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## The only practical approach is to pursue technologies that burn coal more cleanly

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Almost every facet of modern life—from driving to the grocery store to turning on a light—relies on inexpensive and abundant fossil fuels. When burned for power, these fuels yield emissions of carbon dioxide that accumulate in the atmosphere. They are the leading cause of global warming.

Assuring ample energy services for a growing world economy while protecting the climate will not be simple. The most critical task will be curtailing emissions from coal; it is the most abundant fossil fuel and stands above the others in its carbon effluent. Strong lobbies protect coal in every country where it is used in abundance, and they will block any strategy for protecting the climate that threatens the industry. The only practical approach is to pursue technologies that burn coal much more cleanly.

Such new technologies exist on the drawing board, but governments and regulators are failing to bring designs into practice with deliberate speed. Instead, most of the policy effort to tackle global warming has focused on creating global institutions, such as the Kyoto Protocol, to entice change. Although noble, these global efforts usually fall hostage to the interests of critical countries. After negotiating the Kyoto treaty, for example, the United States refused to sign when it found that it could not easily comply with the provisions. Australia did the same, and Canada is also poised to withdraw. Nor have treaties like Kyoto crafted a viable framework for engaging developing countries; these countries' share of world emissions is rising quickly, yet they are wary of policies that might crimp economic growth.

Breaking the deadlocks that have appeared in the Kyoto process requires, first and foremost, a serious plan by the United States to control its emissions. The United States has a strong historical responsibility for the greenhouse-gas pollution that has accumulated in the atmosphere, but little has been done at the federal level. (A few states are implementing some policies, and they, along with rising political pressure, might help

to catalyze a more aggressive federal approach.) It will be difficult, however, for the United States (and other industrial countries) to sustain much effort in cutting emissions unless its economic competitors in China and the other developing countries make some effort as well. Without a strong policy framework to contain emissions throughout the world, levels of greenhouse-gas pollution will reflect only the vagaries in world energy markets. We need a proper strategy for moving away from harmful emissions.

A few years ago, many analysts thought that market forces were already shifting away from coal. They predicted the growth of natural gas, a fuel prized for its cleanliness and flexibility. That vision was good news for the climate because electricity made from natural gas leads to half of the carbon-dioxide emissions of electricity from coal. But natural-gas prices, which tend to track oil prices, have skyrocketed over the past few years, and, unsurprisingly, the vision for the growth of natural has dimmed. Natural-gas plants, which accounted for more than 90 percent of new plants built in the 1990s, are harder to justify in the boardroom. Most analysts now see a surge in the use of coal. One hundred new coal-fired plants are in the planning stages in the United States. Absent an unlikely plunge in gas prices, coal is here to stay.

Despite the challenges of handling coal responsibly, the potential of research and deployment of advanced technologies to help the United States and the major developing countries find common interest on the climate problem is great. In advanced industrialized countries, the vast majority of coal is burned for electricity in large plants managed by professionals—exactly the setting where such technology is usually best applied. In the United States, for example, coal accounts for more than four fifths of all greenhouse-gas emissions from the electricity sector.

Most of the innovative effort in coal is focused on making plants more efficient. Raising the temperature and pressure of steam to a “supercritical” point can yield improvements in efficiency that, all told, can reduce emissions about 20 to 25 percent. Boosting temperature and pressure still again, to “ultra-supercritical” levels, can deliver another slug of efficiency and lower emissions still further. Encouraging investments in this technology is not difficult: most countries and firms are already searching for gains in efficiency that can cut the cost of fuel; a sizeable fraction of new Chinese plants are supercritical; India is a few steps behind, in part because coal is generally cheaper in that country, but even there the first supercritical unit is expected soon. Across the

advanced industrialized world, supercritical is the norm, at least for new plants. A few companies are taking further steps, investing in ultra-supercritical units. Two such plants are going up outside Shanghai, using mainly German technology, evidence that the concept of “technology transfer” is becoming meaningless in the parts of the world economy that are tightly integrated. Markets are spreading the best technologies worldwide where their application makes economic sense. In other countries, technologies to gasify coal—which also promise high efficiency—are also being tested.

But power-plant efficiency alone won't account for the necessary deep cuts in emissions. Already the growth in demand for electricity is outstripping the improvements in power plants such that the need for more plants and fuel is rising ever higher, as are emissions. This is spectacularly true in fast-growing China.

A radical redesign of coal plants will be needed if governments want to limit emissions of carbon dioxide. Here, the future is wide open. One track envisions gasifying the coal and collecting the concentrated wastes. Another would use more familiar technologies and separate carbon dioxide from other gases. All approaches require injecting the pollution underground where it is safe from the atmosphere. This is already done at scale in oil and gas production, where injection is used to pressurize fields and boost output. The consequences of injecting the massive quantities of pollution from power plants, however, are another matter. Regulatory systems are not in place or tested, and public acceptance is unknown.

While these technologies can work, they won't be used widely before they progress on two fronts. First, they must become commercially viable. Despite the huge potential of adopting them, it is striking how little money is being spent on advanced coal technologies. The U.S. government has created some financial incentives to build advanced coal plants, but much of that investment is slated for plants that are not actually designed to sequester CO<sub>2</sub>. In fact, the uncertainty of American policy gives investors in power plants an incentive to build conventional high-carbon technology, because it is more familiar to regulators and bankers. Worse yet, increased emissions today might actually improve a negotiating position in the future when targets for controlling emissions are ratcheted down from whatever is business as usual. Some private firms, such as BP and Xcel, are putting their own money into carbon-free power—but the totality of the private effort is small compared with the

size of the problem. There are good mechanisms in place for encouraging public research and private investment in such technologies; the real shortcoming is in the paucity of the effort.

The second problem is that countries such as China, India, and other key developing nations won't spend the extra money to install carbon-free coal. Yet these countries' share of global coal consumption has soared almost 35 percent over the past ten years.

The inescapable conclusion is that the advanced industrialized countries must create a much larger program to test and apply advanced coal technologies. Electricity from plants with sequestration might eventually cost half more than from plants without the technology. That's not free, but it is affordable and is less than the changes in electric rates that many Americans already experience and accept.

State and federal regulators need to create direct incentives—such as a pool of subsidies—to pay the extra cost until the technology is proven and competitive with conventional alternatives. That subsidy, along with strict limits on emissions, will set a path for cutting the carbon from U.S. electricity without eliminating a future for coal. They must also extend the same incentives to the major developing countries, which have no interest in paying higher rates for electricity because their priorities do not rest on controlling CO<sub>2</sub>. Yet these countries' involvement now is essential. Averting emissions has a global benefit regardless of where the emissions are controlled. And developing countries are especially unlikely to shoulder more of the burden themselves, in the more distant future, unless they are first familiar with the technologies.

Solving the climate problem will be one of the hardest problems for societies to address—it entails complicated and uncertain choices with real costs today, and benefits in the distant future. Yet the stakes are high and the consequences of indecision severe. Serious action must contend with existing political constituencies and aim at existing resources that are most abundant. The technologies needed to make coal viable will not appear automatically. An active policy effort—pursued worldwide and initially financed by the industrialized world—is essential.

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