

## **Sophie Sez #1: “You Loaded 16 Tons. What did you get?”**

**Summary.** The average American injects 16 tons of fossil fuel CO<sub>2</sub> into the air every year. This creates a large debt for young people, which they must pay off by extracting CO<sub>2</sub> from the air. There are beneficial quasi-natural ways of drawing down CO<sub>2</sub>, but their potential is limited.

**Key words:** Climate Change, Fossil Fuels, Carbon Dioxide, Biochar, Soil Carbon, Reforestation

### **Transcript**

**Hi, I’m Sophie Kivlehan.** I want to tell you about your 16 tons. In 2015 the United States burned fossil fuels – that’s coal, oil and gas -- containing 1391 MtC (million tons of carbon).

Burning oxidizes the carbon; the chemical reaction of carbon & oxygen produces CO<sub>2</sub> + energy.

That’s why we burn the fossil fuel: we want the energy that is given off when carbon and oxygen chemically combine. The atomic mass of carbon is C = 12 and oxygen is O = 16, so the mass of CO<sub>2</sub> (12 + 16 + 16) injected into the atmosphere is larger than the mass of carbon by the factor 12 plus 16 plus 16 divided by 12, which is about three point six seven.

So the mass of CO<sub>2</sub> injected into the air by the United States is 1391 million tons of carbon times three point six seven, which is five thousand one hundred million tons of CO<sub>2</sub>

The population of the U.S. is about 320 million people, so that’s 16 tons/person.

**Jim:** Sixteen tons per person! That’s exactly what Tennessee Ernie Ford was talking about!

**Jim:** And the fossil fuel CO<sub>2</sub> stays in the climate system for thousands of years!

Which creates the debt Tennessee Ernie is talking about. Because we now know, the scientific community now realizes, that the amount of CO<sub>2</sub> in the air is already causing climate change and there is more climate change in the pipeline without increasing CO<sub>2</sub> further.

So if we burn still more fossil fuels, we must suck most of the additional CO<sub>2</sub> back out of the air, or young people will suffer major consequences, including eventual loss of most coastal cities.

**Sophie:** It is possible to extract CO<sub>2</sub> from the air, by reforestation & by storing carbon in the soil. Two years ago my grandfather purchased one ton of biochar material. Biochar is charcoal made by pyrolysis of plants or organic waste. Plants suck CO<sub>2</sub> from the air, and when they are heated to high temperature in oxygen-free air it produces charcoal.

**Jim:** This charcoal can be worked into the soil, where the carbon is in a form that is stable for hundreds or even thousands of years. Biochar is good for the soil. It adds nutrients, increases the water-holding capacity of the soil, makes the soil more productive – and clay soil of Pennsylvania needs it – Pennsylvania is not Iowa!

So, Sophie and I worked one ton of stuff into the soil, around several newly planted trees, just outside the initial root zone, choosing those trees that were not doing very well. This worked well – in two years since, those trees have perked up relative to the others. But that one ton of stuff required two days of very hard work.

**Sophie:** The one ton of “stuff” was half organic compost and half biochar, so a bit less than half a ton of carbon. Times 44 over 12 makes it about 1.6 tons of CO<sub>2</sub> that was taken out of the air and is now stored as char in the soil around those trees.

It was a lot of work, yet the carbon we stored in the soil as biochar makes up for only 10 percent of the 16 tons of fossil fuel CO<sub>2</sub> put into the air by one person in a year.

I have two brothers, so with our mother and father, our family of five puts 80 tons of CO<sub>2</sub> into the air each year, if we are average Americans. So to make up for our 80 tons, we need to bury 50 times more than we buried around the trees.

**Jim:** And you need to do it every year! My eight acre farm is not big enough for that!

That picture is indicative of the global situation. We can store a lot of carbon in the biosphere and soil by means of reforestation and improved forestry and agricultural practices, but there is a practical limit on how much CO<sub>2</sub> we can extract from the air in that way.

So the upshot is that we need to rapidly phase down fossil fuel emissions or it will become impossible to stabilize climate at a level that is fair to young people.

**Sophie:** In our next video we talk about how fast emissions must be phased down in order to stabilize climate, and whether it is practical to do that.

It is still possible to stabilize climate, but our government is not taking actions needed to do that. That why I am one of 21 young people who, together with my grandfather, have filed a lawsuit against the federal government. We will talk about that too. Thanks for watching.