New Government Financing for Geoengineering (April update)

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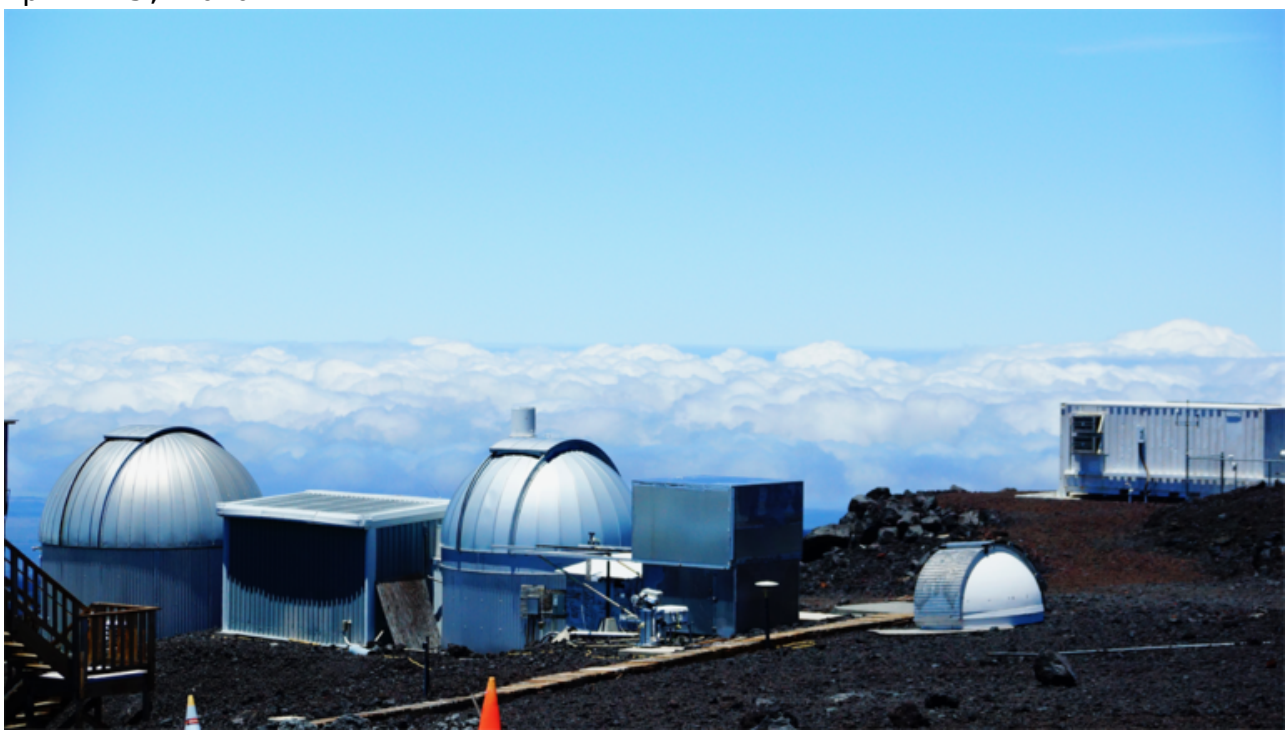

by Anja Chalmin

Recently announced governmental research programs on geoengineering

The current year has started as the old year has ended – with substantial governmental funding announcements for programs researching and testing various geoengineering approaches. Although the US has seen larger governmental funding programmes for various geoengineering approaches in the past,* the recently announced funding programmes are the most extensive so far in terms of subjects and finance.[i]

At the end of last year, the United States Department of Energy announced a US$ 110 million **U.S. Federal Support Programme**. This support measure finances Front-End Engineering Design (FEED) studies to test CO_2 capture technologies, the assessment of commercial-scale CO_2 storage sites and the formation of regional carbon sequestration partnerships.[ii] The U.S. government allocated further funding to the National Oceanic and Atmospheric Administration (NOAA) to conduct **research on Solar Radiation Management**. The program provides US$ 4 million to study the stratosphere, "*including the impact of the introduction of material into the stratosphere from changes in natural systems, increased air and space traffic, proposals to inject material to affect climate, and the assessment of solar climate interventions.*" A further bill was introduced in California, to empower the NOAA to "*broaden its research into atmospheric climate intervention modeling and technologies and to better understand such interventions*".

In January 2020, NOAA announced a plan to explore two different proposals, both aiming to reflect more sunlight back to space: (1) Stratospheric Aerosol Injection (SAI) – a proposal to inject reflective aerosols, such as sulphur dioxide, into the stratosphere; and (2) Marine Cloud Brightening (MCB) – a proposal to create whiter clouds by enhancing the concentration of smaller cloud droplets.[iii] In addition, the U.S. congress passed the "**Sea Fuel Act of 2019,**" which contains the so-called "Direct Air Capture and Blue Carbon Removal Technology Program" and directing the U.S. Department of Defence to research CO_2 capture technologies, including ways to use CO_2 as a raw material for the manufacture of fuels. The first phase of implementation (2020-2023) involves R&D to produce CO_2-based fuels and a FEED study on Direct Air Capture (DAC), a proposed greenhouse gas removal technology that aims to remove CO_2 from ambient air. The second phase of the program (2024-2026) involves projects to test and evaluate the results of the first program phase on demonstration-scale.[iv]

The **European Union's Innovation Fund** plans to invest up to €10 billion in the period from 2020 to 2030 to advance low-carbon technologies, renewable energy generation, energy storage as well as Carbon Capture Use & Storage (CCUS) and Carbon Capture & Storage (CCS) projects. The Fund scheduled the first project call for 2020. Its predecessor programme, NER300, selected one CCS project adjacent to the Drax Power Station in UK, the "White Rose Plant," for funding. This CCS project was cancelled due to high costs and delays.[v] In February 2020, the European Parliament confirmed a list of projects of common interest, among them five CCS projects

in the Netherlands, Scandinavia, the UK and Ireland. Appearing on the list means a project can apply for priority funding, but does not guarantee that it will receive funding.

The UK government supported various geoengineering research projects in the past. The most comprehensive programme to date has been announced in March of this year. a budget of £800 million for a The **CCS Infrastructure Fund**, endowed with a budget of £800 million, plans to establish at least two CCS clusters – one by the mid-2020s and the second by 2030. The government also plans to support the construction of UK's first CCS power plant.[vi] The UK government also announced £2.7 million of additional funding for the Acorn CCS project in February 2020. The project aims to deliver a low-cost CCS, capturing 0.2 million tonnes of CO_2 from the St. Fergus Gas Plant in northeast Scotland for storage in depleted gas fields beneath the North Sea. Instead of creating new structures, the project suggests using existing offshore infrastructure, such as former gas pipelines, and to transport CO_2 in the opposite direction.[vii]

Updates on recently launched and ongoing geoengineering research programs

NECOC, the "**NE**gative **C**arb**O**n dioxide to **C**arbon" project, plans to demonstrate DAC in conjunction with the production of "carbon black," which can be described as solid CO_2, in the form of a blackish carbon powder. The three-year project started in 2020, is financed by the German Federal Ministry for Economic Affairs and Energy, led by the German Karlsruhe Institute (KIT) and conducted in cooperation with the German Power-to-X and KIT-spinoff Ineratec GmbH and the Swiss DAC-technology producing start-up Climeworks AG. According to KIT, the carbon black can be used as a raw material in various industries, for example in the electronics, printing or construction sectors. The entire amount of energy needed to manufacture a certain amount of the substance is not available, but Climeworks' DAC process alone consumes up to 3,100 kWh of thermal and electrical energy to capture 1t of CO_2.[viii] 3,100 kWh is equivalent to the energy needed to complete more than 1,500 loads of laundry.[ix]

Greenhouse Gas Removal by Enhanced Weathering (GGREW), a project led by the University of Oxford, aims to explore the feasibility of Enhanced Weathering (EW) in oceans, conducted tests with different mine wastes for CO_2 removal on lab-scale and assessed different ways to accelerate the weathering process artificially. The project published plans to conduct open-ocean trials in the Great Barrier Reef, Australia and in a coral reef in the Gulf of Aqaba, Israel, aiming to assess the biological responses to EW.[x] EW is a very cost- and energy-intensive proposal, aiming to remove CO_2 by spreading large quantities of finely ground rock material onto extensive surfaces. Potential effects on the marine environment, for example on biochemical processes or the marine food chain, are unknown. Furthermore, finely ground rock material may release substances with harmful effects even in small doses, such as heavy metals. The California-based philanthropic funding organisation **Oceankind** organised a meeting to discuss the potential and limits of ocean alkalinity enhancement (OAE), which can be described as EW in the ocean and involves adding alkalinity to the ocean, for example lime. Oceankind aims to form a knowledge hub on OAE with stakeholders from science, policy and the private sector.[xi]

The project **Coastal Upwelling in a Changing Ocean** (CUSCO) is conducting an open-ocean experiment (in mesocosms) in the coastal waters off of the Peruvian city of Callao, in the Humboldt Current, testing the effects of varying Artificial Upwelling (AU) intensities on plankton communities and biomass production from February to April 2020. CUSCO is led by the German GEOMAR Helmholtz Centre for Ocean Research, financed by the German Ministry for Education and Research and builds on the results of the pan-European project Ocean artUp.[xii] AU aims to artificially transport nutrient-rich deep ocean water to the surface to stimulate the growth of phytoplankton. In theory, the new phytoplankton will absorb CO_2 and store carbon as soon as dead phytoplankton biomass sinks to the ocean floor. In practice, AU is unproven and could pose threats to ecological cycles, fisheries and the climate.

The California-based **Ice911**, founded by Leslie Fields in 2007, suggests covering Arctic ice to insulate rapidly melting polar areas. The proposed cover material is a reflective silica glass and consists mostly of silicon dioxide. After trialling various cover materials on frozen lakes in Canada and the USA, Ice911 started conducting trials on sea ice at the University of Manitoba's sea-ice test facility (SERF) in Winnipeg, Canada. The testing started in February 2020; the available test surface at SERF is about 160m². The trials aim to further quantify the albedo-effects of the cover material and intend to prepare large-scale testing on arctic ice without considering possible negative effects on weather patterns, the hydrologic cycle, the delicate arctic ecosystems, and the environmental impact of the covering material itself.[xiii]

The Swiss Innovation Agency provided a CHF 1.25 million grant to a research group from the Swiss Academia Engiadina to conduct a larger-scale project at the **Morteratsch glacier**, an Alpine glacier in Switzerland. The project hopes to save the glacier from melting by blowing reflective artificial snow across its surface. A preliminary study has been conducted by covering 400m² in a section of the neighbouring Diavolezzafirn glacier. Data regarding the amount of water and energy required to cover a certain glacier area with artificial snow are not yet available.[xiv]

In Finland, the two-year project **BECCU**, conducted by the Technical Research Centre of Finland and 11 business partners, was launched at the start of the year. The project aims to develop a CCUS process, using CO_2 and H_2 as raw material for chemicals to replace fossil fuels, for example to produce polyurethane products, such as insulation materials. The CO_2 will be captured from bioenergy applications, this involves usually energy-intensive post-combustion capture as well as life cycle emissions, such as CO_2 emitted during cultivation, harvest and transport of the plant residues used to generate energy. CCUS is a proposal to "store" captured CO_2 in short-lived goods, and the CO_2 usually re-enters into the atmosphere.[xv]

The UK Department for Business, Energy and Industrial Strategy supports Bulk **Hy**drogen **P**roduction by Sorbent **E**nhanced Steam **R**eforming (**HyPER**) since the beginning of the year. The project aims to develop a hydrogen production process combined with CO_2 capture.[xvi]

In early 2020, the **U.S. Geological Survey** (USGS), a scientific agency of the U.S. government, published an assessment tool for Enhanced Oil Recovery (EOR), a method that aims to estimate how many extra fossil fuels may be extracted by employing EOR with CO_2.[xvii]

Further updates: CCUS and CCS developments

The German start-up **Ineratec GmbH** was founded in 2016 and developed Power-to-X and Gas-to-Liquid modules, converting gases (CO_2, CO, H_2) into synthetic fuels or chemicals. This CCUS technology was/is tested in various projects, among them the above mentioned NECOC, the European P2X Copernicus project and the Rotterdam Jet Fuel project. Ineratec announced that the first 1MW plant module will become operative this year and a larger-scale production is announced for 2021.[xviii]

The Calgary-based start-up Carbon Upcycling Technologies (CUT) and the Swiss Climeworks AG started a CCUS Kickstarter campaign for the production of **bracelets** "made with CO_2." The CO_2 is captured by Climeworks DAC technology and CUT is the producer of the bracelets. The delivery of the bracelets was announced for March 2020 and has recently been delayed to May, due to problems in the manufacturing process.[xix] A full life-cycle assessment for the bracelets, considering the energy-intensive DAC process, the manufacturing and the delivery of the bracelets, is not available.

The **Northern Lights CCS Project** finished drilling its first exploration well this March. In January 2019, the Norwegian authorities granted, for the first time, a permit to exploit an area for CO_2 injection and storage. The well has been drilled with the objective to assess the suitability of a reservoir in the Johansen Formation for CO_2 storage. The project is carried out by Equinor, Shell and Total. The partners aim to transport captured and liquefied CO_2 over 700km by ship from Oslo area to a hub near Equinor's Kollsnes plant. From Kollsnes the CO_2 will be sent offshore by a 110km pipeline and injected into a depleted well in the Johansen formation, in the Norwegian sector of the North Sea, about 30km offshore mainland Norway.[xx] Theoretically, the CO_2 is pumped into the empty oil and gas reservoirs for long-term storage, but leakage is a risk.

The UK-based **Net Zero Teesside** project, a relaunch of the former Teesside Collective Project (formerly Easton Grange Project), has been officially launched in February 2020. The project is operated by BP, in cooperation with Eni, Equinor, Shell and Total. As its two predecessor projects, the new project aims to capture CO_2 and to transport it via pipeline to an offshore site in the North Sea for dedicated geological storage. The two preceding projects have not been implemented due to funding problems: The Easton Grange Project applied for public funding in 2012 but did not succeed. The Teesside Collective Project was put on hold, after the British Government shelved plans to support the project with £ 1 billion.[xxi]

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* (such as the Biochar and Pyrolysis Initiative (2007-2013), support for the Eastern Pacific Emitted Aerosol Cloud Experiment (2011) or for regional carbon sequestration partnerships, for example, the Plains CO_2 Reduction Partnership (since 2003),

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[viii] ETC Group and Heinrich Böll Foundation (2020) *Geoengineering Map: NECOC*, https://map.geoengineeringmonitor.org/other/necoc/; ETC Group and Heinrich Böll Foundation (2020) *Geoengineering Map: Climeworks AG*, https://map.geoengineeringmonitor.org/Carbon-Cioxide-Removal/climeworks-ag/

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aqaba/,
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[xiv] ETC Group and Heinrich Böll Foundation (2020) *Geoengineering Map: Morteratsch glacier cover*,
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[xv] ETC Group and Heinrich Böll Foundation (2020) *Geoengineering Map: BECCU*,
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