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By Degrees

Third-World Stove Soot Is Target in Climate Fight



Adam Ferguson for The New York Times

Cooking in Kohlua, India. Soot from tens of thousands of villages in developing countries is responsible for 18 percent of the planet's warming, studies say. [More Photos >](#)

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KOHLUA, INDIA — “It’s hard to believe that this is what’s melting the glaciers,” said Dr. [Veerabhadran Ramanathan](#), one of the world’s leading climate scientists, as he weaved through a warren of mud brick huts, each containing a mud cookstove pouring soot into the atmosphere.

By Degrees

Black Carbon

This is the first in a series of articles about stopgap measures that could limit global warming. Future articles will address appliance-efficiency standards, reducing global-warming gases other than carbon dioxide and other efforts.

As women in ragged saris of a thousand hues bake bread and stew lentils in the early evening over fires fueled by twigs and dung, children cough from the dense smoke that fills their homes. Black grime coats the undersides of thatched roofs. At dawn, a brown cloud stretches over the landscape like a diaphanous dirty blanket.

In Kohlua, in central India, with no cars and little electricity, emissions of carbon dioxide, the main heat-trapping gas linked to [global warming](#), are near zero. But soot — also known as black carbon — from tens of thousands of villages like this one in developing countries, is emerging as a major and previously unappreciated source of global climate change.

While carbon dioxide may be the No. 1 contributor to rising global temperatures, scientists say, black carbon has emerged as an important No. 2, with recent studies estimating that it is responsible for 18 percent of the planet's warming, compared with 40 percent for carbon dioxide. Decreasing black carbon emissions would be a relatively cheap way to significantly rein in global warming — especially in the short term, climate experts say. Replacing primitive cooking stoves with modern versions that emit far less soot could provide a much-needed stop-gap, while nations struggle with the more difficult task of enacting programs and developing technologies to curb carbon dioxide emissions from fossil fuels.

In fact, reducing black carbon is one of a number of relatively quick and simple climate fixes using existing technologies — often called “low hanging fruit” — that scientists say should be plucked immediately to avert the worst projected consequences of global warming. “It is clear to any person who cares about climate change that this will have a huge impact on the global environment,” said Dr. Ramanathan, a professor of climate science at the Scripps Institute of Oceanography, who is working with [The Energy and Resources Institute](#) in New Delhi on a project to help poor families acquire new stoves.

“In terms of climate change we're driving fast toward a cliff, and this could buy us time,” said Dr. Ramanathan, who left India 40 years ago but returned to his native land for the project.

Better still, decreasing soot could have a rapid effect. Unlike carbon dioxide, which lingers in the atmosphere for years, soot stays there for a few weeks. Converting to low-soot cookstoves would remove the warming effects of black carbon quickly, while shutting a [coal](#) plant takes years to substantially reduce global CO2 concentrations.

But the awareness of black carbon's role in climate change has come so recently that it was not even mentioned as a warming agent in the 2007 [summary](#) report by the Intergovernmental Panel on Climate Change that pronounced the evidence for global warming to be “unequivocal.” Mark Z. Jacobson, professor of environmental engineering at Stanford, said that the fact that black carbon was not included in international climate efforts was “bizarre,” but “partly reflects how

new the idea is.” The [United Nations](#) is trying to figure out how to include black carbon in climate change programs, as is the federal government.

In Asia and Africa, cookstoves produce the bulk of black carbon, although it also emanates from diesel engines and coal plants there. In the United States and Europe, black carbon emissions have already been reduced significantly by filters and scrubbers.

Like tiny heat-absorbing black sweaters, soot particles warm the air and melt the ice by absorbing the sun’s heat when they settle on glaciers. One recent study estimated that black carbon might account for as much as half of arctic warming. While the particles tend to settle over time and do not have the global reach of greenhouse gases, they do travel, scientists now realize. Soot from India has been found in the Maldives Islands and on the Tibetan Plateau; from the United States, it travels to the Arctic. The environmental and geopolitical implications of soot emissions are enormous. Himalayan glaciers are expected to lose 75 percent of their ice by 2020, according to Prof. Syed Iqbal Hasnain, a glacier specialist from the Indian state of Sikkim.

These glaciers are the source of most of the major rivers in Asia. The short-term result of glacial melt is severe flooding in mountain communities. The number of floods from glacial lakes already is rising sharply, Professor Hasnain said. Once the glaciers shrink, [Asia’s big rivers will run low](#) or dry for part of the year and desperate battles over water are certain to ensue in a region already rife with conflict.

Doctors have long railed against black carbon for its devastating health effects in poor countries. The combination of health and environmental benefits means that reducing soot provides a “very big bang for your buck,” said Erika Rosenthal, a senior lawyer at [Earth Justice](#), a Washington organization. “Now it’s in everybody’s self interest to deal with things like cookstoves — not just because hundreds of thousands of women and children far away are dying prematurely.”

In the United States, black carbon emissions are indirectly monitored and minimized through federal and state programs that limit small particulate emissions, a category of particles damaging to human health that includes black carbon. But in March, [a bill](#) was introduced in Congress that would require the [Environmental Protection Agency](#) to specifically regulate black carbon and direct aid to black carbon reduction projects abroad, including introducing cookstoves in 20 million homes. The new stoves cost about \$20 and use [solar power](#) or are more efficient. Soot is reduced by more than 90 percent. The solar stoves do not use wood or dung. Other new stoves simply burn fuel more cleanly, generally by pulverizing the fuel first and adding a small fan that improves combustion.

That remote rural villages like Kohlua could play an integral role in tackling the warming crisis is hard to imagine. There are no cars — the village chief’s ancient white Jeep sits highly polished but unused in front of his house, a museum piece. There is no running water and only intermittent electricity, which powers a few light bulbs.

The 1,500 residents here grow wheat, mustard and potatoes and work as [day laborers](#) in Agra, home of the Taj Majal, about two hours away by bus.

They earn about \$2 a day and, for the most part, have not heard about climate change. But they have noticed frequent droughts in recent years that scientists say may be linked to global warming. Crops ripen earlier and rot more frequently than they did 10 years ago. The villagers are aware, too, that black carbon can corrode. In Agra, cookstoves and diesel engines are forbidden in the area around the Taj Majal, because soot damages the precious facade.

Still, replacing hundreds of millions of cookstoves — the source of heat, food and sterile water — is not a simple matter. “I’m sure they’d look nice, but I’d have to see them, to try them,” said Chetram Jatray, as she squatted by her cookstove making tea and a flatbread called roti. Her three children were coughing.

She would like a stove that “made less smoke and used less fuel” but cannot afford one, she said, pushing a dung cake bought for one rupee into the fire. She had just bought her first rolling pin so her flatbread could come out “nice and round,” as her children had seen in elementary school. Equally important, the open fires of cookstoves give some of the traditional foods their taste. Urging these villagers to make roti in a solar cooker meets the same mix of rational and irrational resistance as telling an Italian that risotto tastes just fine if cooked in the microwave.

In March, the cookstove project, called Surya, began “market testing” six alternative cookers in villages, in part to quantify their benefits. Already, the researchers fret that the new stoves look like scientific instruments and are fragile; one broke when a villager pushed twigs in too hard.

But if black carbon is ever to be addressed on a large scale, acceptance of the new stoves is crucial. “I’m not going to go to the villagers and say CO₂ is rising, and in 50 years you might have floods,” said Dr. Ibrahim Rehman, Dr. Ramanathan’s collaborator at The Energy Resource Institute. “I’ll tell her about the lungs and her kids and I know it will help with climate change as well.”

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