The Meaning of Carbon Neutral

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You may have heard “Carbon Neutral” used as a buzzword for the green movement. It’s the kind of phrase that gets hash-tagged on twitter. Politicians proclaim “Carbon Neutral” as a lofty goal. A warm soft voice praises “carbon neutral” as the camera pans over green forest scenes in advertisements for corn ethanol fuel. But what does it really mean? “Neutral” as a word doesn’t mean good or bad. Does being carbon neutral actually do anything, or does it just float in an environmentalism limbo?

Carbon neutral means we’re not removing CO_2 (Carbon Dioxide) emissions to the atmosphere, but we’re not adding them either. To understand how carbon neutrality works, we have to examine the carbon cycle.

The carbon cycle is movement of carbon in all of its different forms through our planet. In humanity’s time on this planet, we haven’t added or subtracted any carbon from earth, except for what little we’ve dumped in space. However, we do influence the rates at which we transform and move carbon. There are many interfaces in carbon movement, but we’re going focus on the most relevant ones to our fuel needs.

You are made of carbon. It’s part of the protein that makes your muscle, and part of the lipids and fats that may make your belly. Since we are living organisms, it’s in all the organic molecules that keep us going. Carbon gets around. It’s in carbon dioxide, a gas in our atmosphere that traps heat and makes the green-house effect. It’s even in dark syrupy fossil fuels.

When you drive your car, you’re not burning dinosaur bones. The organisms that make our gas and coal actually predate dinosaurs by about 68 million years. Forests, swamps, giant insects, and giant amphibians dominated the earth between 300 and 400 million years ago. Ancient ancestors to today’s sand dollars, sea lilies, corals, a whole host of other marine invertebrates, and tiny single-celled planktons populated the oceans.

Like you, these ancient organisms were living things made of carbon. When they died, that carbon did not cease to exist. After layers of mud and silt buried them deep within the earth, the carbon that made their bodies became the carbon in fossil fuels like petroleum, methane, and coal.

When we burn these fossil fuels, we pump smoggy plumes of carbon dioxide into the atmosphere. The carbon in the carbon dioxide we release from burning fuel once made the fats, carbohydrates, and proteins of ancient organisms.

What’s the problem with this? If the carbon cycle is a loop, shouldn’t the carbon naturally return to the earth as plants wolf down the excess carbon dioxide to make more biomass?

There are natural processes that push geological carbon within the earth into the atmosphere, namely volcanic eruptions. The earth’s plants can handle the occasional volcano or methane seep, but we have a spending problem as a species. We’re pumping up ancient carbon faster than plants can suck it back down. It took hundreds of millions of years to sequester the carbon of fossil fuels, but we’ve introduced enough new carbon dioxide to change the climate in a few centuries. That’s hundreds of years versus *hundreds of millions* of years! The problem is compounded as we deforest the earth.

We can think of carbon sequestration in the earth as a carbon savings account. Every time we burn fossil fuels we're dipping into our savings account. We add a dollar to the account every pay check through natural processes like decomposition ect, but then we spend $1,000,000 from the same account until the next pay check. It's simply not sustainable.

Biofuel is considered carbon neutral because biofuel does not draw from the sequestered carbon savings account. Biofuel's carbon comes from carbon that's already in play, like a flexible spending account. You may have heard about ethanol biofuel from corn. Let's examine this example.

The biomass from corn comes from consuming and transforming the carbon dioxide in the atmosphere into leaves, roots, corn cobs, and etcetera. We turn this biomass into fuel, which we then burn and turn back into carbon dioxide. We did emit carbon dioxide to the atmosphere, but instead of dredging up ancient sequestered carbon from 300 million years ago, we used carbon dioxide that was already hanging around in the atmosphere. We did not add to the problem. The transaction was neutral.

Our project proposes a carbon neutral solution because like corn, it uses carbon already in our atmosphere. Our archaea will hopefully transform the carbon in plant waste, or even farmed plants like switch grass, into butanol which we can then use as fuel. The carbon that went into that plant waste came from the atmosphere. It will go back into the atmosphere in an equal amount. Nothing is lost or gained.

Switching to carbon neutral biofuels will not reverse what we've already done, but it will put the brakes on a growing problem. Carbon neutral fuels give us time to figure out other solutions. They also provide an alternative to gasoline if we run out of fossil fuels before we switch to other energy sources for environmental reasons. Your donations don't just back an experiment, they support prudent thinking for the future. We have alternatives for the future, we just have to think about them in the present.

Simplified Carbon Cycle with Fossil Fuel:

Above is a simplified diagram of the carbon cycle. Carbon can leave the atmosphere through several processes. Photosynthesizing organisms, like plants and phytoplankton, convert atmospheric carbon dioxide into organic carbon. There is also a back and forth exchange of carbon dioxide between the ocean and the atmosphere. Some of the organic carbon can enter long term sequestration by being buried deep within the earth or sinking into the deep ocean. Much more carbon is added to the atmosphere than is removed when we burn fossil fuels. Geologic events like volcanic eruptions and seeps and also add to atmospheric carbon.

Simplified Carbon Cycle with Biofuel:

The purple arrows represent a smaller loop of carbon exchange that is possible with biofuels. Presumably, an equal amount of carbon would be drawn back down into plants as we actively cultivated enough plant matter to supply our energy needs. Instead of drawing up new carbon from fossil fuels, there is an equal exchange between carbon released into the atmosphere, and carbon turned into biomass.