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By ROBERT LEE HOTZ

In Case We Can't Give Up the Cars -- Try 16 Trillion Mirrors

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What if we wait too long to act on global warming? What if nothing we do is enough? Already, scientists are working up plans of last resort: stratospheric sprays of sulfur, trillions of orbiting mirrors and thousands of huge off-shore saltwater fountains.

Each is designed to counteract global warming by deliberately deflecting sunlight, rather than by retooling the world's economy to eliminate carbon-rich oil, coal and natural gas.

JOIN THE DISCUSSION

Join Robert Lee Hotz and other readers in a discussion on global warming.

Some scientists argue that such actions might be easier and relatively cheaper. Until recently though, whenever University of Maryland economist Thomas Schelling, recipient of a 2005 Nobel Prize, raised such geo-engineering ideas, "half the audience thought I was crazy and the other half thought I was dangerous," he said. As global temperatures rise and greenhouse-gas emissions accelerate, however, even wild ideas are becoming respectable.

One now under more serious scrutiny was inspired by volcanoes. Climate researcher Tom Wigley at the National Center for Atmospheric Research in Boulder, Colo., and Nobel Prize-winning chemist Paul Crutzen at the Max Planck Institute for Chemistry in Mainz, Germany, last year proposed that an overheated planet could be safely cooled by an artificial haze of sulfur particles, which would reflect solar radiation. The 1991 eruption of Mt. Pinatubo spewed enough sulfates to lower the average world temperature by almost one degree Fahrenheit for a year, with no apparent ill

effects. A sulfate sunshade might cost $400 million a year.

Earlier this month, researchers at the Carnegie Institution of Washington, D.C., released the most precise computer studies yet evaluating the controversial sunshade idea. Their findings, reported in the journal Proceedings of the National Academy of Sciences, revealed that a last-ditch engineering effort to block sunlight could reverse global warming -- at least temporarily. Indeed, it could lower average temperatures to levels not seen since 1900. "Every study we do seems to indicate it would work," said Carnegie climate modeler Ken Caldeira.

Dr. Caldeira and his colleague Damon Matthews at Concordia University in Montreal calculated the effects of curbing solar radiation instead of CO2 emissions over the next 75 years. They tested 11 different scenarios in a complex computer simulation of the world's climate. They didn't weigh the merits of any particular engineering plan but instead evaluated the broad effects of lowering solar radiation as a counterweight to rising carbon-dioxide emissions. In every case, the planet quickly cooled, often in as little time as five years.

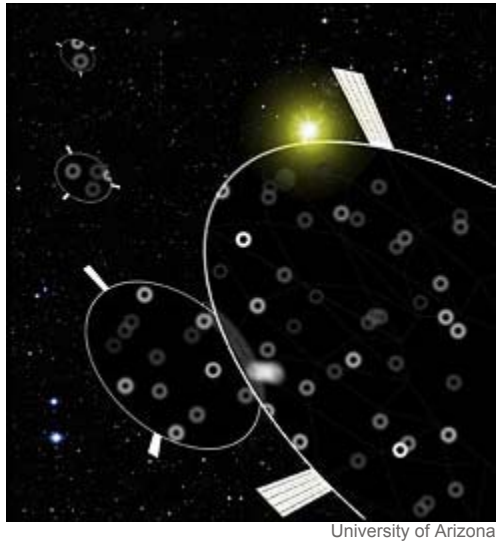
The computer scenarios also revealed the quandaries of climate control without emissions reductions. Even on a cooler planet, oceans still would become more acidic because excess carbon dioxide would continue to leach into sea water, endangering marine wildlife and commercial fisheries. Regional rainfall also would be disrupted, the researchers reported. The world would become much drier.

All in all, geo-engineering is no substitute for reducing greenhouse gases because it can only suppress the symptoms of global warming, the scientists calculated. It might even make things worse. "If the system failed, for technical or political reasons, you would be compressing a century's worth of climate change into a decade or so," said Dr. Caldeira. Depending on the scenario they tested, the rebounding climate could heat up 10-to-20 times faster than today, or as much as 7 degrees Fahrenheit per decade.

"The dangers clearly are very large," said ocean chemist Peter Brewer at the Monterey Bay Aquarium Research Institute. Even the most fervent proponents of geo-engineering are reluctant to sound enthusiastic.

"Nobody likes geo-engineering at all," added University of Arizona astronomer Roger Angel. Even so, Prof. Angel proposed a plan in the journal Science last year to cool Earth by orbiting 16 trillion tiny mirrors -- at a cost also in the trillions. "Just as insurance, we ought to be thinking about it," Prof. Angel said.

Many geo-engineering advocates are desperate for a safety net, worried that



University of Arizona

Trillions of tiny mirrors

people can't cut greenhouse gas emissions quickly enough to make a difference. Since 2000, world-wide CO2 emissions have risen at a faster rate than the most pessimistic trends envisioned by the United Nations Intergovernmental Panel on Climate Change, Carnegie researchers reported last month. "I don't think we can globally reduce emissions enough," said Dr. Wigley. "Forget the politics; I don't think we can do it technologically."

For Nobel laureate Schelling, the political advantages of geo-engineering outweigh its technical risks. It may be easier to launch a climate-control project than to persuade people all over the world to stop using fossil fuels. "It drastically converts the whole subject of climate change from one of regulation involving six billion people to a simple matter of a budgetary agreement about how to manage the modest cost," Prof. Schelling said. "I think geo-engineering is going to be the *deus ex machina* that will save the day."

In case of climate emergency, please break glass. Inside, find contingency plans.

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