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ROBERT SOCOLOW: What would it take to solve climate change?

PHOTO BY JONATHAN SAUNDERS

INTERVIEW BY BEN JERVEY

What would it take to rein in greenhouse gas emissions and solve climate change?

The concentration of carbon dioxide in the atmosphere is about 40 percent higher today than it was 200 years ago. It's going up principally because we are burning fossil fuels (coal, oil and natural gas) and secondarily because we are cutting down forests. Fossil fuel energy represents 85 percent of the energy powering the world economy, and exchanging the current fossil fuel energy system for a low-carbon energy system won't happen overnight. It could require a century or more if we fail to take climate change seriously. The current fossil energy system is a very strong competitor to any low-carbon energy system we will invent.

With all the talk about peak oil, it's not surprising that people imagine that the fossil fuel era will come to an end soon, because we run out of fossil fuels.

CLIMATE STRATEGIST ROBERT SOCOLOW

How can we move from our current climate-changing economy to one in which atmospheric greenhouse gas concentrations are stable or declining?

In 2004, physicist ROBERT SOCOLOW and ecologist Stephen Pacala, co-directors of the Carbon Mitigation Initiative at Princeton University, published a now-famous paper in *Science* proposing that greenhouse gas emissions could be stabilized by mid-century using available technologies to implement a set of additive changes they called "wedges."

In this Q&A, Socolow shares some new thoughts on solving climate change based on his observations over the intervening eight years.

That's not going to happen. What we will run out of is low-cost oil. But there are a lot of buried hydrocarbons in the form of lower quality reserves (coal, shale gas, shale oil, oil sands and others) that will keep the fossil energy system humming. So we are in a pickle. We will need policies that modify the current competition between high-carbon and low-carbon energy in favor of the latter. We will also need success in research, development, and deployment that lowers the cost of low-carbon energy.

You've expressed concerns about the current discussions of long-term climate targets.

The world's diplomats and environmentalists have nearly universally endorsed a target that is extremely difficult to achieve. A consensus could develop – possibly quite soon – that the very difficult goal will not be attained. It would be desirable to prepare now to discuss some relatively less difficult goal that nonetheless requires, starting immediately, major national commitments and international coordination. We will greatly increase the likely damage from climate change if not achieving the current extremely difficult goal disheartens us and we respond by postponing action for decades.

What is this "extremely difficult" goal?

The extremely difficult global target is known as "preventing 2 degrees." Let me decode this. To prevent 2 degrees, those alive today and our successors must keep the Earth's average surface temperature from rising more than 2 degrees Celsius (3.6 degrees Fahrenheit), relative to the value of the same temperature before the Industrial Revolution. Achieving the "2 degrees" target requires the termination of the fossil fuel era in just a few decades. Indeed, "2 degrees" is now widely acknowledged to be shorthand for cutting today's global carbon dioxide emissions rate in half by 2050.

An alternative target is "3 degrees," which is shorthand for allowing the global emissions rate for greenhouse gases at mid-century to be approximately equal to today's rate. The fossil fuel system would be greatly constrained relative to where global economic growth is taking it. Large deployment of energy efficiency and low-carbon technology would take place during the decades immediately ahead to facilitate the steady curtailment of fossil fuels. But there would still be substantial coal, oil and natural gas in the global energy system at mid-century.

Not to constrain the global fossil fuel system at all over the next few decades could be called "5 degrees." It is the only outcome currently contrasted with "2 degrees" in most discussions of climate change policy. "Three degrees" is the middle option, permitting somewhat greater flexibility and caution, but nonetheless requiring immense effort. We should be using the current period to work out the details of the middle option and keep it in play.

Climate scientists such as James Hansen have written that a concentration of 350 parts per million (ppm) carbon dioxide in the atmosphere is the "safe upper limit." There's a whole organization developed around that number (www.350.org). How do these temperature targets correspond to concentration targets?

Indeed, following the current discussion about targets is a daunting task for the nonspecialist. There is a third way of expressing a climate change target: neither a cap on ultimate surface temperature nor a cap on emissions at mid-century, but a cap on the ultimate concentration of greenhouse gases in the atmosphere. Out of every million molecules in the atmosphere right now, 390 are carbon dioxide molecules. We say that the concentration is 390 ppm, or 390 parts per million.

In Shakespeare's time, the concentration was 280 ppm. 350.org is advocating a concentration lower than the present one, setting an agenda for the next century or longer. I think any goal that far out takes our eye off the ball. Our focus needs to be on how quickly we shut down the fossil fuel system over the next few decades, a period when the concentration of carbon dioxide is nearly certain to be rising.

You seem concerned that we could implement warming mitigation strategies too quickly.

The "2 degrees" target emerged from well-meaning but one-sided reasoning. To be sure, the faster emissions of greenhouse gases are reduced, the smaller will be the disruptions from climate change—the less the severity of storms and droughts, the less the increase in sea level, the less the acidification of the oceans, the less the damage to ecosystems. "Two degrees" was the answer to the question: What temperature rise would occur if the fossil energy system were shut down at the fastest conceivable rate? A two-sided analysis would take into account the disruptions that come from closing down the fossil fuel system quickly.

One reason we need two-sided analysis is that climate change is linked to nuclear war. A rapid global expansion of nuclear power is a step toward avoiding climate change, but it also can encourage the development of nuclear weapons.

My generation considered our greatest assignment to be avoiding nuclear war. The horror of nuclear war is less on people's minds today, but nuclear weapons are still seen as desirable in many countries. The more worried anyone is about climate change, the more he or she should be working to develop the international institutions that can prevent the diversion into nuclear weapons of the uranium and plutonium associated with nuclear power. It would be terrible to exchange climate change for nuclear war anywhere on the planet.

Besides nuclear proliferation, do you have other concerns that keep you from endorsing the quickest possible move away from fossil fuels?

Yes, I do. An uncritical espousal of the fastest possible renunciation of fossil fuels is also irresponsible from the perspective of industrialization in the developing world. Fossil fuels are currently powering this industrialization, and plans for the decades ahead assume that the dominance of fossil fuels will continue. An alternative is low-carbon industrialization in various forms. Yet, very little detailed analysis has been done to understand what would be necessary to make low-carbon industrialization attractive.

To understand why such analysis is critical, note that today roughly half of the world's emissions come from industrialized countries and half from developing countries. To meet the goal of cutting global emissions in half by midcentury, even if industrialized country emissions were to go nearly to zero, total emissions from developing countries would need to fall relative to today. By contrast, emissions of greenhouse gases from the developing world have roughly doubled in the past 20 years. Low-carbon industrialization for sure will require much innovation.

Do you have specific innovations in mind for the developing world?

Above all, developing countries undergoing rapid industrialization need to make energy efficiency a priority. Neighborhoods containing blocks of apartment buildings for hundreds of millions of people are being built today, equipped with hundreds of millions of household appliances. To service these neighborhoods, new roads and new grids for electricity, natural gas and

water are being provided. Unfortunately, most of this development repeats mistakes made earlier by industrialized countries. First costs rather than life-cycle costs drive investments. Measurements of actual usage of power and fuel are rare, even though such measurements would permit energy-savings strategies to be evaluated and made more effective.

Aren't you violating a taboo when you talk about the responsibilities of developing countries?

As someone from an industrialized country, I do indeed find it awkward to lecture counterparts in developing countries about their patterns of development. In effect, I am saying: "Don't do what we did."

I advocate fixing the bad habits in industrialized countries *and* limiting their adoption in developing countries. "Developed" countries can and should pursue energy efficiency much more aggressively—addressing our own poorly insulated homes, low-mileage vehicles, and inefficient refrigerators, computers, televisions and air conditioners. We can and should establish land use policies that reduce sprawl and long commutes.

To sum up, what would you recommend for an overall climate change strategy?

We will know more about climate change in a decade or two, and we will also know more about the societal stresses incurred by aggressive climate change mitigation. It is all too easy to imagine outcomes of addressing climate change that bring societal disruptions as severe as climate change itself. I am confident that preventing such outcomes is achievable. But right now there is too much willingness to pretend that such outcomes don't exist.

I recommend, first, the coordinated development of ambitious emissions targets and emission-reduction strategies required to meet these targets. Second, at regular intervals, in accordance with the principle known as iterative risk management, both the targets and the strategies would be revisited and revised in the light of new information and insights.