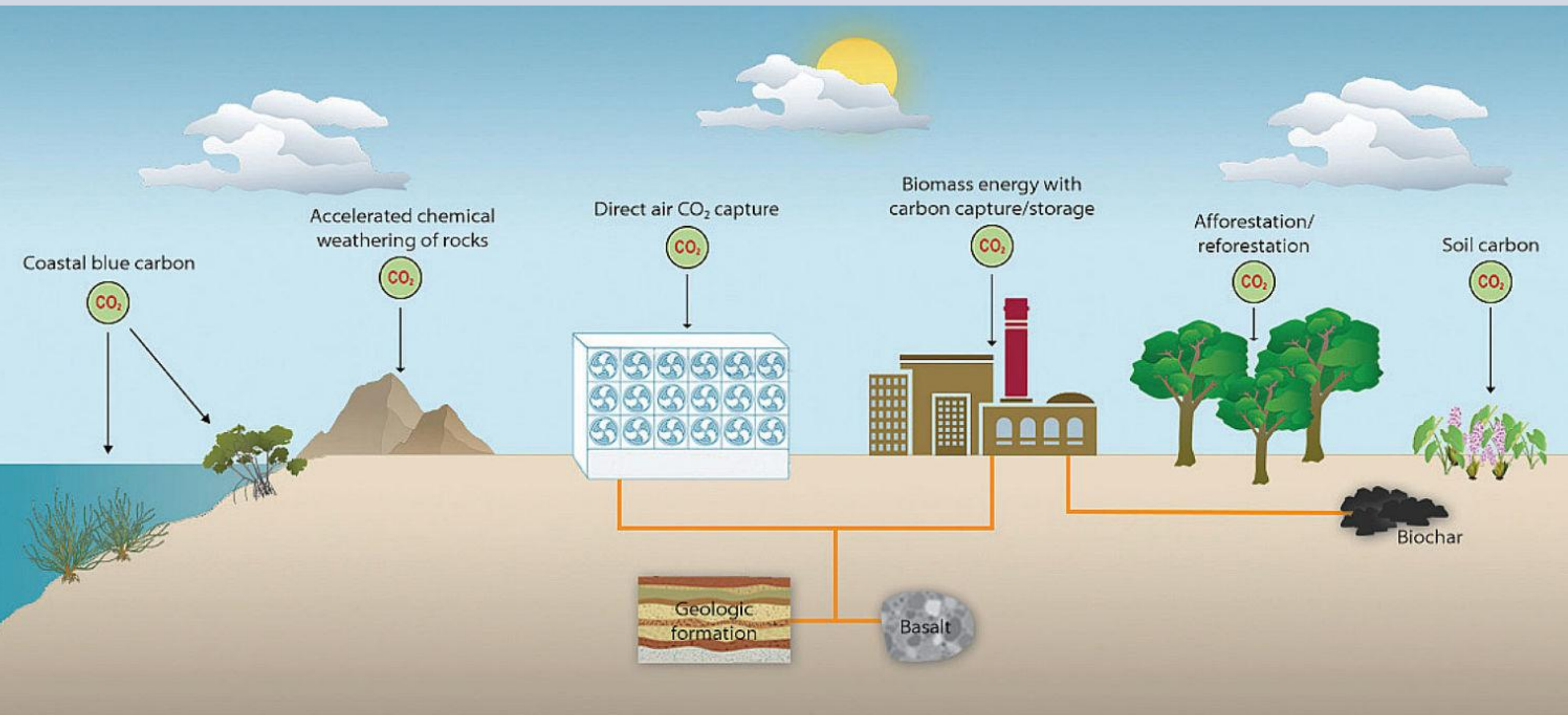


Carbon Sequestration 101

- Moving away from fossil fuels may not be enough to reach climate goals; while the primary focus is “keep it in the ground”, may be able to clean up carbon that’s already in the atmosphere
- [Project Drawdown](#) refers to these as “sinks”, others say “negative emissions”:
 - ❖ Land Sinks - How can we help sequester more carbon in biomass and soil?
 - ❖ Ocean Sinks - What practices can be used to sequester carbon in coastal, marine, and open ocean environments?
 - ❖ Engineered Sinks - Beyond natural processes, how can we remove carbon from the atmosphere?
- Thousands of scientists and engineers working on ways to remove carbon
- Some are very low tech, others much more exotic; here are just a few.



Deforestation and Afforestation

- **Deforestation** - removal of forest and land converted to a non-forest use.
- **Afforestation** - establishing a forest especially on land not previously forested.

[Pope Francis](#) urges action to save burning Amazon rainforest, urges serious measures to save the lungs of the world. Multiple on-going projects.

[Great Green Wall of Africa](#) - an African-led movement to grow an 8,000 km natural wonder of the world across the entire width of Africa. A decade in and roughly 15% underway, the initiative is already bringing life back to Africa's degraded landscapes at an unprecedented scale, providing food security, jobs and a reason to stay for the millions who live along its path.

[FACS](#) urges Fairfax County to support the Tree Action Plan's goal of preserving our current 57% tree canopy and increasing tree canopy in urban corridors, large redevelopment areas, and poorer neighborhoods with less tree cover



Carbon Farming

- **Carbon Farming** - uses agricultural land and plants to trap CO₂, then strategically uses practices such as reducing tilling, planting longer-rooted crops and incorporating organic materials into the soil to encourage the trapped carbon to move into—and stay in—the soil.

[California Association of Resource Conservation Districts](#) developed 30 Carbon Farm Plans, working with farmers and ranchers across the state covering over 34,000 acres

[Toluma Farms](#) , a 160-acre dairy in Marin County, received a grant to add in-field compost and plant 500 trees to create windbreaks. The property is in the Marin Agricultural Land Trust and protected in perpetuity as farmland.

[Compost Application Projects](#) demonstrate that a one-time application of ¼ inch of compost to grazed lands can increase soil carbon sequestration. This strategy can also help reduce emissions from landfills (anaerobic - methane) by putting food waste and green waste to better use (aerobic – CO₂ but no methane).



Coastal Blue Carbon

- **Grasslands, coastal vegetation, peatlands**—also take up and store CO₂, and efforts to enhance their ability to do so could contribute to the carbon storage cause around the world.

[Blue Carbon Project in Indonesia](#) - established marine and coastal conservation work in the mangrove-rich areas of Kaimana, Papua and compliment on-going efforts to integrate blue carbon into policy and management decisions, as well as recent work to develop a sustainable livelihoods program, based on mangrove-crab fisheries.

[Green-Grey Infrastructure in the Phillipines](#) is an approach that protects and restores natural ecosystems – such as mangroves, coral reefs and seagrass – that provide protection to the communities near them. Grey is engineering structures, green is conservation and restoration of mangroves, seagrass and coastal wetlands.



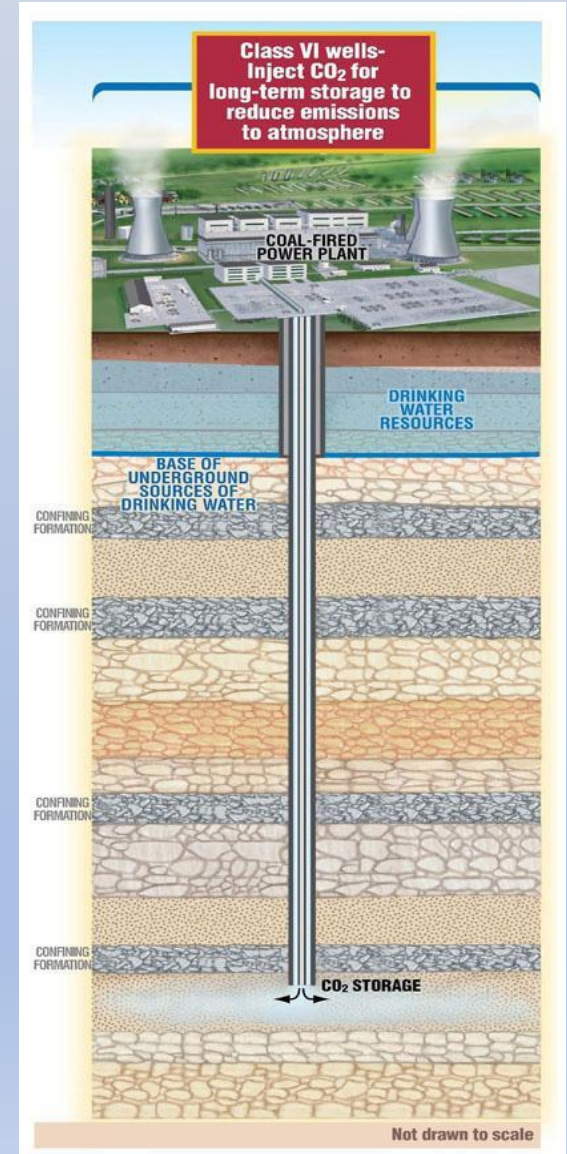
Bioenergy with Carbon Capture and Storage

- **BECCS** - utilization of biomass as an energy source and the capture and permanent storage of CO₂ produced during the conversion of biomass to energy.

[Archer Daniels Midland](#) produces ethanol from corn at its Decatur plant, producing CO₂ as part of the fermentation process. The CO₂ is captured and stored in the layer of sandstone that lies deep beneath the Illinois corn belt.

Four BECCS facilities are operating today at small-scale ethanol production plants, using most of the CO₂ for enhanced oil recovery (EOR).

[USEPA](#) has developed requirements for Class VI wells which are used to inject carbon dioxide (CO₂) into deep rock formations.



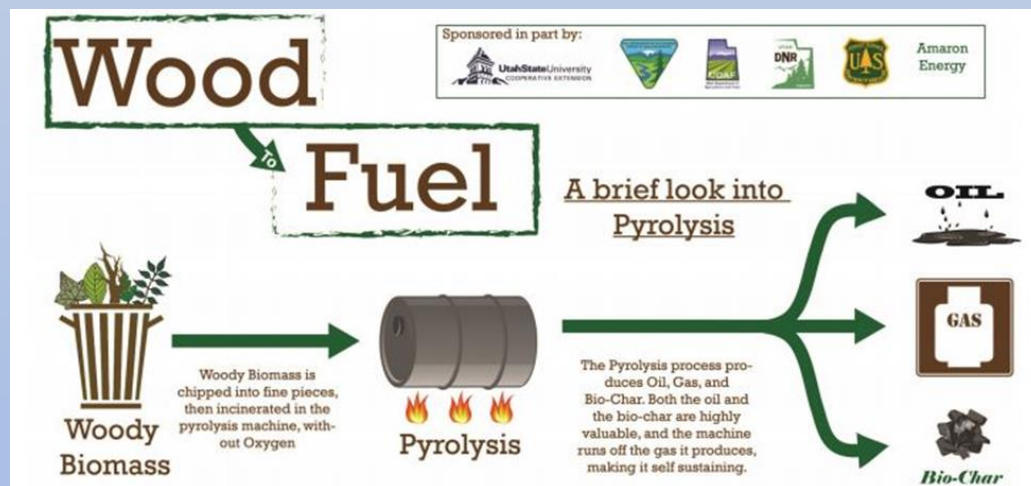
Biochar

- When biomass (wood, plant material) is heated with little or no oxygen, a carbon-rich, slow-to-decompose substance known as [biochar](#), is produced. It can then be buried to sequester carbon or applied to soil as a means to increase soil fertility and agricultural yields.

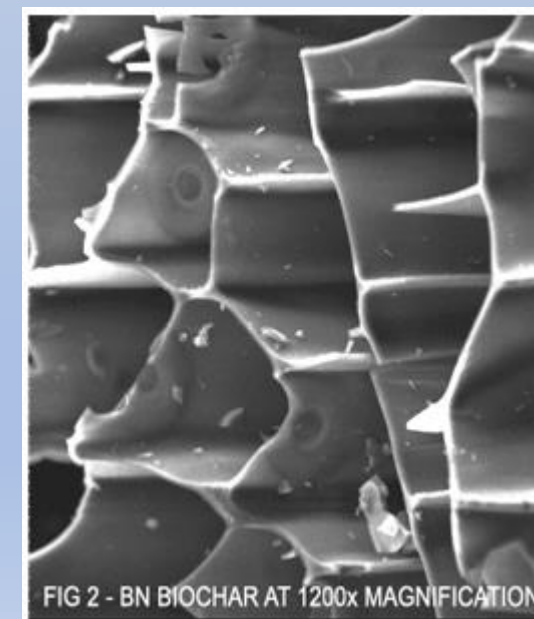


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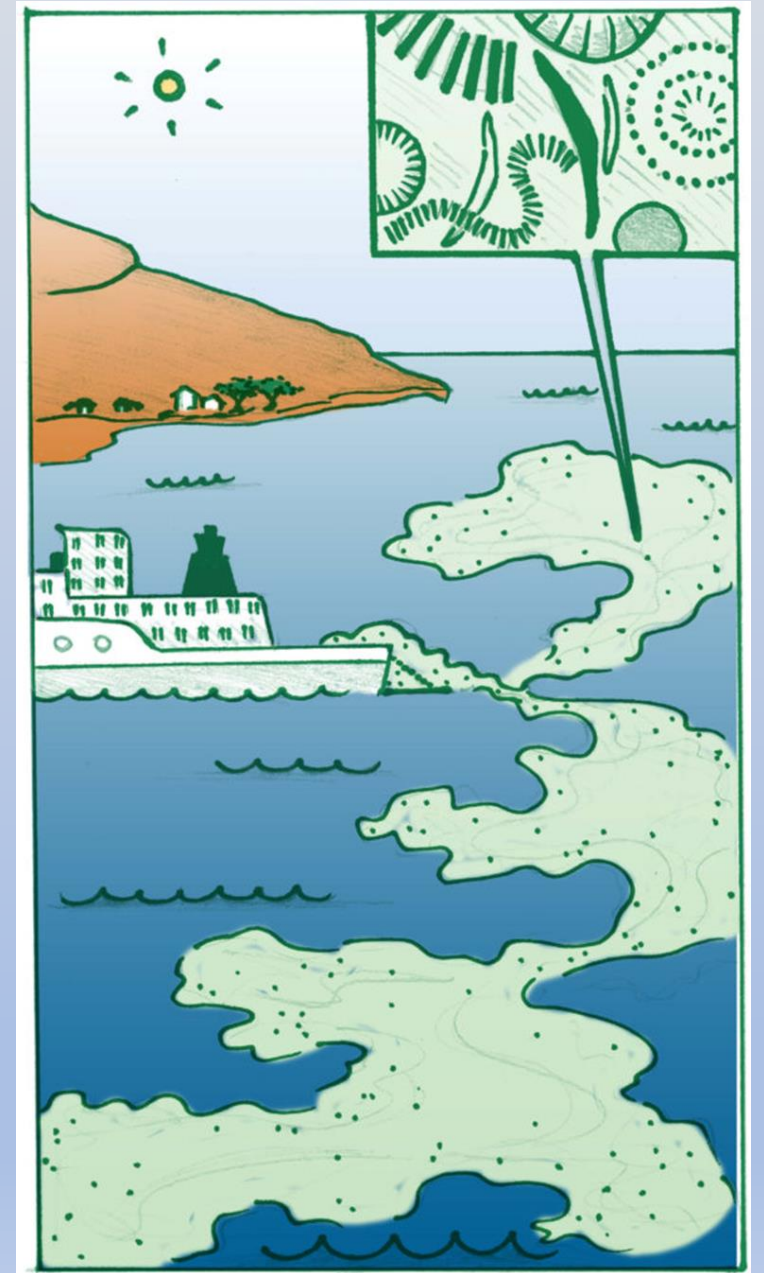
- [BioChar Now](#) has developed the technology for producing biochar as a means to improve today's soil quality and store carbon. They sell their product to farmers, golf courses and for deep storage.



[Source](#)

Fertilizing the Ocean

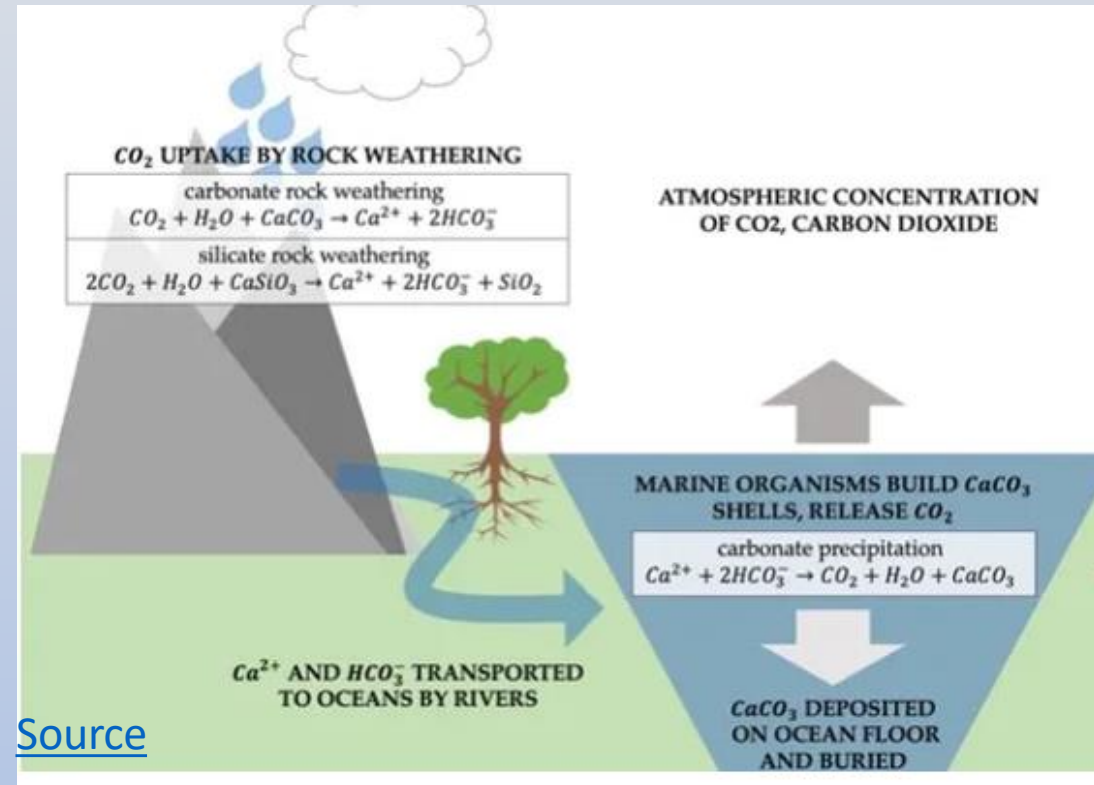
- Ocean fertilization (OF) refers to dumping iron filings or other “nutrients” (e.g., urea) into seawater to stimulate phytoplankton growth in areas that have low photosynthetic production. The idea is that the new phytoplankton will absorb atmospheric CO₂ and, when the phytoplankton die, the carbon will be sequestered as they sink to the ocean floor.
 - [Numerous outdoor OF experiments](#) have taken place, aided by the fact that such experiments are logistically simple to execute. The small scale experiments are determining if and what negative consequences there might be on aquatic systems. Seems to have a large public outcry about doing experiments locally. NIMBY



[Source](#)

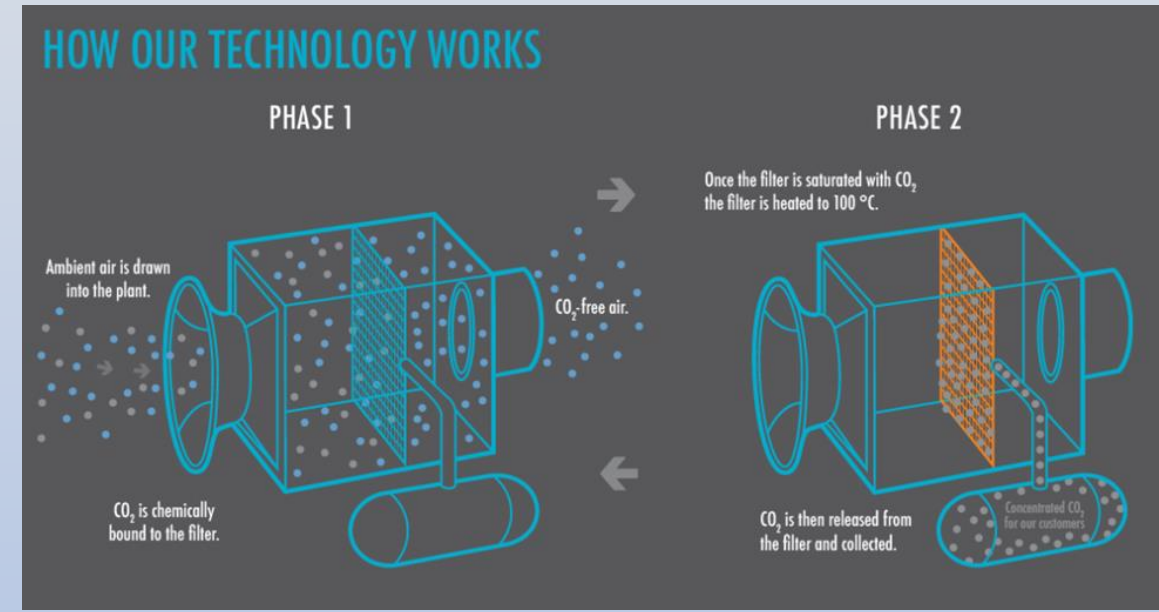
Rock Solutions

- Crushing rocks and exposing them to CO₂ and spreading them over large areas of land or ocean is a way to speed up the natural process of removing CO₂ from the atmosphere through reactions between rainwater and rocks. Increasing the surface area of rock creates more area to react with CO₂ in the air and the reactions is speeded up.
 - The [University of Cambridge](#) is investigating the process of dissolving water with silicate minerals from mine waste to take advantage of all the energy that has already been spent on extracting and crushing this waste. The crushed rock means there are more exposed surfaces, which can react with CO₂.



Direct Air Capture and Storage

- Artificial Trees use chemicals or solids to capture the gas from the air and store it for underground or in long-lasting materials. Because it requires plucking CO₂ molecules from everything else in the air, it takes a lot of energy. 400 ppm = 1 particle in 2500
- [Climeworks](#), a Swiss company, hopes to lower costs to \$100/tCO₂ by 2025 or 2030. It aims to be capturing 1% of global CO₂ emissions each year by 2025. They have lowered costs by selling the CO₂ to a nearby fruit and vegetable grower for use in its greenhouse.



[Climeworks](#)



[Source](#)

Where Do We Go From Here?

- Lots of potential, lots of work to be done
- Feasibility, cost/benefits, unintended consequences
- Scaling up from demonstration to common practice
- Policy, funding
- Negative emissions can't make us complacent to having business as usual – they are needed to meet the gap while and after we reach net zero.

References

Our presentation is based on this article from Eco Watch

<https://www.ecowatch.com/carbon-sequestration-2461971411.html>