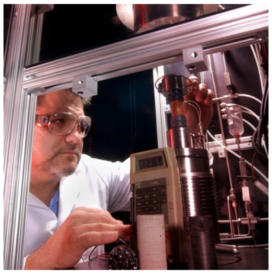


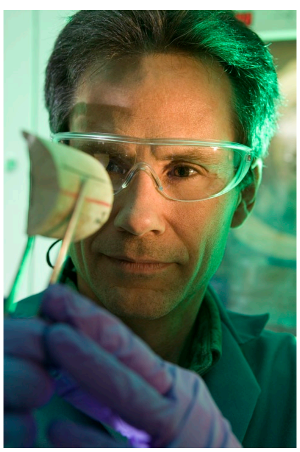

The National Energy Technology Laboratory and Los Alamos National Laboratory are partnering to enable science-based decisions for geologic CO_2 sequestration.

Geologic Sequestration

A National Plan for Making Science-Based Decisions

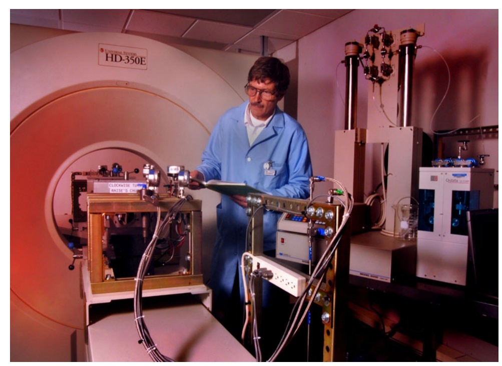
Meeting global energy demands without exacerbating global climate change will require a portfolio of carbon-neutral energy options. Fossil fuels can play a central role in this portfolio if their carbon dioxide emissions are captured and stored rather than released into the atmosphere. Geologic sequestration, storing CO_2 in subsurface geologic reservoirs, is perhaps the best near-term option.

Natural and industrial evidence indicates that geologic sequestration can work safely and effectively. However, to affect climate change, geologic sequestration operations will have to sequester billions of tons of CO_2 yearly. This will require a vast number of geologic sites all with varying site-specific properties, regional issues, and economic considerations. Selecting, engineering, and regulating these sites will require a comprehensive decision making framework that is robust enough to evaluate all possible conditions yet adaptable enough to provide site-specific predictions of long-term effectiveness. To meet this need, Los Alamos National Laboratory (LANL) and the National Energy Technology Laboratory (NETL) are collaborating to develop a national plan to determine the overall long-term effectiveness of geologic CO_2 storage.



A Los Alamos geochemist analyzes a cement sample to see if plugged wellbores will hold up under the pressures of geologic sequestration.

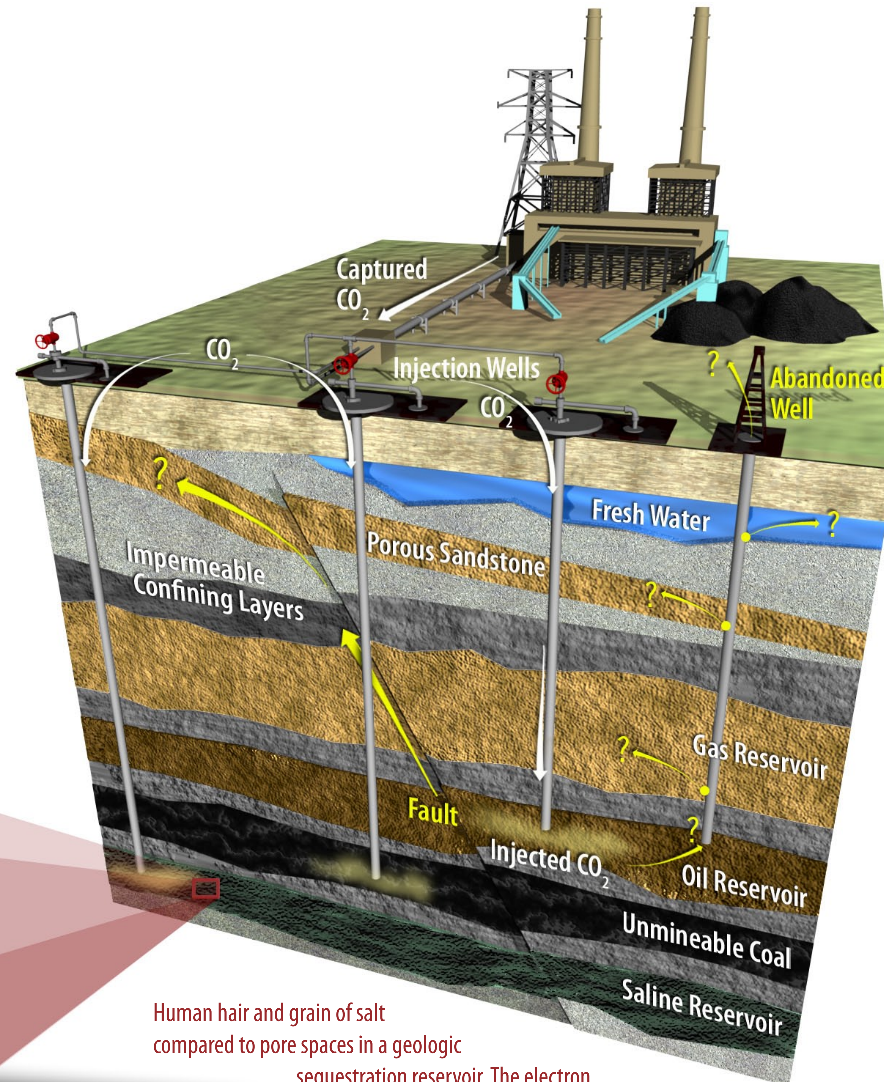
In a geologic sequestration process, CO_2 is compressed into a supercritical state and injected down wells to disperse into layers of porous rock (see image on reverse). The porous layers will usually have other fluids in them, often saline water and sometimes oil and natural gas. These fluids will have to move to make room for the CO_2. A properly selected site will have an impermeable trapping layer, called a "cap rock," above the porous reservoir holding the CO_2. The integrity of the cap rock is important because CO_2 is lighter than saline water and oil and will tend to migrate above these fluids.



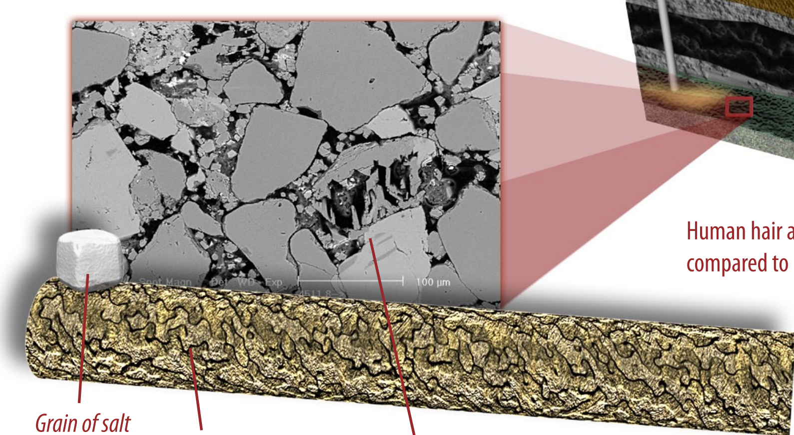
NETL researcher analyzing CO_2 flow using a CT scanner.

As CO_2 is injected into the reservoir, several things could occur. The CO_2 could force the native fluids, and any substances these fluids mobilize, into freshwater aquifers or other natural resources. The increased pressure in the reservoir could cause structural changes in the formation, such as fractures in the cap rock, which could become escape routes. The CO_2 mixed with saline water could react with cement plugging the wells, which may open escape routes or may improve the cement's sealing capability. The CO_2 could chemically react with minerals in the storage reservoir to create new minerals, which could be good because it immobilizes the CO_2 permanently, but could also be bad if it happens quick enough to hamper injection operations. All these things *could* happen but probably will not or their impact could be minimized if sequestration sites are selected and managed using a comprehensive framework that is built upon science. Scientists at Los Alamos National Laboratory have been developing such a framework and a computational model known as CO_2-PENS.

Much is already known from industry experience and past scientific research, but there are many gaps to be filled. The Department of Energy's carbon sequestration program has been working to fill those basic scientific gaps through laboratory, computational, and field efforts. The DOE's Regional Carbon Sequestration Partnership program has been assessing reservoir capacity and conducting injection and storage tests for a wide range of reservoir types. CO_2-PENS is being developed to pull together all the knowledge—industry experience, existing predictive models, field and laboratory experimental results—about basic physical and chemical processes and turn it into predictions that decision makers can use. It will be an invaluable tool for lawmakers, regulators, investors, and sequestration site operators. The partnership between NETL and LANL is laying the foundation for sound, science-based decisions in deploying geologic CO_2 sequestration as part of the solution to climate change.



In geologic sequestration, supercritical CO_2 is injected into porous layers, such as depleted oil and gas reservoirs, unmineable coal seams, and saline aquifers. Impermeable layers, or "cap rocks," would prevent CO_2 from returning to the surface. But CO_2 tends to rise and cap rocks could contain escape routes through faults, fractures, and well holes. The white arrows to the right show injected CO_2, and the yellow indicate possible escape routes. These potential problems can be avoided or their impact minimized with proper site selection and management based on science-based prediction. Los Alamos National Laboratory and the National Energy Technology Laboratory are working together to provide the science base and a computer prediction tool called "CO_2-PENS."



Human hair and grain of salt compared to pore spaces in a geologic sequestration reservoir. The electron microscope image shows a cross section of sandstone taken from a CO_2 injection field study. The large gray areas are mineral grains. The black spaces, which are narrower than a human hair or a grain of salt, are the pore spaces through which injected CO_2 must flow.

For more information

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LALP-08-055