

# Carbon Reduction Strategies

## Energy from Sustainable Resources

Increasing amounts of carbon (as CO<sub>2</sub>) in the atmosphere is rapidly changing Earth's climate. One method of reducing carbon emissions is to harness energy from naturally occurring, sustainable resources. In recent history, we've been developing methods to capture energy from such sources because they do not have a limited supply and they can be replenished in a short period of time.



**SOLAR ENERGY:** Solar energy is energy from the sun. When the sun's energy reaches the earth in the form of sunlight, it can be converted into electricity.



**WIND ENERGY:** Wind energy is energy from moving air. Air has mass. When it moves, it has kinetic energy. Kinetic energy is the energy of motion.



**TIDAL ENERGY:** Tidal energy is energy derived from the movement of the ocean tides. Since water has mass, when it moves, it has kinetic energy which can be harnessed.



**HYDROELECTRIC ENERGY:** Hydroelectric energy is energy derived from the movement of water. Water flows and falls downward due to gravity. As it moves, it has kinetic energy which can be harnessed.



**GEOHERMAL ENERGY:** Geothermal energy is heat extracted from the Earth's interior. The Earth has an internal heat that is due mostly to the radioactive decay of minerals inside the Earth's core and mantle.



**BIOFUELS:** Biofuels are made from plants. Biofuels are being produced from used cooking oils, or derived from plants as ethanol, a type of alcohol.

## Use Less Energy and Use It Wisely

Our society needs energy for travel, communication and for living at home. Since we cannot live without it, we need to find ways to conserve our energy use. Also, when it's used, people should be smart about how they use it.

### Home Life



Energy efficient appliances can conserve water and energy! Choosing such appliances is a wise decision – why doesn't everyone do it?

### Travel Around Town



Walking or riding a bicycle is good for the environment and good for personal health. How could communities encourage more people to choose these wise ways of getting around?

### Long Distance Travel



Airplanes release a lot of carbon into the air. Trains and buses are a wiser way to travel.

### DID YOU KNOW?

People are not the only long distance travelers. Food travels too! It's a wise choice to seek out and support local farmers markets – because local food has traveled less to get to you.

## Overview of Carbon Capture and Storage

The burning of fossil fuels adds a lot of excess carbon dioxide to our atmosphere. To reduce their carbon emissions, power plants can capture and store carbon dioxide.



The power plant captures the carbon dioxide before it leaves the plant, then transports it to a site where they can inject it back into the ground.



## Capture the Carbon!

Finding ways to capture the carbon before it leaves the power plants will reduce the overall amount of carbon in the air.



Let's sweeten the deal! Taking toxic materials out of factory exhaust gas is often called sweetening the gas. Gas sweetening can reduce carbon dioxide emissions by up to 90%!

Carbon dioxide can be removed from exhaust gas in many ways. Here are a few examples:



**Get it wet.** When the toxic gas is sent through a water-based solution with certain chemicals, the  $\text{CO}_2$  will hold on to those chemicals rather than go out through the smokestack.



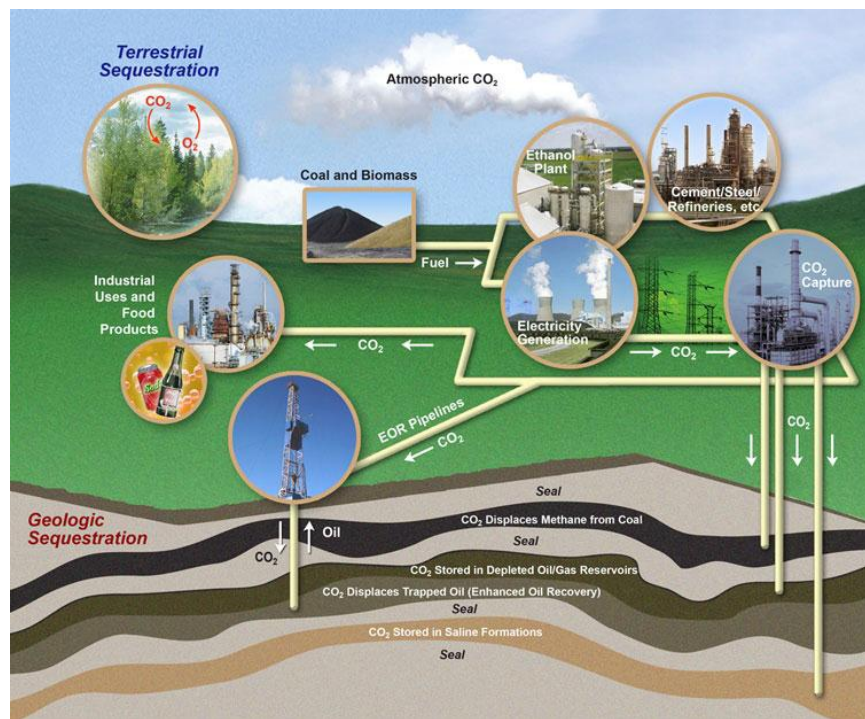
**Burn the fuel in oxygen.** If fossil fuel is burned in oxygen instead of air, the result is carbon dioxide ( $\text{CO}_2$ ) and water vapor.  $\text{CO}_2$  in this form can easily be stored rather than sent through the smokestack.



**Turn it into limestone.** When carbon dioxide ( $\text{CO}_2$ ) reacts with calcium oxide ( $\text{CaO}$ ) it creates calcium carbonate ( $\text{CaCO}_3$ ) also known as limestone.

## Get It Underground!

Once the power plants capture the carbon dioxide, they need to do something with it. So, they force it underground. Since power plants are already located near carbon-based geologic formations, this is a sensible solution to keep carbon from getting into the atmosphere. The extra CO<sub>2</sub> even enhances oil recovery!



Follow the CO<sub>2</sub>! Notice the carbon dioxide leaving the power plants and factories to be captured and sent underground. Scientists estimate that carbon dioxide which is sent underground could stay there for millions of years!

Carbon dioxide is injected into different underground formations:



**Oil and gas reservoirs.** Even oil and gas reservoirs that are in use can get a boost from extra carbon dioxide. Pushing CO<sub>2</sub> into the reservoirs means the wells can pull more oil and gas to the surface.



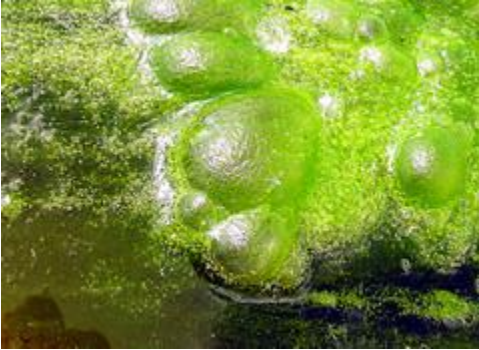
**Coal seams.** A large number of coal seams are already un-mineable. Injecting the coal seam with carbon dioxide actually pushes out methane gas which we can use for energy if we can capture it.



**Saline formations.** Scientists estimate that salt deposits offer the best option for storing a large amount of carbon for the longest amount of time.

## All-Purpose Algae

Algae need carbon dioxide to live and we need to *get rid of* carbon dioxide to live. It's a win-win partnership.



Carbon dioxide is food for algae. Growing algae removes carbon dioxide from the atmosphere.



Algae can even grow in some pretty strange places. It can actually grow on smoke stacks! Before the smoke is emitted from the smoke stack, the algae soaks up some of the carbon dioxide like a sponge would soak up water.



### **And what's really cool...**

The carbon-eating algae can be harvested and used as fuel, biofuel that is.