We need to apply circular economy principles to accelerate CO2 storage

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Amidst an ongoing increase in global emissions, particularly across those generated from hard-to-abate industries, Carbon Capture and Storage (CCS) is increasingly recognised as imperative to achieving net zero.

Offshore CCS projects are spreading across Europe with Norway recently offering two blocks in the North Sea for CO2 storage, and the UK announcing its CCUS Vision, meanwhile, there is a growing pipeline of North American projects centred around the Gulf of Mexico. The IEA estimates we will need to scale storage capacity from 40MT-5,000 MT a year to reach net zero and studies have identified some 13,000 gigatons of untapped CO2 storage capacity beneath the seabed.

But tapping into this will involve overcoming many hurdles, from cost-effectively and securely locating, sealing and re-abandoning legacy wells against CO2 leaks, to drilling new wells and implementing CO2 injection across storage sites of widely varying sizes and depths. Operators also face the challenge of adapting transportation pipes, pressures and flow rates to the unique properties of CO2, not forgetting the need to continuously monitor the integrity and safety of storage sites across their entire lifecycles.

The CO2 storage challenge

Potential CO2 storage sites, such as depleted hydrocarbon reservoirs and saline aquifers, are typically scattered with legacy exploration, appraisal or production wells which could pose a potential leak risk depending on the abandonment approach deployed. For example, if zonal isolation across different formations for future CO2 storage was not considered.

Plugging and re-abandoning previously abandoned legacy wells with methods such as drilling a relief well to intersect and re-abandon the legacy well may be infeasible for some shallow formations, or where the well azimuth and depth are unknown. And while excavation may also seem viable, it quickly presents serious safety and technical difficulties. It does nothing to isolate re-abandonment loading from the compromised legacy well. These approaches can incur costs of over £18-20 million and take up to 95 days per well. Both are prohibitively slow and expensive for large sites with multiple wells and will be unsustainable without more cost-effective alternatives.

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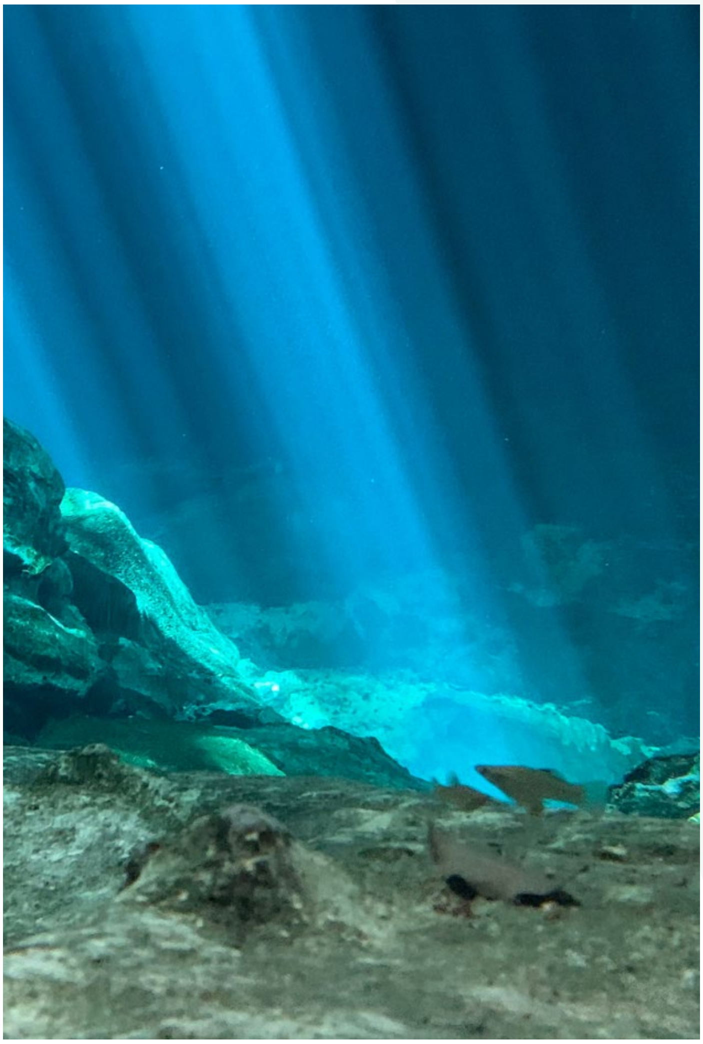

Operators also face the cost of drilling injection wells and installing CO2 injection platforms across everything from single wells in shallow waters to multiple wells in deeper waters. And once CO2 has been stored, ensuring it remains under the seabed introduces additional costs and requires the complex task of continually monitoring seismic and other events that could cause gas migration and lead to a CO2 leak.

Addressing all these risks in an economical and efficient way will require a unified, circular economy approach, adapting and sharing solutions across multiple applications from well re-abandonment and injection to CO2 monitoring.

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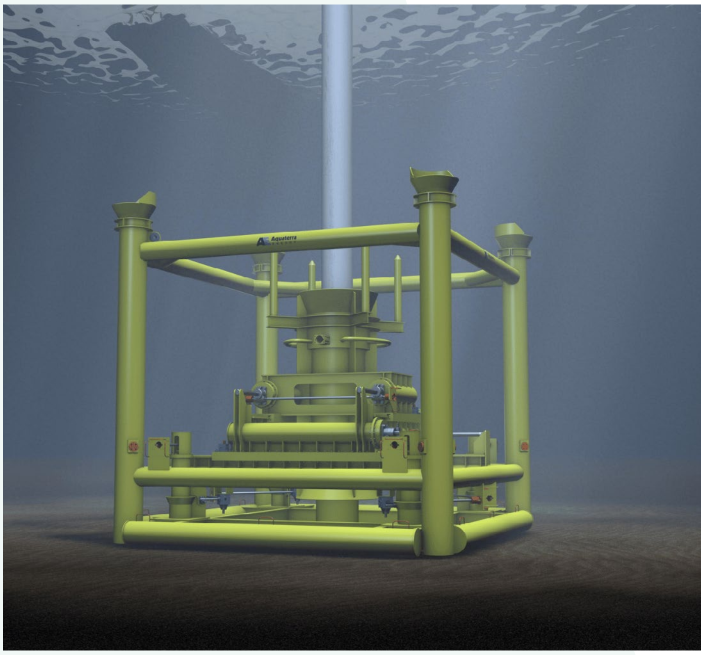
A unified, circular approach

Overcoming the many hurdles to CO2 storage entails an unprecedented effort to consolidate and combine resources across all project stages. At the storage stage, it is absolutely vital to eliminate risks and regulatory delays by quickly and efficiently safeguarding storage sites against CO2 leaks. A recent innovation enables multiple wells to be rapidly, cost-effectively and safely re-abandoned and sealed using a single re-usable and repeatable solution. The technology harnesses seabed surveying, well imaging, marking and tagging technologies to precisely locate wells beneath the seabed with centimeter level accuracy.



A specially designed steel frame can then be positioned precisely over the well to enable safe vertical re-entry while a unique movement mechanism allows the frame to be re-adjusted to account for installation tolerances. The frame is designed to provide structural support for all equipment required for intervention and keep the weight of this equipment off the well to avoid damaging any corroded well casings. It also enables rapid installation of an environmental barrier to keep out sediment and debris and a pressure-retaining barrier to secure the well for re-plugging.

The ability to rapidly and safely vertically re-enter abandoned wells without excavating or drilling new relief wells could drive 80% cost reductions and over 50% time savings on well abandonment. By redeploying the system across multiple wells, these savings can be replicated without additional investment. The same system could be re-used to repurpose abandoned wells by installing fibre optics and geophones to transform them into monitoring wells to monitor CO2 plume migration within the formation or detect potential leaks before they breach the seabed.

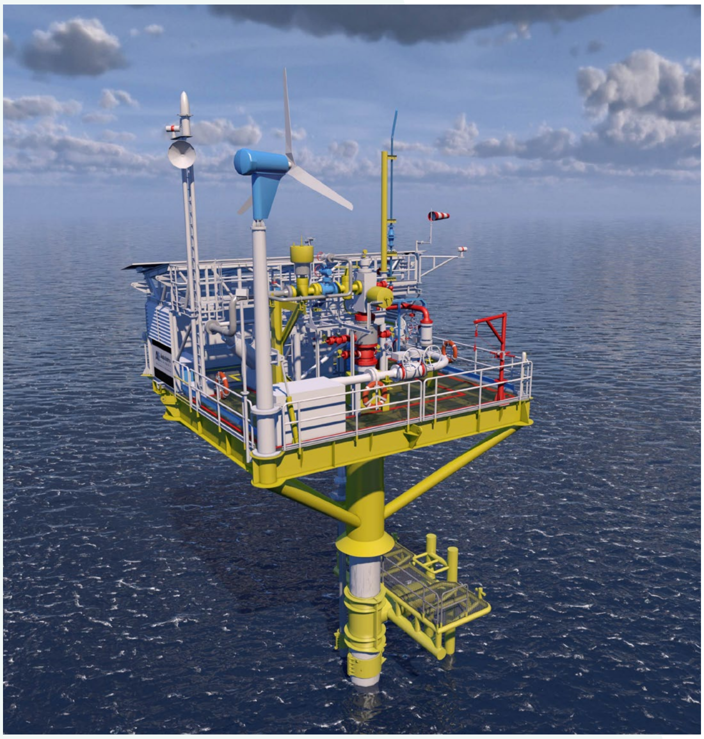
CCS platforms

Where a new CO2 injection platform is required, applying the modular lightweight principles pioneered in oil and gas, such as Aquaterra Energy's Sea Swift provides significant benefits. The Sea Swift platform can be constructed in a range of configurations, from monopiles or conductor supported platforms for up to nine shallow-water wells to jacketed structures injecting up to 15 wells in deeper waters.

Ultimately, a CCS injection platform works a lot like a production platform, just rather than up and out its in and down so we have the basic principles of platform engineering well worked out.

Just as in offshore production, these lightweight, streamlined designs can be built and transported with existing local infrastructure and even installed with the same jack-up rig used to drill injection wells, significantly reducing costs.

Operational costs are also low as the platforms can be designed to be unmanned and self-powered from renewable sources such as wind and solar. If you're going to the effort and cost of capturing and storing CO2 under the seabed permanently, the significant savings generated from a minimum facilities platform ensures that new emissions are kept to an absolute minimum.



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In another scenario, where a developer is in the enviable position of having an existing platform located on a reservoir suitable for CCS, a degree of brownfield engineering may be required to ensure that the platform can be used. This can range from simple changes to the topside equipment configuration to more detailed life extension studies. Aquaterra Energy is currently applying this life extension approach to the Nini platform, which is part of the broader Project Greensand led by INEOS. Project Greensand is a CCS initiative in the Danish North Sea, with a goal to store up to 1.5 million tonnes of CO2 annually by 2025 and potentially scale up to 8 million tonnes per year by 2030. We are working with INEOS to repurpose the platform for CO2 injection until 2045 confirming the viability of the structure and guiding the implementation of any necessary modifications to support CO2 injection and long-term storage.

Additionally, cutting edge CO2 monitoring technologies can be used in tandem with new and repurposed platforms to monitor and safeguard storage sites against seismic effects or leaks. Monitoring, measurement and verification systems composed of fibre-optics, advanced monitoring systems and other sensors, alongside autonomous power sources can be deployed at CCS sites to provide early warning of hazards during injection. These sensors can be deployed to monitor wells post injection, enabling remote long-term oversight of potential leaks or tremors across the lifecycle of storage sites, offering end to end assurances against leaks.

Unlocking the potential of CO_2 storage

Achieving net zero emissions is a critical global goal, with CCS playing a vital role. Offshore hydrocarbon fields, formerly sources of fossil fuels, now offer significant potential for CO_2 storage. However, nobody said tapping into this would be easy, and the industry faces challenges such as safety concerns, regulatory issues, and high costs.

Innovative solutions are essential to overcome these obstacles. Advanced techniques for sealing legacy wells, installing efficient CO_2 injection platforms, and deploying state-of-the-art monitoring systems can make large-scale CCS viable. These innovations combined can reduce costs, enhance safety and speed up project timelines associated with the rollout of CCS at scale.

To find out how our team can support your offshore CCS project, please get in touch.

For more information on our CCS well re-entry services visit us here.

To learn more about our Sea Swift platforms for CCS projects visit us here.

About Aquaterra Energy

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