Unit 10 **BILL GATES**

Innovating to Zero!

Part 1

I'm going to talk today about energy and climate. And that might seem a bit surprising because my full-time work at the **Foundation**[1] is mostly about vaccines and **seeds**[2], about the things that we need to invent and deliver to help the poorest two billion live better lives. But energy and climate are extremely important to these people—in fact, more important than to anyone else on the planet. The climate getting worse means that many years, their crops won't grow: There will be too much rain, not enough rain, things will change in ways that their fragile environment simply can't support. And that leads to starvation, it leads to uncertainty, it leads to unrest. So, the climate changes will be terrible for them.

Also, the price of energy is very important to them. In fact, if you could pick just one thing to lower the price of, to reduce poverty, by far you would pick energy. Now, the price of energy has come down over time. Really advanced civilization is based on advances in energy. The coal revolution fueled the **Industrial Revolution**[3], and, even in the 1900s we've seen a very rapid decline in the price of electricity, and that's why we have refrigerators, air-conditioning, we can make modern materials and do so many things. And so, we're in a wonderful situation with electricity in the rich world. But, as we make it cheaper—and let's go for making it twice as cheap—we need to meet a new constraint, and that constraint **has to do with**[4] CO_2.

CO_2 is warming the planet, and the equation on CO_2 is actually a very straightforward one. If you sum up the CO_2 that gets emitted, that leads to a temperature increase, and that temperature increase leads to some very negative effects: the effects on the weather; perhaps worse, the indirect effects, in that the natural ecosystems can't adjust to these rapid changes, and so you get ecosystem collapses.

Now, the exact amount of how you map from a certain increase of CO_2 to what temperature will be and where the **positive feedbacks**[5] are, there's some uncertainty there, but not very much. And there's certainly uncertainty about how bad those effects will be, but they will be extremely bad. I asked the top scientists on this several times: Do we really have to get down to near zero? Can't we just cut it in half or a quarter? And the answer is that until we get near to zero, the temperature will continue to rise. And so that's a big challenge. It's very different than saying **"We're a twelve-foot-high truck trying to get under a ten-foot bridge, and we can just sort of squeeze under."**[6] This is something that has to get to zero.

Now, we put out a lot of carbon dioxide every year, over 26 billion tons. For each American, it's about 20 tons; for people in poor countries, it's less than one ton. It's an average of about five tons for everyone on the planet. And, somehow, we have to make changes that will bring that down to zero. It's been constantly going up. It's only various economic changes that have even flattened it at all, so we have to go from rapidly rising to falling, and falling all the way to zero.

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[1] "The Foundation" refers to the Bill & Melinda Gates Foundation.

[2] When Gates mentions "seeds," he is referring to the areas of agriculture that his foundation focuses on helping.

[3] The "Industrial Revolution" refers to the period from the mid-1700s to mid-1800s that saw a new age of manufacturing technology.

[4] If something "has to do with" something else, the two things are related in some way.

[5] The term "positive feedbacks" in regards to climate change refers to something that will increase the effect of the CO_2 emissions.

[6] Gates uses the analogy of a twelve-foot truck and a ten-foot bridge to give an example of a small gap that maybe could be manipulated. Whereas what Gates is talking about, the gap between where carbon emissions are now and zero, is very large and will require a major change in how things are done.

Part 2

This equation has four factors, a little bit of multiplication: So, you've got a thing on the left, CO_2, that you want to get to zero, and that's going to be based on the number of people, the services each person's using on average, the energy on average for each service, and the CO_2 being put out per unit of energy. So let's look at each one of these and see how we can get this down to zero. Probably, one of these numbers is going to have to get pretty near to zero. Now that's back from high school algebra, but let's take a look.

First, we've got population. The world today has 6.8 billion people. That's **headed up**[7] to about nine billion. Now, if we do a really great job on new vaccines, health care, reproductive health services, we could lower that by, perhaps, 10 or 15 percent, but there we see an increase of about 1.3.

The second factor is the services we use. This encompasses everything: the food we eat, clothing, TV, heating. These are very good things: Getting rid of poverty means providing these services to almost everyone on the planet. And it's a great thing for this number to go up. In the rich world, perhaps the top one billion, we probably could cut back and use less, but every year, this number, on average, is going to go up, and so, overall, that will more than double the services delivered per person. Here we have a very basic service: Do you have lighting in your house to be able to read your homework? And, in fact, these kids don't, so they're going out and reading their schoolwork under the street lamps.

Now, efficiency, E, the energy for each service, here finally we have some good news. We have something that's not going up. Through various inventions and new ways of doing lighting, through different types of cars, different ways of building buildings—there are a lot of services where you can bring the energy for that service down quite substantially. Some individual services even bring it down by 90 percent. There are other services like how we make fertilizer, or how we do air transport, where the rooms for improvement are far, far less. And so, overall here, if we're optimistic, we may get a reduction of a factor of three to even, perhaps, a factor of six. But for these first three factors now, we've gone from 26 billion to, at best, maybe 13 billion tons, and that just won't cut it.

So let's look at this fourth factor—this is going to be a key one—and this is the amount of CO_2 put out per each unit of energy. And so the question is: Can you actually get that to zero? If you burn coal, no. If you burn natural gas, no. Almost every way we make electricity today, except for the emerging renewables and nuclear, puts out CO_2. And so, what we're going to have to do **at a global scale**[8], is create a new system. And so, we need energy miracles.

Now, when I use the term "miracle," I don't mean something that's impossible. The microprocessor is a miracle. The personal computer is a miracle. The Internet and its services are a miracle. So the people here have participated in the creation of many miracles. Usually, we don't have a deadline, where you have to get the miracle by a certain date. Usually,

[7] In regards to numbers, something that is "headed up" is increasing.

[8] When something happens on "a global scale," it affects the entire world.

you just kind of stand by, and some come along, some don't. This is a case where we actually have to **drive at full speed**[9] and get a miracle in a pretty tight timeline.

Part 3

[. . .] So let's think: How should we measure ourselves? What should our **report card**[10] look like? Well, let's go out to where we really need to get, and then look at the intermediate. For 2050, you've heard many people talk about this 80 percent reduction. That really is very important, that we get there. And that 20 percent will be used up by things going on in poor countries, still some agriculture, hopefully we will have cleaned up forestry, cement. So to get to that 80 percent, the developed countries, including countries like China, will have had to switch their electricity generation altogether. So, the other grade is: Are we deploying this zero-emission technology, have we deployed it in all the developed countries and we're in the process of getting it elsewhere? That's super important. That's a key element of making that report card.

So, **backing up**[11] from there, what should the 2020 report card look like? Well, again, it should have the two elements. We should go through these efficiency measures to start getting reductions: The less we emit, the less that sum will be of CO_2, and, therefore, the less the temperature. But in some ways, the grade we get there, doing things that don't get us all the way to the big reductions, is only equally, or maybe even slightly less, important than the other, which is the pace of innovation on these breakthroughs.

[. . .] So this is a wish. It's a very **concrete**[12] wish that we invent this technology. If you gave me only one wish for the next 50 years—I could pick who's president, I could pick a vaccine, which is something I love, or I could pick that this thing that's half the cost with no CO_2 gets invented—this is the wish I would pick. This is the one with the greatest impact. If we don't get this wish, the division between the people who think short term and long term will be terrible, between the U.S. and China, between poor countries and rich, and most of all the lives of those two billion will be far worse.

So what do we have to do? What am I appealing to you to step forward and drive? We need to go for more research funding. When countries get together in places like Copenhagen, they shouldn't just discuss the CO_2. They should discuss this innovation agenda, and you'd be stunned at the ridiculously low levels of spending on these innovative approaches. We do need the market incentives—CO_2 tax, cap and trade—something that gets that price signal out there. We need to get the message out. We need to have this dialogue be a more rational, more understandable dialogue, including the steps that the government takes. This is an important wish, but it is one I think we can achieve.

This is an edited version of Gates's 2010 TED Talk. To watch the full talk, visit TED.com.

[9] Gates uses the metaphor "drive at full speed" to illustrate that we are moving quickly in the direction of extreme environmental damage due to carbon emissions and global warming.

[10] A "report card" refers to the grades that students get at the end of a school year in the U.S.

[11] The term "backing up" is used by Gates here to indicate that he is moving backwards on the time line he is talking about, from 2050 to 2020.

[12] When an idea or wish is described as "concrete," it means it is specific and fixed.