



Global Warming's Technology Deficit

By Bjørn Lomborg

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Our current approach to solving global warming will not work. It is flawed economically, because carbon taxes will cost a fortune and do little, and it is flawed politically, because negotiations to reduce CO₂ emissions will become ever more fraught and divisive. And even if you disagree on both counts, there is a third and ultimately critical problem: the current approach is flawed technologically.

Many countries are now setting ambitious carbon-cutting goals ahead of global negotiations in Copenhagen this December to replace the Kyoto Protocol. Let us imagine that the world ultimately agrees on an ambitious target. Say we decide to reduce CO₂ emissions by three-quarters by 2100 while maintaining reasonable growth. Herein lies the technological problem: to meet this goal, non-carbon-based sources of energy would have to be an astounding 2.5 times greater in 2100 than the level of **total** global energy consumption was in 2000.

These figures were calculated by economists Chris Green and Isabel Galiana of McGill University. Their research shows that confronting global warming effectively requires nothing short of a technological revolution. We are not taking this challenge seriously. If we continue on our current path, technological development will be nowhere near significant enough to make non-carbon-based energy sources competitive with fossil fuels on price and effectiveness.

In Copenhagen this December, the focus will be on how much carbon to cut, rather than on how to do so. Little or no consideration will be given to whether the means of cutting emissions are sufficient to achieve the goals.

Politicians will base their decisions on global warming models that simply assume that technological breakthroughs will happen by themselves. This faith is sadly – and dangerously – misplaced.

Green and Galiana examine the state of non-carbon-based energy today – nuclear, wind, solar, geothermal, etc. – and find that, taken together, alternative energy sources would get us less than halfway toward a path of stable carbon emissions by 2050, and only a tiny fraction of the way toward stabilization by 2100. We need hundreds of times more non-carbon-based energy than is currently produced.

Yet the needed technology will not be ready in terms of scalability or stability. In many cases, there is still a need for the most basic research and development. We are not even close to getting this revolution started.

Current technology is so inefficient that – to take just one example – if we were serious about wind power, we would have to blanket most countries with wind turbines to generate enough energy for everybody, and we would still have the massive problem of storage: we don't know what to do when the wind doesn't blow.

Policymakers should abandon fraught carbon-reduction negotiations, and instead make agreements to invest in research and development to get this technology to the level where it needs to be. Not only would this have a much greater chance of actually addressing climate change, but it would also have a much greater chance of political success. The biggest emitters of the twenty-first century, including India and China, are unwilling to sign up to tough, costly emission targets. They would be much

more likely to embrace a cheaper, smarter, and more beneficial path of innovation.

Today's politicians focus narrowly on how high a carbon tax should be to stop people from using fossil fuels. That is the wrong question. The market alone is an ineffective way to stimulate research and development into uncertain technology, and a high carbon tax will simply hurt growth if alternatives are not ready. In other words, we will all be worse off.

Green and Galiana propose limiting carbon pricing initially to a low tax (say, \$5.00 a ton) to finance energy research and development. Over time, they argue, the tax should be allowed to rise slowly to encourage the deployment of effective, affordable technology alternatives.

Investing about \$100 billion annually in non-carbon-based energy research would mean that we could essentially fix climate change over the coming century or so. Green and Galiana calculate the benefits – from reduced warming and greater prosperity – and conservatively conclude that for every dollar spent, this approach would avoid about \$11 of climate damage. Compare this to other analyses showing that strong and immediate carbon cuts would be expensive, yet achieve as little as \$0.02 of avoided climate damage.

If we continue implementing policies to reduce emissions in the short term without any focus on developing the technology to achieve this, there is only one possible outcome: virtually no climate impact, but a significant dent in global economic growth, with more people in poverty, and the planet in a worse place than it could be.

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