In terms of invention, I'd like to tell you the tale of one of my favorite projects. I think it's one of the most exciting that I'm working on, but I think it's also the simplest.

It's a project that has the potential to make a huge impact around the world. It addresses one of the biggest health issues on the planet, the number one cause of death in children under five. Which is ...? Water-borne diseases? Diarrhea? Malnutrition? No. It's breathing the smoke from indoor cooking fires -- acute respiratory infections caused by this. Can you believe that?

I find this shocking and somewhat appalling. Can't we make cleaner burning cooking fuels? Can't we make better stoves? How is it that this can lead to over two million deaths every year? I know Bill Joy was talking to you about the wonders of carbon nanotubes, so I'm going to talk to you about the wonders of carbon macro-tubes, which is charcoal.

(Laughter)

So this is a picture of rural Haiti. Haiti is now 98 percent deforested. You'll see scenes like this all over the island. It leads to all sorts of environmental problems and problems that affect people throughout the nation. A couple years ago there was severe flooding that led to thousands of deaths -- that's directly attributable to the fact that there are no trees on the hills to stabilize the soil. So the rains come -- they go down the rivers and the flooding happens.

Now one of the reasons why there are so few trees is this: people need to cook, and they harvest wood and they make charcoal in order to do it. It's not that people are ignorant to the environmental damage. They know perfectly well, but they have no other choice. Fossil fuels are not available, and solar energy doesn't cook the way that they like their food prepared. And so this is what they do. You'll find families like this who go out into the forest to find a tree, cut it down and make charcoal out of it. So not surprisingly, there's a lot of effort that's been done to look at alternative cooking fuels.

About four years ago, I took a team of students down to Haiti and we worked with Peace Corps volunteers there. This is one such volunteer and this is a device that he had built in the village where he worked. And the idea was that you could take waste paper; you could compress it and make briquettes that could be used for fuel. But this device was very slow. So our engineering students went to work on it and with some very simple changes, they were able to triple the throughput of this device. So you could imagine they were very excited about it. And they took the briquettes back to MIT so that they could test them. And one of the things that they found was they didn't burn. So it was a little discouraging to the students.

(Laughter)

And in fact, if you look closely, right here you can see it says, "US Peace Corps." As it turns out, there actually wasn't any waste paper in this village. And while it was a good use of government paperwork for this volunteer to bring it back with him to his village, it was 800 kilometers away. And so we thought perhaps there might be a better way to come up with an alternative cooking fuel.

What we wanted to do is we wanted to make a fuel that used something that was readily available on the local level. You see these all over Haiti as well. They're small-scale sugar mills. And the waste product from them after you extract the juice from the sugarcane is called "bagasse." It has no other use. It has no nutritional value, so they don't feed it to the animals. It just sits in a pile near the sugar mill until eventually they burn it. What we wanted to do was we wanted to find a way to harness this waste resource and turn it into a fuel that would be something that people could easily cook with, something like charcoal. So over the next couple of years, students and I worked to develop a process.

So you start with the bagasse, and then you take a very simple kiln that you can make out of a waste fifty five-gallon oil drum. After some time, after setting it on fire, you seal it to restrict the oxygen that goes into the kiln, and then you end up with this carbonized material here. However, you can't burn this. It's too fine and it burns too quickly to be useful for cooking. So we had to try to find a way to form it into useful briquettes. And conveniently, one of my students was from Ghana, and he remembered a dish his mom used to make for him called "kokonte," which is a very sticky porridge made out of the cassava root. And so what we did was we looked, and we found that cassava is indeed grown in Haiti, under the name of "manioc." In fact, it's grown all over the world -- yucca, tapioca, manioc, cassava, it's all the same thing -- a very starchy root vegetable. And you can make a very thick, sticky porridge out of it, which you can use to bind together the charcoal briquettes. So we did this. We went down to Haiti. These are the graduates of the first Ecole de Charbon, or Charcoal Institute. And these --

(Laughter)

That's right. So I'm actually an instructor at MIT as well as CIT. And these are the briquettes that we made.

Now I'm going to take you to a different continent. This is India and this is the most commonly used cooking fuel in India. It's cow dung. And more than in Haiti, this produces really smoky fires, and this is where you see the health impacts of cooking with cow dung and biomass as a fuel. Kids and women are especially affected by it, because they're the ones who are around the cooking fires.

So we wanted to see if we could introduce this charcoal-making technology there. Well, unfortunately, they didn't have sugarcane and they didn't have cassava, but that didn't stop us. What we did was we found what were the locally available sources of biomass. And there was wheat straw and there was rice straw in this area. And what we could use as a binder was actually small amounts of cow manure, which they used ordinarily for their fuel. And we did side-by-side tests, and here you can see the charcoal briquettes and here the cow dung. And you can see that it's a lot cleaner burning of a cooking fuel. And in fact, it heats the water a lot more quickly. And so we were very happy, thus far. But one of the things that we found was when we did side-by-side comparisons with wood charcoal, it didn't burn as long. And the briquettes crumbled a little bit and we lost energy as they fell apart as they were cooking. So we wanted to try to find a way to make a stronger briquette so that we could compete with wood charcoal in the markets in Haiti.

So we went back to MIT, we took out the Instron machine and we figured out what sort of forces you needed in order to compress a briquette to the level that you actually are getting improved performance out of it? And at the same time that we had students in the lab looking at this, we also had community partners in Haiti working to develop the process, to improve it and make it more accessible to people in the villages there. And after some time, we developed a low-cost press that allows you to produce charcoal, which actually now burns not only -- actually, it burns longer, cleaner than wood charcoal.

So now we're in a situation where we have a product, which is actually better than what you can buy in Haiti in the marketplace, which is a very wonderful place to be. In Haiti alone, about 30 million trees are cut down every year. There's a possibility of this being implemented and saving a good portion of those. In addition, the revenue generated from that charcoal is 260 million dollars. That's an awful lot for a country like Haiti -- with a population of eight million and an average income of less than 400 dollars. So this is where we're also moving ahead with our charcoal project.

And one of the things that I think is also interesting, is I have a friend up at UC Berkeley who's been doing risk analysis. And he's looked at the problem of the health impacts of burning wood versus charcoal. And he's found that worldwide, you could prevent a million deaths switching from wood to charcoal as a cooking fuel. That's remarkable, but up until now, there weren't ways to do it without cutting down trees. But now we have a way that's using an agricultural waste material to create a cooking fuel.

One of the really exciting things, though, is something that came out of the trip that I took to Ghana just last month. And I think it's the coolest thing, and it's even lower tech than what you just saw, if you can imagine such a thing. Here it is. So what is this? This is corncobs turned into charcoal. And the beauty of this is that you don't need to form briquettes -- it comes readymade. This is my $100 laptop, right here. And actually, like Nick, I brought samples.

(Laughter)

So we can pass these around. They're fully functional, field-tested, ready to roll out.

(Laughter)

And I think one of the things which is also remarkable about this technology, is that the technology transfer is so easy. Compared to the sugarcane charcoal, where we have to teach people how to form it into briquettes and you have the extra step of cooking the binder, this comes pre-briquetted. And this is about the most exciting thing in my life right now, which is perhaps a sad commentary on my life.

(Laughter)

But once you see it, like you guys in the front row -- All right, yeah, OK. So anyway --

(Laughter)

Here it is. And this is, I think, a perfect example of what Robert Wright was talking about in those non-zero-sum things. So not only do you have health benefits, you have environmental benefits. But this is one of the incredibly rare situations where you also have economic benefits. People can make their own cooking fuel from waste products. They can generate income from this. They can save the money that they were going to spend on charcoal and they can produce excess and sell it in the market to people who aren't making their own. It's really rare that you don't have trade-offs between health and economics, or environment and economics. So this is a project that I just find extremely exciting and I'm really looking forward to see where it takes us.

So when we talk about, now, the future we will create, one of the things that I think is necessary is to have a very clear vision of the world that we live in. And now, I don't actually mean the world that we live in. I mean the world where women spend two to three hours every day grinding grain for their families to eat. I mean the world where advanced building materials means cement roofing tiles that are made by hand, and where, when you work 10 hours a day, you're still only earning 60 dollars in a month. I mean the world where women and children spend 40 billion hours a year fetching water. That's as if the entire workforce of the state of California worked full time for a year doing nothing but fetching water.

It's a place where, for example, if this were India, in this room, only three of us would have a car. If this were Afghanistan, only one person in this room would know how the use the Internet. If this were Zambia -- 300 of you would be farmers, 100 of you would have AIDS or HIV. And more than half of you would be living on less than a dollar a day. These are the issues that we need to come up with solutions for. These are the issues that we need to be training our engineers, our designers, our business people, our entrepreneurs to be facing. These are the solutions that we need to find.

I have a few areas that I believe are especially important that we address. One of them is creating technologies to promote micro-finance and micro-enterprise, so that people who are living below the poverty line can find a way to move out -- and that they're not doing it using the same traditional basket making, poultry rearing, etc. But there are new technologies and new products that they can make on a small scale.

The next thing I believe is that we need to create technologies for poor farmers to add value to their own crops. And we need to rethink our development strategies, so that we're not promoting educational campaigns to get them to stop being farmers, but rather to stop being poor farmers. And we need to think about how we can do that effectively. We need to work with the people in these communities and give them the resources and the tools that they need to solve their own problems. That's the best way to do it. We shouldn't be doing it from outside. So we need to create this future, and we need to start doing it now.

Thank you.

(Applause)

Chris Anderson: Thank you, incredible. Stay here. Tell us -- just while we see if someone has a question -- just tell us about one of the other things that you've worked on.

Amy Smith: Some of the other things we're working on are ways to do low-cost water quality testing, so that communities can maintain their own water systems, know when they're working, know when they treat them, etc. We're also looking at low-cost water-treatment systems. One of the really exciting things is looking at solar water disinfection and improving the ability to be able to do that.

CA: What's the bottleneck preventing this stuff getting from scale? Do you need to find entrepreneurs, or venture capitalists, or what do you need to take what you've got and get it to scale?

AS: I think it's large numbers of people moving it forward. It's a difficult thing -- it's a marketplace which is very fragmented and a consumer population with no income. So you can't use the same models that you use in the United States for making things move forward. And we're a pretty small staff, which is me.

(Laughter)

So, you know, I do what I can with the students. We have 30 students a year go out into the field and try to implement this and move it forward. The other thing is you have to do things with a long time frame, as, you know, you can't expect to get something done in a year or two years; you have to be looking five or 10 years ahead. But I think with the vision to do that, we can move forward.