



Before it can be injected into the ground, carbon dioxide is compressed, sent through these pipes to large cooling units, and compressed again.

Return Carbon to the Ground: Reducing global warming pollution and enhancing oil recovery

Americans need to transform how we produce and consume energy to prevent dangerous global warming. In fact, scientists say that significant carbon dioxide (CO₂) reductions should begin within 10 years and that U.S. CO₂ emissions should be cut by 50 percent or more by 2050 to avoid the most severe, irreversible effects of heat-trapping pollution. Energy efficiency and renewable energy technologies will be the cornerstones of the solution. To the extent that coal continues to be used, an important additional strategy is to capture the CO₂ emitted from coal-fired power plants and pump it into natural geologic structures deep in the Earth, where it is gradually absorbed.

www.nrdc.org/globalwarming/solutions

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More than 50 percent of the electricity consumed in the United States is produced from coal. Yet coal has the highest uncontrolled carbon dioxide emission rate of any fuel and is responsible for 33 percent of the U.S. carbon dioxide (as well as other harmful emissions) released into the atmosphere. There is no such thing as “clean coal”: coal production, processing, and transportation practices scar the landscape and foul the water, harming people and ecosystems that range from Appalachian coal-field communities to Western ranchers. Although Clean Air Act standards helped reduce sulfur and nitrogen emissions somewhat, carbon dioxide emissions from power plants

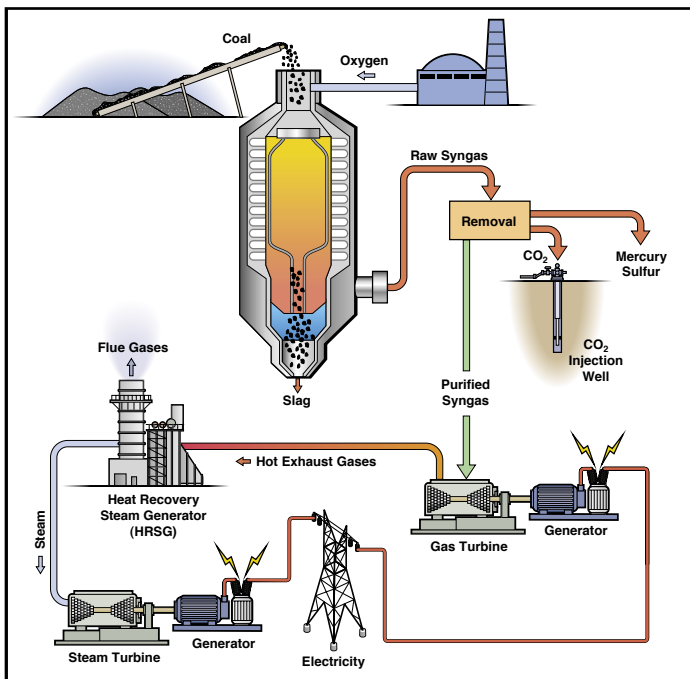
increased by 27 percent since 1990, and there is no end in sight unless emission limits are put into force.

More than 100 new conventional coal-fired power plants are in various stages of development throughout the United States. By 2030, the Department of Energy projects that the equivalent of 450 new large (300 MW) coal-fired power plants will be completed. With a lifetime of more than 60 years, these plants will produce more than 60 billion tons of CO₂ in total—10 times the current annual emissions from all sources—enough to effectively foreclose the option to prevent dangerous global warming.

Return Carbon to the Ground

Carbon Capture and Disposal

Coal gasification with carbon capture and disposal (CCD) technologies are essential if continued use of coal is to be reconciled with preventing dangerous global warming. Long-term geologic disposal of CO₂ (for thousands of years) is viable now and must be implemented quickly if we are to meet the challenge of sharply reducing global emissions this century.¹ These technologies could



prevent 100 billion tons of CO₂ from escaping coal plants in the next 50 years. Well established but in limited use, CO₂ capture and disposal technology involves capturing nearly pure CO₂, compressing it to liquid form, and injecting it into deep, porous rock formations beneath impermeable cap rock. Such geological

formations are common throughout the world at varying depths.

The Intergovernmental Panel on Climate Change has concluded that CCD is viable. In most cases, the CO₂ is gradually (over thousands to tens of thousands of years) absorbed by the surrounding rock, where it mineralizes into solid form. It is possible, however, for stored CO₂ to leak up through well bores and other deep fissures, so accurate siting of injection wells and monitoring of CO₂ floods and disposal are essential. As a result, ensuring that CCD results in the permanent sequestration needed for climate protection will require rigorous criteria and performance standards for CO₂ injection and disposal sites.

CO₂ and Enhanced Oil Recovery

Coal gasification and carbon capture and disposal are more costly than conventional coal plants. But this cost can potentially be offset by producing additional oil from already developed fields using carbon dioxide captured from coal-fired power plants.

When CO₂ is injected at high pressure into mature oil fields, it pressurizes the well and mixes with the oil, increasing the oil's mobility and promoting enhanced oil recovery (EOR). The oil is displaced by the CO₂, which can be safely stored in the geologic formations that held the oil. And although some CO₂ is pumped out along with the oil, this CO₂ can be recaptured and reinjected for additional oil recovery or permanent disposal.

Standard primary and secondary oil production without EOR only recovers about one-third of the original oil in typical reservoirs. Current state-of-the-art EOR techniques generally allow an additional 10 percent of the original oil in place to be recovered. In fact, 35 million tons of CO₂ are currently used each year to recover 75 million barrels of oil. Unfortunately, most of this CO₂ is pumped out of natural reservoirs rather than captured from industrial sources.

The U.S. Department of Energy estimates that if CO₂ were widely available for EOR, current techniques could recover more than 60 billion barrels of oil from domestic fields in the lower 48 states.² Advanced techniques have the potential to double the amount of recoverable oil to upwards of 120 billion barrels—more than 18 times the amount of oil that is estimated to be economically recoverable from the Arctic National Wildlife Refuge.³ At \$40 a barrel, these domestic reserves would be worth between \$2.4 and \$4.8 trillion.

Ironically, in the absence of policies to limit emissions, EOR activity is currently constrained by a shortage of CO₂. Capturing CO₂ from coal-fired power plants could not only reduce global warming pollution, but also significantly contribute to U.S. energy supplies without sacrificing America's few remaining wild places to oil exploration and development.

¹ For more detail, see the IPCC Special Report, "Carbon Dioxide Capture and Storage."

² http://www.fossil.energy.gov/programs/oilgas/eor/Six_Basin-Oriented_CO2-EOR_Assessments.html

³ See <http://www.nrdc.org/land/wilderness/arcticrefuge/facts3.asp>.