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Why Clean Coal Is Years Away

Coal is here to stay, but efforts to cut emissions are ambitious, expensive, and have largely stumbled

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America runs on coal. It's cheap, plentiful (at least for another 100 years or so), and comfortingly domestic. Two hundred years ago, it powered the industrial revolution. Today, it spits out nearly half of the country's electricity.

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Coal's problems, however, are getting to be so big and serious that they are not just overshadowing the industry but threatening to render it obsolete. About 80 percent of the electricity sector's carbon dioxide emissions come from burning coal. A price on CO₂ pollution, which Congress might impose as early as this year, is expected to be so costly that the mere prospect of it is already shaking things up. Some states have banned new coal plants, and many companies are canceling their plans in other places.

The industry's greatest hope for survival, as far as [CO₂ emissions](#) go, is a work-in-progress technological arsenal known as carbon capture and storage, or CCS. With all the makings—and risk—of a classic American gamble, it is in some ways the [energy](#) equivalent of missile defense. It's ambitious, expensive, intricate, and wildly controversial.

Cue the requisite political theatrics in Washington and, behind them, more serious questions about the promise of "clean coal" versus the reality. Last fall, at a campaign rally, then Sen. Barack Obama said, "Clean coal technology is something that can make America energy independent." The coal industry itself is spending millions of dollars on ads—

placed in newspapers, pasted to public buses, and shellacked across subway station entryways—that boast of its commitment to "clean coal technology." Environmentalists have aggressively volleyed back. Clean coal, they say, doesn't exist.

It would be helpful if everyone were using the same definition. The term "clean coal," though alliteratively pleasing, is far from straightforward. Besides CO₂, coal plants emit mercury, particulate matter, nitrogen oxides, and sulfur dioxides. What doesn't go into the air often ends up in the ground as fly ash, a sludgelike material that became big news last year when a retaining wall at an ash dump in Tennessee suddenly gave way, releasing thousands of pounds of waste into people's front yards. So, it's not just CO₂ that's problematic. In fact, in the early 1990s, clean coal referred almost exclusively to efforts aimed at curbing nitrogen and sulfur pollution. Today, clean coal has morphed to mean coal from a plant that doesn't emit CO₂. And it doesn't exist yet.

Making it happen, roughly speaking, will require three steps: capturing the carbon dioxide discharge from a plant's smokestack before it escapes; compressing it into a liquid and transporting that through a pipeline; and storing the compressed CO₂ underground in a repository for hundreds, if not thousands, of years.

To get a sense of where the field stands, take a look at the Mountaineer [power plant](#) in New Haven, W.Va., a coal-fired facility that sits on the Ohio border. Built in 1980, it emits about 8.5 million metric tons of carbon dioxide annually. But it's undergoing a series of major changes to convert it by the end of the year, if all goes well, into one of the country's most ambitious, active clean coal projects. Battelle, the project's main contractor, is currently drilling several deep underground wells at the site. Special chemicals are being added to the smokestack to separate CO₂ from the rest of the emissions. Initially, the goal is to capture and store about 100,000 to 300,000 metric tons of CO₂ annually, and then to go up from there, says Neeraj Gupta, Battelle's research leader. "It's happening now. We can do it," says Gupta. "Just like with oil and natural gas, it's a matter of where, under what conditions, and at what cost."

Just getting to this point—100,000 tons of CO₂ is, after all, slightly over 1 percent of the plant's annual emissions—has taken years of work and research, many false starts, new leads, exciting breakthroughs, and thousands of hours of laboratory testing and analysis. On the other hand, it wasn't until 1998, a mere decade ago, that the Department of Energy

formally carved out a budget for this type of work.

In fact, it has really been the oil and natural gas companies, as well as private contractors, that have been the biggest backers of capture technology. Around 2001, a group of eight oil firms, including Chevron and BP, started the CO₂ Capture Project. During the first few years, they waded through thousands of technical reports and papers on all sorts of schemes for capturing carbon, from gasifying coal to using new chemical solvents and biological membranes. By 2005, they had narrowed their list to the most promising ideas and headed to the laboratory. "What we are looking for is trying to gain more options, newer breakthrough technologies," says Arthur Lee, a principal adviser at Chevron. "The whole chain still needs some work. Capture costs are high, but if those can come down, that will make a huge difference." The next step, slated to begin this year, is to deploy these technologies in small-scale pilot tests.

On the storage side, the work dates back even further and spans the Atlantic. Oil companies have for decades been pumping carbon dioxide into oil wells to force out the stubborn hydrocarbons that don't come up with conventional methods. Of course, the idea there is mainly to inject gas—not to put it in, store it, and keep it there permanently.

Elements of the storage portion are clearly doable. Norway has, since the mid-1990s, been investing huge amounts to inject and store carbon dioxide under the North Sea. So far, so good. The Sleipner Project, as it's known, stores about 1 million metric tons of CO₂ annually. But the site itself is singularly important. What works in one place might not work in another. Each underground site has unique curves, gradients, mineral compositions, porosity values, dips and rises, and seismic activity. Certain types of sites, such as salty aquifers, are more promising because they tend not to leak. In fact, according to Chevron's Lee, as well as the United Nations Intergovernmental Panel on Climate Change, if the appropriate geological site is picked, more than 99 percent of CO₂ pumped in is "very likely" to remain there for 100 years, and that amount is "likely" to stay trapped for 1,000 years. Still, every potential site—and there are many of them throughout the United States—has to be scouted out, assessed, analyzed, and modeled.

The most daunting challenge, then, is for companies to begin combining the capture and storage parts together in real life, at the right location, and to scale it up to a level that might actually help [reduce global warming pollution](#). That's part of the idea behind the

Mountaineer project, although it is admittedly well below commercial scale. Another so-called milestone project, in Wisconsin, isn't even that far along. It's merely trying to capture the CO₂ from 1 percent of its waste stream, but with no plans for storage, it must release the CO₂ back into the air. "The big hurdle is getting the first couple built," says Steve Caldwell of the Pew Center on Global Warming. "No one has built one of these yet; no one has gotten the money to build a 500-megawatt plant with CCS."

In fact, there have been a number of plans to do so, but they haven't turned out so well. In most cases, they've been heralded by news releases and applause. Then, they quietly fall apart. A prime example is an effort by BP and mining giant Rio Tinto in western Australia called Kwinana. When the project was first rolled out in 2007, the companies planned to spend up to \$2 billion on a state-of-the-art, coal-fired power plant that would capture 90 percent of its carbon dioxide emissions and store them underground. In May 2008, however, the companies canceled the project. It turned out that the site they picked had too many cracks in it.

Cost overruns. A more high-profile debacle came with an ambitious project known as [FutureGen](#), which was pitched in 2003 as the first zero-emissions coal plant in the United States. Today, it is truly a zero-emissions project—because it doesn't exist. The idea was to have it work as a cost-share between the government and the private sector. By 2006, a number of private companies and several foreign governments were on board. The project was showing promise. The question was where it would be built. By late 2007, the Department of Energy had narrowed its list of sites under review to four: two in Texas, two in Illinois. Ultimately, the winner was Mattoon, Ill., a nice rural area about 50 miles east of Springfield. A month and a half later, however, the Bush administration abruptly pulled out—yanking some \$1.3 billion, at last count—citing cost overruns. The project is now stuck in legal-political-economic purgatory, Illinois lawmakers are asking President Obama to restore its funding, and the whole thing has become a nagging counterpoint to the idea that clean coal will ever be a reality.

The American Coalition for Clean Coal Electricity, the industry's main lobbying group, says there are more than \$6 billion of projects around the country that are related to clean coal. In fact, many have little or nothing to do with carbon dioxide emissions but instead involve nitrogen and sulfur oxides. Those that do pertain to CO₂ appear to be advancing slowly. There's a project in West Virginia that's been stalled by litigation for several years, one in

Florida that's been canceled, and another in Minnesota that's been stuck in the planning stage for several years.

So, what's needed to break this cycle? Money, for one thing. Credit Suisse Group says \$15 billion needs to be invested in CCS over the next 10 years for it to play an important role in climate change. The International Energy Agency says \$20 billion. Pew's global warming center puts the number as high as \$30 billion. Those numbers dwarf the actual investments thus far. The Bush administration spent about \$2.5 billion on advanced coal technology—an unprecedented amount, to be sure, but far below the estimates of what will be needed. CCS proponents say both the government and the private sector need to step up their investments.

Financing, of course, would help accelerate the deployment of vital trials or demonstration projects. The industry is locked in a vicious game of chicken and egg. In order for large-scale technology to be put in place, the costs need to come down, but for the costs to come down, the technology needs to be put in place, or "perfected," as officials say. Carbon capture techniques might work well enough in a lab, but experts say they don't know what will happen if they put chemical scrubbers on a 500-megawatt commercial coal plant and try to capture all—or even half—of its CO₂. Policy experts say at least 10 to 12 of these demonstration plants are needed to test, analyze, and commercialize the technology. During the campaign, Obama committed himself to building five.

Meanwhile, there's still a need for research. As MIT's Howard Herzog, a leading coal technology researcher, puts it, some capture technologies are pretty well advanced. "Maybe you can shave some costs, but you're not going to cut the costs in half," he says. "There are basic laws of science—laws of thermodynamics—you just can't get around." On the other hand, there are novel technologies in the research pipeline, such as those being looked at by Lee of Chevron, that have higher risk but also potentially higher reward. "It's not a slam-dunk which of these technologies is the right one," Energy Secretary Steven Chu said recently. "We want to pursue a suite of solutions." In Chu's assessment, DOE should be investing in pilot projects looking at different ways of siphoning off CO₂: before coal is combusted, after it's combusted, or even burning coal in pure oxygen rather than regular air.

Not surprisingly, there are plenty of environmentalists who are terribly unhappy with the

focus on coal. They'd rather see money go elsewhere, for scaling up wind or [solar power](#), or for huge improvements in energy efficiency. One of their key arguments is that coal combustion, even if it doesn't release CO2, is still going to be dirty. "You can burn it more cleanly, but no matter how much you scrub coal, you will always have a waste stream. You're just transferring it from one place to another," says Emily Rochon, CCS policy coordinator for Greenpeace International.

But given just how reliant the nation is on coal power, the only real question seems to be how clean it will eventually become.

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