



Engineering the Climate: Global Warming's Cheap, Effective Solution

By Bjørn Lomborg

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Global warming will mean more people die from the heat. There will be a rise in sea level, more malaria, starvation, and poverty. Concern has been great but humanity has done very little that will actually stop this. Carbon emissions have kept increasing despite repeated promises of cuts.

We all have a stake in ensuring that climate change is stopped. We turned to climate scientists to best inform us about the problem of global warming. Now we need to turn to climate economists who can enlighten us about the benefits, costs, and possible outcomes from different responses to this challenge.

World leaders are meeting in Copenhagen this December to make a new pact to tackle global warming. Should they continue with plans to make carbon-cutting promises that - based on history - are unlikely to be fulfilled? Should they instead delay reductions for twenty years? What could be achieved by planting more trees, cutting methane, or reducing black soot emissions? Is it sensible to focus on a technological solution to warming? Or should we just adapt to a warmer world?

Much of the current focus is on cutting carbon, but there are many ways to go about fixing the climate. Our choices will result in different outcomes and different costs. The optimal combination of solutions will create the biggest impact for the least money. My think-tank, the Copenhagen Consensus Center, has commissioned top climate economists to examine the benefits and costs of the different responses to global warming. Eventually, a select group of Nobel Laureate economists will identify the combination of solutions that they believe is most effective. For now, the research offers some important lessons.

A groundbreaking paper by economists Eric Bickel and Lee Lane is one of the first - and certainly the most comprehensive - study of the costs and benefits of climate engineering. Deliberately manipulating the Earth's climate seems like something from science fiction. But President Obama's science advisor John Holdren has said that it has "got to be looked at" and many prominent scientists agree.

Bickel and Lane offer compelling evidence that a tiny investment in climate engineering might be able to reduce as much of global warming's effects as trillions of dollars spent on carbon emission reductions.

Climate engineering has the advantage of speed. There is a significant delay between carbon cuts and any temperature drop - even halving global emissions by mid-century would barely be measurable by the end of the century. Making green energy cheap and prevalent will also take a long time. Consider that electrification of the global economy is still incomplete after more than a century of effort.

Many methods of atmospheric engineering have been proposed. Solar radiation management appears to be one of the most hopeful. Atmospheric greenhouse gases allow sunlight to pass but absorb heat and radiate some down to the Earth's surface. All else being equal, higher concentrations will warm the planet. Solar radiation management is designed to bounce a little sunlight back into space. Reflecting just one or two percent of the total sunlight that strikes the Earth could cancel out as much warming as that caused by doubling pre-industrial levels of greenhouse gases.

When Mount Pinatubo erupted in 1991, about 15 million tons of sulfur dioxide

was pumped into the stratosphere, reacting with water to form a hazy layer that spread around the globe, and - by scattering and absorbing incoming sunlight - cooled the Earth's surface for almost two years. We could mimic this effect through stratospheric aerosol insertion - essentially launching material like sulfur dioxide or soot into the stratosphere.

Another promising approach is marine cloud whitening, where seawater droplets are sprayed into marine clouds to make them reflect more sunlight. This augments the natural process, where sea salt from the oceans provides water vapor with cloud condensation nuclei.

It is remarkable to consider that we could cancel out this century's global warming with 1,900 unmanned ships spraying seawater mist into the air to thicken clouds. The total cost would be about \$9 billion, and the benefits from preventing the temperature increase - would add up to about \$20 trillion. That is the equivalent of doing about \$2000 worth of good with every dollar spent.

Many of the risks of climate engineering have been overstated. Marine cloud whitening would not lead to permanent atmospheric changes, and could be used only when needed. Turning seawater into clouds is a natural process. The biggest challenge is public perception. Many environmental lobbyists oppose even researching climate engineering. This is startling given the manifold benefits. If we care most about avoiding warmer temperatures, it seems that we should be elated that this simple, cost-effective approach shows so much promise.

Climate engineering could remain a back-up option in case of necessity. Or we could put it on the agenda today. In either case, there is a commanding case for its serious consideration. We are on track to being the generation that wasted decades bickering over carbon emission cuts and neglected to stop the harmful effects of warming. That is a shameful legacy. Climate policy needs re-thinking.

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