A steamy solution to global warming

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Waste Not

Forty years ago, the steel mills and factories south of Chicago were known for their sooty smokestacks, plumes of steam, and throngs of workers. Clean-air laws have since gotten rid of the smoke, and labor-productivity initiatives have eliminated most of the workers. What remains is the steam, billowing up into the sky day after day, just as it did a generation ago.

The U.S. economy wastes 55 percent of the energy it consumes, and while American companies have ruthlessly wrung out other forms of inefficiency, that figure hasn't changed much in recent decades. The amount lost by electric utilities alone could power all of Japan.

A 2005 report by the Lawrence Berkeley National Laboratory found that U.S. industry could profitably recycle enough waste energy—including steam, furnace gases, heat, and pressure—to reduce the country's fossil-fuel use (and greenhouse-gas emissions) by nearly a fifth. A 2007 study by the McKinsey Global Institute sounded largely the same note; it concluded that domestic industry could use 19 percent less energy than it does today—and make more money as a result.

Economists like to say that rational markets don't "leave $100 bills on the ground," but according to McKinsey's figures, more than $50 billion floats into the air each year, unclaimed by American businesses. What's more, the technologies required to save that money are, for the most part, not new or unproven or even particularly expensive. By and large, they've been around since the 19th century. The question is: Why aren't we using them?

One of the few people who's been making money from recycled steam is Tom Casten, the chairman of Recycled Energy Development. Casten, a former Eagle Scout and marine, has railed against the waste of energy for 30 years; he says the mere sight of steam makes him sick. When Casten walks into an industrial plant, he told me, he immediately begins to reconfigure the pipes in

his head, totting up potential energy savings. Steam, of course, can be cycled through a turbine to generate electricity. Heat, which in some industrial kilns reaches 7,000F, can be used to produce more steam. Furnace exhaust, commonly disposed of in flares, can be mixed with oxygen to create the practical equivalent of natural gas. Even differences in steam pressure between one industrial process and another can be exploited, through clever placement of turbines, to produce extra watts of electricity.

By making use of its "junk energy," an industrial plant can generate its own power and buy less from the grid. A case in point is the ArcelorMittal steel mill in East Chicago, Indiana, where a company called Primary Energy/EPCOR USA has been building on-site energy plants to capture heat and gases since 1996. Casten, Primary Energy's CEO from 2003 to 2006, was involved in several projects that now sell cheap, clean power back to the mill.

As a result of Primary Energy's projects, the mill has cut its purchases of coal-fired power by half, reduced carbon emissions by 1.3 million tons a year, and saved more than $100 million. In March, the plant won an EPA Energy Star award. Its utilities manager, Tom Riley, says he doesn't foresee running out of profitable projects anytime soon. "You'd think you might," he says, "but you can always find more ... Energy efficiency is a big multiplier."

Casten wants to help everyone see such possibilities, so he's been combining EPA emissions figures with Google Earth images to let investors "peer" into smokestacks and visualize the wasted energy. Recycled Energy Development recently received $1.5 billion in venture funding, which should enable it to expand its reach greatly. Casten gives a whirlwind tour of the targets: natural-gas pipelines, he says, use nearly a tenth of the gas they carry to keep the fuel flowing. Capture some of the heat and pressure they lose, and the U.S. could take four coal-fired power plants offline (out of roughly 300). Another power plant could be switched off if energy were collected at the country's 27 carbon-black plants, which make particles used in the manufacture of tires. And so on through facilities that make silicon, glass, ethanol, and orange juice, until, Casten hopes, he has throngs of competitors. "I always thought that if we were successful, people would emulate us and I'd be happy at the end of the day. I just didn't think it would take 30 years."

Yet in fact, Casten still has few competitors, and the improvements he's made remain rare in American industry. With pressure growing to reduce greenhouse-gas emissions, the age of recycled steam may seem closer now than it has in the past, but because of a variety of cultural, financial, and—especially—regulatory barriers, its arrival is no sure thing.

The first barrier is obvious from a trip through ArcelorMittal's four miles of interconnected pipes, wires, and buildings. Steel mills are noisy, hot, and smelly—all signs of enormous interdependent energy systems at work. In many cases, putting waste energy to use requires mixing the exhaust of one process with the intake of another, demanding coordination. But engineers have largely been trained to focus only on their own processes; many tend to resist changes that make those processes more complex. Whereas European and Japanese corporate cultures emphasize energy-saving as a strategy that enhances their competitiveness, U.S. companies generally do not. (DuPont and Dow, which have saved billions on energy costs in the past decade, are notable exceptions. ArcelorMittal's ownership is European.)

In some industries, investments in energy efficiency also suffer because of the nature of the business cycle. When demand is strong, managers tend to invest first in new capacity; but when demand is weak, they withhold investment for fear that plants will be closed. The timing just never seems to work out. McKinsey found that three-quarters of American companies will not invest in efficiency upgrades that take just two years to pay for themselves. "You have to be humbled," Matt Rogers, a director at McKinsey, told me, "that with a creative market economy, we aren't getting there," even with high oil prices.

Some of these problems may fade if energy costs remain high. But industry's inertia is reinforced by regulation. The Clean Air Act has succeeded spectacularly in reducing some forms of air pollution, but perversely, it has chilled efforts to reuse energy: because many of these efforts involve tinkering with industrial exhaust systems, they can trigger a federal or local review of the plant, opening a can of worms some plant managers would rather keep closed.

Much more problematic are the regulations surrounding utilities. Several waves of deregulation have resulted in a hodgepodge of rules without providing full competition among power generators. Though it's cheaper and cleaner to produce power at Casten's projects than to build new coal-fired capacity, many industrial plants cannot themselves use all the electricity they could produce: they can't profit from aggressive energy recycling unless they can sell the electricity to other consumers. Yet byzantine regulations make that difficult, stifling many independent energy recyclers. Some of these competitive disadvantages have been addressed in the latest energy bill, but many remain.

Ultimately, making better use of energy will require revamping our operation of the electrical grid itself, an undertaking considerably more complicated than, say, creating a carbon tax. For the better part of a century, we've gotten electricity from large, central generators, which waste nearly 70 percent of the energy they burn. They face little competition and are allowed to simply pass energy costs on to their customers. Distributing generators across the grid would reduce waste, improve reliability, and provide at least some competition.

Opening the grid to competition is one of the more important steps to take if we're serious about reducing fossil-fuel use and carbon emissions, yet no one's talking about doing that. Democratic legislators are nervous about creating incentives for cleaner, cheaper generation that may also benefit nuclear power. Neither party wants to do the dirty work of shutting down old, wasteful generators. And of course the Enron debacle looms over everything.

Technocratic changes to the grid and to industrial plants don't easily capture the imagination. Recycling industrial energy is a solution that looks, well, *gray*, not green. Steel plants, coated with rust, grime, and a century's worth of effluvia, do not make for inspiring photos. Yet Casten, pointing to the 16 heat-recycling contraptions that sit on top of the coke ovens at the East Chicago steel plant, notes that in 2004 they produced as much clean energy as all the grid-connected solar panels in the world. Green power may pay great dividends years from now. Gray power, if we would embrace it, is a realistic goal for today.