16.

²²⁷ Ibid, Article 9, 17.

²²⁸ Ibid, Article 18.

²²⁹ Ibid, Article 10.

²³⁰ Ibid, Article 20.

²³¹ Ibid, Article 4.

²³² Elaboration of economic activities is carried out in Regulation (EU) 2019/2088, and financial product is referenced in Article 9 of that regulation.

²³³ Regulation (EU) 2020/852, Article 5-7.

²³⁴ Ibid, Article 16.



activity emissions are lower than industry average, do not block future low-carbon alternatives, and do not lock-on assets incompatible with climate neutrality.²³⁵

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.²³⁶

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.²³⁷

For any economic activity claiming environmental sustainability, the principle of “do no significant harm” must be observed.²³⁸ 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,²³⁹ which sets out to ensure transparency and comparability of financial reporting of publicly traded companies.²⁴⁰ These regulations cover harmonisation of accounting standards and presentation of financial information;²⁴¹ securities information published on stock exchanges;²⁴² disclosures related to financial reporting and issuance of securities, bonds, and debts;²⁴³ banking and insurance undertakings.²⁴⁴ These directives also cover requirements related to corporate governance

²³⁵ Ibid, Article 10(2).

²³⁶ Ibid, Article 8.

²³⁷ Ibid, Article 9.

²³⁸ Ibid, Article 17.

²³⁹ 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).

²⁴⁰ 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.

²⁴¹ Regulation (EC) No 1606/2002 of the European Parliament and of the Council of 19 July 2002 on the application of international accounting standards.

²⁴² 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.

²⁴³ 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.

²⁴⁴ 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.



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.²⁴⁵ 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,²⁴⁶ 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,²⁴⁷ 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.²⁴⁸ Activity contributions to this environmental objective must relate to atmospheric greenhouse gas concentration stabilisation consistent with long-term temperature goals of the Union.²⁴⁹ The Regulation explicitly qualifies economic activities as environmentally sustainable by “Increasing the use of environmentally safe carbon capture and utilization (CCU) and carbon capture and storage (CCS) technologies that deliver a net reduction in greenhouse gas emissions.”²⁵⁰ 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.²⁵¹ 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

²⁴⁵ 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.

²⁴⁶ The European Green Deal.

²⁴⁷ European Commission. (2020), supra note 215.

²⁴⁸ Regulation (EU) 2020/852, Article 10.

²⁴⁹ Either through avoidance or reduction of greenhouse gas emissions or increase of greenhouse gas removal.

²⁵⁰ Regulation (EU) 2020/852, Article 10(e).

²⁵¹ Ibid, Article 11.



issues include substantial contribution to use and protection of water and marine resources;²⁵² the circular economy;²⁵³ pollution prevention and control;²⁵⁴ protection and restoration of biodiversity and ecosystems.²⁵⁵

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.²⁵⁶ 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.²⁵⁷ 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.

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.”²⁵⁸

²⁵² 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).

²⁵³ Regulation (EU) 2020/852, Article 13.

²⁵⁴ Ibid, Article 14.

²⁵⁵ 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).

²⁵⁶ Regulation (EU) 2020/852, Article 17.

²⁵⁷ 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.

²⁵⁸ Rio Declaration, Principle 10.



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.²⁵⁹ 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.²⁶⁰ 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.²⁶¹

Regarding public participation, the Aarhus Convention lays down rules on public participation in decisions on specific activities.²⁶² 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 public²⁶³ and during the preparation of executive regulations and other generally applicable legally binding rules that may have a significant effect on the environment.²⁶⁴

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.²⁶⁵ 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.²⁶⁶

EU law and policy

Directive 2003/35/EC provides for public participation in environmental assessment of plans and programmes.²⁶⁷ 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 justice²⁶⁸ 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

²⁵⁹ 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.

²⁶⁰ *Ibid*, Article 2.3.

²⁶¹ *Ibid*, Article 5(1)(b).

²⁶² *Ibid*, Article 6, Annex I.

²⁶³ *Ibid*, Article 7.

²⁶⁴ *Ibid* Article 8.

²⁶⁵ *Ibid*, Article 4.

²⁶⁶ *Ibid*, Article 9.

²⁶⁷ 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.

²⁶⁸ 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.



programmes.²⁶⁹ 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.²⁷⁰

EU ascension to the international Aarhus Convention in 2005 set in motion a range of additional rights and protections related to environmental justice proceedings.²⁷¹

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.²⁷² 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).²⁷³ The public has the right to apply for access to information regardless of citizenship, nationality, or domicile.²⁷⁴ 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.²⁷⁵ 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.²⁷⁶ 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.²⁷⁷ 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) 2021/1767²⁷⁸ 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

²⁶⁹ Directive 2003/35/EC, Article 2.

²⁷⁰ Ibid.

²⁷¹ Darpö, J. (2021), *supra* note 212, p.73.

²⁷² 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.

²⁷³ Ibid, Article 2.

²⁷⁴ Ibid, Article 3.

²⁷⁵ Ibid, Article 4.

²⁷⁶ Ibid, Article 9.

²⁷⁷ Ibid, Article 10-11.

²⁷⁸ 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.



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).²⁷⁹

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.²⁸⁰

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 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

²⁷⁹ Darpö, J. (2021), supra note 212, p. 37.

²⁸⁰ See generally, Darpö, J. (2021), supra note 212.



environment and human health is more or less predictable and well recognized and its magnitude and scale are rather manageable.”²⁸¹

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.²⁸² 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.²⁸³ These principles are also reflected in the Rio Declaration and in international jurisprudence, which reinforces that States can be held liable for transboundary pollution.²⁸⁴ ‘Pollution’ is generally understood to be a form of environmental harm, and as such constitutes a narrower concept.²⁸⁵ Yet, various international agreements are solely or primarily concerned with the prevention, reduction and control of pollution.²⁸⁶ Furthermore, the Rio declaration places an obligation on States to adopt laws regarding liability and compensation for victims of pollution,²⁸⁷ and holds that polluters should, in principle, bear the cost of pollution, also known as the polluter-pays principle.²⁸⁸ Two important underlying principles of international environmental law related to pollution prevention are the precautionary principle and the customary obligation of due diligence.²⁸⁹

²⁸¹ 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>.

²⁸² 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>.

²⁸³ Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, p. 153.

²⁸⁴ 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.

²⁸⁵ Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, p. 212-213.

²⁸⁶ 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.

²⁸⁷ Rio Declaration, Principle 13.

²⁸⁸ Ibid, Principle 16.

²⁸⁹ Birnie P., Boyle A., and Redgwell C. (2021), supra note 172, p. 205.



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.²⁹⁰ 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.²⁹¹ Following amendments, the Protocol now also addresses particulate matter, including black carbon.²⁹²

The 1998 Rotterdam Convention on Prior Informed Consent, for example, regulates the international trade of hazardous chemicals and pesticides contained in Annex III.²⁹³ It codifies the Prior Informed Consent procedure aimed at helping governments make informed decisions when importing hazardous chemicals.²⁹⁴ The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) regulates chemicals recognised as posing long-term hazards to human and animal health.²⁹⁵ 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.²⁹⁶ 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 their disposal including illegal traffic in those wastes.”²⁹⁷ 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.²⁹⁸ 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.”²⁹⁹

²⁹⁰ UNECE, *Protocols*/UNECE [Online]. Available at: <https://unece.org/protocols>.

²⁹¹ 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).

²⁹² 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>

²⁹³ Rotterdam Convention, Annex III.

²⁹⁴ 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>.

²⁹⁵ Stockholm POPs Convention, Article 1.

²⁹⁶ Minamata Convention, supra note 286, Article 1.

²⁹⁷ Basel Convention, Article 1.

²⁹⁸ Consolidated Version of the Treaty on the Functioning of the European Union (TFEU) (2012) (OJ C326/01), Article 191(2).

²⁹⁹ Ibid, Article 191(1).



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.³⁰⁰

The Environmental Liability Directive establishes a framework based on the polluter pays principle to prevent and remedy environmental damage.³⁰¹ Furthermore, pollution is a key consideration in Environmental Impact Assessments.³⁰² 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.³⁰³ The Air Quality Directive establishes ambient air quality objectives to protect human health and the environment from harmful effects.³⁰⁴ 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),³⁰⁵ and Directive (91/676/EEC) concerns the protection of waters against pollution caused by nitrates from agricultural sources.³⁰⁶ 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.³⁰⁷ 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.³⁰⁸ The control of major 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.³⁰⁹

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,³¹⁰ which would make any pollution the responsibility of the State. Nevertheless, even if the climate engineering activities

³⁰⁰ Ibid, Article 192 (1).

³⁰¹ 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).

³⁰² 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.

³⁰³ 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).

³⁰⁴ 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 152/1), Article 1 (1).

³⁰⁵ 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).

³⁰⁶ 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).

³⁰⁷ 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).

³⁰⁸ 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).

³⁰⁹ 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).

³¹⁰ 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>.



are carried out by a private actor, States have a responsibility to regulate these activities to prevent and remedy pollution.³¹¹

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.³¹² Furthermore, the potential health impacts of the aerosols that may be used for stratospheric aerosol injection can be significant.³¹³ On the other hand, however, one could argue that the reduction of GHGs from various sources could also result in a reduction of SO₂,³¹⁴ whereas some level of sulphur particulates in the atmosphere would be desirable for their cooling effect as can be observed following volcanic eruptions.³¹⁵ Yet, it is unclear to what extent stratospheric aerosol injection may affect air quality or to what extent they will affect public health.³¹⁶ 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.³¹⁷ Leakage of stored CO₂ may also result in local air pollution, as 10% of CO₂ in the air is assumed to be fatal.³¹⁸ Furthermore, other forms of pollution, including air and noise pollution, may be associated with the development of the 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.³¹⁹ That means that measures targeting GHG emissions can have both synergistic and antagonistic effects on emissions of other pollutants.³²⁰ As might be expected, afforestation and reforestation clearly also have a positive impact on air quality.³²¹ By reducing GHG emissions, climate engineering techniques may also positively impact air quality and therefore human health and the environment.³²² It is therefore important that the overall benefit of

³¹¹ Ibid.

³¹² Gothenburg Protocol; Amendment to the Gothenburg Protocol.

³¹³ 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>.

³¹⁴ 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>.

³¹⁵ 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>

³¹⁶ 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>.

³¹⁷ 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>.

³¹⁸ Ibid, p. 24.

³¹⁹ Ibid, p. 13.

³²⁰ Ibid.

³²¹ 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).

³²² European Environment Agency. (2011), supra note 317, p. 13.



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.³²³ This has been seen in the mining and waste disposal industry.³²⁴ 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.³²⁵ Tax havens are the prime example of this, although it has also been seen in polluting industries.³²⁶ 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 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.³²⁷ The Gothenburg Protocol, for instance,³²⁸ 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.³²⁸

³²³ Lockley A. (2016), supra note 310, p. 6.

³²⁴ 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>.

³²⁵ Lockley A. (2016), supra note 310, 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>.

³²⁶ Lockley A. (2016), supra note 310, 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>.

³²⁷ UNECE, *Protocols* / UNECE [Online]. Available at: <https://unece.org/protocols>.

³²⁸ Amendment to the Gothenburg Protocol; Office of Environmental Quality, supra note 292.



The 1998 Rotterdam Convention on Prior Informed Consent, for example, regulates the international trade of hazardous chemicals and pesticides contained in Annex III.³²⁹ It codifies the Prior Informed Consent procedure aimed at helping governments make informed decisions when importing hazardous chemicals.³³⁰ The 2001 Stockholm Convention on Persistent Organic Pollutants (POPs) regulates chemicals recognised as posing long-term hazards to human and animal health.³³¹ 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.³³²

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.”³³³ 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.³³⁴ 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.”³³⁵ 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 disposal.³³⁶ The EMAS Regulation created a voluntary scheme for organisations to participate in eco-management and environmental audit.³³⁷ Furthermore, EU law establishes procedures and control regimes for the shipment of waste,³³⁸ 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.³³⁹

³²⁹ Rotterdam Convention, Annex III.

³³⁰ 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>.

³³¹ Stockholm POPs Convention, Article 1.

³³² Minamata Convention, Article 1.

³³³ Basel Convention, Article 1.

³³⁴ European Commission, *Waste Law / European Commission* [Online]. Available at: https://ec.europa.eu/environment/topics/waste-and-recycling/waste-law_en.

³³⁵ 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.

³³⁶ 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.

³³⁷ 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).

³³⁸ 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).

³³⁹ 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.



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.³⁴⁰ The ECHA also contributes to the functioning of the internal market, innovation and competitiveness of the chemicals industry in Europe.³⁴¹

The EU has adopted various regulations, Directives and decisions concerned with specific elements of environmental management, including packaging and packaging waste,³⁴² end-of life vehicles,³⁴³ batteries and accumulators,³⁴⁴ industrial emissions,³⁴⁵ restriction on the use of certain hazardous substances in electrical and electronic equipment,³⁴⁶ on waste electrical and electronic equipment,³⁴⁷ port facilities for the delivery of waste from ships,³⁴⁸ reduction of single-use plastic,³⁴⁹ and the landfill of waste.³⁵⁰ Finally, EU policy focuses an action plan and strategy for the implementation of a circular economy.³⁵¹

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.³⁵² 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.

³⁴⁰ 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).

³⁴¹ European Chemicals Agency, *About us* / ECHA [Online]. Available at: <https://echa.europa.eu/about-us>

³⁴² Directive 94/62/EC of 20 December 1994 on packaging and packaging waste (OJ L365/10).

³⁴³ Directive 2000/53/EC of the European Parliament and of the Council of 18 September 2000 on end-of life vehicles (OJ L269/34).

³⁴⁴ 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).

³⁴⁵ 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).

³⁴⁶ 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).

³⁴⁷ 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).

³⁴⁸ 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).

³⁴⁹ 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).

³⁵⁰ Directive 1999/31/EC of 26 April 1999 on the landfill of waste (OJ L182/1).

³⁵¹ 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>

³⁵² See, e.g., Gothenburg Protocol and Amendment to the Gothenburg Protocol.



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.³⁵³ According to the IPCC, the main risk of transporting CO₂ are leakage and unintended release,³⁵⁴ which could harm human health and the environment.³⁵⁵ There may also be an impact on climate change if CO₂ is suddenly released back into the atmosphere.³⁵⁶ An analysis of CO₂ indicated that CO₂ may even be classified as hazardous waste.³⁵⁷ 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.³⁵⁸ 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.³⁵⁹ 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.³⁶⁰ Such classification would affect CCS activities and would also have an impact on the treatment of CO₂ under other EU Directives, including the Integrated Pollution Prevention and Control (IPPC) Directive and Environmental Impact Assessment (EIA) Directive.³⁶¹

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.

³⁵³ Basel Convention, Article 2(1).

³⁵⁴ 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/srccs_wholereport-1.pdf.

³⁵⁵ Ibid.

³⁵⁶ 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>.

³⁵⁷ Raine, A. (2008), supra note 356, p.359.

³⁵⁸ Basel Convention, Article 1 and Annex III; Raine, A. (2008), supra note 356, p.358.

³⁵⁹ Raine, A. (2008), supra note 356, p.359.

³⁶⁰ 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/cclp/ccsoneuropewaste-3.php#key>

³⁶¹ 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/cclp/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).



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."³⁶² 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 environmental damage.³⁶³ 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."³⁶⁴ 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.³⁶⁵

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

³⁶² 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.

³⁶³ *Ibid*, Principles 2, 3, 4, 5, 6, 7, 13, and 22.

³⁶⁴ Rio Declaration, Principle 7.

³⁶⁵ *Ibid*, Agenda 21.



common concern of humankind.”³⁶⁶ 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”.³⁶⁷ 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.³⁶⁸ The Conference of Parties meets periodically³⁶⁹ 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.³⁷⁰

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.³⁷¹ However, the Convention does not have any provisions on liability for or remediation of harm.

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.³⁷² 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.”³⁷³ 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 200 is protected”.³⁷⁴ For species protection, flora and fauna are classified by level of protection, with some designated for ‘strict protection’³⁷⁵ while others can be taken or exploited within reason.³⁷⁶ Member

³⁶⁶ Convention on Biological Diversity (CBD) (entered into force 29 December 1993) 1750 UNTS 79, 31 ILM 818, Preamble, para. 3.

³⁶⁷ Ibid, Article 14(1)(d).

³⁶⁸ 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/>

³⁶⁹ CBD, Article 23.

³⁷⁰ UNESCO. (1972) Convention Concerning the Protection of the World Culture and Natural Heritage.

³⁷¹ Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). (1979) E.T.S. No. 104, Articles, 3-4.

³⁷² Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206).

³⁷³ Ibid, Article 6.

³⁷⁴ Ibid, Article 6 (4).

³⁷⁵ Ibid, Article 12-13.

³⁷⁶ 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.”



States are required to report on their status of and progress of certain conservation activities, including any compensatory measures.³⁷⁷

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.³⁷⁸ 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.

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 2010.³⁷⁹ 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.³⁸⁰ This movement, should it develop further, may influence the governance of climate engineering, though it could either

³⁷⁷ Ibid, Article 6, 16-17.

³⁷⁸ 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>

³⁷⁹ 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.qarn.org/universal-declaration/>

³⁸⁰ "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.



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.³⁸¹ 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,³⁸² 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 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.³⁸³ 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.

³⁸¹ 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.

³⁸² 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.

³⁸³ 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>



International law and policy

The basis for global climate legislation is the United Nations Framework Convention on Climate Change (UNFCCC).³⁸⁴ 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.”³⁸⁵ 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).³⁸⁶

The 1997 Kyoto Protocol was adopted during the third session of the Conference of the Parties (COP3).³⁸⁷ 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.

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).³⁸⁸ 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 [...]”.³⁸⁹ 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.”³⁹⁰

EU law and policy

EU climate law is concerned primarily with GHG emission reduction, energy security, energy efficiency, and renewable energy.³⁹¹ 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.³⁹² Much of EU Climate law connects to the polluter-pays principle of the Treaty on the Functioning of Europe (TFEU).³⁹³

³⁸⁴ United Nations Framework Convention on Climate Change (UNFCCC) (entry into force 21 March 1994) 1771 UNTS 107.

³⁸⁵ *Ibid*, Article 2.

³⁸⁶ 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>

³⁸⁷ Kyoto Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol) (entry into force 16 February 2005) 2303 UNTS 162.

³⁸⁸ Conference of the Parties, Adoption of the Paris Agreement (Paris Agreement) (entry into force 4 November 2016) 3156 UNTS, Article 4(2).

³⁸⁹ *Ibid*, Article 2(1)(a); Birnie P., Boyle A., and Redgwell C. (2021), *supra* note 172, p. 392.

³⁹⁰ UNFCCC, Article 2.

³⁹¹ 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>

³⁹² European Commission. *2050 long-term strategy* [Online]. Available at: https://ec.europa.eu/clima/eu-action/climate-strategies-targets/2050-long-term-strategy_en

³⁹³ TFEU, Article 191(2).



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.³⁹⁴ 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.³⁹⁵ The succeeding EU Climate Roadmap for 2050³⁹⁶ 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%.³⁹⁷

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.³⁹⁸ The law sets forth binding EU targets of domestic reduction in GHG emissions³⁹⁹ for 2030 (55% reduction compared to 1990 levels) and climate neutrality by 2050,⁴⁰⁰ 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.⁴⁰¹

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.⁴⁰² 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 solutions⁴⁰³ and ecosystem-based adaptation.⁴⁰⁴

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.⁴⁰⁵ 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

³⁹⁴ Woerdman, E. Roggenkamp, M. and Holwerda, M. (2021), supra note 391.

³⁹⁵ 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

³⁹⁶ 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

³⁹⁷ 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

³⁹⁸ 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.

³⁹⁹ Greenhouse gasses 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).

⁴⁰⁰ European Climate Law, Article 4.

⁴⁰¹ 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.

⁴⁰² European Climate Law, Article 2.

⁴⁰³ Nature-based solutions include afforestation and reforestation.

⁴⁰⁴ European Climate Law, Article 5.

⁴⁰⁵ 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).



operators capable of cheaply reducing emissions to do so and sell excess allowance to those operators facing more expensive emission reduction pathways.⁴⁰⁶

The EU ETS allows for increasing reduction requirements as necessary to avoid dangerous climate change.⁴⁰⁷ Annex I sets out five specific types of industrial activities that produce significant amounts of CO₂.⁴⁰⁸ Under the EU ETS, Member States are responsible for ensuring any Annex I activities hold a permit issued by competent authority.⁴⁰⁹ Applications for permits must include installation descriptions and technologies, material and emission sources, planned measures for monitoring and reporting, and a non-technical summary.⁴¹⁰ Changes to stationary installations increasing or reducing capacity require emission permit updates.⁴¹¹ 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).⁴¹² The framework stipulates rules governing auctioning of allowances not allocated free-of-charge,⁴¹³ 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,⁴¹⁴ and required use of revenues generated from auction.⁴¹⁵

The framework also harmonises free emissions allocations and revision of free allocation benchmarks.⁴¹⁶ 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.⁴¹⁷ 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,⁴¹⁸ and monitoring and reporting of emissions requirements, based on up-to-date

⁴⁰⁶ 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>.

⁴⁰⁷ 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.

⁴⁰⁸ 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.

⁴⁰⁹ Directive 2003/87/EC, Chapter III.4.

⁴¹⁰ Ibid, Chapter III.5.

⁴¹¹ Ibid, Chapter III.7.

⁴¹² Ibid, Chapter III.9.

⁴¹³ Ibid, Chapter III.10.

⁴¹⁴ Ibid, Chapter III.10(d).

⁴¹⁵ 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.

⁴¹⁶ Directive 2003/87/EC, Chapter III.10.a.

⁴¹⁷ Ibid, Chapter III.10.b.4.

⁴¹⁸ Ibid, Article 12.



scientific evidence.⁴¹⁹ Monitoring and reporting are further governed by Regulation (EU) 2917/2066.⁴²⁰

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).⁴²¹ 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.⁴²²

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).⁴²³ 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*.⁴²⁴

Under the CCS Directive, operators bear environmental, climate, and civil liability for geological storage.⁴²⁵ 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.⁴²⁶

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

⁴¹⁹ Ibid, Article 14.

⁴²⁰ 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).

⁴²¹ 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.

⁴²² 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 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>

⁴²³ Directive 2009/31/EC, Article 2.

⁴²⁴ Woerdman, E. Roggenkamp R. and Holwerda M. (2021), *supra* note 391, pp.156-189.

⁴²⁵ 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).

⁴²⁶ Directive 2009/31/EC, Article 28.



include those structuring the internal market for natural gas,⁴²⁷ the public sector loan facility for the Just Transition Mechanism (which includes eligible projects working toward climate neutrality by 2050),⁴²⁸ the Union greenhouse gas ETS market stability reserve,⁴²⁹ the activities related to governance of the Energy Union and Climate Action,⁴³⁰ directives on energy efficiency,⁴³¹ and monitoring greenhouse gas emissions.⁴³² Finally, the Regulation (EU) 2018/841 on GHG emissions removals from land use, land use change, and forestry would specifically apply to CRD projects involving afforestation and reforestation, and avoiding deforestation.⁴³³

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.⁴³⁴ 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.⁴³⁵ The Law specifically encourages maintenance, management, and enhancement of natural emissions sinks in the long-term.⁴³⁶

Under the Law, CE technologies may be integrated in Union and Member State actions to achieve carbon-neutrality targets for 2030 and thereafter.⁴³⁷ 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.

⁴²⁷ 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).

⁴²⁸ 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).

⁴²⁹ 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).

⁴³⁰ 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).

⁴³¹ 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.

⁴³² 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).

⁴³³ 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).

⁴³⁴ European Climate Law, Recital 20.

⁴³⁵ Ibid, Recital 23, 32.

⁴³⁶ Ibid, Article 4.

⁴³⁷ Ibid.



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).⁴³⁸

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.

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”.⁴³⁹ Additionally, auction revenues are explicitly mentioned to support afforestation, reforestation, and avoiding deforestation in Europe and developing countries; and carbon capture and storage.⁴⁴⁰ Emissions from biomass are excluded from small installations,⁴⁴¹ 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.⁴⁴² 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.⁴⁴³ 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).⁴⁴³

⁴³⁸ Regulation (EU) 2018/1999.

⁴³⁹ 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.

⁴⁴⁰ Ibid, Chapter III.10.3.c-e.

⁴⁴¹ Ibid, Article 27.

⁴⁴² Müller, M.N. (2021), supra note 406.

⁴⁴³ Ibid.



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).⁴⁴⁴ 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.⁴⁴⁵ 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 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.⁴⁴⁶ 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).⁴⁴⁷ 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.⁴⁴⁸ 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.⁴⁴⁹ 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

⁴⁴⁴ Woerdman, E. Roggenkamp, M. and Holwerda, M. (2021), supra note 391.

⁴⁴⁵ Ibid, p.207.

⁴⁴⁶ 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.

⁴⁴⁷ Directive 2003/87/EC.

⁴⁴⁸ Regulation (EC) No 1367/2006.

⁴⁴⁹ 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>



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,⁴⁵⁰ 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.

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.⁴⁵¹ 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.⁴⁵²

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,⁴⁵³ and the key obligations in the Treaty are accepted as part of customary international law.⁴⁵⁴ 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.⁴⁵⁵ All states have free access for the exploration of space, including “freedom of scientific investigation,”⁴⁵⁶ and states cannot make any claims of sovereignty in outer space, which includes the Moon.⁴⁵⁷ In carrying out activities, all states should be “guided by the principle of cooperation and mutual assistance,”⁴⁵⁸ and are required to inform the United Nations and the public about their activities.⁴⁵⁹

⁴⁵⁰ Eliason, A. (2022) 'Avoiding Moonraker: Averting Unilateral Geoengineering Efforts', *University of Pennsylvania Journal of International Law*, 43(2), pp.442, 448.

⁴⁵¹ 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).

⁴⁵² EUSPA and ESA. (2004) Framework Agreement between the European Community and the European Space Agency (L. 261/64).

⁴⁵³ 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)

⁴⁵⁴ 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/>

⁴⁵⁵ 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.

⁴⁵⁶ Ibid.

⁴⁵⁷ Ibid, Article 2.

⁴⁵⁸ Ibid, Article IX.

⁴⁵⁹ Ibid.



Under the Outer Space Treaty, states are responsible for their activities in space (carried out by governmental agencies or private parties)⁴⁶⁰ and are liable for damages caused to another state or person by an object launched into space.⁴⁶¹ As part of this responsibility, states are required to authorize and supervise the activities of private parties in space.⁴⁶² States must adopt “appropriate measures” to avoid “harmful contamination and also adverse changes in the environment of the Earth.”⁴⁶³ 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.”⁴⁶⁴

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.⁴⁶⁵ 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 2020.⁴⁶⁶

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.”⁴⁶⁷ 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.⁴⁶⁸ 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,⁴⁶⁹ and liable for damage caused by fault to another space object in orbit.⁴⁷⁰ 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.⁴⁷¹ 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

⁴⁶⁰ Ibid, Article VI.

⁴⁶¹ Ibid, Article VII.

⁴⁶² Ibid, Article VI.

⁴⁶³ Ibid, Article IX.

⁴⁶⁴ Ibid.

⁴⁶⁵ Ibid, Article IV.

⁴⁶⁶ Reducing space threats through norms, rules and principles of responsible behaviours (7 December 2020) G.A. A/RES/75/36.

⁴⁶⁷ 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.

⁴⁶⁸ Eliason, A. (2022), *supra* note 450, p.450; Crawford, J. (2008), *supra* note 136, 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”.

⁴⁶⁹ Space Liability Convention, Article II.

⁴⁷⁰ Space Liability Convention, Article III.

⁴⁷¹ 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>



information about space objects launched into orbit to a centralised registry at the U.N.⁴⁷² The U.N. Office for Outer Space Affairs (UNOOSA) currently maintains the registry, available publicly online.⁴⁷³

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”⁴⁷⁴ and provides some guidance on the exploration of resources in 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 exploration⁴⁷⁵ and have the right to collect and remove minerals and resources from outer space.⁴⁷⁶

Artemis Accords The Artemis Accords are a non-binding international agreement for principles governing space exploration drafted by the United States.⁴⁷⁷ Though not limited to participating countries, the principles are meant to be a cooperation framework for NASA’s Artemis missions to the Moon.⁴⁷⁸ 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”.⁴⁷⁹

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.⁴⁸⁰ 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,

⁴⁷² Convention on Registration of Objects Launched into Outer Space (Registration Convention) (15 September 1976) 1023 U.N.T.S. 15.

⁴⁷³ United Nations Register of Objects Launched into Outer Space. *UNOOSA* / [Online]. Available at: <https://www.unoosa.org/oosa/en/spaceobjectregister/index.html>

⁴⁷⁴ 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.

⁴⁷⁵ *Ibid*, Article 3(4)

⁴⁷⁶ *Ibid*, Article 6(2).

⁴⁷⁷ 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>

⁴⁷⁸ 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>

⁴⁷⁹ NASA. (2020), *supra* note 477.

⁴⁸⁰ Larsen, P.B. (2020), *supra* note 454, p.116.



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.

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.⁴⁸¹ Liability of harm for the space environment is not address. Under the Outer Space Treaty, States are directed to avoid “harmful contamination of celestial bodies”,⁴⁸² 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.⁴⁸³ Therefore, international law provides no clear answer on whether and who would be held responsible for environmental harm in space caused by climate engineering.⁴⁸⁴

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.”⁴⁸⁵ Space debris is not addressed in any binding instruments of space law, but there are a number of non-binding guidelines.⁴⁸⁶ 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).⁴⁸⁷ 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.

⁴⁸¹ Space Liability Convention.

⁴⁸² Outer Space Treaty, Article IX.

⁴⁸³ 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.”

⁴⁸⁴ Eliason, A. (2022), supra note 450, p. 339

⁴⁸⁵ 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.

⁴⁸⁶ 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.

⁴⁸⁷ 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).



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.⁴⁸⁸ 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).⁴⁸⁹ The Moon Agreement also calls on States to establish an international regime to govern the exploitation of natural resources that is orderly and safe, rational, and provides for equitable benefits sharing.⁴⁹⁰ 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.⁴⁹¹ For example, the U.S. legalized space mining in the 2015 U.S. Commercial Space Launch Competitiveness Act⁴⁹² and initial coverage of the Artemis Accords referred to them as a “legal blueprint for mining on the moon”.⁴⁹³ 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.⁴⁹⁴ 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.⁴⁹⁵ 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.⁴⁹⁶

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

⁴⁸⁸ 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

⁴⁸⁹ Outer Space Treaty, Article 2; Moon Agreement, Article. 11(2).

⁴⁹⁰ Moon Agreement, Article 11(7).

⁴⁹¹ 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/>

⁴⁹² U.S. Congress. (2015) U.S. Commercial Space Launch Competitiveness Act, Public Law 114-90.

⁴⁹³ 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-sources-idUSKBN22H2SB>

⁴⁹⁴ Luxembourg Chambre des Deputes (Chamber of Deputies). (2017) Law on the Exploration and Uses of Space Resources, No. 674 of 28 July 2019.

⁴⁹⁵ 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 383.

⁴⁹⁶ McGee, J., Brent., K. and Burns, W. (2017), supra note 383, p.6.



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 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.⁴⁹⁷ UNCLOS guarantees freedom in the high seas for all states, including freedom of navigation, fishing, and scientific research.⁴⁹⁸ Any ship/vessel on the high seas must register with a single state and fly its flag;⁴⁹⁹ the state must then exercise jurisdiction⁵⁰⁰ and is responsible for ensuring the vessel/ship complies with international rules and standards.⁵⁰¹ Contracting states are obligated to protect and preserve the marine environment.⁵⁰² 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.⁵⁰³ UNCLOS is concerned with five different types of pollution: land-based pollution,⁵⁰⁴ pollution from seabed activities,⁵⁰⁵ dumping,⁵⁰⁶ pollution from vessels,⁵⁰⁷ and pollution from or through the atmosphere.⁵⁰⁸ 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.⁵⁰⁹

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,⁵¹⁰ which includes a prior project assessment, permitting, and monitoring.⁵¹¹ The London Convention prohibits dumping

⁴⁹⁷ 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 136, 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&clanq=en#1

⁴⁹⁸ UNCLOS, Article 87.

⁴⁹⁹ Ibid, Article 92.

⁵⁰⁰ Ibid, Article 94.

⁵⁰¹ Ibid, Article 217.

⁵⁰² Ibid, Article 192.

⁵⁰³ Ibid, Article 145, 194.

⁵⁰⁴ Ibid, Article 207.

⁵⁰⁵ Ibid, Article 208.

⁵⁰⁶ Ibid, Article 210.

⁵⁰⁷ Ibid, Article 211.

⁵⁰⁸ Ibid, Article 212.

⁵⁰⁹ Ibid, Annex VI.

⁵¹⁰ 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.

⁵¹¹ Ibid, Article IV and Annex III.



some categories of wastes; other wastes require either a special or general permit.⁵¹² The International Maritime Organization hosts the permanent secretariat of the London Convention.⁵¹³ There are currently 87 States party to the London Convention.⁵¹⁴ 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 principle⁵¹⁵ to prohibit all dumping except for certain materials.⁵¹⁶ 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.⁵¹⁷ However, as under the Convention, Contracting States are required to assess, issue permits, and monitor any non-prohibited dumping activities.⁵¹⁸ Referencing the rules of state responsibility for transboundary environmental harm (see Section 4.2.2), Contracting Parties are liable for damage to the environment⁵¹⁹ and bear the costs of pollution ('polluter pays' principle).⁵²⁰ States are also prohibited from exporting their waste to other countries to dump to avoid liability.⁵²¹ 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.⁵²² The IMO also hosts the permanent secretariat of the London Convention.⁵²³ There are currently 53 states party to the Convention.⁵²⁴

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."⁵²⁵ 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."⁵²⁶ 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

⁵¹² Ibid, Article IV.

⁵¹³ 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>

⁵¹⁴ Ibid.

⁵¹⁵ 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."

⁵¹⁶ Ibid, Article 1(4).

⁵¹⁷ 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.

⁵¹⁸ London Protocol, Article 4, 9.

⁵¹⁹ Ibid, Article 15.

⁵²⁰ Ibid, Article 3(2).

⁵²¹ Ibid, Article 6.

⁵²² Ibid, Article 14.

⁵²³ Ibid, Article 19.

⁵²⁴ International Maritime Organization, supra note 513.

⁵²⁵ CBD, Article 2.

⁵²⁶ 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.



generations.”⁵²⁷ Additional guidance in the form of criteria and methodological standards were adopted in 2017.⁵²⁸ 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.”⁵²⁹ Obligations for Member States include assessing the current status of their marine environment, setting environmental targets, establishing monitoring programmes, and updating the European Commission.⁵³⁰ 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.⁵³¹

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.⁵³² 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.⁵³³

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.”⁵³⁴ The definition in the London Protocol is nearly

⁵²⁷ Ibid, Article 3(5).

⁵²⁸ 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).

⁵²⁹ Directive 2008/56/EC, Article 1.

⁵³⁰ Ibid, Article 8-11.

⁵³¹ Ibid, Article 14.

⁵³² Rayfuse, R. Lawrence, M.G. and Gjerde, K.M. (2008), supra note 517, p.313.

⁵³³ *Trail Smelter* case, supra note 284. 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.

⁵³⁴ UNCLOS, Article 1(4).



identical.⁵³⁵ ‘Dumping’ – a type of pollution – is defined under the UNCLOS and the London Convention as “any deliberate disposal of wastes or other matter...or other man-made structures at sea.”⁵³⁶ The London Protocol expands that definition to include “any storage of wastes other matter in the seabed and the subsoil”.⁵³⁷

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.⁵³⁸ 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”.⁵³⁹

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”.⁵⁴⁰ 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.⁵⁴¹ 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.”⁵⁴² 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.⁵⁴³ 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.

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,

⁵³⁵ London Protocol, Article 1(10).

⁵³⁶ UNCLOS, Article 1(5); London Convention, Article 3(1)(a).

⁵³⁷ London Protocol, Article 1(4).

⁵³⁸ 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.

⁵³⁹ 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”).

⁵⁴⁰ London Protocol, Article 3(1).

⁵⁴¹ London Protocol, Annex 1.

⁵⁴² Rayfuse, R. Lawrence, M.G. and Gjerde, K.M. (2008), supra note 517, p.312.

⁵⁴³ Ibid, p.313.



project in 2007 in the high seas near the Galapagos Islands.⁵⁴⁴ 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.⁵⁴⁵

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.”⁵⁴⁶ Following up in 2010, the Contracting Parties adopted an assessment framework to assess whether proposed activities qualify as legitimate scientific research.⁵⁴⁷ Around the same time, the Contracting Parties began to consider binding rules for marine climate engineering beyond ocean fertilisation.⁵⁴⁸ They adopted a resolution in 2013 amending the London Protocol to prohibit marine geoengineering more broadly, except for legitimate scientific research.⁵⁴⁹ However, the resolution will not become binding until it enters into force, which requires adoption by two-thirds of the Contracting Parties.⁵⁵⁰ To date, only six states have adopted the resolution.⁵⁵¹

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.”⁵⁵² There is an exception for small-scale scientific research, but only if a prior impact assessment is conducted and the research is “strictly controlled.”⁵⁵³ 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.”⁵⁵⁴ Their follow-up 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,

⁵⁴⁴ 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.popsci.com/environment/article/2008-07/carbon-discredit/>

⁵⁴⁵ 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>

⁵⁴⁶ 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.

⁵⁴⁷ 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).

⁵⁴⁸ 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).

⁵⁴⁹ 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”).

⁵⁵⁰ London Protocol, Article 21(2).

⁵⁵¹ 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>

⁵⁵² 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.

⁵⁵³ Ibid.

⁵⁵⁴ Ibid.



economic, and cultural impacts.⁵⁵⁵ The exception for small-scale scientific research remains, so long as the studies are controlled and subject to prior assessment.⁵⁵⁶

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.⁵⁵⁷ 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,⁵⁵⁸ making it possible for a state with insufficient seabed storage capacity to export to a state with more capacity.⁵⁵⁹ Two additional documents set out the rules for exporting the CO₂ to another country,⁵⁶⁰ and a revised framework for permitting seabed injection.⁵⁶¹ 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.”⁵⁶² Those specific requirements include permitting, EIA, risk assessment and management, monitoring, and mitigation and remediation plans.⁵⁶³

⁵⁵⁵ 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).

⁵⁵⁶ Ibid.

⁵⁵⁷ 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.

⁵⁵⁸ 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).

⁵⁵⁹ Dixon, T., Garret, J., and Kleverlaan, E. (2014), supra note 557, p.6624.

⁵⁶⁰ 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.

⁵⁶¹ 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].

⁵⁶² Dixon, T., Garret, J., and Kleverlaan, E. (2014), supra note 557, p.6625.

⁵⁶³ 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.



5. Conclusion and future outlook

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 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.



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