

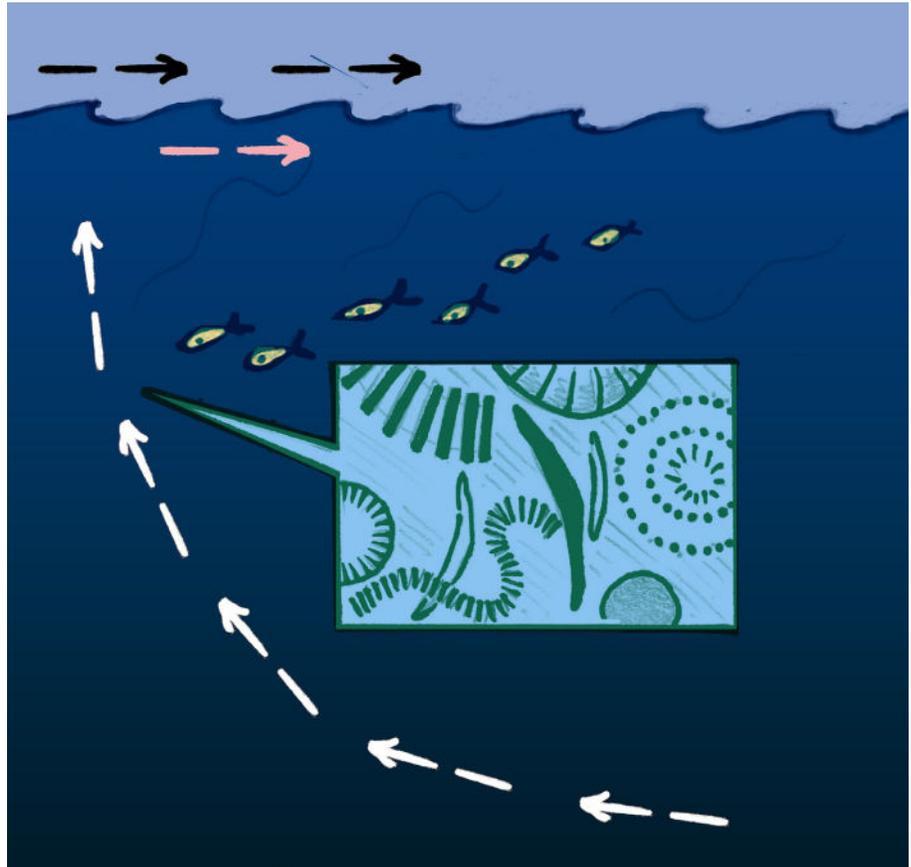
# Artificial Upwelling

**POINT OF INTERVENTION**



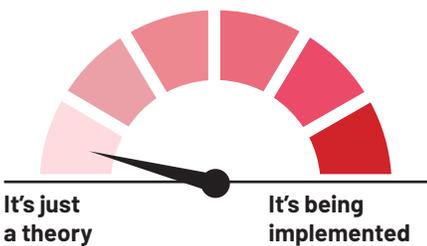
**OVERVIEW**

Artificial upwelling aims to artificially pump up cooler, nutrient-rich waters from deep in the oceans to the surface to stimulate phytoplankton activity and draw down CO2. Proponents also claim that artificial upwelling could potentially alleviate pressure on fish stocks. Artificial upwelling suffers from many of the same problems as Ocean Fertilization,<sup>1</sup> including unknown, unpredictable, and potentially highly damaging impacts on marine ecosystems, with little evidence to suggest that carbon is actually sequestered. It is based on a false equivalence between the complexities of natural



Natural upwelling occurs when wind pushes warmer water, causing nutrient-rich cold water to rise up from the depths, which stimulates plankton growth. Artificial upwelling would use a system of giant pipes – potentially millions of them – to accelerate the process.

**REALITY CHECK**



upwelling events and artificial ones, and ironically, this method may also “upwell” already sequestered CO2 in the form of dead or living sea creatures.<sup>2</sup>

Techniques for artificial upwelling involve giant sea pumps powered by offshore wind farms, wave power, or plastic floating tubes that reach

hundreds of meters deep. Initial experiments with the wave-powered pumps have been performed off the coast of Hawai'i by researchers at Oregon State University and University of Hawai'i (as part of the Center for Microbial Oceanography), and in China through Zhejiang University.



Whales and other marine life already do a very good job of mixing surface waters (Christopher Michel/Flickr)

### ACTORS INVOLVED

James Lovelock (of “Gaia theory”) has advocated vertical pipes ten metres wide and hundreds of metres long as a means of achieving artificial upwelling<sup>3</sup> (one modeling

exercise suggested that 7 million pipes would be needed<sup>4</sup>). This would create algal blooms in surface waters and produce nuclei that form sunlight-reflecting clouds. He acknowledged that such an approach

may fail on engineering or economic grounds, and that the impact on ocean acidification would need to be considered.<sup>5</sup>

In 2017, China announced to the London Convention that it had conducted artificial upwelling experiments.<sup>6</sup> One sea trial has been conducted in the East China Sea and two in Qiandao Lake, through Zhejiang University.<sup>7</sup> In 2010, the researchers developed a pumping system and tested it using wave energy, allowing it to operate on its own for long periods.<sup>8</sup> The experiments were conducted between 2011-14 and pumped water from 30 metres below the

### PROTECT MARINE LIFE, DON'T FILL THE SEA WITH PLASTIC PIPES!

Whales feed at depth, returning to surface waters and fertilizing it with “fecal plumes” that are rich in iron and nitrogen. By plunging up and down through the water column they also force plankton back up into surface waters, giving the plankton more time to reproduce before it sinks again. The vertical mixing of water caused by movements of animals up and down through the column of the oceans is immense, even with whale populations as low as they currently are. Animals cause roughly as much mixing as all the world's winds and waves and tides. More whales therefore means more CO<sub>2</sub> sequestration.<sup>12</sup>

// **The scientists concluded that its benefit would be limited, with little evidence to suggest that it would sequester significant amounts of carbon.**

surface. Researchers reported that the “challenges in designing and fabricating a technologically robust artificial upwelling device for structural longevity were basically overcome.” The results of the experiments are yet to be submitted to scientific journals and, for large-scale deployment, the “uncertainties related to the potential effects on ecosystems remain unresolved.”<sup>9</sup>

#### IMPACTS

An international team of scientists in Kiel, Germany, modeled the effects of artificial upwelling on a global scale, and determined that the method wasn’t feasible. They concluded that its benefit would be limited, with little evidence to suggest that it would sequester significant amounts of carbon, and the side effects could be severe. For example, the low temperature of water pumped to the surface was predicted to cool the atmosphere and subsequently to slow decomposition of organic material in soils on land, an effect that could be felt far away from areas where pumps or pipes are used. It was also predicted that whenever the pumps stop, atmospheric

CO<sub>2</sub> concentrations and surface temperatures would increase rapidly to even higher than before the pumps were used. This would happen because upwelling cools surface temperatures, leading to

// **One modeling exercise suggested that 7 million plastic pipes (10 meters in diameter) would be needed.**

more heat being absorbed by the oceans while artificial upwelling is taking place. This heat would then be quickly re-released into the atmosphere once the pumps were switched off.<sup>10</sup> In practice, this means that once the pumps were switched on, they could never be turned off.

One experiment in a Norwegian fjord looked at upwelling as a means of stimulating algae growth for commercial mussel farming. It found

that after the experiment ended there was a distinct increase in the relative biomass of potentially toxic algae.<sup>11</sup>

#### REALITY CHECK

Numerous outdoor experiments in the deep ocean, lakes and fjords have taken place, on varying scales, and linked as often to increasing the productivity of fish and sea food farming as CO<sub>2</sub> sequestration. There are no current plans for larger or more extensive field experiments or deployment.

#### FURTHER READING

ETC Group and Heinrich Böll Foundation, “Geoengineering Map.” [map.geoengineeringmonitor.org](http://map.geoengineeringmonitor.org)

The Big Bad Fix: The Case Against Climate Geoengineering, <http://etcgroup.org/content/big-bad-fix>

Whales in surface waters: <https://sustainablehuman.tv/remix/how-whales-change-climate>

**SOURCES**

1. See Geoengineering Monitor, "Ocean Fertilization," Technology [Fact Sheet](#), March 2018.
2. Andreas Oschlies et. al., "Climate engineering by artificial ocean upwelling: Channeling the sorcerer's apprentice," *Geophysical Research. Letters*, Vol. 37, No. 4., 2010, <http://onlinelibrary.wiley.com/doi/10.1029/2009GL041961/full/>
3. James E. Lovelock and Chris G. Rapley, "Ocean pipes could help the Earth to cure itself," *Nature*, Vol. 449, No. 403, 27 September 2007, <https://www.nature.com/articles/449403a>
4. Andreas Oschlies et. al., "Climate engineering by artificial ocean upwelling: Channeling the sorcerer's apprentice."
5. James E. Lovelock and Chris G. Rapley, "Ocean pipes could help the Earth to cure itself."
6. IMO, Scientific Group of the London Convention, 40th meeting, Scientific Group of the London Protocol, 11th meeting, March 2017, LC/SG 40/INF.25.
7. Pan YiWen et. al., "Research Progress in artificial upwelling and its potential environmental effects," *Science China, Earth Sciences*, Vol. 59, 2016.
8. Ibid.
9. Ibid.
10. IFM-GEOMAR, "CO2 Reduction by artificial ocean upwelling?" Press release, 15 February 2010, [https://www.geomar.de/uploads/media/pm-2010\\_10\\_zauberlehrling\\_e.pdf](https://www.geomar.de/uploads/media/pm-2010_10_zauberlehrling_e.pdf)
11. Aleksander Handå et. al., "Artificial upwelling to stimulate growth of non-toxic algae in a habitat for mussel farming" *Aquatic Research*, Vol. 45, Issue 11, 2013.
12. Sustainable Human, <https://sustainablehuman.tv/remix/how-whales-change-climate>