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Annex 9.3 National legal case study: Climate engineering in the United Kingdom

D4.2 Comparative analysis of national legal case studies December 2022

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D4.2 National legal case studies: Annex 9.3 Climate engineering in the United Kingdom			
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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 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
Greenhouse gas removal (GGR)	Refers to climate engineering technologies which remove greenhouse gases from the atmosphere. GGR is understood to be broader than CDR, as it includes the potential for removing greenhouse gases other than carbon dioxide.
Carbon dioxide removal (CDR)	Refers to climate engineering technologies which remove carbon dioxide from the atmosphere.
Solar radiation management (SRM)	Refers to technologies that seek to enhance the earth's albedo, i.e. the earth's ability to reflect the sun's radiation to reduce the warming effect.

Table 2: List of Abbreviations

Term	Explanation
BECCS	Bioenergy carbon capture and storage
BEIS	Department for Business, Energy & Industrial Strategy (UK)
CAT	Convention against Torture and Other Cruel, Inhuman or Degrading Treatment or Punishment
CB	Carbon budget
CBD	Convention on Biological Diversity

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CCC	Committee on Climate Change
CCR	Carbon capture ready
CCS	Carbon capture and storage
CCUS	Carbon capture usage and storage
CDR	Carbon Dioxide Removal
CE	Climate engineering
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CO2	Carbon dioxide
COP	Conference of the Parties
CRC	Convention on the Rights of the Child
CRPD	Convention on the Rights of Persons with Disabilities
DAC	Direct air capture
DACCS	Direct air carbon capture and storage
DoA	Description of Action
EA	Environment Agency
ECHR	European Convention on Human Rights
ECtHR	European Court of Human Rights
EIA	Environmental Impact Assessment
EOR	Enhanced oil recovery
ETS	Emissions Trading Scheme
FOIA	Freedom of Information Act 2000
FOISA	Freedom of Information (Scotland) Act 2002
GGR	Greenhouse Gas Removal
GHG	Greenhouse gas
HoC	House of Commons
HoL	House of Lords
HSE	Health & Safety Executive
ICCPR	International Covenant on Civil and Political Rights

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ICERD	International Convention on the Elimination of All Forms of Racial Discrimination
ICESCR	International Covenant on Economic, Social and Cultural Rights
IEA	International environmental agreement
IPCC	Intergovernmental Panel on Climate Change
MEA	Multilateral environmental agreement
MtCO2e	Metric tonnes of carbon dioxide equivalent
NDC	Nationally determined contributions
NSTA	North Sea Transition Authority
OEP	Office for Environmental Protection
PC	Project Coordinator
SAI	Stratospheric Aerosol Injection
SEA	Strategic Environmental Assessment
SEPA	Scottish Environment Protection Agency
SoS	Secretary of State
SRM	Solar Radiation Management
UDHR	Universal Declaration of Human Rights
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WP	Work Package

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Abstract

The objective of this study is to review the current state of the law and legal responses on climate engineering in the United Kingdom, as evidenced in policy, legislation, case law and regulation. It focuses on issues affecting and/or contributing to the protection of fundamental human rights, environmental law obligations and principles, and climate change targets under UK climate change law. The study sets out the extent to which these legal domains are capable of regulating climate engineering, before highlighting gaps and challenges in the existing legal frameworks.

A summary overview of the main findings and legal issues surrounding climate engineering in the UK is provided in section 3.1.3 of the TechEthos D4.2 Comparative analysis of national legal case studies. This report is primarily aimed at informing the UK government and UK policy makers regarding the regulatory challenges of climate engineering in the UK. Furthermore, it provides further background to readers to the specific UK context of the main points and key regulatory challenges identified in the comparative analysis to which this report is annexed.

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1. Introduction

Climate engineering presents many significant legal issues that impact socio-economic equality and fundamental rights in the United Kingdom (UK). This study provides an overview of those legal issues and challenges.

This study analyses relevant laws and policies from the UK legal system in relation to climate engineering. For TechEthos project and this national legal case study, we have used the following definition for 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."[1]

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

This **introduction** sets out the purpose of the UK legal case study, and describes the scope and limitations of the study, before providing a high-level overview of the UK legal system and current state of climate engineering in the UK. **Section II** of this study explores the existing and proposed laws and policies that specifically address climate engineering. **Section III** explores the legal implications of climate engineering in relation to specific legal domains, including human rights law, environmental law and climate change law. **Section IV** provides an overview of the gaps and challenges in relation to the regulation of climate engineering. **Section V** concludes the case study, followed by a reference list.

1.1 Purpose of the UK legal case study

The objective of this study is to review the current state of the law and legal responses on climate engineering in the UK, as evidenced in policy, legislation, case law and regulation. We prepared this study through desk research, using legal research and academic databases such as WestLaw UK.

Whilst there is no dedicated body of law addressed directly at climate engineering technologies, many existing legal frameworks, such as environmental laws, still apply and cover climate engineering activities, including the regulation of environmental damage resulting from them. Legal and policy discourse in the UK has mostly focused on the need for climate engineering to achieve climate law and policy targets, and a general recognition that such targets cannot be achieved without deploying climate engineering technologies. At the same time, there is a need for more research to increase the scientific knowledge base around the use of such technologies and mitigate potential risks of harm to the environment and human health.

This study is part of a series of national legal case studies prepared in the TechEthos project covering three technology families: climate engineering, neurotechnologies, and digital extended reality. A complementary report covers the international and European Union law dimensions of the three

[1] Shepherd, J., Caldeira, K., Cox, P., Haigh, J., Keith, D., Launder, B., & Mace, G. (2009) G*eoengineering the Climate: Science, Governance, and Uncertainty*. Available at: https://royalsociety.org/~/media/royal_society_content/policy/publications/2009/8693.pdf.

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technology families. The following table provides an overview of the nine country studies conducted as part of the *Comparative analysis of national legal case studies* (D4.2 of the TechEthos project):

Table 3: Overview of nine national legal case studies (TechEthos WP4)

Climate Engineering	Neurotechnologies	Digital Extended Reality
Australia	Germany	France
Austria	Ireland	Italy
United Kingdom	United States	United Kingdom

1.2 Scope and Limitations

This study was prepared as part of the TechEthos project's work package on policy, legal and regulatory analysis. Therefore, the scope is demarcated by that project task's workplan. The legal issues related to climate engineering are too vast to be covered comprehensively in a study of this size. Therefore, this national legal case study seeks to provide a high-level overview of the legal implications of climate engineering in the UK, focusing on a pre-defined range of topics and legal frameworks with significant human rights and socio-economic impacts that are of high policy relevance, particularly in the European context.

The primary focus of the legal analysis in this case study is on UK-wide laws in relation to the regulation of climate engineering technologies. Where there are relevant differences between legal systems in the UK in relation to the regulation of climate engineering, such as between the laws of England and Wales, and Scotland, those differences are drawn out. This report takes into account the legal and policy developments in the UK in relation to climate engineering up to November 2022.

1.3 Overview of the UK legal system

Constitutional governance and devolution

The United Kingdom is a unitary State with devolved administrations in Scotland, Northern Ireland and Wales.[2] These administrations were established through Acts of Parliament and have powers passed to them from the UK Parliament. The UK system is typically described as asymmetrical, meaning that each devolved administration has a varying degree of powers. Those powers that are retained with the UK Parliament are described as reserved powers. There are three legal systems in the UK, with England and Wales falling under the same legal system, and separate legal systems for Scotland and Northern Ireland.[3]

The constitutional governance of the UK and its devolved administrations, rests on the principle of parliamentary sovereignty. This means that the UK Parliament is the supreme legal authority to make

[2] *United Kingdom / European Committee of the Regions*, [Online]. Available at: https://portal.cor.europa.eu/divisionpowers/Pages/UK-intro.aspx.
[3] Practical Law Environment (2022) *Wales: devolution of environmental powers / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/8-501-7826?comp=pluk&transitionType=Default&contextData=(sc.Default)&OWSessionId=a8f8e0611c2e48aeb3608ff5489b2ff5&skipAnonymous=true&firstPage=true.

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and revoke laws.[4] In principle, courts cannot overrule legislation and the Parliament cannot pass laws which cannot be changed by future Parliaments.[5] The principle of parliamentary sovereignty also covers the devolved administrations, meaning that these administrations are established on the basis of Acts of Parliament, and that the UK Parliament can – in principle – also revoke these laws.

The UK Parliament comprises the House of Commons, which constitutes the lower chamber, and the House of Lords, as the upper chamber. Proposed law can be introduced by any Member of Parliament as a Bill, which each House of Parliament gets to debate and approve or reject. Approved Bills become law after receiving Royal Assent and are then known as Acts.[6] In Scotland, the Scottish Government can present Bills to the Scottish Parliament. The Scottish Parliament is unicameral, and once a Bill is passed and it has received Royal Assent, it becomes an Act of the Scottish Parliament.[7] The Northern Ireland Assembly is the devolved legislature for Northern Ireland. Bills passed by the Assembly and given Royal Assent become Acts of the Assembly.[8] In Wales, Bills passed by the Senedd and given Royal Assent become Acts of the Senedd Cymru.[9]

UK legal system and sources of law

Unlike most other States, the UK does not have one self-contained Constitution which sets out governance principles, fundamental rights, and the rules of State. Instead, UK constitutional law comprises a variety of documents, including statutes, conventions, judicial decisions, and treaties.[10]

The UK is a common law jurisdiction, which means that the legal system is based on court precedent. This means that lower courts are bound by judicial decisions made by higher courts. In addition to judge-made law, sources of law in the UK include legislation (Acts adopted by the UK Parliament, or Parliaments of the devolved administrations), as well as international law and retained EU law.

[4] *Parliamentary Sovereignty / UK Parliament*, [Online]. Available at: https://www.parliament.uk/site-information/glossary/parliamentary-sovereignty/#:~:text=Parliamentary%20sovereignty%20is%20a%20principle,that%20future%20Parliaments%20cannot%20change.
[5] Ibid.
[6] Cabinet Office (2013) *Legislative process: taking a bill through Parliament / Gov.uk,* [Online]. Available at: https://www.gov.uk/guidance/legislative-process-taking-a-bill-through-parliament#:~:text=Once%20a%20bill%20has%20been,introduced%20into%20Parliament%20by%20ministers.
[7] Scotland Act 1998, c. 46, s. 28; *Bills and Laws / The Scottish Parliament,* [Online]. Available at: https://www.parliament.scot/bills-and-laws/about-bills/how-a-bill-becomes-an-act.
[8] Northern Ireland Act 1998, c. 47, s. 5; *Law Making in the Northern Ireland Assembly / Northern Ireland Assembly,* [Online]. Available at: http://www.niassembly.gov.uk/assembly-business/legislation/bills-explained/.
[9] Government of Wales Act 2006, c. 32, s. 107; *Legislation / Welsh Parliament,* [Online]. Available at: https://senedd.wales/senedd-business/legislation/.
[10] See, *Constitutional law – Overview / LexisPSL,* [Online]. Available at: https://www.lexisnexis.com/uk/lexispsl/publiclaw/document/413479/5CYB-SMH1-DYY6-F311-00000-00/Constitutional_law_overview; *What is the UK Constitution? / UCL The Constitution Unit*, [Online]. Available at: https://www.ucl.ac.uk/constitution-unit/explainers/what-uk-constitution.

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UK judiciary & court structure

Courts and tribunals in the UK are responsible for the enforcement of laws. Scotland's judiciary is separate from the rest of the UK.[11] The table below provides a simplified overview of the structure of courts and tribunals in the UK:

Table 4: Overview of court structure in England and Wales, Northern Ireland, and Scotland

Type of court	England and Wales; and Northern Ireland[12]	Scotland
Court of first instance	Magistrates' court (criminal) Crown Court (serious crimes) County Court (civil)	Justice of the Peace Courts (summary crimes only) Sheriff Courts (criminal and civil)
Appeals court	High Court Court of Appeal	Sheriff Appeal Court
Court of last instance	UK Supreme Court	The Court of Session (supreme civil court) The High Court of Justiciary (supreme criminal court)

International law in the UK

The UK is a signatory to a wide range of international laws and treaties. This includes international human rights law, international environmental law, and international climate law. As a dualist state, international law cannot be invoked in national courts unless it is transposed into national law. In relation to many international laws, the UK has legislated at the national level to transpose the provisions of international law into domestic law, such as the Human Rights Act 1998, which implements the European Convention of Human Rights (ECHR).[13]

European Union law: implications of the UK's withdrawal from the EU

Many areas of UK law are influenced by EU law. As a dualist state, many EU laws with indirect effect, such as Directives, have been transposed into domestic EU law. In 2016, the UK voted to leave the European Union. At the end of the transition period in December 2020, many EU laws were retained in

[11] Although some reserved tribunals are administered by HM Courts and Tribunal Service. See, *Other courts and tribunals / Scottish Courts and Tribunals,* [Online]. Available at: https://www.scotcourts.gov.uk/the-courts/the-tribunals/other-courts-and-tribunals.

[12] The Northern Irish court structure corresponds to that of England and Wales, although courts and tribunals are administered separately by the Judiciary Northern Ireland. See, *Court Sittings and Court Structure / Judiciary NI,* [Online]. Available at: https://www.judiciaryni.uk/court-sittings-and-court-structure; *Structure of the Courts & Tribunals system / Courts and Tribunals Judiciary,* [Online]. Available at: https://www.judiciary.uk/about-the-judiciary/our-justice-system/court-structure/.

[13] Human Rights Act 1998, c. 42; 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.

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UK law by the European Union (Withdrawal) Act 2018.[14] The Trade and Cooperation Agreement signed by the EU and the UK in 2020, recognises the right of both parties to regulate within their territories, including environmental regulation.[15] As such, it is expected that UK law and EU law will gradually diverge.[16] Furthermore, a recent Bill to revoke most of the retained EU law was introduced to the House of Commons in September 2022. The heavily contested Bill sets out that all retained EU law will be repealed by December 2023 unless it has been explicitly transposed into UK domestic law.[17] The Bill has been criticised by various opponents, including the Welsh and Scottish governments,[18] and may still be subject to further review.[19]

1.4 Current state of climate engineering in the UK

The UK Government generally refers to the terms greenhouse gas removal (GGR) and Solar Radiation Management (SRM) as technologies that "aim to counteract human-caused climate change by deliberate large-scale intervention in the Earth's natural systems. They are sometimes referred to as 'geo-engineering' or 'climate engineering'."[20] GGR as a group of technologies includes Carbon Dioxide Removal (CDR), with GGR also referring to the possibility of removing other greenhouse gases.[21]

Since the 2019 amendment to the Climate Change Act 2008 reflecting the net-zero by 2050 target,[22] the UK Government has taken various steps to investigate the role GGR technologies can play in meeting its climate targets. It has been estimated that the GGR sector will need to be scaled up to remove between 60 and 150 MtCO2e by 2050 if the UK is to reach its net zero target by 2050.[23] The UK Government is therefore investing in various schemes with a focus on research, development and

[14] European Union (Withdrawal) Act 2018, s. 2.
[15] Trade and Cooperation Agreement between the United Kingdom of Great Britain and Northern Ireland, of the one part, and the European Union and the European Atomic Energy Community, of the other part, entry into force 1 May 2021, Treaty Series No.8 (2021) (TCA), article 123 (2).
[16] Coxall M. and Souter K. (2021) *Environmental Law and Practice in the UK (England and Wales): Overview / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/6-503-1654?transitionType=Default&contextData=(sc.Default)&firstPage=true.
[17] Department for Business, Energy & Industrial Strategy (2022) *The Retained EU Law (Revocation and Reform) Bill 2022 / Gov.uk*, [Online]. Available at: https://www.gov.uk/government/news/the-retained-eu-law-revocation-and-reform-bill-2022.
[18] Moran S. (2022) *"Unfettered authority"? The Retained EU Law (Revocation and Reform) Bill in Wales / Welsh Parliament: Senedd Research,* [Online]. Available at: https://research.senedd.wales/research-articles/unfettered-authority-the-retained-eu-law-revocation-and-reform-bill-in-wales/.
[19] O'Carroll L. (2022) 'Sunak may deprioritise Rees-Mogg Brexit bill to switch off 2,400 EU laws', *The Guardian*, 27 October 2022, [Online]. Available at: https://www.theguardian.com/law/2022/oct/27/sunak-may-deprioritise-brexit-bill-to-switch-off-2400-eu-laws.
[20] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.
[21] Ibid.
[22] The Climate Change Act 2008 (2050 Target Amendment) Order 2019, No. 1056, s. 2.
[23] Simon R., et al (2021) *Greenhouse gas removal methods and their potential UK deployment: A report published for the Department for Business, Energy and Industrial Strategy by Element Energy and the UK Centre for Ecology and Hydrology*. Element Energy and the UK Centre for Ecology & Hydrology, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026988/ggr-methods-potential-deployment.pdf, p. 76.

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deployment, and wants to better understand the costs, feasibility, as well as environmental and societal impacts.[24]

In its pursuit to develop an evidence base for GGR, the UK government has, for instance, supported the launch of an £8.6 million GGR research programme,[25] launched a £31.5 million programme to support GGR demonstrator projects over a 4.5 year period,[26] and committed £100 million through its Energy Innovation Programme to help decarbonise industry and includes the exploration of Carbon Capture Usage and Storage (CCUS) solutions.[27] Similarly, the Scottish Government established a £180 million Emerging Energy Technologies Fund (EETF) to support CCS, including CDR technologies in Scotland.[28] Co-funded by the UK Energy Innovation Programme, C-Capture and Drax successfully delivered Europe's first Bioenergy Carbon Capture and Storage (BECCS) pilot capturing the first CO2 at a BECCS plant in North Yorkshire in February 2019.[29] Drax has since signed a deal with Mitsubishi Heavy Industries for world's largest deployment of negative emissions in power generation.[30]

In addition to funding GGR research and pilots, the UK Government has been investigating policy options to support GGR deployment in the UK. In 2019, Vivid Economics published a report commissioned by the Government which sets out the policy opportunities and challenges surrounding GGR in the UK.[31] Challenges include the cost and source of funding of GGR, defining accounting methodologies to quantify negative emissions, scientific uncertainty linked to the immaturity of most GGR technologies and associated cost of uncertainties, and policy interactions and coordination

[24] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.
[25] Ibid.
[26] UKRI (2021), *UK invests over £30m in large-scale greenhouse gas removal* / UK Research and Innovation, [Online]. Available at: https://www.ukri.org/news/uk-invests-over-30m-in-large-scale-greenhouse-gas-removal/.
[27] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management; Department for Business, Energy & Industrial Stategy (2022) *Notice: Hydrogen BECCS Innovation Programme: successful projects / Gov.uk*, [Online]. Available at: https://www.gov.uk/government/publications/hydrogen-beccs-innovation-programme-successful-projects.
[28] Cabinet Secretary for Net Zero, Energy and Transport, *Renewable and low carbon energy: Emerging Energy Technologies Fund / Scottish Government,* [Online]. Available at: https://www.gov.scot/policies/renewable-and-low-carbon-energy/emerging-energy-technologies-fund/#:~:text=The%20EETF%20will%20provide%20capital,with%20our%20Hydrogen%20Policy%20Statement.
[29] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management; Drax (2019) *Carbon dioxide now being captured in first of its kind BECCS pilot / Drax* [Online]. Available at: https://www.drax.com/press_release/world-first-co2-beccs-ccus/.
[30] Drax (2021) *Drax and Mitsubishi Heavy Industries sign pioneering deal to deliver the world's largest carbon capture power project / Drax* [Online]. Available at: https://www.drax.com/press_release/drax-and-mitsubishi-heavy-industries-sign-pioneering-deal-to-deliver-the-worlds-largest-carbon-capture-power-project/.
[31] Vivid Economics (2019) *Greenhouse Gas Removal (GGR) policy options – Final Report*. London: Vivid Economics, [Online]. Available at: https://www.gov.uk/government/publications/greenhouse-gas-removal-policy-options.

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between different sectors and government departments.[32] The report explores four policy pathways for encouraging GGR, setting out the strengths and weaknesses for each one. It suggests that the imposition of GGR obligations as a percentage of carbon content on wholesale suppliers of fossil fuels and agricultural products may be the preferred policy pathway given its effectiveness and certainty over carbon quantity as well as minimal distributional impacts.[33]

The UK Government commissioned the National Infrastructure Commission (NIC) in 2020 to assess the role of GGR in delivering on the UK's climate targets and the policies required to encourage their take up.[34] The study focused on engineered greenhouse gas removals requiring economic infrastructure, including Direct Air Capture (DAC) and BECCS, as opposed to alternative methods, such as afforestation, peatland restoration, and enhanced marine weathering.[35] The study recognises the need for GGR technologies to offset emissions from sectors hard to decarbonise and predicts that GGR will become a major infrastructure sector in the UK over the next few decades.[36] The NIC makes eight actionable recommendations and encourages the UK Government to act quickly to help mobilise GGR activities in the UK and create the right policy incentives.[37]

Element Energy and the UK Centre for Ecology & Hydrology published a report in October 2021 on behalf of BEIS on the analysis of the costs and deployment potential of GGR in the UK.[38] It found that significant uncertainty remains around the cost of GGR, required resources and potential timeline for GGR deployment, and that further research is needed to update evidence base for GGR.[39]

The £31.5 million GGR demonstrators programme (GGR-D) funded by the UK Research and Innovation Fund (UKRI) started in April 2021 and runs until October 2025.[40] It will assess sustainable routes for the large-scale deployment of GGR technologies. The programme consists of five demonstrator projects which focus on biochar, enhanced rock weathering, peatland restoration, perennial biomass crops, and woodland creation and management.[41] The programme is coordinated by CO2RE, the Greenhouse Gas Removal Hub, which conducts GGR research and evaluates economically, socially and environmentally scalable GGR solutions over the course of the GGR-D programme.[42] The research focuses on the

[32] Ibid, p. 4.
[33] Ibid, p. 5.
[34] *Greenhouse gas removal technologies / National Infrastructure Commission*, [Online]. Available at: https://nic.org.uk/studies-reports/greenhouse-gas-removals/#:~:text=The%20UK%20government%20must%20commit,by%20the%20National%20Infrastructure%20Commission.
[35] HM Treasury (2020) *Policy Paper: NIC Greenhouse Gas Removal Technologies Study: Terms of Reference / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/publications/national-infrastructure-strategy/nic-greenhouse-gas-removal-technologies-study-terms-of-reference.
[36] *Engineered greenhouse gas removals: In brief / National Infrastructure Commission,* [Online]. Available at: https://nic.org.uk/studies-reports/greenhouse-gas-removals/engineered-greenhouse-gas-removals/.
[37] *Greenhouse gas removal technologies: Recommendations / National Infrastructure Commission,* [Online]. Available at: https://nic.org.uk/studies-reports/greenhouse-gas-removals/#tab-recommendations.
[38] Simon R., et al (2021) *Greenhouse gas removal methods and their potential UK deployment: A report published for the Department for Business, Energy and Industrial Strategy by Element Energy and the UK Centre for Ecology and Hydrology*. Element Energy and the UK Centre for Ecology & Hydrology, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1026988/ggr-methods-potential-deployment.pdf.
[39] Ibid, p. v.
[40] *GGR Directorate CO2RE Hub / UK Research and Innovation,* [Online]. Available at: https://gtr.ukri.org/projects?ref=NE%2FV013106%2F1#/tabOverview.
[41] *The UK Greenhouse Gas Removal from the Atmosphere Research Programme / Greenhouse Gas Removal: Research Programme*, [Online]. Available at: https://www.ggrprogramme.org.uk/; *What we do / CO2RE The Greenhouse Gas Removal Hub,* [Online]. Available at: https://co2re.org/what-we-do/.
[42] *What we do / CO2RE,* [Online]. Available at: https://co2re.org/what-we-do/.

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environmental, economic, social, cultural, ethical, legal and governance issues of GGR, with a view to developing supportive policy options, an evaluation framework for scalable technologies, and linking GGR initiatives to enhance capacity within the UK and beyond.[43]

Research coming out of the CO2RE group suggests that the legal nature of greenhouse gas (GHG) removals and the regulatory model adopted for GGR projects will have an influence on the cost and efficiency of GGR activities.[44] Creating a market for GHG removal units to be traded similarly to the market for emissions trading, and bundling GGR methods together to create fungibility, can help upscale the GGR sector and create positive policy outcomes.[45]

[43] Ibid.
[44] Macinante J., Ghaleigh, N. S. (2022) 'Regulating Removals: Bundling to Achieve Fungibility in GGR 'Removal Units'' *University of Edinburgh School of Law Research Paper Series, No 2022/05,* [Online]. Available at: http://dx.doi.org/10.2139/ssrn.4064970; the Royal Society and Royal Academy of Engineering (2018) *Greenhouse gas removal.* The Royal Society and the Royal Academy of Engineering, [Online]. Available at: https://royalsociety.org/topics-policy/projects/greenhouse-gas-removal/?utm_source=royalsociety.org&utm_medium=redirect&utm_campaign=greenhouse-gas-removal.
[45] Ibid.

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2. Climate engineering-specific legal developments

This section presents an overview of the legal developments pertaining to climate engineering in the UK. It examines relevant policies and laws in relation to climate engineering and identifies the national authorities invlved in the implementation and enforcement of such laws and policies.

UK policy on climate engineering

The UK Government published and regularly updates its position on greenhouse gas removal (GGR) technologies and solar radiation management (SRM) in a policy paper.[46] GGR refers to technologies aimed at, as the name says, removing greenhouse gases from the atmosphere, and include afforestation and reforestation, bioenergy with carbon capture and storage (BECCS), direct air capture (DAC) and marine fertilisation.[47] GGR is understood to be broader than carbon dioxide removal (CDR), in the sense that it includes the possibility of also removing other greenhouse gases.[48] The position paper is brief but clear regarding SRM, stating that the Government is not currently deploying and does not plan to deploy SRM.

The policy paper describes the Government's priority to "tackle the root cause of climate change by reducing emissions of greenhouse gases from human activities, and adapting to those impacts that are unavoidable."[49] It goes on to say that it recognises the role GGR will need to play in meeting the UK's net zero targets in order to meet its commitments under the 2015 Paris Agreement.[50] This position was informed by the Committee on Climate Change (CCC), which was established under the 2008 Climate Change Act to act as the government's independent advisor on climate change.[51] The CCC advised that, on the basis of the UK's updated legal commitment to tackling climate change, GGR will be necessary to offset emissions from sectors where it will be difficult to reduce emissions.[52]

The UK's position with regard to climate engineering has gained significance and urgency following the UK's legal commitment to achieving net-zero emissions by 2050.[53] In its Net Zero Strategy, the UK Government set out the ambition of deploying CCUS at scale in line with our ambition to capture up to 20-30 metric tonnes of carbon dioxide, per year, by 2030.[54] After all, the CCC advised the UK

[46] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.
[47] Ibid.
[48] Ibid.
[49] Ibid.
[50] Ibid.
[51] Climate Change Act 2008, s. 32.
[52] Committee on Climate Change (2016) *UK climate action following the Paris Agreement*. Committee on Climate Change, [Online]. Available at: https://www.theccc.org.uk/publication/uk-action-following-paris/, p. 42.
[53] Climate Change Act 2008, s. 1 (1) as amended by the Climate Change Act 2008 (2050 Target Amendment) Order 2019 (S.I. 2019/1056), articles 1 and 2.
[54] Department for Business, Energy & Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*. HM Government, [Online]. Available at:

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Government that GGR is not just an option, but a necessity.[55] Whilst UK policy now recognises the role climate engineering will have to play in helping to meet the UK's climate targets, details as to what that role will look like remain under development. This, however, creates an opportunity to develop a governance scheme for climate engineering technologies that builds on broad public support.[56]

UK law on climate engineering

There is no comprehensive body of law that directly addresses climate engineering technologies in the UK. Nevertheless, there are a few laws directly concerned with specific climate engineering, or greenhouse gas removal technologies, as commonly referred to in the UK. Regulation of CCS is most developed, with the Energy Act 2008 providing a licensing regime for offshore storage of CO2.[57] Together with The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010,[58] the Act transposes the provisions from the EU Directive on the geological storage of CO2 into UK law.[59] The North Sea Transition Authority (NSTA and formerly the Oil and Gas Authority) is the licensing authority for offshore CO2 storage in the UK, except for Scotland's territorial sea, for which Scottish Ministers have the authority.[60] A 2011 amendment to the Act extended the licensing regime to onshore and adjacent internal waters in the UK.[61] Unlicensed CCS activities are prohibited.[62]

The Climate Change Act 2008 recognises that removals of greenhouse gases are part of the mix with regard to UK domestic action on climate change.[63] Yet the Act limits the definition of 'removals' to those achieved "due to land use, land use change or forestry activities in the United Kingdom."[64] Engineered technologies, such as BECCS, DAC, seem to be excluded from the Act, as opposed to 'natural' forms of greenhouse gas removal activities, such as afforestation and reforestation.

Large-scale afforestation is covered by the Environmental Impact Assessment Regulations.[65] Furthermore, the UK Government has supported the review of existing regulations by the Convention

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf , p. 21 and 126-128.

[55] Committee on Climate Change (2019) *Net Zero: The UK's contribution to stopping global warming.* Committee on Climate Change, [Online]. Available at: https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/, p. 23; Department for Business, Energy & Industrial Strategy (2022) *Energy Security Bill factsheet: Carbon dioxide transport and storage regulatory investment model / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/publications/energy-security-bill-factsheets/energy-security-bill-factsheet-carbon-dioxide-transport-and-storage-regulatory-investment-model.

[56] Lezaun J. et al (2021) 'Governing Carbon Dioxide Removal in the UK: Lessons Learned and Challenges Ahead' *Frontiers in Climate*, 3:673859, [Online]. DOI: 10.3389/fclim.2021.673859, p. 1.

[57] The Energy Act 2008; Department for Business, Energy & Industrial Strategy (published 2013, updated 2019) *Guidance: UK carbon capture, usage and storage / Gov.uk*, [Online]. Available at: https://www.gov.uk/guidance/uk-carbon-capture-and-storage-government-funding-and-support#international-collaboration-on-ccus.

[58] The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010, No. 2221.

[59] 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, (CCS Directive).

[60] Energy Act 2016, part 2, s. 78

[61] The Storage of Carbon Dioxide (Amendment of the Energy Act 2008 etc.) Regulations 2011, s. 2.

[62] Energy Act 2008, s. 2.

[63] Climate Change Act, s. 15 (2).

[64] Ibid, s. 29 (1) (b).

[65] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-

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on Biological Diversity (CBD) and contributed to work under the London Protocol on marine dumping within the context of GGR technologies and marine fertilisation.[66]

Whilst there is no dedicated body of law that governs climate engineering technologies, many existing laws and legal frameworks would apply nonetheless if such activities were to be carried out. Section 3 explores how a number of legal frameworks would apply to climate engineering.

Proposals for dedicated law

The Energy Bill (previously Energy Security Bill) was introduced to the House of Lords (HoL) on 6 July 2022. At the time of writing, the bill was at the committee stage in the HoL.[67] The bill covers a wide range of energy-related topics and includes a provision about the licensing of CO2 transport and storage.[68] The bill will establish a regulatory framework for CCUS and seeks to remove market barriers to attract private investment by providing:[69]

- Financial assistance
- CO2 transport and storage licencing framework
- Funded decommissioning programme and asset re-use
- Special administration regime
- Statutory transfer scheme

Furthermore, the bill proposes to amend the meaning of 'removals' under the Climate Change Act 2008 (see section 3.3.2 of this case study), to include 'engineered' removals, so that such removals will count towards carbon budgets within the meaning of the Climate Change Act 2008.[70]

This bill is an interesting legal development regarding the regulatory regime for CCS, particularly in relation to transport and storage of carbon dioxide. It is a step by the UK government in the direction of creating a regulatory framework for climate engineering technologies and may serve as an example to other jurisdictions struggling with similar regulatory challenges. Furthermore, the financial support is a clear signal of the UK government that it wishes to attract private investment. The government recognises the need for such investment if it wants to create a CCS sector capable of capturing 20-30 metric tonnes of CO2 a year, by 2030.[71] Whilst an interesting legal development, it appears that the bill

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view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management; Town and Country Planning (Environmental Impact Assessment) Regulations 2017, No. 571.

[66] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.

[67] House of Lords (2022) *Energy Bill [HL] / Parliamentary Bills UK Parliament,* [Online]. Available at: https://bills.parliament.uk/bills/3311.

[68] Energy Bill [HL], HL Bill 39 (as introduced on 6 July 2022); House of Lords (2022) *Energy Bill [HL] / Parliamentary Bills UK Parliament,* [Online]. Available at: https://bills.parliament.uk/bills/3311.

[69] Department for Business, Energy & Industrial Strategy (2022) *Guidance: Energy Security Bill factsheet: Carbon dioxide transport and storage regulatory investment model,* [Online]. Available at: https://www.gov.uk/government/publications/energy-security-bill-factsheets/energy-security-bill-factsheet-carbon-dioxide-transport-and-storage-regulatory-investment-model.

[70] Energy Bill [HL], HL Bill 39 (as introduced on 6 July 2022), s. 111.

[71] Department for Business, Energy & Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*. HM Government, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf , p. 21 and 126-128.

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has been put on hold by the new administration to prioritise emergency support for businesses in light of the energy crisis.[72]

At the time of writing in November 2022 here are no proposals for dedicated law on other types of climate engineering technologies in the UK.

Responsibility for enforcement

The UK Government has wide-ranging responsibilities under international and national human rights law, environmental law and climate change law. Various Government departments are tasked with implementing such laws. Furthermore, various regulatory bodies have been established, often as independent regulators or advisory bodies, tasked with overseeing and enforcing the implementation of such laws, and regulating activities which are affected by or may impact such laws.

The Secretary of State for Business, Energy and Industrial Strategy (BEIS) is the Government department responsible for areas of business, industrial strategy, science, research and innovation, energy and clean growth, and climate change.[73] Furthermore, regulatory powers can be further delegated to regional and local authorities, such as in relation to planning.[74]

Various executive agencies and arms-length organisations[75] are responsible for overseeing, regulating or implementing specific areas of policy. With respect to human rights, for instance, the Equality and Human Rights Commission is the statutory body established for the protection of human rights and has a set of enforcement powers.[76] The Commission acts as a centre of excellence and national contact point for human rights law issues.[77] In Scotland, the Scottish Human Rights Commission fulfils a similar role, and so does the Wales Committee for Wales.[78] In relation to the environment, the Environment Agency is the responsible agency in England.[79] In Scotland, the Scottish Environment Protection Agency (SEPA) fulfils a similar role and so does Natural Resources Wales for Wales.[80] Furthermore, the Health & Safety Executive is the responsible government agency for health, safety and welfare in connection with work, and control of dangerous substances and certain emissions into the atmosphere.[81]

Following the recent enactment of the Environment Act 2021, the Office for Environmental Protection (OEP) was established with the principal objective 'to contribute to environmental protection, and the

[72] Pickard J. and Thomas N. (2022) 'UK energy security bill paused to prioritise support for business' *Financial Times*, 15 September 2022, [Online]. Available at: https://www.ft.com/content/5abde541-3f5d-463e-8b10-683016d10a3b.
[73] Department for Business, Energy and Industrial Strategy, *About us / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/organisations/department-for-business-energy-and-industrial-strategy/about.
[74] Town and Country Planning Act 1990, c. 8, s. 1.
[75] An arm's length organisation refers to 'a specific category of central government public bodies that is administratively classified by the Cabinet Office', see: *Guidance:* Cabinet Office (2022) *Public bodies / Gov.uk,* [Online]. Available at: https://www.gov.uk/guidance/public-bodies-reform#:~:text=An%20arm's%20length%20bodies%20(%20ALBs,classified%20by%20the%20Cabinet%20Office.
[76] Equality Act 2006, c. 3, s. 1 and 20.
[77] *Who we are / Equality and Human Rights Commission,* [Online]. Available at: https://www.equalityhumanrights.com/en/about-us/who-we-are.
[78] Equality Act 2006, c. 3, s. 7; *Wales Committee / Equality and Human Rights Commission,* [Online]. Available at: https://www.equalityhumanrights.com/en/amdanor-comisiwn-yng-nghymru/wales-committee.
[79] Environment Act 1995, c. 25, s. 1.
[80] Ibid, s. 9-10 and 20.
[81] Health and Safety at Work etc. Act 1974, c. 37.

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improvement of the natural environment.'[82] The OEP has certain enforcement powers to hold the Government to account for failure to comply with environmental laws.[83]

The Climate Change Act 2008 establishes the Committee on Climate Change (CCC) as advisory body on climate targets and carbon budgets.[84] Whilst not an enforcement body in the strict sense of the word, the UK Government is obliged to respond to the CCC's assessment of progress made towards achieving the climate target for 2050 and progress towards meeting interim carbon budgets.[85]

The North Sea Transition Authority (NSTA, formerly known as the Oil and Gas Authority) is a private company owned by the Secretary of State for BEIS and regulates the UK oil, gas and carbon storage industries.[86] The NSTA regulates offshore CCS, and acts as the licensing authority for approving and issuing storage permits.[87]

Finally, the UK judiciary is responsible for the enforcement of the laws that apply in the context of climate engineering. Alleged infringements of such laws will be adjudicated by the appropriate court or tribunal, depending on their specific scope and jurisdiction.

Significant legal cases

There is only a limited number of known legal cases specifically concerned with climate engineering activities in the UK. In 2021, the Court of Appeal, in the case of *R (ClientEarth) v Secretary of State for BEIS*, upheld a decision that the Secretary of State had not acted unlawfully by granting planning permission to Drax for the construction of two gas-fired generating units at an existing power station in North Yorkshire.[88] In its decision, the Court found that the Secretary of State had rightfully determined that the national need for carbon capture ready (CCR) fossil fuel generation outweighed the adverse environmental and climate change implications, such as associated GHG emissions.[89] Indeed, the Court found that the Secretary of State had acted in line with its Overarching National Policy Statement (NPS) for Energy (EN-1), which stated that the 'weight given to GHG emissions in a particular case was for the decision-maker to decide.'[90] This case illustrates the possible tensions between the reliance on fossil-fuel based power generation for energy security reasons, emission reduction targets and environmental protection objectives. A careful balance must be struck between seemingly competing objectives. It appears that, in this case, the fact that the gas-powered units were 'carbon

[82] Environment Act 2021, c. 30, s. 23 (1).
[83] Ibid, s. 31 – 41.
[84] Climate Change Act 2008, c. 27, s. 32.
[85] Ibid, s. 36 and 37.
[86] *Our Mission Statement / North Sea Transition Authority,* [Online]. Available at: https://www.nstauthority.co.uk/about-us/our-mission-statement/.
[87] Energy Act 2016, c. 20; *UK carbon dioxide storage / North Sea Transition Authority,* [Online]. Available at: https://www.nstauthority.co.uk/licensing-consents/carbon-storage/.
[88] *R (ClientEarth) v Secretary of State for Business, Energy and Industrial Strategy* [2021] EWCA Civ 43 (21 January 2021); *Carbon capture and storage: UK policy and regulatory regime: Judicial review challenge to approval of Drax gas Turbines, CCR assessment / Thomson Reuters Practical Law,* [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/Document/Ib5556d5de83211e398db8b09b4f043e0/View/FullText.html?comp=pluk&ppcid=2ca3c9c81e9945599dcb0a664a362a76&originationContext=assetPage&transitionType=KnowHowItem&contextData=(sc.Default)&OWSessionId=7f4c8e4f2c614130bedbc67269c95eab&skipAnonymous=true&firstPage=true#co_anchor_a367822.
[89] Ibid.
[90] Practical Law Environment (2021) *Court of Appeal dismisses ClientEarth appeal concerning approval of Drax gas turbines / Thomson Reuters Practical Law,* [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/w-029-3443?originationContext=document&transitionType=DocumentItem&contextData=(sc.Default)&ppcid=6404a5d594484947913a0f6843c82b18.

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capture ready' played a role in this balancing exercise. It is worth noting that the policy's lack of a requirement for a quantitative assessment, meant that the matter was indeed left to the judgment of the Secretary of State and that the Court was unable to adjudicate on the merits of that judgment.[91]

Similarly, the claimant in the recent case of *Friends of the Earth and others v the Secretary of State for BEIS* claimed that the Government's Net Zero Strategy lacked detail and ambition in light of the Climate Change Act 2008 and the Government's obligation to meet the sixth Carbon Budget.[92] Interestingly, the Court acknowledged the CCC's criticism of the Government's Net Zero Strategy 'for failing to quantify the effect of each policy and proposal on emission reductions.'[93] The case also invoked human rights law in the context of demanding greater climate action, and is considered in more detail in section 3.1.2 of this report.[94] The human rights ground in the case was dismissed, illustrating that invoking human rights in the context of climate action is not a straightforward exercise.

Current debates and future policy and/or legal developments

The UK Government is implementing its Net Zero Strategy, including its ambition to develop a GGR sector capable of removing 20-30 MtCO2 by 2030.[95] To achieve this ambition, the UK Government is investigating policy options to support GGR deployment in the UK.[96] Furthermore, various legal amendments have been proposed to remove barriers to GGR deployment, such as the HoL Energy Bill which seeks to clarify the definition of 'removals' under the Climate Change Act 2008.[97] Other significant policy and legal developments are identified throughout this case study.

[91] *R (ClientEarth) v Secretary of State for Business, Energy and Industrial Strategy* [2021] EWCA Civ 43 (21 January 2021), para 96.
[92] *R (on the application of Friends of the Earth, ClientEarth, Good Law Project and Joana Wheatley) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (18 July 2022), para. 261 (iii) and (iv); Department for Business, Energy & Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*. HM Government, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf.
[93] *R (on the application of Friends of the Earth, ClientEarth, Good Law Project and Joana Wheatley) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (18 July 2022), para. 215
[94] Ibid, ground 3, paras. 261-279.
[95] Department for Business, Energy & Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*. HM Government, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf , p. 21 and 126-128.
[96] See, Vivid Economics (2019) *Greenhouse Gas Removal (GGR) policy options – Final Report*. London: Vivid Economics, [Online]. Available at: https://www.gov.uk/government/publications/greenhouse-gas-removal-policy-options.
[97] Energy Bill [HL], HL Bill 39 (as introduced on 6 July 2022), s. 111.

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3. Domain-specific legal issues

There is only a limited number of UK laws that explicitly mention climate engineering technologies. Many existing legal frameworks would nonetheless apply to climate engineering and impact the manner in which such technologies may be deployed. This section examines the legal implications of climate engineering in the context of UK human rights law, environmental law, and climate change law.

3.1 UK human rights law

The UK human rights law framework lays down the fundamental rights and principles that apply in the UK. Furthermore, UK human rights law provides avenues for accessing justice for alleged human rights violations. Climate engineering has potential to affect human rights in different ways, both positively and negatively. This section examines the key sources of UK human rights law and considers how human rights law may be impacted by climate engineering.

3.1.1 Sources of human rights law

The UK endorsed the United Nations (UN) Universal Declaration of Human Rights (UDHR) in 1948,[98] and has since signed and ratified 7 core United Nations Human Rights Treaties:

- Convention against Torture and Other Cruel and Inhuman or Degrading Treatment or Punishment (CAT)[99]
- International Covenant on Civil and Political Rights (ICCPR)[100]
- Convention on the Elimination of All Forms of Discrimination against Women (CEDAW)[101]
- International Convention on the Elimination of All Forms of Racial Discrimination (ICERD)[102]
- International Covenant on Economic, Social and Cultural Rights (ICESCR)[103]
- Convention on the Rights of the Child (CRC)[104]
- Convention on the Rights of Persons with Disabilities (CRPD)[105]

The UK does not have one single codified constitution. The Human Rights Act 1998 is the primary piece of human rights legislation in the UK. The UK was involved in the drafting of the ECHR and was one of

[98] Universal Declaration of Human Rights (8 December 1948), G.A. Res. 217(A) III.
[99] Convention against Torture and Other Cruel Inhuman or Degrading Treatment or Punishment (entered into force 26 June 1987), 1465 U.N.T.S 85, signed by the UK on 15 March 1985, ratified on 8 December 1988.
[100] International Covenant on Civil and Political Rights (entered into force 23 March 1976), G.A. Res 2200A (XXI), signed by the UK on 16 September 1968, ratified on 20 May 1976.
[101] Convention on the Elimination of All Forms of Discrimination against Women (entered into force 3 September 1981), 1249 U.N.T.S. 13, signed by the UK on 22 July 1981, ratified on 7 April 1986.
[102] International Convention on the Elimination of All Forms of Racial Discrimination (entry into force 4 January 1969) G.A. Res. 2106 (XX) (ICERD), signed by the UK on 11 October 1966, ratified on 7 March 1969.
[103] International Covenant on Economic, Social and Cultural Rights (entered into force 3 January 1976), G.A. Res 2200A (XXI), 993 U.N.T.S. 3, signed by the UK on 16 September 1968, ratified on 20 May 1976.
[104] Convention on the Rights of the Child (entered into force 2 September 1990) GA Res. 44/25, 1577 U.N.T.S. 3, signed by the UK on 19 April 1990, ratified on 16 December 1991.
[105] Convention on the Rights of Persons with Disabilities (entered into force 3 May 2008), GA Res. A/61/106, signed by the UK on 30 March 2007, ratified on 8 June 2009.

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the first to ratify the Convention in 1951.[106] The Human Rights Act is the UK's incorporation of the European Convention on Human Rights (ECHR) into domestic law.[107] The articles of the ECHR are referred to as 'the Convention Rights' and are contained in Schedule 1 of the Act.[108] The rights can be split between substantive rights (e.g. the right to life, right to private life) and procedural rights (e.g. the right to a fair trial). The Act means that individuals can seek justice in a British court for alleged human rights violations. The Act also means that public bodies are required by law to respect and protect human rights in carrying out public functions.[109] In general, Parliament will make laws that are compatible with the rights set out in the Act, although the principle of Parliamentary sovereignty means that it could in theory pass laws that are incompatible.[110] Furthermore, Courts are required to interpret legislation insofar as possible in a way that is compatible with the Convention rights.[111]

This means that, in relation to climate engineering, individuals have a right to legal recourse if they believe their human rights have been violated because of climate engineering activities. In regulating climate engineering, Parliament needs to ensure such regulation is compatible with the Convention rights and Courts would be required to interpret legislation in light of the Convention rights.

A Bill of Rights Bill was introduced to the House of Commons in June 2022, seeking to reform UK human rights law by repealing and replacing the Human Rights Act 1998.[112] The Bill was prompted by the UK Government's pledge in 2019 to "update the Human Rights Act and administrative law to ensure there is a proper balance between rights of individuals, our vital national security and effective government."[113] The Bill was criticised by the Law Society, stating it would "damage the rule of law and make it harder for people to protect their rights."[114] At the time of writing, Bill's legislative passage had been paused, as the new Government reassesses the way to deliver this agenda.[115]

Another noteworthy legal development in the context of human rights and climate engineering, is the Clean Air (Human Rights) Bill as introduced in the House of Lords on 19 May 2022.[116] The Bill seeks to establish a right to breathe clean air, and was prompted by the death of a nine-year old due to air pollution-induced asthma.[117] Whilst there is no explicit mention of climate engineering in the Bill, such

[106] Ministry of Justice (2022) *Collection: Human Rights: The UK's international human rights obligations / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/collections/human-rights-the-uks-international-human-rights-obligations#:~:text=The%20United%20Kingdom%20was%20one,1998%2C%202010%20and%202021%20respectively.
[107] Human Rights Act 1998, introductory text.
[108] Ibid, s. 1, schedule 1 (1), (3).
[109] Ibid, s. 6 (1).
[110] *The Human Rights Act / Equality and Human Rights Commission*, [Online]. Available at: https://www.equalityhumanrights.com/en/human-rights/human-rights-act; Human Rights Act 1998, s. 19.
[111] Human Rights Act 1998, s. 3.
[112] *Bill of Rights Bill* [as introduced] (2022). Parliament: House of Commons. Bill no [117].
[113] Conservative and Unionist Party (2019) *Get Brexit Done: Unleash Britain's Potential – The Conservative and Unionist Party Manifesto 2019,* [Online]. Available at: https://assets-global.website-files.com/5da42e2cae7ebd3f8bde353c/5dda924905da587992a064ba_Conservative%202019%20Manifesto.pdf, p. 48.
[114] *Human Rights Act reforms and the Bill of Rights Bill / The Law Society,* [Online]. Available at: https://www.lawsociety.org.uk/topics/human-rights/human-rights-act-reforms.
[115] Elgot J. (2022) *Liz Truss halts Dominic Raab's bill of rights plan / The Guardian*, [Online]. Available at: https://www.theguardian.com/law/2022/sep/07/liz-truss-halts-dominic-raab-bill-of-rights-plan; (2022) *Human Rights Act reforms and the Bill of Rights Bill / The Law Society,* [Online]. Available at: https://www.lawsociety.org.uk/topics/human-rights/human-rights-act-reforms.
[116] *Clean Air (Human Rights) Bill* [as introduced] (2022). Parliament: House of Lords. Bill no 5.
[117] Fuller G. (2022) *'Ella's law' bill seeks to establish right to clean air in the UK / The Guardian*, [Online]. Available at: https://www.theguardian.com/environment/2022/may/20/ellas-law-bill-right-to-clean-air-uk-pollution-jenny-jones.

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activities may nonetheless be affected by the passing of this Bill. The inherent connection between air pollutants and greenhouse gases is worth noting, because these often originate from similar emission sources.[118] This means that a measure targeting air pollution can have both synergistic and antagonistic effects on emissions of other pollutants. For example, a measure aimed at improving air quality, such as car-free days, may also result in a drop in CO2 emissions originating from car traffic. The effect, however, may not automatically be synergistic, as traffic may simply be shifted elsewhere. As such, it is important to align air quality measures with climate change measures.

The following section examines the implications climate engineering may have on the existing human rights law framework in the UK. Whilst there is seemingly limited case law on environmental matters invoking the Human Rights Act 1998, the European Court of Human Rights (ECtHR) case law on such matters informs the way UK courts are to interpret the Convention rights,[119] and is therefore referenced on various occasions in the following sections.

3.1.2 Human rights law implications of climate engineering

Climate engineering has the potential to affect various human rights, both positively and negatively. Ultimately, climate engineering seeks to mitigate global warming, thereby avoiding, or at least minimising, potentially catastrophic effects of climate change on the environment and livelihoods. In doing so, climate engineering may positively impact various human rights, by enhancing and protecting the right to life, the right to a healthy environment, the right to private life, and the right to property. On the other hand, climate engineering technologies by themselves may be associated with a risk of negatively affecting the environment and human health.

The ECHR and UK Human Rights Act do not explicitly provide for certain rights pertaining to the environment, such as the right to a healthy environment, food, water, and health. Nevertheless, the ECtHR has recognised these rights within the meaning of the existing Convention rights through the Court's case law.[120] Indeed, rights pertaining to the environment and quality of life, are often considered within the meaning of other Convention rights, including the right to life, the prohibition of inhuman or degrading treatment, the right to respect for private and family life, the right to freedom of expression, the right to an effective remedy, the protection of property.[121] These rights have served the legal basis for a series of recent climate change-related case applications to the ECtHR.[122] The position the ECtHR will take in these cases influences the ways in which human rights may be relied on in relation to climate

[118] See, for instance, 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, p. 13.
[119] Human Rights Act 1998, s. 2 (1).
[120] See, *Human rights and health / Council of Europe,* [Online]. Available at: https://www.coe.int/en/web/impact-convention-human-rights/human-rights-and-health#:~:text=Although%20there%20is%20no%20specific,being%20in%20many%20different%20circumstances; ECtHR (2022) *Factsheet – Environment and the European Convention on Human Rights.* European Court of Human Rights, Press Unit, [Online]. Available at: https://www.echr.coe.int/documents/fs_environment_eng.pdf; European Court of Human Rights (2020) *Case of Hudorovič and Others v. Slovenia*, 10 March 2020, Nos. 24816/14 and 25140/14, CE:ECHR:2020:0310JUD002481614.
[121] ECtHR (2022) *Guide to the case-law of the European Court of Human Rights: Environment.* Council of Europe/European Court of Human Rights, [Online]. Available at: https://echr.coe.int/Documents/Guide_Environment_ENG.pdf.
[122] See, *Duarte Agostinho and Others v. Portugal and 32 Other States,* Relinquishment in favour of the Grand Chamber, 30 June 2022, No. 39371/20; *Verein KlimaSeniorinnen Schweiz and Others v. Switzerland*, Relinquishment in favour of the Grand Chamber, 29 April 2022, No. 53600/20; *Carême v. France*, Relinquishment in favour of the Grand Chamber, 7 June 2022, No. 7189/21.

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change and climate engineering in a UK context. The right to life and the right to respect for private and family life in relation to climate engineering are considered in further detail below.

Substantive rights – The right to life

The Human Rights Act 1998 provides that "everyone's right to life shall be protected by law."[123] This means that no one is allowed to end someone's life, that the Government has a positive obligation to take measures to protect the right to life, and that the Government must consider the right to life when making decisions that might affect life or life expectancy.[124] The right to life is considered an 'absolute right', meaning this right cannot be restricted under any circumstances.[125] The article itself provides for limited circumstances under which the deprivation of life is not to be regarded as inflicted, such as in self-defence from unlawful violence, to make a lawful arrest, to stop escape from lawful detainment, or to quell a riot or insurrection.[126]

The ECtHR has interpreted the positive obligation of States to safeguard the right to life under article 2 of the Convention to apply to any activity, public or private, within its jurisdiction.[127] ECtHR case law also indicates that a States' positive obligation to protect the right to life, extends to industrial activities considered dangerous by their very nature.[128] This arguably applies to climate engineering as well considering that the risks associated with these activities may include pollution, such as during the transportation of CO2 or following a leak of stored CO2 as part of CCS activities. This means that, in the context of climate engineering, the UK Government has an obligation to protect the right to life in its decision-making processes, such as when authorising, commissioning and overseeing climate engineering projects, whether these are publicly or privately funded activities. As such, the Government is obliged to prevent and mitigate climate engineering activities that may infringe the right to life.

The flipside to this, is that one could argue that by permitting and funding climate engineering activities, the UK Government is acting on its positive obligation to protect the right to life. Such a claim was made in the case of *Friends of the Earth and others v the Secretary of State for BEIS*, in which the claimant argued that the Government's Net Zero Strategy lacked detail and ambition in light of the Climate Change Act 2008 and the Government's obligation to meet the sixth Carbon Budget.[129] Drawing on parallels with

[123] Human Rigths Act 1998, schedule 1, article 2.
[124] *Article 2: Right to life / Equality and Human Rights Commission*, [Online]. Available at: https://www.equalityhumanrights.com/en/human-rights-act/article-2-right-life.
[125] *How are your rights protected? / Equality and Human Rights Commission,* [Online]. Available at: https://www.equalityhumanrights.com/en/what-are-human-rights/how-are-your-rights-protected.
[126] Human Rights Act 1998, schedule 1, article 2 (2); *Article 2: Right to life / Equality and Human Rights Commission*, [Online]. Available at: https://www.equalityhumanrights.com/en/human-rights-act/article-2-right-life.
[127] ECtHR (2022) *Guide on Article 2 of the European Convention on Human Rights: Right to life*. Council of Europe/European Court of Human Rights, [Online]. Available at: https://www.echr.coe.int/Documents/Guide_Art_2_ENG.pdf, p. 8.
[128] ECtHR (2022) *Guide to the case-law of the European Court of Human Rights: Environment.* Council of Europe/European Court of Human Rights, [Online]. Available at: https://echr.coe.int/Documents/Guide_Environment_ENG.pdf; *Case of Öneryildiz v. Turkey*, 30 November 2004, No. 48939/99, ECLI:CE:ECHR:2004:1130JUD004893999, para. 71; *Case of Budayeva and Others v. Russia*, 20 March 2008, Nos. 15339/02, 21166/02, 20058/02, 11673/02 and 15343/02, ECLI:CE:ECHR:2008:0320JUD001533902, para. 130; *Case of Kolyadenko and Others v Russia*, 28 February 2012, Nos. 17423/05, 20534/05, 20678/05, 23263/05, 24283/05 and 35673/05, ECLI:CE:ECHR:2012:0228JUD001742305, para. 158; *Case of Brincat and Others v Malta*, 27 July 2014, Nos. 60908/11, 62110/11, 62129/11, 62312/11 and 62338/11, ECLI:CE:ECHR:2014:0724JUD006090811, para. 101.
[129] *R (on the application of Friends of the Earth, ClientEarth, Good Law Project and Joana Wheatley) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (18 July 2022), para. 261 (iii)

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the human rights law basis in the Dutch *Urgenda* case,[130] the claimant invoked the UK Government's obligations "under articles 2, 8 and [Article 1 of Protocol 1] [of the Human Rights Act 1998] to take effective action against climate change because this represents a real and "imminent threat" to "life, quality of life and to property"."[131] The Court, however, rejected this ground, stating that the Court's obligation under the Human Rights Act to interpret legislation in a manner compatible with the Convention rights,[132] only applies to the extent that the ordinary interpretation of the provisions concerned (in this case sections 13 and 14 of the Climate Change Act 2008) would be incompatible with the Convention rights.[133] This case illustrates that invoking human rights to demand climate action in itself is not self-evident, let alone to specifically mandate climate engineering activities that are beneficial to society and human life.

Substantive rights – The right to respect for private and family life

The right to respect for private and family life is explicitly protected by the Human Rights Act 1998.[134] ECtHR case law suggests that the scope of States' positive obligations in relation to this right largely overlap with those in relation to the protection of the right to life.[135] As such, so do the principles developed by the ECtHR in relation to planning and environmental matters.[136]

Similar to the right to life, the State's objective to protect right to respect for private and family life extends to industrial activities considered dangerous by their nature and applies to both public and privately funded activities. In relation to climate engineering, it is the UK Government's obligation to consider the right to respect for private and family life when authorising and overseeing climate engineering activities. The risks associated with these activities may include pollution, such as during the transportation of CO2 or following a leak of stored CO2 as part of CCS activities. Whilst there are no current legal cases on CCS specifically, the ECtHR has found a violation of the right to respect for private and family life in the context of industrial pollution and the treatment of waste.[137] The principles

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and (iv); Department for Business, Energy & Industrial Strategy (2021) *Net Zero Strategy: Build Back Greener*. HM Government, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1033990/net-zero-strategy-beis.pdf.

[130] *In de zaak van De Staat der Nederlanden tegen Stichting Urgenda*, arrest, Hoge Raad, 20 december 2019, ECLI:NL:HR:2019:2006; for unofficial English translation see *The State of the Netherlands v Stichting Urgenda,* judgement, Supreme Court of the Netherlands, 20 December 2019, ECLI:NL:HR:2019:2007.

[131] *R (on the application of Friends of the Earth, ClientEarth, Good Law Project and Joana Wheatley) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (18 July 2022), para. 261 (i).

[132] Human Rights Act 1998, s. 3 (1).

[133] *R (on the application of Friends of the Earth, ClientEarth, Good Law Project and Joana Wheatley) v Secretary of State for Business, Energy and Industrial Strategy* [2022] EWHC 1841 (18 July 2022), para. 265.

[134] Human Rights Act 1998, schedule 1, article 8.

[135] *Case of Öneryildiz v. Turkey*, 30 November 2004, No. 48939/99, ECLI:CE:ECHR:2004:1130JUD004893999, paras 90 and 160; ECtHR (2022) *Guide to the case-law of the European Court of Human Rights: Environment.* Council of Europe/European Court of Human Rights, [Online]. Available at: https://echr.coe.int/Documents/Guide_Environment_ENG.pdf, p. 10.

[136] *Case of Budayeva and Others v. Russia*, 20 March 2008, Nos. 15339/02, 21166/02, 20058/02, 11673/02 and 15343/02, ECLI:CE:ECHR:2008:0320JUD001533902, para. 133; ECtHR (2022) *Guide to the case-law of the European Court of Human Rights: Environment*. Council of Europe/European Court of Human Rights, [Online]. Available at: https://echr.coe.int/Documents/Guide_Environment_ENG.pdf, p. 10.

[137] See, for instance, *Lopez Ostra v. Spain*, 9 December 1994, No.16798/90, ECLI:CE:ECHR:1994:1209JUD001679890; *Taskin and Others v. Turkey*, 10 November 2004, No. 46117/99, ECLI:CE:ECHR:2004:1110JUD004611799; *Fadeyeva v. Russia*, 9 June 2005, No. 55723/00, ECLI:CE:ECHR:2005:0609JUD005572300; *Giacomelli v. Italy*, 2 November 2006, No. 59909/00, ECLI:CE:ECHR:2006:1102JUD005990900. See also ECtHR (2022) *Factsheet – Environment and the European Convention on Human Rights*. European Court of Human Rights, Press Unit, [Online]. Available at: https://www.echr.coe.int/documents/fs_environment_eng.pdf.

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developed through this case law may apply to climate engineering activities, for example when a leak in a CCS storage facility results in pollution of the local environment and air quality.

The right to respect for family and private life is particularly significant, as the threshold for determining infringement of this right has been established to be lower than the threshold for determining infringement of the right to life. The ECtHR case law suggests that the right to respect for private and family life can be violated when the *quality* of life is affected due to harm associated with industrial activities, without the need for life itself to be endangered.[138] This means that the UK Government, in meeting its positive obligations under the Human Rights Act 1998, would be expected to give due regard to the right to private and family life and the impact on the quality of life when authorising or overseeing climate engineering activities. This also means that individuals or communities whose quality of life is affected by climate engineering activities, would generally have a right of access to a legal remedy. This is considered further in more detail in the section below.

Procedural rights – The right to a fair and public hearing

Procedural human rights relate to rights of individuals during official processes and include rights such as the right to a fair and public hearing,[139] and the right to an effective remedy.[140] The Human Rights Act 1998 provides an avenue for individuals to seek an effective remedy in UK courts for alleged human rights violations. As such, the Act implements the right to an effective remedy as provided by the ECHR.[141] The right to an effective remedy includes access to the ECtHR for alleged human rights violations if all domestic legal remedies have been exhausted.[142]

The right to a fair and public hearing is enshrined in article 6 of schedule 1 of the Human Rights Act 1998.[143] This right not only refers to the right to a fair trial in relation to criminal proceedings but entitles all individuals to a fair and public hearing in relation to civil rights and obligations, and when a public authority is making a decision that has an impact on those rights.[144] The 'civil' limb of this article may be relied on in disputes over 'civil rights' which are recognised under domestic law.[145] So depending on the 'civil rights' provided by UK law, individuals have a right to a fair and public hearing in relation to alleged violations of those rights. For instance, UK law provides certain 'civil rights' relevant to climate engineering activities and the right to a fair trial, such as the right of local communities to be consulted with respect to development planning applications,[146] or to make representations in relation to

[138] See, for instance, *Fadeyeva v. Russia*, 9 June 2005, No. 55723/00, ECLI:CE:ECHR:2005:0609JUD005572300; *Factsheet – Environment and the European Convention on Human Rights*. European Court of Human Rights, Press Unit, [Online]. Available at: https://www.echr.coe.int/documents/fs_environment_eng.pdf, p. 14.
[139] Human Rights Act 1998, schedule 1, article 6.
[140] 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, article 13.
[141] Ibid; *The Human Rights Act / Equality and Human Rights Commission,* [Online]. Available at: https://www.equalityhumanrights.com/en/human-rights/human-rights-act#:~:text=Article%2013%20makes%20sure%20that,to%20make%20sure%20this%20happens.
[142] 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, article 34.
[143] Human Rights Act 1998, schedule 1, article 6.
[144] Ibid, article 6 (1); *Article 6: Right to a fair trial / Equality and Human Rights Commission,* [Online]. Available at: https://www.equalityhumanrights.com/en/human-rights-act/article-6-right-fair-trial#:~:text=Article%206%20protects%20your%20right,your%20civil%20rights%20or%20obligations..
[145] *Guide to the case-law of the European Court of Human Rights: Environment*. Council of Europe/European Court of Human Rights, [Online]. Available at: https://echr.coe.int/Documents/Guide_Environment_ENG.pdf, p. 17.
[146] Planning Act 2008, s. 47.

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planning applications for major infrastructure projects.[147] Climate engineering activities will be subject to domestic regulation, such as planning regulation and other environmental regulation, considered in more detail in section 3.2. The right to a fair and public hearing under the Human Rights Act provides a legal remedy should such civil rights be violated in relation to climate engineering activities.

3.2 UK environmental law

UK environmental law is concerned with the protection of the environment and human health. Much of UK environmental regulation originated from the EU law.[148] The environmental regulatory regime in the UK covers a variety of areas, ranging from the Environmental Permitting Regime including pollution prevention and control, waste management and industrial emissions, to water, waste management, contaminated land, conservation and biodiversity, environmental impact assessments, and climate change.[149] Climate change is considered separately in section 3.3.

3.2.1 Sources of UK environmental law

International environmental law in the UK

UK environmental law comprises a variety of sources. International environmental law is an important source of UK environmental law, as the UK is a State Party to various international environmental agreements. As a dualist state, and in line with the principle of parliamentary supremacy, international environmental laws and principles generally require transposition into domestic law to have legal effect. The UK has signed and ratified the following International or Multinational Environmental Agreements (IEA/MEA) which are relevant in the context of climate engineering:

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention)[150]
- Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention)[151]
- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention)[152]
- Convention on Biological Diversity (CBD)[153]
- Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention)[154]

[147] Ibid, s. 51 (1) (b).
[148] Coxall M. and Souter K. (2021) *Environmental Law and Practice in the UK (England and Wales): Overview / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/6-503-1654?transitionType=Default&contextData=(sc.Default)&firstPage=true.
[149] Ibid.
[150] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (entered into force 5 May 1992) 1673 U.N.T.S 57 (Basel Convention), signed by the UK on 6 October 1989, ratified on 7 February 1994.
[151] Convention for the Protection of the Marine Environment of the North-East Atlantic (entered into force 25 March 1997) 2354 U.N.T.S. 67 (OSPAR Convention), ratified by the UK on 15 July 1997.
[152] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (entered into force 30 October 2001) 2161 U.N.T.S. 447 (Aarhus Convention), signed by the UK on 25 June 1998, ratified on 23 February 2005.
[153] Convention on Biological Diversity (entered into force 29 December 1993) 1760 U.N.T.S. 79 (CBD), signed by the UK on 12 June 1992, ratified on 3 June 1994.
[154] Convention on Environmental Impact Assessment in a Transboundary Context (entered into force 10 September 1997) 1989 U.N.T.S. 309 (Espoo Convention), signed by the UK on 26 February 1991, ratified on 10 October 1997.

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- Convention on Long-Range Transboundary Air Pollution (Geneva Convention)[155]
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention) and the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (as amended in 2006) (London Protocol)[156]
- Convention on the Transboundary Effects of Industrial Accidents (Helsinki Convention)[157]
- Minamata Convention on Mercury (Minamata Convention)[158]
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention)[159]
- Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention)[160]

Many of these IEA/MEAs are legally binding, and the rules and principles of which have found their way into domestic environmental legislation in the UK. Furthermore, these international regimes influence policy and guidance on environmental matters, such as climate engineering. In 2007, for instance, OSPAR adopted a decision on the safe storage of CO2 in geological formations, and a separate decision to prohibit the storage of CO2 streams in the water column or seabed.[161] It also issued guidelines for risk assessment and management of CO2 storage.[162] Furthermore, the UK ratified the article 6 amendment to the 1996 London Protocol, allowing the transboundary export of CO2 for offshore geological storage.[163] Once the amendment enters into force, the 'placement of matter into the sea … for marine geoengineering activities listed in annex 4…[will be permissible] under a permit.'[164] Furthermore, contracting parties are urged to adopt the precautionary approach into the consideration of these techniques.[165] Currently, ocean fertilisation is the only marine geoengineering activity listed in annex 4, although this may be updated in the future.[166]

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[155] Convention on Long-Range Transboundary Air Pollution (entered into force 16 March 1983) 1302 U.N.T.S. 217 (Geneva Convention), signed by the UK on 13 November 1979, ratified on 15 July 1982.
[156] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 30 August 1975) 1046 U.N.T.S. 120 (London Convention), ratified by the UK on 17 November 1975; 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 24 March 2006) ATS 11 (London Protocol).
[157] Convention on the Transboundary Effects of Industrial Accidents (entered into force 19 April 2000) 2105 U.N.T.S. 457 (Helsinki Convention), signed by the UK on 18 March 1992, ratified on 5 August 2002.
[158] Minamata Convention on Mercury (entered into force 16 August 2017) 3202 U.N.T.S. C.N. 560.2014 (Minamata Convention), signed by the UK on 10 October 2013, ratified on 23 March 2018.
[159] Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (entered into force 24 February 2004) 2244 U.N.T.S. 337 (Rotterdam Convention), signed by the UK on 11 September 1998, ratified on 17 June 2004.
[160] Stockholm Convention on Persistent Organic Pollutants (entered into force 17 May 2004) 2256 U.N.T.S. 119 (Stockholm Convention), signed by the UK on 11 December 2001, ratified on 17 January 2005.
[161] OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations (adopted 2007, Ostend); OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed (adopted 2007, Ostend).
[162] OSPAR Commission (2007) *OSPAR Guidelines for Risk Assessment and Management of Storage of CO2 Streams in Geological Formations* (Reference number: 07-12
[163] Amendment to Article 6 of the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972 (adopted on 30 October 2009, not yet entered into force).
[164] Ibid, article 6*bis* (1).
[165] IMO (2022) *Marine geoengineering techniques for climate change mitigation – LP/LC evaluates potential for marine environment effects / International Maritime Organisation,* [Online]. Available at: https://www.imo.org/en/MediaCentre/PressBriefings/pages/Marine-geoengineering.aspx.
[166] Eustice G. (2014) *Explanatory Memorandum on the Amendments to the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (London Protocol) to Regulate Marine Geoengineering.* Foreign & Commonwealth Office. Available at:

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Retained EU environmental law

Much of UK environmental regulation originates from the EU law.[167] Closely related to the Espoo Convention, is the UK law on Environmental Impact Assessments (EIAs)[168] which was based on an EU Directive.[169] Following Brexit, most environmental laws were retained in UK law through the European Union (Withdrawal) Act 2018,[170] albeit with some amendments put in place to ensure their proper functioning after the Transition Period.[171] The Trade and Cooperation Agreement between the EU and the UK recognises the right of both parties to regulate within their territories, including environmental regulation.[172] As such, it is expected that UK law and EU law will gradually diverge.[173]

Post-Brexit: The Environment Act 2021

In the context of the new regulatory environment post-Brexit, the UK Government passed the Environment Act 2021 in November 2021.[174] The Act makes provision about 'targets, plans and policies for improving the natural environment'[175] and covers areas such as air quality and emissions, nature and biodiversity, environmental improvement plans, waste and resource efficiency, water, conservation, and chemicals regulation. It also establishes an Office for Environmental Protection (OEP) whose function is to 'contribute to environmental protection, and the improvement of the natural environment.'[176]

It is important to note that in Scotland, Wales and Northern Ireland, environmental regulation is a (partly) devolved power.[177] This means that not all provisions of the Environment Act 2021 apply in the

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/376395/EM_Misc_9.2014.pdf, p. 4.

[167] Coxall M. and Souter K. (2021) *Environmental Law and Practice in the UK (England and Wales): Overview / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/6-503-1654?transitionType=Default&contextData=(sc.Default)&firstPage=true.

[168] Town and Country Planning (Assessment of Environmental Effects) Regulations 1988, now replaced by the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, No. 571.

[169] Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (OJ L175/40, 5.7.1985), repealed by 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, 25.4.2014)

[170] European Union (Withdrawal) Act 2018, s. 2.

[171] Coxall M. and Souter K. (2021) *Environmental Law and Practice in the UK (England and Wales): Overview / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/6-503-1654?transitionType=Default&contextData=(sc.Default)&firstPage=true. See, for instance, the European Union (Future Relationship) Act 2020, s 21; and the Trade and Cooperation Agreement between the United Kingdom of Great Britain and Northern Ireland, of the one part, and the European Union and the European Atomic Energy Community, of the other part, entry into force 1 May 2021, Treaty Series No.8 (2021) (TCA), article 391 on 'non-regression from levels of protection'.

[172] Trade and Cooperation Agreement between the United Kingdom of Great Britain and Northern Ireland, of the one part, and the European Union and the European Atomic Energy Community, of the other part, entry into force 1 May 2021, Treaty Series No.8 (2021) (TCA), article 123 (2).

[173] Coxall M. and Souter K. (2021) *Environmental Law and Practice in the UK (England and Wales): Overview / Thomson Reuters Practical Law*, [Online]. Available at: https://uk.practicallaw.thomsonreuters.com/6-503-1654?transitionType=Default&contextData=(sc.Default)&firstPage=true.

[174] Environment Act 2021

[175] Ibid, introductory text.

[176] Ibid, s. 23 (1).

[177] See, Scotland Act 1998, s. 29 in conjunction with schedule 5; Government of Wales Act 2006, schedule 7A; Northern Ireland Act 1998, s. 6 in conjunction with schedule 3.

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devolved administrations.[178] The Northern Ireland Assembly, however, passed the Environment (2021 Act) (Commencement and Saving Provision) Order (Northern Ireland) 2022 on February 2022, bringing the provisions of the Environment Act 2021 into Northern Irish law, and extending the remit of the OEP.[179]

3.2.2 Environmental law implications of climate engineering

Climate engineering technologies involve a variety of activities that may impact the environment and human health. Currently there is still a lot of scientific uncertainty surrounding the risks of climate engineering activities in relation to the environment and human health. The risks associated with climate engineering, are also heavily dependent on the specific climate engineering technology or activity, and the methods, materials, and processes involved.[180]

Climate engineering and the Net Biodiversity Gain

Climate engineering may be impacted by the Environment Act 2021 to the extent that it involves areas, substances or activities that fall within the scope and remit of the Act. An important change regarding planning law in England, for instance, is the requirement for Net Biodiversity Gain in relation to planning.[181] This means that a net gain for biodiversity is now a condition for planning permission for new developments and nationally significant infrastructure projects.[182] This may impact the feasibility and cost of the development of a BECCS plant, or other climate engineering programme that requires planning permission. On the other hand, however, it may be argued that climate engineering activities could contribute to the protection of biodiversity and conservation of nature. Quantifying actual gains and establishing a causal link between the climate engineering activity and the enhanced protection of biodiversity may be not be straightforward. Furthermore, there does not seem to be a consensus as to whether additional biomass growth will positively or negatively impact biodiversity, suggesting that more research may be required.[183]

Emissions and chemical substance regulation

Climate engineering technologies such as BECCS may have negative environmental implications, for example on land requirements and air quality. First, the biomass for BECCS must be grown somewhere, which may put pressure on the availability of land for other purposes, such as food production. Second,

[178] Reid, C. (2022) 'Environment Act 2021', *Scottish Planning and Environmental Law,* 209, 16-17, [Online]. Available at: https://discovery.dundee.ac.uk/ws/portalfiles/portal/71696149/EnvironmentAct21dec.pdf.
[179] Department of Agriculture, Environment and Rural Affairs (2022) *Assembly approves new environmental provisions for Northern Ireland / Department of Agriculture, Environment and Rural Affairs*, [Online]. Available at: https://www.daera-ni.gov.uk/news/assembly-approves-new-environmental-provisions-northern-ireland.
[180] See, the distinction between CDR and SRM activities more generally, and the characteristics of climate engineering techniques and technologies more specifically, at: *Climate Engineering / TechEthos,* [Online]. Available at: https://www.techethos.eu/climate-engineering/.
[181] Environment Act 2021, part 6; Reid, C. (2022) 'Environment Act 2021', *Scottish Planning and Environmental Law,* 209, 16-17, [Online]. Available at: https://discovery.dundee.ac.uk/ws/portalfiles/portal/71696149/EnvironmentAct21dec.pdf, p. 17.
[182] Reid, C. (2022) 'Environment Act 2021', *Scottish Planning and Environmental Law,* 209, 16-17, [Online]. Available at: https://discovery.dundee.ac.uk/ws/portalfiles/portal/71696149/EnvironmentAct21dec.pdf, p. 17.
[183] See, for example, Hof C. et al (2018) 'Bioenergy cropland expansion may offset positive effects of climate change mitigation for global vertebrate diversity', *PNAS*, 115 (52), [Online]. Available at: https://doi.org/10.1073/pnas.1807745115, p. 13294; in contrast with Donnison C. et al (2021) 'Land-use change from food to energy: meta-analysis unravels effects of bioenergy on biodiversity and cultural ecosystem services', *Environmental Research Letters,* 16 (11), [Online]. Available at: https://doi.org/10.1088/1748-9326/ac22be.

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the biomass would need to be transported to the power generation and CCS plant. Currently, 65% of the UK biomass used for heat and power is imported.[184] Growing the bioenergy sector for the purpose of BECCS may increase emissions from importing additional biomass to the UK, which would add to the UK's emissions budget.[185] Once at the power plant, biomass is converted into bioenergy. During this process, the CO2 released from the biomass is captured, transported, and stored at a storage site. Each different stage brings its own risks to the environment and regulatory challenges. CO2 may accidentally be released during any of these stages, contributing to climate change. Furthermore, the high concentration of CO2 in one place may pose a risk of harm to human health. Whilst this would not generally be an issue for an offshore storage site, a carbon leak at an onshore site may cause harmful effects to human health including asphyxiation by displacing oxygen.[186] There are no onshore storage sites in the UK, and current regulation restricts the storage of CO2 to internal waters and offshore.[187] Nevertheless, research into the safe onshore storage of CO2 has been conducted elsewhere and could inform future policy.[188]

In the UK, CO2 is classed as a 'substance hazardous to health' and workplace exposure is limited by regulation.[189] Whilst this concerns exposure at much higher concentrations, it is relevant to note existing regulation regarding CO2 exposure and compare these to the risks associated with CO2 capture, transportation and storage.

A British proposed CCS project, cancelled in 2015,[190] relied on technology using amine-based post-combustion CCS.[191] Amine compounds, such as nitrosamines and nitramines are possible carcinogens. The environmental toxicity of individual compounds is not well understood.[192] It is not clear whether chemicals are being used in ongoing CCS projects, such as the Drax CCS project.[193]

SRM activities such as stratospheric aerosol injection (SAI), involve the use of certain chemicals to reflect sunlight back into space. Proposals range from using finely powdered salt and calcium carbonate, to sulphur dioxides.[194] The latter is a strictly regulated air pollutant, triggering air quality standards regulations to apply.[195] Indeed, sulphur dioxide emissions are associated with significant risks of harm

[184] Whitaker J., *Can we increase sustainable bioenergy production in the UK? / UK Centre for Ecology & Hydrology*, [Online]. Available at: https://www.ceh.ac.uk/news-and-media/blogs/can-we-increase-sustainable-bioenergy-production-uk.
[185] See section 3.3.1 on the Climate Change Act 2008 and carbon budgets.
[186] HSE, *General hazards of Carbon Dioxide / Health and Safety Executive*, [Online]. Available at: https://www.hse.gov.uk/carboncapture/carbondioxide.htm.
[187] The Storage of Carbon Dioxide (Amendment of the Energy Act 2008 etc.) Regulations 2011, No. 2453.
[188] See, for example, the ENOS project, funded by Horizon 2020 under grant agreement No. 653718. DOI: https://doi.org/10.3030/653718; *Enabling decarbonisation of the fossil fuel-based power sector and energy intensive industry / ENOS,* [Online]. Available at: http://www.enos-project.eu/about/.
[189] Control of Substances Hazardous to Health Regulations 2002 (COSHH), No. 2677.
[190] BBC (2017) 'UK government spent £100m on cancelled carbon capture project', *BBC News*, [Online]. Available at: https://www.bbc.co.uk/news/uk-scotland-scotland-business-38687835.
[191] SEPA (2014) *Carbon Capture and Storage / Scottish Environment Protection Agency,* [Online]. Available at: https://www.sepa.org.uk/regulations/climate-change/carbon-capture-and-storage/.
[192] Natural Scotland and SEPA (2015) *Review of amine emissions from carbon capture systems*. Version 2.01, Natural Scotland and Scottish Environment Protection Agency, [Online]. Available at: https://www.sepa.org.uk/media/155585/review-of-amine-emissions-from-carbon-capture-systems.pdf.
[193] Drax (2021) *Drax and Mitsubishi Heavy Industries sign pioneering deal to deliver the world's largest carbon capture power project / Drax*, [Online]. Available at: https://www.drax.com/press_release/drax-and-mitsubishi-heavy-industries-sign-pioneering-deal-to-deliver-the-worlds-largest-carbon-capture-power-project/.
[194] Geoengineering Monitor (2021) *Stratospheric Aerosol Injection (Technology Briefing) / Geoengineering Monitor,* [Online]. Available at: https://www.geoengineeringmonitor.org/2021/02/stratospheric_aerosol_injection/.
[195] The Air Quality Standards Regulation 2010, No. 1001.

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to the environment,[196] which may have been a contributing factor to informing the Government's policy on SRM.

Developing criteria for the sustainable operation of climate engineering technologies, such as a whole life-cycle carbon assessment, would help take into account possible negative externalities or unforeseen environmental impacts. Whilst desirable, establishing such criteria would be a challenging exercise, given the often location- and context-specific risks and challenges associated with such technologies.[197]

Waste regulation and CO2 storage

The UK waste framework regulation is another area of law influenced by international and EU law. As mentioned above in section 3.2.1, the UK is party to the OSPAR Convention on the Protection of the Marine Environment of the North-East Atlantic, and the London Protocol to the London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter.[198] Waste regulation is particularly relevant in relation to storage of CO2 as part of CCS activities, as it may be argued that CO2 is essentially a waste gas that results from energy production.[199] The EU CCS Directive defines the purpose of CCS as the 'permanent containment of CO2'.[200] Similarly, the UK's Energy Act 2008 considers the 'storage of carbon dioxide' to mean 'storage with a view to its permanent disposal, or as an interim measure prior to its permanent disposal'.[201]

Correspondingly, 'waste', under EU and UK domestic law, is defined as 'any substance or object which the holder discards or intends or is required to discard.'[202] The London Protocol places a general prohibition on the dumping of wastes and other matter except for those materials listed in Annex 1.[203] 'Dumping' means the 'deliberate disposal into the sea of wastes or other matter', as well as 'any storage of wastes or other matter in the seabed and the subsoil thereof'.[204] Disposal of wastes or other matter is not considered 'dumping' if it is incidental, or it is placed or abandoned for a purpose other than mere disposal thereof.[205] As such, the meaning of CO2 storage within the context of CCS is remarkably close to the definition of dumping, which would trigger a prohibition on the geological storage of CO2

[196] See, for instance, Department for Environment, Food & Rural Affairs (2022) *National Statistics: Emissions of air pollutants in the UK – Sulphur dioxide (SO2) / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-sulphur-dioxide-so2#:~:text=SO2%20can%20also%20combine%20with,as%20forests%20and%20freshwater%20habitats.
[197] Broad O., Butnar I. and Cronin J. (2021) *Can BECCS help us get to net zero? / The Bartlett, UCL,* [Online]. Available at: https://www.ucl.ac.uk/bartlett/news/2021/jul/can-beccs-help-us-get-net-zero.
[198] Convention for the Protection of the Marine Environment of the North-East Atlantic (entered into force 25 March 1997) 2354 U.N.T.S. 67 (OSPAR Convention), ratified by the UK on 15 July 1997; 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 24 March 2006) ATS 11 (London Protocol).
[199] Sheridan P. (2009) *Carbon Capture and Storage – don't ignore the waste connections / CMS Law-Now,* [Online]. Available at: https://www.cms-lawnow.com/ealerts/2009/02/carbon-capture-and-storage-dont-ignore-the-waste-connections?cc_lang=en.
[200] 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, article 1 (2).
[201] Energy Act 2008, c. 32, s. 17 (2) (a).
[202] 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, 22.11.2008); Environmental Protection Act 1990, c. 43, s. 75 (2).
[203] 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 24 March 2006) ATS 11 (London Protocol), article 4 (1) (1).
[204] Ibid, article 1 (4) (1).
[205] Ibid, article 1 (4) (2).

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storage into the seabed. One could argue that CCS with Enhanced Oil Recovery (EOR) would mean that CO2 is stored not merely for the purpose of its disposal, but also to extract oil from partially depleted reservoirs where the CO2 would be stored.[206] Whilst controversial, since it reinforces reliance on fossil fuels, it may facilitate the development of a CCS sector. In any case, an amendment to the 1996 London Protocol and a decision under the OSPAR Convention seek to remove the ambiguity of the status of CO2 storage in the context of waste regulation.[207] Once these amendments enter into force, the transboundary export of CO2 for the safe offshore storage of CO2 in geological formations will be allowed and classed as falling outside the waste regulations.[208]

These legislative changes clarify that the offshore geological storage of CO2 should considered as distinct from the 'deliberate disposal into the sea of wastes', or at least permittable within the general prohibition of marine dumping of waste.[209] Nevertheless, the exact difference between 'waste disposal' and 'CO2 storage with a view to its permanent disposal' remains ambiguous. Should the regulatory regime concerning CO2 storage be ever expanded to include onshore storage for instance, the relation to waste regulatory frameworks would certainly need to be addressed. The EU CCS Directive, does seek to amend the EU's waste framework by excluding CO2 'captured and transported for the purposes of geological storage' from the definition of waste and therefore from the scope of the waste framework.[210]

Environmental procedure: access to information, public participation, and environmental justice

The Aarhus Convention stipulates the international rules and principles regarding access to information, public participation, and access to justice in environmental matters.[211] While, the Aarhus Convention has not been transposed into UK domestic law word for word, many of its rules and principles have found their way into domestic UK law, partly through retained EU law.

For instance, the UK provides access to environmental information, covered under article 4 of the Aarhus Convention, through the Freedom of Information Act (FOIA) 2000.[212] Public participation is covered by planning law, including the Town and Country Planning (Environmental Impact Assessment) Regulations 2017, the Planning Act 2008, and the Localism Act 2011. Planning applications for major infrastructure projects are regulated by the Planning Act 2008, as amended by the Marine and Coastal Access Act 2009, the Localism Act 2011, the Growth and Infrastructure Act 2013, the Infrastructure Act 2015, the Housing and Planning Act 2016 and the Wales Act 2017. Furthermore, the EU Regulation on

[206] See, for instance, *CCS with CO2-Enhanced Oil Recovery / SCCS,* [Online]. Available at: https://www.sccs.org.uk/ccs-with-co2enhanced-oil-recovery.
[207] OSPAR Decision 2007/2 on the Storage of Carbon Dioxide Streams in Geological Formations (adopted 2007, Ostend); OSPAR Decision 2007/1 to Prohibit the Storage of Carbon Dioxide Streams in the Water Column or on the Sea-bed (adopted 2007, Ostend); Amendment to Article 6 of the 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972 (adopted on 30 October 2009, not yet entered into force).
[208] Ibid.
[209] 1996 Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (entered into force 24 March 2006) ATS 11 (London Protocol), article 1 (4) (1).
[210] Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste (OJ L 114, 27.4.2006) as amended by Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 (OJ L 312/3, 22.11.2008) and Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 (OJ L 140/114, 5.6.2009), article 2 (1) (a).
[211] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (entered into force 30 October 2001) 2161 U.N.T.S. 447 (Aarhus Convention), signed by the UK on 25 June 1998, ratified on 23 February 2005.
[212] Freedom of Information Act 2000, s 1 (for England, Wales and Northern Ireland; see Freedom of Information (Scotland) Act 2002 (FOISA), s. 1 for Scotland).

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trans-European energy infrastructure impacts the planning process for energy infrastructure, such as a (BE)CCS plant.[213]

The public participation requirement is relevant in respect of specific developments, such as the planning application for a BECCS plant, and is generally part of the EIA process.[214] Furthermore, UK planning law allows individuals to make representations about major infrastructure projects.[215] Consultation, publicity and notification requirements provide opportunities for the general public to participate in the decision-making process, and the Secretary of State has a duty to inform the public on how the results from the consultation process have been incorporated or otherwise addressed.[216]

Public participation is also required in relation to the development of plans, programmes and policies. Such participation generally occurs as part of a Strategic Environmental Assessment (SEA).[217] In designating national policy statements, the Secretary of State determines the requirements for consultation and publicity requirements as he or she deems appropriate.[218] The consultation procedure involves bringing 'relevant documents to the attention of the persons who, in the authority's opinion, are affected or likely to be affected by, or have an interest in the decisions involved in the assessment and adoption of the plan or programme concerned […].'[219] With respect to climate engineering, however, it may not be straightforward to find out in advance who is likely to be affected the activities. Climate engineering may have an environmental effect on biodiversity, air, water, or soil quality. This effect may be wide ranging and include multiple communities, potentially not limited to the UK alone. It is unclear, how current public participation requirements are to be addressed effectively in respect of climate engineering plans and activities.

In any case, public participation is an important aspect of policy development and legislative processes and is considered essential for the protection of fundamental human rights in relation to the environment.[220] Furthermore, public consultation promotes the rule of law, by helping scrutinise bills and ensure final laws are evidence-based, effective and coherent.[221] In line with the principles of the Aarhus Convention, FOIA and UK planning law provide mechanisms for appeal and access to justice in relation to environmental access to information and public participation.[222] As such, the Government would be expected to incorporate the principles of public participation and access to justice in its approach to regulating climate engineering.

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[213] Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009.
[214] Town and Country Planning (Environmental Impact Assessment) Regulations 2017, s. 4 (1) (b).
[215] Planning Act 2008, s. 51 (1) (b).
[216] Town and Country Planning (Environmental Impact Assessment) Regulations 2017, s. 30 (d) (iii).
[217] The Environmental Assessment of Plans and Programmes Regulations 2004, No. 1633, regulation 13.
[218] Planning Act 2008, part 2, s. 5 (4) and s. 7 (2) (3).
[219] The Environmental Assessment of Plans and Programmes Regulations 2004, No. 1633, regulation 13, (2) (b).
[220] Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (entered into force 30 October 2001) 2161 U.N.T.S. 447 (Aarhus Convention), signed by the UK on 25 June 1998, ratified on 23 February 2005, preamble and article 1.
[221] Bingham Centre for the Rule of Law (2016) *Written evidence to the House of Lords Constitution Committee / Parliament.uk,* [Online]. Available at: http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/constitution-committee/legislative-process/written/41147.html; *Chapter 3: Consultation and pre-legislative scrutiny / parliament.uk,* [Online]. Available at: https://publications.parliament.uk/pa/ld201719/ldselect/ldconst/27/2706.htm#_idTextAnchor028.
[222] See, for example, Planning Act 2008, s. 118; Freedom of Information Act 2000, part V.

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Liability for environmental damage

Civil and criminal liability for environmental damage is governed by the Environmental Damage (Prevention and Remediation) (England) Regulations 2015.[223] The Regulations establish strict liability for environmental damage caused by regulated activities under EU law, as listed in Schedule 2.[224] The Regulations also establish liability for damage caused by any activity not listed in Schedule 2, if the operator acted intentionally or negligently.[225] Schedule 2 covers the operation of permitted installations, waste management operations, mining waste, discharges requiring authorisation, water abstraction and impoundment, dangerous substances, plant protection products and biocidal products, transport, genetically modified organisms and the transboundary shipment of waste.[226]

These regulations establish that an operator is liable for environmental damage caused by these listed activities, or by any other activity if the operator acted with intent or negligently. Obligations of operators are centred around the prevention and remediation of environmental damage.[227] Failure to do so, can give rise to civil liability, as well as a warning, formal caution, or criminal prosecution, in line with standard criminal responses.[228]

These regulations essentially implement the 'polluter-pays' principle of international environmental law, which provides that those who cause environmental damage, should bear the costs for it.[229] Climate engineering activities are not explicitly listed in Schedule 2 of the regulations. Nevertheless, certain climate engineering technologies may involve activities that fall within the meaning of those listed in Schedule 2. This might trigger the regulatory regimes of Schedule 2 to apply and establish a form of strict liability for failure to prevent or remediate environmental damage. CCS, for instance, involves the capturing transportation and storage of carbon dioxide, involving a risk of pollution at each stage of the process. Furthermore, the storage of CO2 may trigger the application of waste regulations, and give rise to liability for failure to comply with them.

Moreover, operators of climate engineering technologies would be liable for intentionally or negligently causing environmental harm, regardless of whether the activity is listed in Schedule 2 or not.[230] This imposes a general duty to prevent and remediate environmental damage in relation to climate engineering activities.

In practice, however, it may not be so easy to ascribe liability for a failure to prevent or remediate environmental harm caused by climate engineering activities. In some possible instances, it may be straightforward to establish liability for environmental harm caused by climate engineering activities. An example could be that the CCS operator is held responsible for local air or water pollution caused by a CO2 storage leak. Other climate engineering activities, such as Stratospheric Aerosol Injection (SAI), may affect the climate at a global scale, and could have unforeseen negative consequences on different

[223] Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (SI 2015/810)
[224] Ibid, Regulation 5 (1) and (2).
[225] Ibid.
[226] Ibid, schedule 2.
[227] Ibid, Part 2 and 3.
[228] Environment Agency (2020) *Policy Paper: Environmental damage offences / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/publications/offence-response-options-environment-agency/environmental-damage-offences.
[229] See for instance (2022) *What is the polluter pays principle? / The London School of Economics and Political Science*, [Online]. Available at: https://www.lse.ac.uk/granthaminstitute/explainers/what-is-the-polluter-pays-principle/#:~:text=The%20'polluter%20pays'%20principle%20is,human%20health%20or%20the%20environment.
[230] Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (SI 2015/810), Regulation 5 (2).

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climates in a variety of places. It may be challenging to retrace the environmental harm back to the original and precise climate engineering activity or to establish and quantify its contributory factor.

Furthermore, the Regulations impose a duty on operators to take all practical steps to prevent environmental damage if the threat of environmental damage is 'imminent'.[231] The risk of environmental degradation caused by climate engineering may not always be considered imminent but may be a long-term risk. For example, some research suggests that bioenergy cropland expansion for the purpose of BECCS may negatively affect biodiversity based on possible scenarios for the year 2080.[232]

On top of that, the Regulations only apply to environmental damage or a risk of environmental damage that is *significant*.[233] The use of certain chemicals by a single operator, such as sulphur dioxide for SAI or amine for CCS, may not be sufficient to constitute a significant risk of harm to the environment. The cumulative effect of the use of chemicals by all operators combined, however, may constitute a significant risk of harm to the environment, without triggering the liability regime for single operators.

For these reasons, it is recommended that an independent body is established or appointed, to regulate and oversee all climate engineering activities in the UK and monitor the overall impact of the sector on the environment. This way, the actual combined risk of climate engineering can be monitored and controlled. Furthermore, it is recommended that Schedule 2 of the Regulations is expanded to include climate engineering activities. This removes any ambiguity as to whether certain climate engineering activities fall within the meaning of Schedule 2 or not and establishes a strict liability regime for operators. Whilst allocating accountability may be challenging due to the difficulty of establishing causation, it would help clarify operators' responsibilities in relation to the prevention and remediation of environmental harm. As climate engineering is specifically aimed at "… the deliberate large-scale intervention in the Earth's climate system, in order to moderate global warming,"[234] it is pertinent that such activities have a positive environmental impact and are aligned to wider sustainability objectives. Establishing a liability regime for failing to prevent or remediate environmental harm helps to ensure that climate engineering is deployed in a sustainable manner.

The flipside to this, is that certain nature-based climate engineering techniques enhance nature's ability to store harmful chemicals, such as carbon and mercury.[235] Enhancing sinks, such as by peatland restoration currently being tested in the UK as part of the CO_2RE project,[236] may have wider positive environmental impacts, which strengthens the mandate for exploring such techniques further. It is nonetheless important to consider an appropriate regulatory regime for minimising and remediating the negative environmental impacts of climate engineering.

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[231] Ibid, Regulation 13.
[232] Hof C. et al (2018) 'Bioenergy cropland expansion may offset positive effects of climate change mitigation for global vertebrate diversity', *PNAS*, 115 (52), [Online]. Available at: https://doi.org/10.1073/pnas.1807745115, p. 13294.
[233] Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (SI 2015/810), Regulation 4, Schedule 1 and 3.
[234] Shepherd, J., Caldeira, K., Cox, P., Haigh, J., Keith, D., Launder, B., & Mace, G. (2009) G*eoengineering the Climate: Science, Governance, and Uncertainty*. Available at: https://royalsociety.org/~/media/royal_society_content/policy/publications/2009/8693.pdf.
[235] See, for instance, Haynes K. M. et al (2017) 'Gaseous mercury fluxes in peatlands and the potential influence of climate change' *Atmospheric Environment,* 154, [Online]. Available at: https://doi.org/10.1016/j.atmosenv.2017.01.049.
[236] *Why peatland restoration? / CO2RE The Greenhouse Gas Removal Hub*, [Online]. Available at: https://co2re.org/ggr-projects/peatland-restoration/.

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3.3 UK climate change law

UK climate change law refers to legislation concerned with the reduction of greenhouse gas emissions, emission trading schemes, and regulating the impacts and adaptation to climate change. In the UK, climate change law is comprised of and influenced by international climate law, retained EU law, and domestic climate change law. The UK Climate Change Act 2008 was the first of its kind worldwide to establish a comprehensive legal framework for reducing emissions and adapting to a changing climate.[237] In 2019, the UK became the first major economy to legally commit itself to net-zero by 2050.[238] The Scottish Government went even further, by committing to achieving net-zero by 2045, and declared a national climate emergency.[239] This section explores the UK legal framework on climate change law in more detail and examines its implications on the development and deployment of climate engineering technologies.

3.3.1 Sources of UK climate change law

International climate law in the UK

The UK is party to the United Nations Framework Convention on Climate Change (UNFCCC), and adopted the Paris Agreement in 2016.[240] In December 2020, the UK communicated its Nationally Determined Contributions (NDCs) within the meaning of article 4 of the Paris Agreement to the UNFCCC Secretariat, committing to a 68% reduction in GHG emissions by 2030.[241] Following COP26, held in Glasgow in 2021, the UK Government further detailed how it plans to achieve this reduction by 2030. At the COP27 in Sharm el-Sheikh in November 2022, the UK government reaffirmed its commitment to and progress towards meeting its emission reduction targets, and made a series of funding commitments to support climate mitigation and adaptation globally.[242]

[237] OECD (2021) *In Practice: The United Kingdom's pioneering Climate Change Act / OECD,* [Online]. Available at: https://www.oecd.org/climate-action/ipac/practices/the-united-kingdom-s-pioneering-climate-change-act-c08c3d7a/.
[238] Department for Business, Energy & Industrial Strategy and The RT Hon Chris Skidmore MP (2019) *News story: UK becomes first major economy to pass net zero emissions law / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/news/uk-becomes-first-major-economy-to-pass-net-zero-emissions-law.
[239] The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019, s. A1 (1) and (2); Climate Change Secretary Roseanna Cunningham (2019), *The Global Climate Emergency – Scotland's Response: Climate Change Secretary Roseanna Cunningham's Statement to the Scottish Parliament on 14 May 2019 / Scottish Government,* [Online]. Available at: https://www.gov.scot/publications/global-climate-emergency-scotlands-response-climate-change-secretary-roseanna-cunninghams-statement/.
[240] United Nations Framework Convention on Climate Change (entered into force 21 March 1994) 1771 U.N.T.S. 107, signed by the UK on 12 June 1992, ratified on 8 December 1993; Paris Agreement (entered into force 4 November 2016) 3156 U.N.T.S., signed by the UK on 22 April 2016, ratified on 18 November 2016.
[241] Department for Business, Energy & Industrial Strategy (2020) *United Kingdom of Great Britain and Northern Ireland's Nationally Determined Contribution.* UK Government, [Online]. Available at: https://www.gov.uk/government/publications/the-uks-nationally-determined-contribution-communication-to-the-unfccc.
[242] Coleman C. (2022) *COP27: Progress and outcomes / UK Parliament: House of Lords Library,* [Online]. Available at: https://lordslibrary.parliament.uk/cop27-progress-and-outcomes/#heading-6.

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Retained EU climate law

Prior to Brexit, the UK was subject to EU climate law, including the EU's NDC of a 40% reduction in GHGs by 2030,[243] and other laws and policies, such as the EU Emissions Trading System.[244] Following the end of the Transition Period, the UK Government adopted the Climate and Energy (Revocation) (EU Exit) Regulations 2021, which revoked many EU climate and energy laws that no longer had practical application to the UK following its withdrawal from the EU.[245] To replace the EU ETS, the UK established the UK ETS scheme, considered further in section 3.3.2.

Domestic climate law: the Climate Change Act 2008

The main piece of domestic climate law is the Climate Change Act, originally adopted in 2008, and amended in 2019 to reflect the UK's updated climate target.[246] The Act is built around four pillars: (i) a goal, (ii) a pathway, (iii) a toolkit, and (iv) a monitoring framework.[247]

The goal is the legally binding emissions target to reduce greenhouse gas emissions by 2050. The original 2008 Act had set this goal at 80% reduction compared to 1990 levels based on the advice from the CCC.[248] This goal was updated to 100% reduction, or 'net-zero' by 2050 following the 2019 amendment to the 2008 Climate Change Act.[249] The revised target came about following the publication of the 2018 IPCC report and updated advice from the CCC.[250]

The pathway, as described by the Act, refers to legally-binding 'carbon budgets', or interim targets for reducing UK greenhouse gas emissions over five-year periods.[251] To date, the UK Government has set six carbon budgets in agreement with the Climate Change Committee, each budget covering a five-year

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[243] Rix O. and Priestley S. (2020) *EU policy and action on climate change / UK Parliament: House of Commons Library*, [Online]. Available at: https://commonslibrary.parliament.uk/eu-policy-and-action-on-climate-change/.
[244] *EU Emissions Trading System (EU ETS) / European Commission: Climate Action,* [Online]. Available at: https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en.
[245] The Climate and Energy (Revocation) (EU Exit) Regulations 2021, SI 2021 No. 519.
[246] Climate Change Act 2008; Climate Change Act 2008 (2050 Target Amendment) Order 2019 (S.I. 2019/1056).
[247] CCC (2020), *CCC Insights Briefing 1: The UK Climate Change Act*. CCC, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf.
[248] Climate Change Act 2008, s. 1 (1); Turner A. (2008) *Letter: Advice on the long-term (2050) target for reducing UK greenhouse gas emissions*. CCC, [Online]. Available at: https://www.theccc.org.uk/publication/letter-interim-advice-from-the-committee-on-climate-change/.
[249] Climate Change Act 2008, s. 4.
[250] CCC (2020), *CCC Insights Briefing 1: The UK Climate Change Act*. CCC, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf, p. 3; Climate Change Act 2008, s. 1 (1); Climate Change Act 2008 (2050 Target Amendment) Order 2019 (S.I. 2019/1056), articles 1 and 2.
[251] Wilkinson S. (2019) *The road to net zero / The Law Society: Gazette,* [Online]. Available at: https://www.lawgazette.co.uk/legal-updates/the-road-to-net-zero/5101588.article; IPCC (2018) *Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty.* Cambridge University Press, Cambridge, UK and New York, USA, [Online]. Available at: https://doi.org/ 10.1017/9781009157940; CCC (2020), *CCC Insights Briefing 1: The UK Climate Change Act*. CCC, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf, p. 3.

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period between 2008 and 2037.[252] Figure 1 below shows the UK's legally binding carbon budgets (CB) (six columns) against the UK's net annual GHG emissions to date.

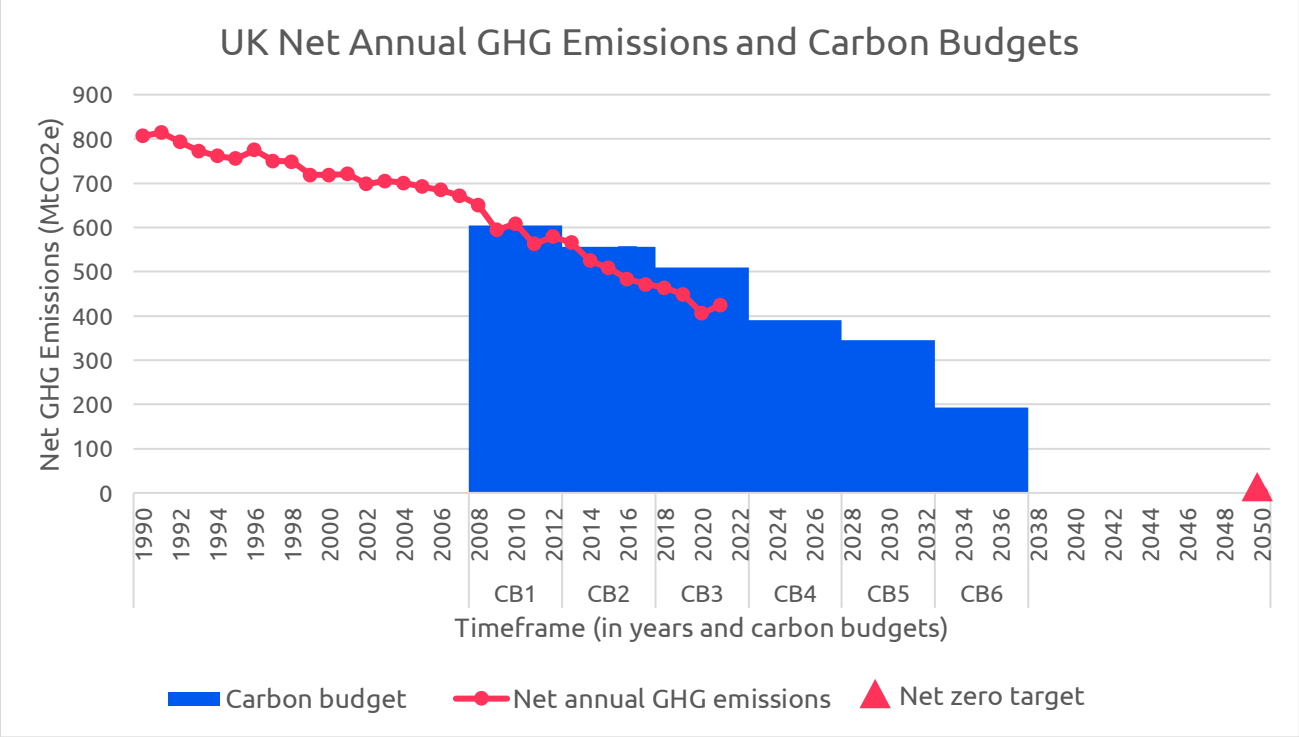

Figure 1: UK net annual GHG emissions and carbon budgets[253]

To deliver on this pathway, the Climate Change Act imposes a duty on the Secretary of State to prepare proposals and policies that enable the carbon budgets to be met.[254] The Secretary of State must then present a report detailing its proposals and policies for meeting the carbon budgets to Parliament.[255] Such proposals and policies are considered the part of the 'toolkit' pillar of the Climate Change Act.[256]

[252] See, Department for Business, Energy & Industrial Strategy (2016) *Carbon Budgets / Gov.uk*, last updated 13 July 2021, [Online]. Available at: https://www.gov.uk/guidance/carbon-budgets#setting-of-the-fifth-carbon-budget-2028-2032; The Carbon Budget Order 2009, SI 2009 No. 1259; The Climate Change Act 2008 (Credit Limit) Order 2011, SI 2011 No. 1602; The Climate Change Act 2008 (Credit Limit) Order 2016, SI 2016 No. 786; Carbon Budgets Order 2011, SI 2011 No. 1603; Carbon Budgets Order 2016, SI 2016 No. 785; Carbon Budget Order 2021, SI 2021 No. 750.

[253] Adapted by the author from Department for Business, Energy & Industrial Strategy (2022) *National Statistics: Final UK greenhouse gas emissions national statistics: 1990 to 2020: 2020 UK greenhouse gas emissions: final figures – data tables (Excel)*. Gov.uk, [Online]. Available at: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2020; Department for Business, Energy & Industrial Strategy (2022) *2021 UK greenhouse gas emissions, provisional figures.* National Statistics, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1064923/2021-provisional-emissions-statistics-report.pdf.

[254] Climate Change Act 2008, c. 27, s. 13.

[255] Ibid, s. 14.

[256] CCC (2020), *CCC Insights Briefing 1: The UK Climate Change Act*. CCC, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf, p. 3.

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The 2008 Act established the CCC as advisor to the Secretary of State on the 2050 target, carbon budgets, and on the inclusion of international aviation and shipping emissions in domestic emission sources calculations.[257] Furthermore, the CCC is tasked with laying before Parliament a report on the progress made towards the 2050 target and meeting the carbon budgets.[258] The CCC comprises two Committees, covering mitigation and adaptation. Members are experts and politically impartial, so that the CCC can provide independent and evidence-based advice to the Government.[259] As such, the CCC fulfils the monitoring role under the Climate Change Act. Furthermore, the Government has an obligation to respond to the CCC's advice and assessment, which establishes an annual cycle of policy development.[260]

3.3.2 Climate change law implications of climate engineering

In its sixth carbon budget, the UK Government commits to reducing its net GHG emissions by 78% by 2035. For the first time, this carbon budget includes the UK's share of international aviation and shipping emissions.[261] In order to meet this target, the CCC recommends the UK Government takes the following four key steps:[262]

1. Take up low-carbon solutions
2. Expand low carbon energy supplies
3. Reduce demand for carbon-intensive activities
4. Invest in land and land use change, and greenhouse gas removals.

This is a clear indication by the CCC that greenhouse gas removals should be considered part of the mix of tools to take climate action. Furthermore, the Government's current policy reflects the CCC's view that GGR technologies will be essential to achieve the UK's climate targets.[263] To date, options for GGR in the UK have mostly focused on BECCS, DACCS and wood in construction.[264] Section 1.5 above highlighted various such projects currently underway in the UK.[265] In addition, the CO2RE project is

[257] Climate Change Act 2008, c. 27, s. 33-35.
[258] Ibid, s. 36.
[259] CCC (2020), *CCC Insights Briefing 1: The UK Climate Change Act*. CCC, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/10/CCC-Insights-Briefing-1-The-UK-Climate-Change-Act.pdf, p. 4.
[260] Ibid.
[261] Department for Business, Energy & Industrial Strategy, Prime Minister's Office, 10 Downing Street, The Rt Hon Kwasi Kwarteng MP, The Rt Hon Alok Sharma MP, and The Rt Hon Boris Johnson MP (2021) *Press Release: UK enshrines new target in law to slash emissions by 78% by 2035 / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035.
[262] CCC (2020) *Sixth Carbon Budget / Climate Change Committee,* [Online]. Available at: https://www.theccc.org.uk/publication/sixth-carbon-budget/.
[263] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.
[264] CCC (2020) *The Sixth Carbon Budget: Greenhouse gas removals*. Climate Change Committee, [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-GHG-removals.pdf.
[265] See, for instance, UKRI (2021), *UK invests over £30m in large-scale greenhouse gas removal* / UK Research and Innovation, [Online]. Available at: https://www.ukri.org/news/uk-invests-over-30m-in-large-scale-greenhouse-gas-removal/.

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testing mostly nature based GGR technologies.[266] SRM is not currently being considered by the Government.[267]

Whilst the policy direction is clear, certain legal challenges remain. As previously mentioned, the Climate Change Act limits the definition of 'removals' to those achieved "due to land use, land use change or forestry activities in the United Kingdom."[268] Engineered technologies, such as BECCS, DACCS, are seemingly excluded from the Act, in contrast to 'natural' forms of greenhouse gas removal activities. The Energy Bill, introduced to the HoL on 6 July 2022, proposes to amend the meaning of 'removals' to include 'engineered' removals, so that such removals will count towards carbon budgets within the meaning of the Climate Change Act 2008.[269] A legal amendment like this would affirm the UK's policy direction and clarify the legal status of removals achieved by climate engineering under the UK climate law regime.

This alludes to a more general legal uncertainty at the international climate law level, and the meaning of 'removals' within the context of the Paris Agreement. Article 4 of the Paris Agreement refers to achieving 'a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases…'.[270] The Paris Agreement does not provide a definition of 'sinks', and it therefore remains unspecified whether 'removals by sinks' refers to nature-based sinks alone or may also include engineered sinks, such as BECCS or DACCS. Interestingly, the French version of the Paris Agreement refers to '…*un équilibre entre les émissions anthropiques par les sources et les absorptions anthropiques*…', which translates to a balance between emissions from anthropogenic emissions by sources and *anthropogenic* sinks or removals.[271] Clarification of this legal ambiguity would be welcomed to provide greater certainty as to the legality of climate engineering technologies in the national and international context. After all, the IPCC climate mitigation pathways published in 2018 all rely on the assumption that climate engineering technologies will be deployed in order to limit global warming in line with the objective of the Paris Agreement.[272]

Furthermore, an important distinction must be made between different types of climate engineering techniques. Policy and legal developments should be developed to appropriately reflect and govern these different types. UK policy towards GGR is very different from SRM, with the UK Government investing in various GGR programmes and projects, whilst refraining from further exploring SRM.[273] As such, it is important that the regulatory regime for climate engineering is developed in such a way that

[266] *GGR Projects / CO2RE: The Greenhouse Gas Removal Hub*, [Online]. Available at: https://co2re.org/ggr-projects/.
[267] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.
[268] Climate Change Act, s. 29 (1) (b).
[269] Energy Bill [HL], HL Bill 39 (as introduced on 6 July 2022), s. 111.
[270] Paris Agreement (entered into force 4 November 2016) 3156 U.N.T.S., signed by the UK on 22 April 2016, ratified on 18 November 2016, article 4 (1).
[271] Accord De Paris (French language version of the Paris Agreement) (entered into force 4 November 2016) 3156 U.N.T.S., signed by the UK on 22 April 2016, ratified on 18 November 2016, article 4 (1).
[272] IPCC (2018) *Global Warming of 1.5 °C: An IPCC Special Report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge University Press, Cambridge, UK and New York, USA, [Online]. Available at: https://doi.org/ 10.1017/9781009157940, 4.1.
[273] Department for Business, Energy & Industrial Strategy (published 2013, last updated 2020) *Policy paper: Geo-Engineering: the government's view*. Department for Business, Energy & Industrial Strategy, [Online]. Available at: https://www.gov.uk/government/publications/geo-engineering-research-the-government-s-view/uk-governments-view-on-greenhouse-gas-removal-technologies-and-solar-radiation-management.

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it recognises the various types of climate engineering technologies and appropriately governs them. This includes providing greater clarity regarding the legal status of 'nature-based' and 'engineered' GGR technologies, as well as the definition of 'removals' within the meaning of the Climate Change Act, and at the international climate law level.

A study conducted in 2020 highlights the importance of a strategic legal framework for action against climate change.[274] Based on stakeholder interviews on the success of the UK Climate Change Act, most interviewees felt that the Act had established a firm long-term framework and a clear direction of travel.[275] Furthermore, most of the respondents felt that the Act had helped inform UK climate policy and become more forward looking. Some also felt the Act helped increase policy certainty and protect against political backsliding.[276] This research indicates that a regulatory framework, such as the UK Climate Change Act, can help increase policy certainty and protect a long-term commitment such as a climate target from short-term politics. Furthermore, such a framework can help increase long-term predictability, which is key for making investment decisions, particularly in the context of climate engineering. As such, the framework created by the Climate Change Act may serve as an example for future climate engineering regulatory frameworks, to increase policy certainty and long-term predictability. Legal amendments, such as proposed clarification in the Energy Bill of the definition of 'removals' within the meaning of the Climate Change Act, are important steps towards the development of a body of law that appropriately regulates climate engineering technologies. A UK Government report from 2010 suggested that the UN would ultimately be the appropriate body to provide the regulatory framework for climate engineering at the international level.[277]

The UK ETS and governing removals

The Climate Change Act also makes provision for GHG emission trading schemes.[278] Following Brexit, the UK Emissions Trading Scheme (UK ETS) was established to replace the UK's participation in the EU ETS.[279] The cap-and-trade scheme applies to energy intensive industries, power generation sector and aviation.[280] UK regulators set a cap on the total amount of carbon that can be emitted per sector. Businesses covered by the scheme receive free carbon allowances and can buy additional emission allowances at auction or trade with other scheme participants.[281] By putting a price on carbon emissions, the scheme creates a financial incentive to reduce emissions in these sectors.

In March 2022, the UK ETS Authority, which comprises the four UK Governments, launched a joint consultation on the further development of the UK ETS.[282] In the consultation document, the Authority

[274] Averchenkova A., Fankhauser S., and Finnegan J. J. (2021) 'The impact of strategic climate legislation: evidence from expert interviews on the UK Climate Change Act' *Climate Policy,* 21 (2), [Online]. Available at: https://doi.org/10.1080/14693062.2020.1819190.
[275] Ibid.
[276] Ibid.
[277] House of Commons Science and Technology Committee (2010) *The Regulation of Geoengineering: Fifth Report of Session 1009-10.* House of Commons, London, [Online]. Available at: https://publications.parliament.uk/pa/cm200910/cmselect/cmsctech/221/221.pdf.
[278] Climate Change Act 2008, c. 27, s. 44.
[279] The Greenhouse Gas Emissions Trading Scheme Order 2020, SI 2020 No. 1265.
[280] Department for Business, Energy & Industrial Strategy (2022) *Guidance: Participating in the UK ETS / Gov.uk,* [Online]. Available at: https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets#who-the-uk-ets-applies-to; Greenhouse Gas Emissions Trading Scheme Order 2020, SI 2020 No. 1265, schedule 1 and 2.
[281] Ibid.
[282] Department for Business, Energy & Industrial Strategy, Welsh Government, The Scottish Government, and Department of Agriculture, Environment and Rural Affairs (Northern Ireland) (2022) *Consultation outcome: Developing the UK Emissions Trading Scheme (UK ETS),* [Online]. Available at: https://www.gov.uk/government/consultations/developing-the-uk-emissions-trading-scheme-uk-ets.

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recognises that the UK ETS may, in time, become a market for GGR. At the same time, however, it recognises that the inclusion of GGR into the UK ETS market should not weaken the incentive to reduce emissions as a primary objective.[283] Furthermore, challenges of additionality, double counting, the permanency of carbon removals, and effective monitoring, reporting and verification of emission reductions must be overcome before GGR technologies can reasonably be included in the UK ETS.[284] Also, wider land management goals and impacts must be taken into consideration to create the right incentives for GGR methods and offer wider environmental benefits or land management goals, such as through nature-based GGR.[285] Finally, future policies to include GGR in the UK ETS must give due consideration to the different types of GGR techniques and their current state of deployment, to support their deployment and ensure their proper functioning in the market.[286]

It has been suggested elsewhere that the legal and financial nature of carbon removal 'units' would need to be clarified for the creation of a market that includes carbon removals.[287] Policy makers will need to determine how to scale up the GGR market, and whether or not to include social and environmental outcomes in the creation of regulatory incentives for GGR investments.[288] For example, such outcomes could incorporate human rights, public participation and biodiversity considerations, to ensure climate engineering contributes to wider societal and environmental objectives than climate mitigation alone. In any case, removals generated by diverse GGR methods are likely to have different characteristics. It has therefore been proposed that characterising removal units as 'property' would help the development of a GGR market by providing a material benefit.[289] Furthermore, the creation of standardised GGR removal units and the 'bundling' of GGR projects to create fungibility would contribute to the proper functioning of an ETS market that includes carbon removal units.[290] Standardisation, particularly if achieved at the level of the International Standards Organisation (ISO), would open the door to international trading of GGR removal units.[291]

[283] UK ETS Authority (2022) *Developing the UK Emissions Trading Scheme (UK ETS): A joint consultation of the UK Government, the Scottish Government, the Welsh Government and the Department of Agriculture, Environment and Rural Affairs of Northern Ireland.* UK Government, Scottish Government, Welsh Government and the Department of Agriculture, Environment and Rural Affairs for Northern Ireland, [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067125/developing-the-uk-ets-english.pdf, p. 128.
[284] Ibid.
[285] Ibid, p. 129.
[286] Ibid.
[287] Macinante J. and Ghaleigh N. S. (2022) 'Regulating Removals: Bundling to Achieve Fungibility in GGR 'Removal Units'', *University of Edinburgh School of Law Research Paper Series, No 2022/05*, [Online]. Available at: https://dx.doi.org/10.2139/ssrn.4064970.
[288] Ibid, p. 27.
[289] Ibid, p. 26.
[290] Ibid, p. 27.
[291] Ibid, p. 28.

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4. Overview of gaps and challenges

The UK is committed to deploying climate engineering to help meets its climate change targets. Existing legal frameworks, however, impact the manner in which climate engineering may be deployed. Certain legal gaps and challenges will need to be addressed to ensure UK regulation is adequately equipped to govern climate engineering. This section highlights the key gaps and challenges identified with respect to UK human rights law, environmental law and climate change law.

UK human rights law

- The UK human rights law framework incorporates various rights which may be affected by climate engineering activities. Victims of alleged human rights violations have access to legal recourse through the UK courts and tribunals, and ultimately also through the ECtHR. Furthermore, the Government has a positive obligation to protect human rights in exercising its duties and functions. In the context of climate engineering, this means that human rights must be given due regard, such as when approving planning permission for a CO2 storage site. Furthermore, the threshold for triggering an interference with the right to respect for private and family life is seemingly lower than that for the right to life. The right to respect for private and family life can be interfered with when the *quality* of life is affected, as has seen in ECtHR case law concerning harm caused by industrial activities.

- Climate engineering seeks to prevent climate change, which in itself is likely affect life and the quality of life of present and future generations on a global scale. As such, it may be argued that climate engineering can protect and enhance human rights. A UK recent case, however, illustrated that invoking human rights to demand greater climate action is not self-evident, let alone to mandate climate engineering.

UK Environmental law

- The UK environmental law framework is primarily concerned with the protection of today's environment and human health. Climate engineering is considered an 'essential' mitigation tool by the UK Government, and will have to play a key role in achieving the UK's climate targets. As such, climate engineering will be deployed to prevent future harm to the environment and human health caused by dangerous climate change. Furthermore, climate engineering is concerned with the prevention of global effects of climate change, whereas environmental regulation is primarily concerned with local impacts, such as on air quality, soil, water, waste and local communities. Finally, environmental principles tell us to take a precautionary approach to deploying technologies for which there is a limited scientific knowledge base. On the other hand, urgent climate action is needed, and climate engineering are considered essential if climate targets are to be achieved. As such, there is a tension between environmental law objectives and the need for climate engineering to help meet the UK's climate targets. This tension might need to involve amendments to environmental law to incorporate the future interests of the environment and human health.

- Climate engineering technologies may have negative environmental consequences, depending on the way they are deployed and operated. Furthermore, scientific uncertainty means that some risks to the environment and human health are not yet fully understood. Developing criteria for the sustainable operation of climate engineering, such as whole life-cycle assessments, would help assess these risks and account for possible negative externalities. Developing such criteria will not be a straightforward exercise, and must be able to account for the specific characteristics of various climate engineering technologies in different contexts.

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- Greater clarity is needed regarding the scope and requirements for the Net Biodiversity Gain as introduced by the Environment Act 2021. Climate engineering technologies may have local and context-specific impacts on biodiversity and are likely to require a case-by-case assessment. Furthermore, impacts on biodiversity may differ between the short and long term. Scientific uncertainty means that measuring and quantifying actual gains, as well as establishing a causal link between the climate engineering activity and the impact on biodiversity may not be straightforward.

- It may be argued that CO2 is essentially a waste gas that results from energy production. Whilst some legal amendments seek to clarify that CO2 storage in offshore sites is compatible with international waste regulations, ambiguity concerning the difference between the permanent disposal of CO2 at a storage site and the definition of waste remains. It is recommended that the relation between CO2 storage and waste regulations is clarified, to provide greater certainty to operators of the applicable regulation to CCS activities, which would help normalise operations and encourage uptake.

- UK law makes provision for public participation in environmental decision making, is primarily focused on engagement with local communities. This, however, fails to incorporate communities which may be affected by the wide-ranging impacts of climate engineering. It is unclear how public participation principles can best be incorporated in respect of climate engineering. The Government would be expected to give public participation and access to justice due consideration in its approach to regulating climate engineering.

- Environmental Damage Regulations may fall short of adequately protecting against a possible negative cumulative effect of climate engineering activities in the UK. It is therefore recommended that an independent body is established or appointed, to regulate and oversee all climate engineering activities in the UK and monitor the cumulative impact of the sector on the environment. This body could also collaborate internationally to monitor climate engineering activities elsewhere. This way, the actual combined risk of climate engineering can be monitored and controlled.

UK Climate change law

- The UK Government has committed to growing a GGR sector to help meet is climate targets under the Climate Change Act. To clarify which climate engineering technologies are within the scope of the UK Government's commitment, it is recommended that the definition of GGR is clarified. This includes clarifying the legal status of nature-based approaches and 'engineered' technologies. As such, it is recommended that policy and legal developments are developed to appropriately reflect and govern these types of climate engineering techniques according to their distinct characteristics and associated risks.

- The definition and legal status of removals must also be clarified. The current proposed amendment to the Climate Change Act is a step towards clarifying legal status of removals achieved by climate engineering under the UK climate law regime. This could serve as an example on the international climate law level and the remaining ambiguity under the Paris Agreement as to the inclusion of 'engineered' removals within the meaning of article 4. Furthermore, standardisation would open the door to the future inclusion of removals in emission trading schemes.

- The strategic framework provided by the Climate Change Act allows for the inclusion of long-term and interim climate targets, as well as a cycle of policy development. Furthermore, the independent role of the CCC has been instrumental to informing the Government's view on climate engineering. As such, the framework provided by the Climate Change Act may serve as an example to further inform the regulatory regime related to climate engineering in the UK and beyond.

- Given the global impacts of climate engineering, international coordination, such as by the UN, is essential. There may be a need for a dedicated agreement at the regional or international level to

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standardise the governance of climate engineering and carbon removals, and strengthen international collaboration to monitor environmental impacts. The UK could play an instrumental role in such an initiative.

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5. Conclusion

This UK case study sets out the most prevalent legal and policy issues surrounding climate engineering in the UK. Whilst steering clear of SRM, the UK Government has set out in the direction of the large-scale deployment of GGR technologies. Ongoing policy and legal developments therefore make the UK case study an interesting one to continue to follow from an international perspective. The UK's environmental law framework will need to be adapted to become adequately equipped to regulate GGR technologies in the UK. Furthermore, the Government has an obligation to protect human rights as it develops a GGR sector. UK environmental law framework restricts climate engineering to the extent that it poses a risk to the environment and human health. Whilst climate engineering seeks to prevent future risk of harm to the environment caused by climate change, current environmental regulation is limited to the protection of today's environment and human health. Further research may be required to understand the role SRM might be able to play in the UK's commitment to tackling climate change. Such research will likely need to focus on whether SRM can be considered safe for the environment and human health, and whether it should be deployed at all. In contrast, further research into GGR technologies will likely need to focus on the ways these technologies can best be deployed and regulated to maximise their benefits and mitigate potential risks.

The tension between environmental law objectives and climate engineering for the purpose of meeting climate change targets, is not limited to the UK. It is likely that this tension will need to be addressed both at the national and international level. Furthermore, the UK Government will need to develop ways of incorporating public participation into climate engineering decision-making. International collaboration will be key to adequately monitor the impacts of climate engineering on a wider, if not global, scale. Whilst this cannot be achieved alone, the UK should take the lead and align its GGR commitments to other climate engineering initiatives elsewhere. The UK's Climate Change Act, and the role of the CCC as independent advisor, could inform the development of a regulatory regime of climate engineering in the UK and beyond.

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