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Cloud control

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There is a disturbing tendency among many in the climate debate today to deride as "deniers" anyone who does not advocate making huge and immediate carbon cuts. The framing began nearly a decade ago with discussions about the science of climate change. People who questioned the link between carbon emissions and warming were branded "deniers".

The semantic similarity to Holocaust denial was made overt when several prominent environmental campaigners suggested a need for Nuremberg-style trials for their opponents. Such rhetoric was deeply unfortunate. However, one could at least argue that the resulting fiery debate achieved one positive thing: it played a role in rousing most climate scientists to join together to underscore the message that global warming is largely man-made.

We have long since moved on from any mainstream disagreements about the science of global warming. Now, the crucial conversation is about the economics of our response. Today, the labels "denier" and "sceptic" are hurled at anyone who does not fervently argue for drastic, immediate carbon cuts. There is no possible justification, given that so many climate economists - the specialists in this field - recommend very different policies from those being advocated by the zealous carbon cut lobbyists.

In my book, first published in Danish in 1998, and then in English as *The Skeptical Environmentalist* in 2001, I wrote that man-made global warming exists. I could not have been clearer; the introduction to the section on climate change states: "This chapter accepts the reality of man-made global warming." My position has not changed. Thus, when I am labelled a "long-time climate sceptic" or "climate change denier" by bloggers and activists, it is not based on any suggestion I have ever declared that the science of global warming is wrong. Rather, it is the campaigners' heated response to my pointing out that drastic carbon cuts don't make sense and that smarter policy responses should be considered.

It is understandable that emotions run high in such a defining discussion. I can appreciate, even in those who disagree with me, a moral intent to do good for humanity. But I cannot see how responding to empirical economics with slander will ever be helpful. Much worse than that, I believe that ignoring - or, indeed, denying - basic economic reality is a shoddy way of helping the planet.

In July, the G8 agreed to make carbon emission cuts to limit global warming to no more than 2°C above pre-industrial levels. This would be the most costly public policy humanity has ever enacted.

The Copenhagen Consensus Centre recently asked top climate economists to explore the benefits and costs of different responses to global warming, to prompt a discussion about the solutions that would have the biggest impact on climate for the lowest cost. We convened a second stellar group of top economists, including three Nobel laureates, to examine independently all of the research and rank the proposals in order of desirability.

One research author, the prominent climate economist Professor Richard Tol, who has been a contributing, lead, principal and convening author for the IPCC, strikingly showed that grand promises of drastic, immediate carbon cuts are a hugely expensive way of doing very little good. Reducing emissions by 80 per cent by mid-century (to achieve the 2°C goal) would avert much of the expected damage of global warming; based on conventional estimates, it would avoid climate damages of about £1.9trn a year by 2100. However, the cost of this would be a reduction in growth - particularly damaging to the world's poor - to the tune of around £25trn a year. Moreover, the costs would come much sooner than the benefits. Every pound spent on this grand plan would achieve twopence worth of good.

Put starkly: drastic carbon cuts would hurt much more than climate change. Cutting carbon is extremely expensive, especially in the short term, because the alternatives to fossil fuels are few and costly. Without feasible alternatives, we just hurt growth, which would be especially damaging for countries such as Brazil, China and India, dependent on fossil fuels to lift millions out of poverty.

It is important to emphasise that Tol's figures are based on projections from all the major economic energy models of the Stanford Energy Modelling Forum. Around half of the models found it impossible to achieve the target of keeping temperature rises lower than 2°C with carbon cuts. The £25trn price tag is optimistic because it comes only from the models that project the target is even possible.

The cost assumes that politicians everywhere in the world would, throughout the entire century, make the most effective, efficient choices possible to reduce carbon emissions. Dump that far-fetched assumption and the cost could be ten or even 100 times higher.

The Copenhagen Consensus on Climate's expert panel considered Tol's research - along with other proposals for responses to global warming - and concluded that drastic carbon cuts would be the poorest approach. The economic lessons are underpinned by real-world experience. In Rio de Janeiro in 1992, politicians from wealthy countries promised to cut emissions by 2000, but did no such thing. In Kyoto in 1997, leaders promised even stricter reductions by 2010, yet emissions have kept increasing unabated. It is little wonder that politicians are backing away from promising that they will be able to broker a new deal on carbon cuts in Copenhagen this December.

Despite the shambles of the Copenhagen negotiations, many carbon cut campaigners refuse to discuss alternative approaches. By dismissing critics as "deniers" and "sceptics", they commit the planet to the poorest policy choice - and one with very little chance of succeeding in controlling temperature rises. We could and should do better. The expert panel of Nobel laureate economists, working for the Copenhagen Consensus on Climate, revealed smarter solutions.

The panel recommended immediate research into climate engineering technology and a substantial increase in research and development of green energy alternatives. The two approaches complement each other. 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. And making green energy cheap and prevalent will also take a long time. After all, electrification of the global economy is still incomplete after more than a century of effort.

Climate engineering has a lot of potential as a way for us to buy more time - but it does not appear to be a long-term answer. We could gain time to ensure that we can shift sustainably and efficiently away from reliance on fossil fuels, which requires the investment in researching alternatives to these fuels.

Many of us fear climate engineering. But the groundbreaking research paper by Eric Bickel and Lee Lane at the University of Texas - one of the first studies of the costs and benefits of these technologies - offers compelling evidence that a tiny investment in climate engineering might be able to reduce as much of global warming's effects as trillions of pounds spent on carbon emission reductions.

The most attractive technology Bickel and Lane examine appears to be marine cloud whitening, where boats spray seawater drop-lets into clouds at sea to make them whiter and thus reflect more sunlight back into space, so reducing warming. This augments the natural process whereby sea salt from the ocean is whipped up and provides cloud condensation nuclei. Marine cloud whitening would not lead to permanent atmospheric changes, and could be used only when needed.

The researchers conclude, remarkably, that we might be able to cancel out this century's entire global warming with 1,900 unmanned ships spraying seawater mist into the air, at a total cost of about £6bn. When the benefits from averted warming are calculated, this is the equivalent of doing more than £2,000 worth of good with every pound spent.

President Barack Obama's science adviser, John Holdren, has said that climate engineering has "got to be looked at", and many prominent scientists agree. Concerns about the ramifications of this technology are a reason to research now to identify all of the limitations and risks. If it turns out that this is not a feasible or sensible approach, we need to have that information as soon as possible.

Marine cloud whitening would obviously not solve every aspect of global warming. But it would achieve more, much faster, than any plausible carbon cuts could ever do, and at a fraction of the price. If we are concerned with solving global warming, then we have a moral obligation to research what we could achieve with this technology.

But there is no point in using climate engineering to buy more time if we do not use it effectively. Since politicians started negotiating carbon agreements, we have wasted nearly 20 years without making any significant progress in reducing global warming. Focusing primarily on how much carbon to try to cut through taxes, rather than on how to achieve this technologically, puts the cart before the horse.

Global energy demand will double by 2050, according to research by the respected climate change economists Chris Green and Isabel Galiana from McGill University in Montreal. Use of fossil fuels remains vital for our development, prosperity and survival. Alternative sources of energy are unfortunately far from ready for widespread use. Green and Galiana show that, to reduce carbon emissions by three-quarters by 2100 while maintaining reasonable growth (a less ambitious goal than the G8's), non-fossil-fuel-based sources of energy will have to be an astonishing two and a half times greater in 2100 than the total level of global energy consumption in 2000.

If we continue on our current path, technological development will not be anywhere near significant enough to make non-carbon-based energy sources competitive with fossil fuels on price and effectiveness. 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 towards a path of stable carbon emissions by 2050, and only a tiny fraction of the way towards stabilisation by 2100. The 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 we would have to blanket most countries with wind turbines to power everybody's needs, and even then we would have the problem of storage when the wind doesn't blow.

Many environmental campaigners lauded China's ambition to create "green cities", powered by huge wind farms. But China plans to build dozens of new coal-fired power plants for these cities, too: otherwise, there will be blackouts every time there is not enough wind. The vast majority of Chinese cities will still rely on electricity from coal.

If governments try to cut carbon through taxes and trading schemes without effective replacements, we will make virtually no difference to climate change in the future, while in the shorter term there will be significant damage to economic growth.

Public funds on research and development also need to increase dramatically. We cannot rely on private enterprise alone. As with medical research, early innovations will not reap significant financial rewards, so there is no strong incentive for private investment today. While many of us assume that green research and development must have increased dramatically over the past decade, the actual numbers from the International Energy Agency show that not only has this spending not risen, but it has actually declined significantly since the early 1980s.

Policymakers should abandon fraught carbon reduction negotiations and instead make agreements to invest in research and development to get this technology to the level it needs to be. Provided that this spending doesn't go into subsidising existing, inefficient technology, but is instead put towards promoting innovation, this would have a far greater chance of tackling climate change - and a far greater chance of political success.

The biggest carbon emitters of the 21st century, including India and China, are understandably 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. Ultimately, we will not succeed politically or economically in tackling climate

change by making fossil fuels so expensive that nobody will use them. However, if we forge onwards with dramatically increased research and development, towards the middle of the century we could make green energy so cheap that everyone will use it.

Discussions about solving the planet's problems will always be emotional. But they should also be reasoned. The most reasonable response to global warming is to change our course and focus on an approach that would actually work.

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