FREQUENTLY ASKED QUESTIONS

WHAT IS CARBON DIOXIDE (CO_2)?

Carbon dioxide is a chemical compound, formed of one atom of carbon and two atoms of oxygen, is a major component of the exhaled breath of humans and animals, and has a wide range of commercial uses, from the production of lasers to the carbonation of soft drinks. This compound exists naturally from the Earth's environment, and it is produced in a variety of ways, including through the combustion of fossil fuels (coal, oil, or natural gas), as a byproduct of industrial processes, and from transportation. This gas is a topic of interest because it is classified by environmental and climate scientists among the greenhouse gases, which impact the Earth's environment when they reach high concentrations in the atmosphere.

WHAT IS CO_2 MANAGEMENT?

The goal of CO_2 management is the reduction of the amount of CO_2 released into the atmosphere by any of several methods. Some methods seek to reduce the amount of CO_2 produced by increasing the efficiency of fossil fuel energy systems; switching to alternative, renewable energy methods such as wind and solar; and through energy conservation techniques by individuals and the private and public sectors. Removing CO_2 once it has entered the atmosphere is difficult, at best, so new methods focus on capturing CO_2 before it is released into the atmosphere, utilizing it to increase oil or natural gas production, or by transporting and storing it in a variety of ways, including underground.

WHAT IS CARBON CAPTURE AND STORAGE (CCS), OR CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS)?

Carbon capture and storage, or as it is also called, carbon capture, utilization, and storage, are methods of carbon management that involve capturing CO_2 before it is released into the atmosphere and either using it for other purposes or storing it in underground geological formations. Sometimes, the injection of CO_2 into an underground formation for the purposes of long-term storage also enhances the recovery of oil or gas, valuable commodities that can in turn be used for energy production.

HOW IS THAT RELEVANT TO THIS PROJECT IN BUCHANAN COUNTY?

In this project, we will employ CCUS to store 20,000 tons of CO_2 in unmineable coal seams in Buchanan County and to use it to increase, or 'enhance,' the production of natural gas that is found in the coal seams. The wells that will be used to inject the CO_2 have already been producing natural gas for years, and as those reservoirs become depleted, the remaining natural gas is hard to recover. The injected CO_2 has the effect of displacing the remaining natural gas so that it can be recovered and used for energy production.

CAN CO_2 BE STORED IN FORESTS, TREES, WETLANDS, GRASSLANDS, AND SOIL?

"Terrestrial" storage is also a possibility, but while terrestrial storage options are being used and researched today, they are not believed to have the potential to store enough CO_2 to result in a significant decrease in the amount of CO_2 in the atmosphere. Also, there is a question about whether terrestrial storage will be effective for long-term storage, since when croplands and soil are tilled, or when trees and grass storing CO_2 are cut or decay, the CO_2 is released into the atmosphere again. For these reasons, some scientists and engineers see geological storage as the primary option for reducing the future emissions of CO_2 into the atmosphere.

WHY STORE, OR "SEQUESTER," CO_2?

Greenhouse gases, including CO_2, naturally trap a portion of the sun's energy in the Earth's atmosphere, and this maintains the temperatures needed to keep our planet hospitable to life. However, human (anthropogenic) activity, including the use of fossil fuels, adds CO_2 and other greenhouse gases to the atmosphere. Some scientists are concerned that the anthropogenic greenhouse gases entering the atmosphere are causing increased warming and that this warming will affect climate on a global scale. This concern is being addressed by international efforts and by individual countries. Conservation, more efficient fossil fuel power systems, renewable energy, and geologic storage are all tools to help reduce CO_2 intensity. CO_2 storage is one of several actions that would help to control anthropogenic CO_2 emissions to the atmosphere.

FREQUENTLY ASKED QUESTIONS

WHAT ROLE DOES THIS PROJECT PLAY IN THE BIGGER PICTURE OF CCUS?

In order for carbon capture and storage to play a significant role in reducing the amount of human-caused (anthropogenic) CO_2 into the atmosphere, large-scale storage projects, on the level of millions of tons of stored CO_2, will have to be commercially viable. Several large-scale storage projects of this scope and size exist in the world today. In order to explore opportunities for such large-scale CO_2 storage projects in different types of geological formations, the U.S. Department of Energy awards grants to partnerships of academia and private industry. These research grants include a) funding for characterization of the various geologies across the country, to be sure that adequate seals and other storage mechanisms exist to provide safe, effective long-term storage, and b) funding for smaller-scale projects to test the behavior of injected CO_2 into the various formations. Is this kind of storage a viable way of managing CO_2? While it is believed to be, the way to demonstrate this is to study the geology of various formations and regions in great detail and then conduct successful small scale pilot projects. Beginning as early as 2005, the VCCER has successfully completed both characterization projects and small-scale tests. The Buchanan County test, where up to 20,000 metric tons of CO_2 will be injected into unmineable coal seams, is the next step beyond the 1,000 metric ton test that the VCCER managed from 2008 to 2010, in Russell County, Virgina.

Again, the Central Appalachian basin, in Southwest Virginia, is believed to have extensive storage potential for CO_2, and with the successful completion of this test, the region could be the beneficiary of substantial economic activity from large-scale projects in the future.

HOW MIGHT I, AS A CITIZEN OF BUCHANAN COUNTY, EXPECT TO BENEFIT FROM THIS PROJECT?

As a joint partnership of academia (the VCCER at Virginia Tech) and industry, this approximately $14 million research project will bring increased economic activity in the region during the duration of the project (2011-2014), as workers and contractors come to work and attend conferences and meetings, staying at hotels, eating at local restaurants, and patronizing gas stations, convenience stores, hardware stores, and supermarkets, among other businesses. This activity is of benefit to the community. There is increased likelihood of much larger projects in the future because of the success of projects such as this today.

IS THIS SAFE?

It should be recognized that CO_2 is not a toxic substance. For millions of years, CO_2 has been and is stored naturally, along with other gases such as methane, in various geological formations. Testing will ensure that injected CO_2 does not migrate into surface or underground water reservoirs. We have conducted significant geological characterization of the coal seams that will store the CO_2 to verify the existence of adequate mechanisms, including specific types of rock formations that serve as barriers, or seals, that lie above the coal seams and prevent the CO_2 from migrating upwards.

At a microscopic level, coal contains pores, that are filled with methane. In the case of storage in coal seams, it is well-known that CO_2 "adsorbs," or bonds, to the discrete pores in coal very tightly. Methane in the pores has adsorbed to the coal surfaces for millions of years. CO_2 bonds even more closely, causing the methane to be "kicked out" naturally when the CO_2 is injected in. The same mechanisms that have kept the methane in the coal serve to ensure that the CO_2 will stay in place for many years to come.

HOW WOULD WE KNOW IF THERE WAS A CONTAINMENT ISSUE DURING, OR AFTER, THE PROJECT?

The Virginia Center for Coal and Energy Research, in conjunction with industry and government partners, has designed a monitoring program that will reveal if a CO_2 escape occurs, so that it can be addressed quickly. This monitoring program begins even before the CO_2 is injected, establishing baseline measurements for the amount of CO_2 that is already in the air and soil, so that it can be determined if a new source of CO_2 is introduced. Monitoring continues well after the project, to make sure no CO_2 is emitted into the atmosphere.

FREQUENTLY ASKED QUESTIONS

WHERE DOES THE CO_2 USED FOR THIS TEST COME FROM?

This CO_2 will be purchased from a commercial vendor and transported to the injection site by truck and pipeline, where it will be stored onsite until it is injected. For future research and commercial projects, the CO_2 could be provided in much larger volumes by using technologies to capture the CO_2 at nearby energy plants such as Dominion Virginia Power's Virginia City Hybrid Energy Center in Wise County, Virginia, and other nearby industrial plants and factories.

HOW CAN I LEARN MORE ABOUT CCUS AS A MEANS OF MANAGING CARBON?

We suggest you start with the U.S. Department of Energy's carbon capture and storage website (http://energy.gov/fe/science-innovation/carbon-capture-and-storage-research), as a way of learning about our energy needs and resources, and how we can best ensure that everyone has access to clean, affordable energy with a minimal impact on the environment.

FREQUENTLY ASKED QUESTIONS

DEFINITIONS OF KEY TERMS

SEQUESTRATION
Sequestration means storage. To sequester CO_2 is to store it, as opposed to emitting it into the atmosphere.

MIGRATION
The movement of CO_2 in underground formations is called migration.

UNMINEABLE, AS IN "UNMINEABLE COAL SEAM"
An unmineable coal seam is one that it is not economically or technically feasible to mine. For instance, some coal seams are too thin to be economical to mine.

(GEOLOGICAL) CHARACTERIZATION
Before injecting CO_2 into underground formations, the extent and properties of the formations must be carefully examined and analyzed, as well as what kinds of geological formations and structures lie above and below. The process of studying these geological formations is called 'characterization.'

CONVENTIONAL (VS. 'UNCONVENTIONAL') RESERVOIR
The primary differences between conventional and unconventional reservoirs are based on oil or gas resource characteristics, the available exploration and production technologies, the economic environment, and the scale, frequency, and duration of production from the resource. A conventional reservoir has buoyant forces keeping hydrocarbons, such as oil and natural gas, in place below a local geological formation or structure that traps the resource and serves as a seal, or caprock. When oil or natural gas is produced from conventional reservoirs, it flows readily to the surface through a well. Unconventional resource is an umbrella term for oil and gas that is produced by means that do not meet the criteria for conventional production. Unconventional reservoirs may be larger in scale and lack the influence of buoyant forces that would allow the resources to be produced as easily as conventional resources. Coalbed methane, gas hydrates, shale gas, fractured reservoirs, and tight gas sands are considered unconventional resources.

ANTHROPOGENIC
The term 'anthropogenic' means created by humans or caused by human activity.