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CIEL CENTER for INTERNATIONAL ENVIRONMENTAL LAW

Deep Trouble: The Risks of Offshore Carbon Capture and Storage

Facing growing scrutiny over their contributions to climate change, polluting industries are increasingly looking to the ocean as a potential dumping ground for their carbon dioxide waste. Rather than phase out fossil fuels, oil, gas and petrochemical companies claim they can, instead, capture some of their carbon dioxide emissions and inject them underground or under the seabed. But this carbon capture and storage (CCS) technology has yet to be proven at scale, and its buildout poses a host of environmental, safety and health risks. The very few offshore CCS projects that exist worldwide today cast serious doubt on the feasibility of CCS, and raise questions about its potential adverse impacts on ecosystems, communities, and the climate. Despite these concerns and uncertainties, fossil fuel giants are proposing to increase offshore CCS at a massive rate, threatening the world's oceans and delaying real action on climate change. Offshore CCS is no solution to fossil fuel pollution.

A forthcoming report from the Center for International Environmental Law explores this growing threat.

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Key Findings:

Offshore CCS is now being proposed at a never-before-seen scale.

There are at least 38 new proposals for offshore carbon sequestration worldwide, the vast majority of which are planned for operation before 2030. Combined, these projects envisage storing more than 165 million tonnes of CO_2 in geological repositories under the seabed per year, nearly 100 times the current offshore injection rate.[1] This massive proposed scaling of offshore CCS is largely concentrated in areas that have been the sites of intense oil and gas drilling for decades, such as the U.S. Gulf of Mexico (where ExxonMobil[2] and Chevron[3] are proposing CCS hubs) and the European North Sea (where Equinor is leading the Northern Lights hub project[4]).

The few offshore CCS projects that do exist cast doubt on the technology's feasibility in general, let alone at massive scale.

Only two CCS projects in the world, both in Norway, inject CO_2 into a dedicated offshore storage site.[5] While CCS proponents often tout both of these projects as success stories, a recent report casts doubt on this characterization. The report's author found that the CO_2 injected in both of these flagship CCS projects behaved in unpredicted ways and required unplanned interventions. These findings led the author to conclude that the world may lack the commitment, technical know-how, and regulatory strength to safely manage large-scale CCS.[6]

Offshore CCS carries uncalculated risks.

Injecting CO_2 under the earth's surface has the potential to contaminate groundwater, cause earthquakes, and displace deposits of toxic brine. Though the consequences can be grave, managing these potential hazards is largely untested.[7] The dynamics of CO_2 storage under the sea are even more difficult to ascertain than those on land, requiring expensive surveys using specialized vessels.[8] Risks, like leaks, may be more likely to occur in CCS projects located offshore due to the robust transportation and technical requirements, and the difficulties in mitigating problems underwater.[9] Furthermore, the geologic formations where CO_2 is stored can contain unseen passages through which gas can escape.[10] These potential leaks pose a major threat to tackling the climate crisis. According to one estimate, if CCS is widely deployed, even a 0.1% leakage rate could cause up to 25 gigatonnes of additional CO_2 emissions in the 21st century.[11]

The interaction with legacy oil and gas wells exacerbates the risk of leaks.

Since the 19th century, oil and gas operators have punched holes in the ocean floor for extraction. Because these legacy wellbores can provide pathways through which CO_2 may escape,[12] they pose the single greatest risk of leakage or 'containment failure' at CCS projects, both onshore and offshore.[13] Despite this risk, some of the areas being targeted for offshore CCS, such as the Gulf of Mexico, are pockmarked with oil and gas wells. Regulatory agencies acknowledge that many of these existing wells may already be leaking without detection or oversight.[14]

Offshore CCS poses untested monitoring challenges.

Many of the risks of offshore CCS have yet to be fully assessed, let alone comprehensively regulated, but the long history of offshore oil and gas exploration and production demonstrates the difficulty of keeping tabs on industrial activity on the ocean. Government reports show a systematic lack of monitoring of

pipelines and wells,[15] and the offshore oil and gas industry's history of horrific disasters demonstrates the challenges of regulating ocean operations.[16] CCS also creates safety hazards for offshore platform workers,[17] and transporting and storing CO_2 poses similar oversight challenges for regulators who cannot easily spot problems without the use of helicopters, boats, or costly underwater surveillance equipment.

Existing offshore infrastructure routinely fails. Offshore CCS would rely on similar leak-prone systems.

Offshore pipeline and oil shipping leaks are already so common that one recent study of satellite images found enough oil patches on the ocean to coat all of France twice-over.[18] Decommissioned pipelines and other offshore infrastructure are often left unmonitored at the bottom of the sea, and reviews of pipeline safety data show that leaks and other problems occur more frequently in offshore operations than onshore.[19] The industry's failure to manage its existing offshore infrastructure calls into question its ability to safely manage the entirely new network of undersea pipelines required for the proposed build-out of offshore CCS.

Offshore CCS could cause irreversible harm to the ocean, which is already under stress.

Laying undersea pipelines is complex, costly, and can significantly disturb coastal and marine environments - even if there are no leaks.[20] When a leak or pipeline blowout does occur, the sudden release of significant quantities of CO_2 could be irreversible,[21] hurting sensitive marine organisms and making the surrounding seawater more acidic, compounding the ocean acidification crisis.[22]

Legal regimes provide important bulwarks against the risks of offshore CCS but need to be strengthened.

Although regulatory frameworks for offshore CCS are incomplete, any offshore activity implicates existing national and international legal regimes. In countries where major storage hubs have been proposed – such as the United States, Norway, and Australia – laws governing environmental impact assessment and management, the use of coastal zones and territorial waters, the protection of endangered species and ecosystems, emergency response plans, and other safeguards may put the brakes on the buildout of offshore CCS projects. International laws also restrict the types of activity that can be conducted on the ocean, for example, legal frameworks that govern the law of the sea; the protection of the marine environment, biodiversity, and maritime safety; and the prevention of marine pollution, climate change, and other forms of transboundary environmental harm.[23]

The applicable regulations are in flux, as some international bodies[24] and national authorities[25] evaluate the potential impacts of CCS and consider new rules. Now is a critical time to take stock of the myriad new and unknown risks from offshore CO_2 injection – *before* projects begin and while those risks can inform and strengthen relevant regulatory regimes.

The price of offshore CCS is steep, and it would come largely from the public purse.

Like onshore CCS, many emerging plans for offshore CO_2 storage depend on government subsidies.[26] Without such public funds, offshore CCS projects would not be economical. Subsidies for carbon capture and storage have ballooned in recent years, especially under new legislation in the U.S.[27] Polluters are therefore being paid with public money to bury their emissions - in a perversion of the polluter pays principle. Plowing public subsidies into offshore CCS diverts scarce funds needed for proven, available, and essential climate measures that support the transition to a fossil-free future, like investment in renewables and energy demand reduction.

CCS doesn't deliver its promised emissions reductions. It keeps fossil fuel facilities running, delaying the energy transition.

While many CCS proponents promise to drastically reduce or eliminate emissions by capturing carbon, most flagship CCS projects have been resounding failures. According to a 2022 report examining more than a dozen such facilities, the vast majority have failed to achieve their promised carbon capture rates. The report also found that nearly all carbon captured to date was injected underground to extract more oil through a process known as enhanced oil recovery (EOR).[28] That oil is then sold and combusted, directly contributing more CO_2 to the atmosphere. CCS keeps polluting facilities in operation, delaying the phase out of fossil fuels.[29] A large-scale CCS buildout would also require constructing a vast array of new infrastructure – like pipelines, transportation networks, and well pads.[30] This construction would create an enormous monitoring burden for government agencies and exacerbate environmental injustices.[31]

Key Conclusions:

- Whether on land or under the sea, CCS is not a solution to the climate crisis. CCS is a strategy for industry to stall action on climate and delay the phaseout of fossil fuels.
- Given the limited global experience with CCS, the proposed scale and complexity of new offshore CCS projects raises major feasibility questions.
- The risks of CO_2 leaks from underwater pipelines and storage sites pose environmental, health, and safety threats, and could have a significant impact on the marine environment.
- Oceans are increasingly under stress, and injecting CO_2 under the seabed will create new problems.
- In targeting oil and gas production zones, such as the Gulf of Mexico and the North Sea, for offshore CCS, proponents are promoting CO_2 injection precisely where the risk of leaks is greatest.
- The history of offshore oil and gas exploration reveals major problems with monitoring industrial activity on the ocean. There is little reason to believe oversight would improve with offshore CCS.
- A variety of existing domestic and international laws may restrict the deployment of CCS in the oceans, and require governments and companies to exercise precaution in the face of the myriad known and unknown risks it poses. Evolving regulatory regimes for CCS must strengthen protections.
- Governments must end public subsidies for CCS, especially CCS used for enhanced oil recovery. Instead, governments should direct public resources towards reducing reliance on fossil fuels, scaling up renewable energy, and increasing energy efficiency.

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