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P R O C E E D I N G S

MS. SIERRA: Good afternoon, everyone. It is my pleasure to speak with you today. My name is Kathy Sierra and I'm a senior fellow here at Brookings in the Global Economy and Development Program and it's my great pleasure to moderate today's discussion on innovation and growth in developing countries. We are a couple months away from a major event in Rio, the Rio+20 gathering of heads of state and stakeholders who will be looking at how we can push forward issues of sustainability. And one of the issues that will be on the table is can we use the concepts around green growth to really push the sustainability agenda even further, marrying the sustainability agenda with growth agenda.

We are doing some research on this issue with the Global Green Growth Institute and you'll be hearing about some of that research in a minute. But I was just at a meeting of the Global Green Growth Institute, which is a new institute in Seoul, Korea, and many policymakers were there talking about green growth. And one of the things they said was that technology provides the glue between the green and the growth. And I thought that was a very nice way to put it. So today we are talking about the glue and how can we help support developing countries in building their capacity to develop technologies, to deploy technologies, and to mainstream those technologies as we go forward. So thank you.

What we're going to hear today is from four colleagues who are on the stage. And let me introduce them in turn before I ask them to give their remarks. Our first speaker on my far right is Dr. Nate Hultman. He's a nonresident fellow here at Brookings in our Global Economy Development Program. He specializes in international

climate policy, carbon markets, and their relationship to low carbon investment decision. He is the director of environmental policy at the University of Maryland School of Public Policy and teaches extensively on climate change and energy policy. He was also a visiting fellow at the Institute for Science, Innovation, and Society and at the Environmental Change Institute at the University of Oxford and has a Ph.D. from Berkeley in energy and resources. He's been leading a team of researchers that are looking at green growth and innovation. He'll be presenting that. Our colleague, Allison Shapiro, is in the audience who has been part of that team. So thank you.

Next, we will be hearing from Dr. Romain Murenzi. Since April 2011, Dr. Murenzi has been the executive director of the Academy of Sciences for the Developing World in Trieste, Italy, TWAS. Before that he was the director of the Center for Science, Technology, and Sustainable Development at the American Association for the Advancement of Science here in Washington, D.C. But the real reason that we brought him here, even though he's got these very distinguished posts, is because he's going to tell us what it really is like on the ground. He served for a number of years as the minister of education, science, technology, and scientific research in Rwanda and was also in the president's cabinet in charge of science, technology, and scientific research. All of this from 2001 to 2009. He has a doctorate in physics from Catholic University, Louvain.

After Dr. Murenzi speaks we'll be hearing from Tim Richards. He is the managing director for international energy policy for General Electric. He serves as the chairman of the World Energy Council's newly formed task force on energy and trade. He co-chairs the Energy Services Coalition, chairman of the Task Force on Trade and

National Electrical Manufacturing Association. Before that he was in the U.S. Government as deputy assistant to the U.S. trade representative for Western Europe and the Middle East, served as a trade policy attaché in Brussels, and has degrees from the Fletcher School of Law and Diplomacy, as well as from Bowdoin College.

Finally, to my near right is colleague, Al Watkins. Since September of last year he has been the executive chairman of the Global Innovation Summit, which is sponsored by the T2 Venture Capital and is a policy advisor to a number of international organizations and emerging market governments. Prior to taking these positions, he served for more than 23 years at the World Bank, serving six years as the World Bank science and technology program coordinator and head of the World Bank's science, technology, and innovation global expert team. He's been an assistant professor at the University of Texas at Austin and an economic advisor to several members of Congress.

So I think as you can see from the lineup we are going to be talking about both what the research tells us, what we are actually seeing on the ground in developing countries, what it looks like from the point of view of the private sector, and how does international cooperation try to provide some glue to this topic.

So I would now like to ask Nate Hultman to spend a few minutes walking through the issue. And you may have had a chance to get a policy brief which is the first summary of the research that Nate and the team is doing. So Nate.

MR. HULTMAN: Well, thanks, Kathy. And it is a great honor to be on the panel with our distinguished guests. I'm looking forward to hearing their perspectives on this really, I think, interesting and important issue at a time that is, I have to say, I think, very exciting. We have the Rio+20 meeting coming up and these international

meetings are good at some things. They're maybe not good at other things but one thing they are good at is focusing our minds on what are the big concepts or the big agenda items that we should be focusing on maybe for the next decade or something like this. Maybe the next two decades if they happen every 20 years.

So they give us an opportunity to pause and reflect and see. Obviously, we've all thought a lot about issues of development, environment, sustainability over the past 40-plus years. Some, not all of us, but some of us have thought it for at least that long. And this is an opportunity to look and see where has sustainable development gotten us and what is maybe missing. What are we needing to do to adapt that model to the present day? What might be missing and how might we improve the way we go about trying to achieve the many goals that we have out of our sort of international development process?

So it's in that light that we undertook this project, as Kathy said, with the Global Green Growth Institute in Seoul. And I'd like to just again acknowledge our co-author on this work, Allison Shapiro, who is sitting here in the audience and has been very instrumental in helping us with that. That work is motivated by this Rio+20 sort of moment, where in the Rio+20 moment the organizers have thought, well, you know, first we had environment and development, then we had sustainable development. This year, as many of you may know, the theme is green economy in the context of sustainable development and poverty eradication, all which are laudable goals. But one of the elements that isn't obviously clear in those goals, although it's been certainly part of the discussions, is the role of innovation in development and simultaneously in helping solve a lot of the pressing issues that we have, the seven-part pressing issues that we're

discussing at the Rio meeting.

So let me focus on that innovation piece for a just a moment. I mean, when we think about that, we think about how can innovation, in particular in diverse development context, address energy access, climate change, economic development, and energy and environmental security simultaneously? Is there a way that we can embed this process in a more sort of rich way across development contexts to get us there? And that is what we've been thinking about in our group. And I know the other panelists have as well.

The goal there is really twofold. It's really to re-envision this innovative process and links to sustainability in the economy, but also then to think about how the international community and national governments can actually add value to what we're already doing. So what is it that's missing? What are we lacking at this stage that we can do better on? And I hope that this moment is an opportunity for us to evaluate what the gaps are and where we might make interventions.

So it's in that light that we undertook this project. We did look at something like 150 to 200 or maybe more, depending on how you count it, international initiatives to address innovation across different kinds of country situations. It's important when we think about this to imagine what I like to call the three dimensions of innovation. So you have the dimension that is sort of the type of innovation. And this is just sort of to help us think through this on the panel today. But you have certainly stages of innovation. There's the frontier innovation, the things that are really high tech that happen in well-funded labs. You have adaptive innovation, which is taking existing technologies or existing ideas and packaging them in different ways. And absorption.

Sort of taking technologies that might already exist and bring them into more broad use.

The second dimension or what we often call the stages of innovation. So that's the RDD&D. So research, development, deployment, and diffusion. And each of those is obviously a different market. There's a different market phase for each of those. The research part doesn't have a market. There's no sale of a product at the end, whereas the diffusion is based almost primarily on market operation. People are buying large quantities of a product that's already viable.

And the third dimension which I'd like to add in, we often talk about those first two, but the other one is development context. And that's one that I think is often maybe not in the kind of people who do innovation very specifically, but in the broader world we often don't think of innovation happening across different development contexts. A lot of people imagine innovation is something that happens primarily against Silicon Valley or very high tech applications but it's important to remember that a lot of the disruptive innovations we've had in the world over the past century or centuries have come not from the predictable places but they've come from sort of the margins. They've come from low margin areas. They've come in terms of surprises that have happened to the people who are trying to kind of, you know, carry on their large industry. And so it's in that spirit that it helps to think about different development contexts also being not only to take new technologies as a diffusion concept but actually make new technologies that could then go into other directions. So it's that that is I think motivating a lot of this.

In order to get to that idea of how we might intervene, what we might do differently, there is a question about what's national versus international. And it is clear that the national governments retain most of the cards in these situations. And so as the

international community we have to think about what is the advantage to doing processes internationally. Really in the end we have to find any ways that we can take advantage of skill, of opening new markets, maybe pooling or collecting financing or giving signals of quality to financers and then finally accountability. So those are the four areas we've thought might be areas amenable to kind of multilateral approaches.

When you look at policy tools, what are the policy tools available to us? And we don't have time for a full exposition of this but there's really tens of them. You know, patent pools, procurement, standards. I'm going to rattle off a few. Rankings, prizes, research grants, market pull, like subsidies, this kind of thing, tech transfer mechanisms, business incubators, investment de-risking. We'll talk a little bit more about a couple of those but again, there's a large portfolio of tools that are available. And one of the questions that I think is a good one to ask at this point is what tools are appropriate for what gaps? And it's in that light that sort of we looked at these gaps.

I want to just mention a few. As we've looked across, what are the needs and what are the institutions that already exist with the idea that we don't want to create new institutions. We have enough of them already. They're already existing; let's make them better. But if there's not an institution, if there's not a coverage there, let's imagine how we might cover that. But there are certainly some issues that stand out and I'd be happy to hear comments from either the floor or the panel, but certainly R&D capacity building at what's called the base of the pyramid or bottom of the pyramid sometimes for, again, the large numbers of people who don't necessarily have access -- full access to energy services and this kind of thing.

Also, the diffusion and deployment sides. Entrepreneurship, developing

entrepreneurship among the areas that haven't had a kind of really healthy or well supported culture for entrepreneurship thus far. Thinking about national strategies and assistance on national strategy implementation and development, both on green growth but also S&T, science and technology and innovation could be an area of help. And then financing. Obviously, a big one. Even in this country we think very hard about how to assist companies with good lab ideas to bring their ideas from the lab bench into commercial viability, a concept often called the Valley of Death. Bringing sort of these companies across the Valley of Death. Is there a way that we can do that without creating excessive moral hazard or without putting a lot of government resources on the line unnecessarily. So that financing part, both making financing available but also maybe making the existing financing a lower cost are areas that we sort of imagined might be useful to address.

I'm going to conclude by mentioning four different areas that we believe that based on our work and discussions not only with these panelists but other people as well, that there might be both gaps and policy mechanisms that could address them currently. So number one is thinking about the research capacity in a lot of not just emerging economies but even lower income countries. And something that a lot of people have thought about but it remains the case that there's still a very low level of research funding available for a lot of the university researchers or research organizations in a lot of countries. So thinking about pooling these resources somehow is something we'd like to raise as a possibility, perhaps through regional science foundation of the kind that Professor Murenzi has been working on extensively.

A second is thinking about the entrepreneurship culture, possibly via

national business incubators. And there are a couple of examples really, interesting examples if successful or partially successful business incubators. We obviously have our venture capital Silicon Valley group here in this country but Brazil has the Center for Innovation and Entrepreneurship and Technology. India has the Center for Innovation, Incubation, and Entrepreneurship as well, and those are, again, early stage models but models that seem to be providing useful tools for entrepreneurs to know how to put an idea together and then also get access to the resources that they need to bring something to market.

Investment de-risking. This is something that the bank and a lot of other people have been thinking about in great depth. We even have the new green climate fund in the climate world. But that's another area. And some areas of technology, maybe not energy but others that de-risking may be a useful area to investigate further.

And finally, and it should not be left completely to the last in some ways, is actually the synergy or the links between these previous three. We often talk about an innovation ecosystem. That you need not only the financing but you also need the set of trained engineers and entrepreneurs in a country or in an environment. And so the idea of an ecosystem I think is helpful for us. There are links between all of them and so there's a way in which pursuing on multiple fronts with these ideas might be value adding beyond just taking any of the three of them in isolation.

So one thing that I think we're interested in is knowing how the links can actually build on each other. It's both a research and a policy agenda of thinking about how those various components of the innovation chain could be linked together more efficiently or better to actually make an outcome that is more valuable to everybody.

Thanks, Kathy.

MS. SIERRA: Thank you very much, Nate. I think you've laid out the evidence that we have so far, as well as some of the propositions that we want to test. So I'm going to now turn to Dr. Murenzi, who has spent his career trying to build science and technology capabilities in both his own country, Rwanda, but now more broadly in Africa and other places in the developing world. It would be great to hear from you what are the obstacles that you see in building this capacity and how are some of the new ideas, such as the one that I know you're working on on regional science foundations, how could those support.

MR. MURENZI: Thank you very much. As you know, the resources that we have, such as water, these are fine energy sources. And the publicity is increasing. By 2050, understand it may be 9 billion. And that is very challenging. Diversity is the same. The number of trees will never really increase dramatically. The number of gorillas or the number of other plants that we know. So it's very important to understand this issue of growth and how do you deal with it really. And then if you go in Africa, let's say for everything in the tropics, you go in the tropics and people there, they rely on the wood to cook their energy. You can talk about sustainable development, clean energy for the cars. At the end of the day, the guy woke up in the morning and he cut the tree. And you don't know what's going to happen in the next 20 to 50 years. And that happened in the tropics. It may be very challenging.

So the capacity to do green growth grows with the capacity to do science and technology. So building science and technology in developing countries is an imperative. There is no choice. Countries have already emerged - China, India, Brazil --

those countries, science and technology, you can say that they are on the right track. China is publishing a lot in terms of publication. It has become, in terms of the volume, the number one actually in terms of publications. (Inaudible) has identified 81 countries that are lagging behind in science and technology -- Benin, Guatemala, Burundi, Rwanda. Those countries are lagging behind in science and technology. So that is very, very important. How do you build their capacity?

Some countries have understood and are working very, very hard on the issue of policy and leadership, but some countries, there is no understanding in terms of leadership of the importance of science and technology for development. And also, you don't see globally a support to build science in developing countries. You don't see -- I was minister for education. You could see people wanted to help for education for all, building schools, putting the roofs. You could see that but you don't see that movement to move really to build science capacity in the south. So that is very, very important. There is a lack of global support for scientifically advanced countries to build science and technology capacity in the south.

Of course, I can talk of the issue of infrastructure, the issue of communication and bandwidth, all these issues I think are very, very important. What are some possible approaches to address this issue? When I was minister of education I established what they call a sector-wide approach to education. I would like to see a sector-wide approach to science. Where you have government, let's say government of Benin or Burundi, really, what can the donors, let's say, the African Development Bank, the World Bank, working with bilaterals, such as USAID, DFID, but having DFID and USAID, having really a science policy. Can the World Bank have a science policy for

development? Can ADB have one? Can IDB have one? Can CEDA have one? That is very, very important. You don't see that coming and then you work with industry, et cetera. Sometimes it can be very important. So the issue of funding of science is very, very important.

And then you can say, okay, what kind of programs can I put in? The continent of Africa, in the next 10 years, they will have more than 10 million students more in tertiary education. And most likely it's one professor, one Ph.D. professor per thousand students. You can't build science. So training, Ph.D. training is very, very important. Once the guy is trained and returned back to his own country, how do you help him? The issue of human capital mobility. You want the guy to be able to come to the U.S. for three months every year. For example, one year in the U.S. in a good lab, one year in Japan, one year somewhere else. Or even link with the other universities around. So human capital mobility is very important. Being able to be given the opportunity to compete on grants and also compete on the innovation issue for prizes, et cetera.

So why do we need a regional science foundation? You see, countries that are small, it's very difficult to have a good and efficient funding agency. But if five countries work together it can work. Don't forget that the U.S. is a continent but you have only one science foundation. But you understand Africa is a continent and we are going to have 45 national science foundations. That is very challenging.

China has one national science foundation. The National Science Foundation of China. China is a continent. Is Africa willing to have 50? So having a regional would be able to help, could put resources together and be able to share

knowledge and do some other things.

MS. SIERRA: Thank you very much. I think you've taken Nate's recommendation for us to see whether we can increase the investment in research and development and kind of walked us through the barriers that are seen particularly on the African continent but I would dare say in other low income regions, other parts of the world.

So now let's move to the other stage of the innovation chain, to the part where the private sector comes in and tries to take advantage of these new technologies and integrate them into the market. So I asked Tim Richards from GE what are your experiences in the developing world on innovation and on moving into the market. Tim.

MR. RICHARDS: Thank you very much, Kathy. And good afternoon, everybody.

Let me start by saying I think the goals of developing a new green sustainable economy are in many ways universal. So if you think about cleaner, lower carbon affordability, reliability of the electricity or the fuel source and access to that energy, those are actually pretty universal themes. And it doesn't mean that all of the technologies that can be developed to address those different themes are identical, but a lot of the basic work that needs to be done is the same. And I think some of the principles that guide how you actually bring those technologies to the market are, in fact, the same, with difference in nuance about how you apply it in developing versus developed countries.

Let me just say a word about GE and not make this an advertisement but more in context partly as an example and partly because I think it helps to kind of

understand what some in the private sector are doing.

So GE as a company about six years ago adopted a program we call "Eco Imagination." And the explicit idea of eco is that there are certain things that are global needs, and many of them are environmental. We believed that we had some technologies and we could develop further these technologies in order to meet those global needs and that we felt that this was a good business model. So we sold this to shareholders because we believed that this was a good investment from a corporate point of view. But at the same time we knew that we were doing it because the reason it was a good investment is because the needs were really there and therefore, if we could provide a better product that there would be markets for it.

So we've now risen to the point where we're investing in R&D alone, not new plant, new equipment, but just research and development on our Eco Imagination products. We're spending $2 billion per year. That's going to last for two more years at least. That's the current corporate commitment. And what are the things we're spending it on? Well, it's all about either zero emissions, lower emissions, higher efficiency, and one more thing, which is water. I'll come back to water in one second.

So the particular products are things like wind turbines, biofuels, a whole range of different types of biofuels and the ability to burn that biofuel in a variety of power generation equipment. Solar, where we've invested in thin film photovoltaics. High efficiency gas turbines and other engines that, among other things, they can burn the biofuels but they're also just more efficient than previous generations. And transmission and distribution efficiency and intelligence. So when you talk about smart grid, which is a little bit of a hackneyed term and misunderstood, but really what it's about is applying

information technology to make grids more efficient and more reliable. And all those are examples of the Econ Imagination products that we've developed.

Very relevant to this conversation, none of these things are developed in one country anymore. So it's actually a fundamental misunderstanding of the nature of innovation today to think that major new inventions are coming out of a single country. At least in our case we have corporate research centers now. Our largest one in the world is in India. We have one in China. We have one in Germany, in Munich. And we're going to be building one in San Paolo -- sorry, excuse me, in Rio de Janeiro. All of you Brazilians cross out that San Paolo. In Rio de Janeiro, which will be opening in about a year. And then we have the first one, which is in Niskayuna, New York, which is outside of Albany.

So when we invest that $2 billion in Eco Imagination products, we're doing that all over the world. And as our senior management says, we don't do anything that is just done in Niskayuna. We also don't do anything that's really just done in Bangalore. It's a teamwork and often we have these teams which are, you know, work during their day, transfer what they've done over to either China or to India where the work continues and the end product is actually truly a global product development.

So that's just a little bit about where we're coming from. So we see, because the very nature of our research is global and quite international, we have people who are very much thinking about the application of the technologies we develop in places all over the world. And I'm sure we can certainly do better but it's something we do think about.

Let me just say -- I have three subjects that I'll touch very, very briefly on

and we can discuss them more in Q&A later. But three concepts that I think we need to think about when we think about what it takes to really accelerate deployment of these cleaner energy technologies and other cleaner technologies. First of all, the word "sustainability." This is, from my experience, what it comes down to is sustainability really is that intersection between public goals, many of which are the ones I started off talking about, but a lot of times what we're really talking about is that cleaner and lower carbon element of those public goals, with what keeps things going, which is the ability of the private sector to make investments and have those investments be profitable long-term investments so that somebody has a real, a true commitment to the projects or the industry in which this is taking place.

So successful stories of technology deployment are almost always stories where you have the public sector setting up the framework within which successful investments are directed towards certain types of areas or technologies and can be done profitably over a long period of time. So that's sustainability, the key point on that.

The second is scale. And this is something that Nate talked about. This whole energy industry is the very definition of a scale industry. It's very hard to develop great technology and then produce it or deploy it on a small scale. So examples where people have tried to do small pilot projects with the idea that that will sort of catch and replicate rapidly have been really difficult because it's difficult to get the cost down and the whole economics of a pilot project, if it's a one of a kind, don't work very well. So we need to be thinking. As we think of sustainability, we also have to add scale into the equation, that the ultimate success stories are usually scale success stories.

And finally, subsidies. And I wanted to end on subsidies because it is a big problem when you try to create the sustainable models of investment where there are subsidized prices for electricity or subsidized prices for fuels, it distorts the entire marketplace. So if you want to have a private investor come in and build a biofuel par generation facility but the customer base is accustomed -- let's take India where the customer base is accustomed to being able to buy power at about one or two U.S. cents per kilowatt hour because it's subsidized. Then either nobody is willing to pay the higher price that the investor of this small biofuel facility would need to stay in business, or if they do, there's the potential for political backlash eventually where people say, well, you know, this investor must be charging us unreasonable prices because it's so much more than we can get it for if we buy the electricity from the public utility where, of course, it's subsidized.

So those are three concepts I think that are important to get out there and consider as we continue this conversation. Kathy.

MS. SIERRA: Thank you. And I think that that -- I particularly appreciate you reminding us that investment in R&D, if you don't have actually the enabling environment and prices to create that market, it may not get the impact that you would like. So we have to keep that in the forefront.

Al, you heard Dr. Murenzi say, gee, why is it that the multilateral development banks or bilateral are not really in a coherent and cohesive way pushing on science and technology in developing countries as part of their cooperation. You were in charge of that at the World Bank and are trying to promote this more broadly in your post-World Bank career. Can you reflect a little bit on what's worked and what hasn't worked

and what would you be recommending?

MR. WATKINS: Yes. Thank you very much.

The way I'll approach it is to look at the issue of architecture. And I want to sort of focus first on the research and development architecture, then on technology transfer, and then on the scaling and the business environment and entrepreneurship architecture.

First of all, for research and development, Minister Murenzi really covered the waterfront very well. And the way I saw it he was talking about two things -- capacity, building capacity in developing countries, and then collaboration. In terms of building capacity, the World Bank -- and he was talking about something called a sector-wide approach, which is a way of getting all of the various organizations to coordinate what they're doing in a particular sector, be it the water sector or the education sector or the electricity generation sector. Something like a sector-wide approach to the best of my knowledge has not been applied for capacity building in Rwanda, Burundi, Africa more generally, but perhaps it's something whose time has come and in my experience at the World Bank, the way these things really tended to move was not that the World Bank was the leader but rather the World Bank was the follower. When there was a demand coming from the clients, the World Bank was, generally speaking, very receptive in terms of meeting that demand. But it wasn't, in this particular case of science, it wasn't in the forefront of pushing the agenda but rather being pulled along happily but being pulled along into that agenda.

So the World Bank is very well positioned to support capacity building and has done a lot of science and technology capacity building, whether it's under the

auspices of an agriculture project or under the auspices of a science and technology capacity building project, we're good at doing that -- or they, since I'm no longer there -- are good at doing that. I don't know if it's a "we" or a "they" situation when I talk about it.

MS. SIERRA: It takes you two years to be gone.

MR. WATKINS: In terms of collaboration, and that's something very important that Minister Murenzi was talking about, you have a scientist in Rwanda and another scientist 50 kilometers away in Burundi and the World Bank, for example, has no mechanism the way the National Science Foundation has a mechanism to take a principal investigator from one country and a principal investigator from another country and put them together on a common research project. The World Bank was designed very explicitly to do more bilateral relationships. World Bank and government in Rwanda, World Bank and government of Burundi. There is some capacity to do these regional projects but it requires a lot of infrastructure on top of it to make it happen. That's something that, however, the African Development Bank and some of the other donors can really begin to take a lead on, but somebody again needs to start pushing this idea, moving it into the forefront, putting it on the development agenda. I don't think it's off the agenda because somebody's thought about it and rejected it; I think it's not on the agenda because people just haven't begun to think about it and this is a wonderful opportunity to start that process.

However, assuming you've solved all of the research and development problems of the world, you haven't solved the world's problems of green growth because having a great invention come out of a laboratory is not the same thing as solving a problem. A patent is not a product, and a product is not a business. And so you have no

way of scaling anything up. You have no way of diffusing something just because you've invented something. And it gets even worse if you've invented something at Cal Tech or you've invented something in India and you have potential beneficiaries in El Salvador and rural Botswana, for example, how are you going to get these ideas from one place to another? There's no transmission mechanism. And that's where -- I guess it's a little bit of advertising although I don't have any financial stake in it -- if you look at the global forum action plan, something that was done when I was at the World Bank, we talked about something there called an ITEC (innovation and technology entrepreneurship center), which was really building the capacity in countries not only to do their own research -- that's important -- but also to find out what's been done in other countries and bring that into your country. Because after all, no matter how good Rwanda is in its research, 99 percent of the world's research will be done outside of Rwanda. And if Rwanda is only going to rely on the output of its scientists, it's going to miss the output of the 99 percent of the research that's being done outside of Rwanda. So a lot of countries, Latin America, for example, Asia, have gone about -- they haven't necessarily put it in these terms but building the capacity to find knowledge that's been generated elsewhere. Bring it into the country, turn it over to local scientists to adapt it for local needs and circumstances, and then you still have the problem that, okay, now you have something that's been adapted to local needs and circumstances but you need to get it out into the market. And that is not a function of science policy in the narrow sense of the world but innovation and entrepreneurship policy, which is inextricably linked but it's something different.

One bit of I guess advertisement, the Global Innovation Summit is really

looking at this last piece of the puzzle. Not the R&D piece of the puzzle, but taking an idea and moving it from the lab to the market by building up the innovation ecosystem of the country, the entrepreneurial capacity of the country. And I would add one more issue here before I stop, which is that scaling becomes really important because even if you've taken a research output and you've combined it with other research outputs and you've imported all sorts of interesting ideas from outside the world and you've solved the problem in Village X, well, in Rwanda there are several hundred villages. In Nigeria there are several thousand villages. How are you going to go from solving the problem in one village or building as a lot of, you know, great NGOs -- Acumen, Endeavor, Omidyar, they're doing this very well. Lemelson. They find an entrepreneur in a village and they support him or her to build a business around an interesting innovation. But they are all stuck at the process of scaling up, moving from one village to a thousand villages and finding financing mechanisms to do this. And combining the money that's available from charitable foundations, like Gates and donors, with venture capital money coming from the venture capital community in Silicon Valley, New York, London, wherever it happens to be.

So these are all very critical parts of the puzzle. If you're going to look at a green growth -- global green growth initiative, it's the research and development, it's the technology circulation and building that capacity, and then it's taking the technology and turning it into scaled-up -- it could be scaled-up small businesses. It's not necessarily one large business like a General Electric, but rather it could be a franchise model where it's a thousand SMEs in different villages taking an idea and deploying it in that one particular village. How you finance that, how you do that, these are I think critical pieces

of the global green growth agenda and challenge. Thank you.

MS. SIERRA: Thank you all.

So I think we've got a lot of food for thought here. I'm going to turn to Dr. Murenzi just to recap. We heard from both Nate and now from Al that there would be a multiplier effect if the international community or we organize support that's not just in terms of building capacity, research and development, but also takes you through this entrepreneurship and business incubation, all the way to commercialization using de-risking funds.

Dr. Murenzi, you said that one of the issues that you found on the continent was a lack of maybe understanding by leaders and perhaps leadership in terms of science and technology. Do you think that if this package was put together it might get more momentum? Or do you think that the African leaders are already thinking in terms of how to link innovation to job creation and to businesses?

MR. MURENZI: It is always a process. The issue of understanding the importance of science technology for economic growth. We know that it works. So we already know that. But it takes time. India, when India got independence, India, Gandhi in 1947 said, "Science is going to feed India." And then he asked the developed countries at the time to help build the Institute of Technology, the Indian Institute of Technology. So each major country, I think Germany built one. And then they started the focus on that. That is understanding.

So people will always say science is important, education is important, but if you realize that the investment in education does not correspond to the rhetoric, that's what I'm saying. So globally, you see it's not only Africa. You have like more than

81 countries or 80 countries; 50 percent in Africa is Islamic. Even an Islamic region. What do you have? You have actually money. So in this country you have money but there is no investment in science and technology. There is no focus on that that believes that science will make the difference. You can go and complain about some other things but realize it is not really that.

So this is what as the head of the TWAS I've been going from China, India, Brazil, all these, whatever, writing, to push people in these country to adopt science and technology policy, which has four objectives, known as a position and deepening, what kind of science in primary educations? Because that's where it starts. The scientists of tomorrow, the entrepreneurs of tomorrow are in the school now. And then you go to knowledge creation. What kind of science for your own country or the region? And then you go to the issue of understanding that science is not only -- most people will tell you the science is the dissection; the dissection they had in secondary school. They were learning about algebra. That was a sign that they know. And they will go and have a focus on that but let's see the healthy science. The water you are drinking is science. The energy science. And then you have innovation culture. If you have education, you have research only and technology transfer, you don't have innovation. You live only in the plane. Innovation makes you lead in three dimension because then you really move forward.

And if you look at the case of water, for example, there is a major project with USAID and Michigan State University. They come (inaudible) of Rwanda and they walk on the coffee. This story is known. Before 2000, the coffee in Rwanda was fetching a half dollar per kilo. Now, it's fetching at $6, $10, $12 per kilo. You can even get

Rwanda coffee in Starbuck's, Costco, because what they did was they work with the farmers, wash the coffee, dry it, take the beans properly, choose the beans properly and get the highest ones, the top quality ones, and export them, rather than just exporting the unprocessed.

And that made a huge difference. What he said a few minutes ago, the technology that Rwanda needs, what is needed in Guatemala to get green growth, that technology exists already. How do you use that technology? Washing the coffee. It exists already. But for that particular village it is new for them. You know it, but they've never used it. So for them it's a new technology. So that I feel is very, very important. And then as a country you need to have that package. The education part, the research part, the technology transfer part, and the entrepreneurship and commercialization and innovation. That package actually, if you have it as a country, that makes a huge difference.

MS. SIERRA: It can be very powerful.

MR. MURENZI: So that is what I am saying. That is missing, that package. A president or a prime minister who will see that package and he will make a speech saying that this is what I want for my country, we don't see them.

MS. SIERRA: And I think hopefully we're going to be seeing some of those presidents coming to Rio to talk about this.

But let me turn now to Tim Richards because you mentioned how research and innovation is actually happening across boundaries and your company is investing in India and China and more recently in Rio de Janeiro. But I think, you know, these are countries that, as Dr. Murenzi has said, have invested for decades in science

and technology capacities there and the market is there. The rising middle class is there. So I think it's not surprising that GE would be there and other companies in your peer group.

The question I have for you is, you know, what would it take to get investment, similar investment to the next tier of middle income, lower middle income as well as least developed countries? Or is that just not going to happen because the capacity in the markets are not sufficient to be attractive?

MR. RICHARDS: I think that, well, obviously, India has a tremendous capacity in terms of fantastic educational system, a lot of Ph.D.s, a lot of technical Ph.D.s. The same is true in China. Brazil is the most recent one and, you know, I think with Brazil we're moving into a country that hasn't had as many people that you would say are in that top tier Ph.D. capacity. And so I think that's a new development in and of itself.

But I don't think you need -- you shouldn't assume that what you need always is the cutting edge research. I think that the kind of activity that Dr. Murenzi is talking about, that might not be something that is corporate activity but it's essential to building the capacity of the country. So I think that there is a sort of fundamental educational element that's probably required before you build a really large research center in lots of countries. You also have to have -- it kind of goes back to scale, too. You have to have a scalable operation for the research center itself, although you can do some things in smaller bites.

I just wanted to just make one more comment though. I think in the innovation culture, I just wanted to connect that because I think your coffee example

connects to the idea that sustainability has to involve the ability to invest in the projects and have the projects be self-sustaining. And I think that's so essential because if you don't have the ability to commercialize the innovation, then it makes it a lot more difficult for the innovation to occur in the first place.

MS. SIERRA: Al, let me ask you the same -- a similar question. So you're having meetings with entrepreneurs in Silicon Valley, the next wave of technology leaders. What would it take for them to invest in the next tier of countries, whether that's the lower middle income countries or the developing countries -- least developed countries?

MR. WATKINS: Well, I would rephrase the question just slightly.

MS. SIERRA: That's okay.

MR. WATKINS: Or maybe the way to answer your question is to say that I've been rather disappointed by what I've seen in Silicon Valley. I'm working with some folks in Silicon Valley. I've been going out there reasonably frequently over the past couple of months. They have no interest in a lot of emerging markets, or to them emerging markets are limited to Brazil, India, and China. But that's not really a problem because they don't understand those markets because they live in California. They live in a completely different reality. But there are tremendous amounts of entrepreneurs and entrepreneurial spirit in emerging markets and there are interesting ways of financing these people. And it's not going to require necessarily Silicon Valley money; it will require Silicon Valley type of mechanisms in the sense that if you go to Silicon Valley and you get a venture capitalist to invest in you, whether it's Facebook or some smaller, less successful, less spectacularly successful but still successful company. What the venture

capitalist does is he doesn't just give you money like a banker does and then sort of walk away and expect to get those regular monthly payments or else they repossess something, no, you get the money and you get adopted. They give you advice. They say, oh, you're producing this product. I know a guy over here who's looking for something like that. I'll help make the linkages to the markets for you. Did you look at this management approach to things? Everything that happens to you is you get adopted and mentored and tutored and connected with a whole global ecosystem so that you're not sitting there as an isolated entrepreneur with somebody's money who is sitting there as a passive investor. That's what leads to the successes that you see in Silicon Valley.

So money is ubiquitous. The techniques that they use are easily transferrable and people are beginning to see them, learn them, and adapt them to their local circumstances. And you find people, whether they were successful eBay executives who go back to Jordan and say, okay, this is what I learned in Silicon Valley and I've got my own billion dollars now so I can create my own mechanism to give back to my country, or you see people who have done something called "start up weekends." Maybe they were students at Stanford or someplace like that. They saw the concept. They got in touch with some people who were running them in Stanford, and now they're going back and they're running them in the West Bank. They're running them in Nairobi. And they're sort of finding these young entrepreneurs and creating the enthusiasm for it, for entrepreneurship and for people to start their own businesses. The challenge I've posed to some of them is how do you take these mechanisms and not use them only for people who are creating the next iPhone or iPad app but how do you get -- use the same entrepreneurial mechanisms for people who are developing and deploying green growth

technologies in clean energy, clean drinking water, all those other sectors which are never going to produce the spectacular returns of a Facebook but will produce good returns in the sense of creating a sustainable business which will yield a return on your money and it'll be a locally successful company that will solve a problem and employ people and generate wealth. You could do all of that but you're not necessarily going to get the Silicon Valley money to do that.

Having said that, one last point, I was at a meeting at the State Department two weeks ago and I think it was Morgan Stanley or JP Morgan announced that they are creating a mutual fund of $1.2 billion that is going to invest in social enterprises in emerging markets. And what they're going to do is collect money in $2,000 increments from the public, just like any other mutual fund that you can invest in the New York Stock Exchange. So money is beginning to find its way over into these sectors because people realize this is where the growth is going to be in the future.

MS. SIERRA: So that takes us back, and I won't ask Nate to comment because I do want to get to the audience questions, but it takes us back to I think their initial proposition, is that you've got a link with research and development but also creating through maybe business incubation centers or other scaled up mechanisms to bring entrepreneurs together with finance and then a financing mechanism that brings it together. So the question that we're going to be probing as we finish our research is how could one organize that in terms of international cooperation so it happens at scale.

So let me now turn to the audience. I'll be taking two or three questions at a time. I ask you to please identify yourselves and then I'll direct questions. And if you have a specific question to one of the panelists, please say so. In front, Lisa.

MS. FRIEDMAN: Hi. Thank you, Lisa Friedman from ClimateWire. Thanks for doing this.

My question I think is mostly for Mr. Richards but anyone who wants to ring in. And I'm wondering if when we speak about green growth or the green economy if there's a role in the innovation that you're talking about for adaptation. You know, I know there's been a lot of discussion lately about the role of private sector, for example, in adaptation. You know, when I listen to Mr. Richards, to the list of investments that you mentioned, you did say water in passing but mostly you talked about things that relate to mitigation. I mean, PV and wind and biofuels. Is there an incentive for investment in the technologies that would help countries adapt better to climate change? Thanks.

MS. SIERRA: Thank you. Way back, please.

SPEAKER: Thank you. My name is (inaudible). I am the lead person for the Special Operations Division for the United States of Africa 2017 project. I usually don't ask a question; I just make a statement. Please go to our website and check --

MS. SIERRA: A question, please.

SPEAKER: Check the $54 trillion consortium that should be place by 2015 when the referendum is held for the United States of Africa. And Mr. Murenzi, please talk to me so that we can include your concern in it.

MS. SIERRA: Thank you. Another question. Right over here. Thank you.

MS. CROUSE: My question -- I'm Tracy Crouse from Cummins. I have a question regarding what the role of corporations -- I know GE's got, you know, a lot of great ideas and they're really working towards the goal of green growth but what can

other corporations do in terms of creating that sort of STEM-educated workforce in developing nations that would really help us to grow? And basically I'm asking what the role of corporations is in furthering these goals.

MS. SIERRA: Thank you very much. And I think there was one last question here.

MS. KLINE: Andrea Kline, development consultant.

I have a question with regard to the patents. You listed that 30 percent, or excuse me, emerging nations; there are just a few nations with U.S. patents. What's done with those patents from the national perspective? Is there a place where it's advertised so that potential investors like the Carlyle Group, the Angel Network could look into that? Or is the USAID or other organizations helping to facilitate that?

MS. SIERRA: Thank you. So let's take that set of questions. There was a particular question to Tim on investment, corporate investment in adaptation, like water. So I'll ask you to take that one. Others can bring it up as well. The role of corporations in STEM education, perhaps Dr. Murenzi and Al could pick that one up. And Nate, if you can talk a little bit about patents and any of the other issues that you might want to take on. So let's start with Tim.

MR. RICHARDS: Okay. So I think there are certain areas where there's a business model in adaptation. And for us it is primarily water. So our water business is focused both on purification technologies, largely membrane based, but others as well. And water reuse. So what we see as some of the biggest opportunity, Dr. Murenzi mentioned the fact that water is a finite resource. In many countries the water tables have been dropping steadily. This is something that will have to be addressed. And so

we see water reuse as a fundamental technology that needs to be developed and can be -- it's already very competitive in certain applications. In California, a lot of jurisdictions have water reuse requirements now. In Australia there are frequently water reuse requirements. I think this technology is something that can be applied in developing countries as well. So that's a very clear -- where there's a need and a business opportunity that warrants the investment. And I think that's enough on that point.

MS. SIERRA: Dr. Murenzi on STEM education and the role of the private sector.

MR. MURENZI: I think the private sector being the recipient of the knowledge -- we all know that the private sector is the investment in technology. (Inaudible) did the study from 1909 and '49 and it showed that actually from that period the labor and the capital was less than around 10-12 percent and knowledge contributed to more than 80 percent. And that is very important. This is why for a long time corporate should invest in science, look forward, because these are going to be the workers of tomorrow. The children in primary education. How does GE, how does Microsoft, how do these companies actually invest in the little ones, those ones? Science and technology, people, when they think of the university they think Cal Tech. Unh-unh. It is the guy in primary school. The guy in kindergarten. That's where the brain, you can still frame the brain. That is very, very important.

Even this issue of sustainable development. How do you use the resources? Where do you use resources if you look at it? So you can even just be educated. Social. How do you link social sciences so that people can do behavior? How do you behave in a way that actually you use the resources in an efficient way?

And that starts with education. At that level, linking education with sustainable development at a very early stage.

Apparently, the secretary general of the United Nations would like -- they are working on appointing -- they have studied, they put up a team to look into appointing a science advisor or an advisory body. And they did ask several questions. What do you want to do? I said educate science for all. Is it possible, like we adopted education for all in 2000, to put a long plan on the science for all? And for that I see a role of the corporate because normally the government would like to invest in things like that but they don't involve the corporate. So if you look at a sector approach to science and technology -- actually that is what I'm doing now. What I did, I visited all the countries -- China, India, Brazil, Malaysia. No, China, India, Brazil, and I went to Japan. Each time I went to meet the leadership of science. The ministers of science in the academies. And then what I'm working on now with Africa, I'm working with the Africa Development Bank. And then I'm looking into Africa. Can some of the corporate in Africa be also involved? So I've been asking Al to link me with the Inter-American Development Bank. But also I am working to link it with the Arab Fund, but also the Asian Development Bank for Asia.

And then you link with the bilateral, DFID, USAID, CEDA. These guys, you work with them. You approach them. And then you ask them, do you want to link with me on that? By putting those together you put a financial mechanism that can be very successful. So then I said the corporate is part of it.

MS. SIERRA: As we go forward. Al?

MR. RICHARDS: Can I say one thing on that, Kathy?

MS. SIERRA: Tim, please. Yeah.

MR. RICHARDS: I think two things to add. One is that there's a big corporate role in providing foundation0type grants to educational programs in the developing world and that's something that we do. Our foundation is primarily oriented towards education and a very large portion of that is science and technology education. And increasingly, we've been focusing more on the primary grades. So that's something we actually really agree with you on and we're putting through our foundation. We're making investments there.

And then the other thing is training, which is more associated with -- in our case a lot of it is training people in countries to be able to work on the equipment that's being installed so that you have local people who have knowledge to maintain and service the equipment as it's being used. And that's so important. First of all, it builds local capacity and it's very difficult to operate any kind of equipment if you're always having to bring people for any problem from outside of the country. So it works both ways.

MS. SIERRA: Al, you wanted to touch this question as well?

MR. WATKINS: Yes, thank you very much. Three quick points. One, I had the privilege of working when I was at the World Bank in Rwanda with Minister Murenzi when he was minister. And one of the things he's too modest to say, but one of the things he did wonderfully well, he was Minister of Education and Science at the time, was building up the science curriculum and the science education programs in the primary schools. And really building it up around locally relevant -- not abstract science but very locally relevant things so that the kids were dealing with science as it applied to their daily life. And he may remember he wrote an article for a World Bank magazine,

Development Outlook, which I edited one volume of and the title of the article was something like “Beer is Science, Cows are Classrooms.” Because if you’re making beer, you’re doing chemistry. And if you have a cow, then you’re all of a sudden involved in animal husbandry and milk processing. And that’s chemistry. So to the extent that you can link all of this it becomes very relevant to the students. And he was a leader in doing that.

You were mentioning the whole question, Tim, of getting people to maintain equipment. I was talking to one of the vice presidents of Hewlett Packard several years ago and he said that we, Hewlett Packard, could sell twice as many copiers and printers if we could find trained people to install and maintain them. He was talking about Africa. So the constraint that Hp was facing was not market demand but trained technicians to install and maintain rather complex pieces of equipment when you think about it.

Last but not least, Hewlett Packard and some other corporations got together in Latin America several years ago under the auspices of the IDB and the OAS, the Organization for American States, and started a program called Engineering for the Americas, which was really getting the big multinationals to work with the local engineering schools to improve the science and engineering curricula so that the students who are graduating would have the right sort of skills to take the jobs for which there was a demand from the big companies. In early April I organized a conference for the African Development Bank and we had the people from Engineering for the Americas Program come out and talk in Africa about there’s nothing that we did in Latin America they said that you couldn’t do in Africa. And it doesn’t have to necessarily be tied to the

Microsofts and the big electronics companies which were the ones that were leading the charge in Latin America. It could be GE on wind power and sustainable energy and water purification. And other companies like that in a variety of different sectors that are relevant for Africa. And so there are models out there to harness the collective power of the governments, the universities, the private sector, to improve curriculum and the quality of education.

MS. SIERRA: Thanks, Al. So Nate.

MR. HULTMAN: Just real quickly on the patents, you've touched on one of the sort of elephants in the room as it were in the innovation area. And in fact, we enter this project looking in much more detail at IP than we've talked about today. We will have something on that in the final report which should be coming out in a couple of months. But on your early one, basically one of the problems with patent sharing and IP sharing is that it's very, very difficult. So that's really, you know, we're looking at international coordination. It turns out that it can be done and we have some good examples of how it's done. In fact, U.S. and China have a nice joint energy research center, for example, but that took a year and a half of essentially constant negotiation to manage the kind of joint IP issues that would arise under that kind of a situation.

So there's been a lot of proposals. There's patent pooling, patent sharing, public purchase of patents even that might be publicly owned. And then joint creation of IP. All of these are tantalizing in some way and all of them so far have some kind of obstacle or sort of complication with them.

I'm not going to go into great detail about that. I'm going to refer you to a couple of sources. Mark Dutz at the World Bank has been working a lot on this issue and

has a couple of nice papers on it. D-U-T-Z. And then the other group, not an individual researcher, but is the World Intellectual Property organization. And they have a whole -- they're starting up, in fact, a very large kind of IP sharing initiative to try to tackle some of the problems that you were identifying, like who actually owns it? How is it -- in fact, it's come up several times. If there is a patent that's owned by some public entity, how do you actually learn about it as an entrepreneur? Like, so in other words, just the basic element of information sharing about getting -- that there is something available that we might be able to take advantage of has been a big gap. And so they've got a sort of multipronged project that sounds very well thought out. They're the World Intellectual Property. They're based in Geneva. They think a lot about it. So I refer you there as well for, I think, some interesting ideas.

Let me, if I could, just touch on this -- I'd love to hear what can corporations do? That's very heartening. And I had the same sort of initial thought as you've heard a couple of times here. Fund researchers, right, but I want to go one step further and sort of embed that a little bit more. I think it's great to fund primary ad and that's something that's useful but let me give some context. I'm biased. I'm a professor at the University of Maryland. It's one of what I consider, one of the great sort of accomplishments of our educational system in the USA, which is our extension state land grant and sea grant institutions. And they've been with us for 150 years and one of the mission of the higher education institutions here, the land and sea grant institutions, is to bridge between the university level work and essentially work that is helpful economically. Just period. Right, like something that is economically useful. And I therefore then look to the model. What can we borrow from this and how might this be applicable? Clearly,

it's not exactly the same institutional context but if you think about that model of VC versus just banker which I think is an interesting model to kind of keep in mind, what do the VCs do? They work with. Right? They don't just give, they work with.

And so thinking about our model here, what do the engineering schools do when they have companies that sponsor their students? They work -- the engineering companies work with the students through their educational process. They have internships. They go back and forth. They work on projects that are of direct interest to the companies that are sponsoring the research. And that's good. Similarly, I think about business schools. They have good relationships with students as well. And there's that very strong back and forth relationship that business schools, that companies work with the students in the business schools. Right? They go back and forth. There's a lot of hands-on.

And so, yes, it's good to fund, you know, fellowships. It's good to fund primary. It's good to fund secondary. It's good to fund tertiary education via fellowships. But even better, if you can somehow work with, if you can bring those -- I'm not saying I have the answer of how to do that but, you know, it requires a kind of longer term commitment and a more -- sort of a little more tenacious commitment honestly to do that. But a focused working-with program is maybe going to be more effective than a broad giving hypothesis. Not proven.

MS. SIERRA: Thank you, Nate. Let's open it up again. Did you have a follow-on question?

SPEAKER: Well, a different question.

MS. SIERRA: Let me see if I can get some other questions first. Thank

you. Yes.

SPEAKER: Hi, Kerry Neiter from Mercy Corps. I was really interested in your comment about franchise models for green growth. And I was wondering if you could speak a little bit about any case studies that you've seen for successful franchise models, and in particular micro franchise models. Thanks.

MS. SIERRA: Thank you. Other questions. Yes, here.

SPEAKER: (Inaudible) I am a visiting scholar at the University of Maryland and I'm also associate professor at (inaudible) University.

Today's topic is green growth innovation for developing countries. So I'm a little confused. What is the role of government? Because we are saying about private corporations' role here, so what is the role of government? Or what is the role of international groups or organizations? And if we say about some technological innovation, especially in developed countries cooperation, what is the contribution to green growth in developing countries? So I cannot see the kind of stream here so I'm a little confused, especially there is a special need in different social, economic, and political context, especially we need to satisfy here we are talking about African society so there is a special need in Africa. So what kind of needs should be prioritized to be satisfied? In that case, what is the role of the cooperation from developed countries or what is the role of international organizations for green growth innovation?

MS. SIERRA: Thank you very much. Another question. I'll come back to you. Thank you. Right here. This young lady right here and then in the back. So we'll take here and then in the back.

SPEAKER: I just have a question with regard to leveraging. If I'm an

organization that's working in a particular country and I have someone that's developed something that's patentable or has potential, what is some ground with regard to the use of technology, that being the Internet, social media, to broadcast that capability and bringing in partnerships? I think if we're looking at a global situation, why are we not looking at international trade associations and the like?

MS. SIERRA: Thank you. Last question way in the back.

MS. SCHALCH: Hi, I'm Kathy Schalch. I'm with the Bureau of International Labor Affairs and I've been working on approaches to the Rio+20 meeting. And one of the topics that was discussed was subsidies. So I was interested to hear that fossil fuel subsidies are, in addition to being hated by economists and being a poor way to alleviate poverty and a huge drain on budgets of developing countries, that these subsidies also inhibit the dissemination and development of green technologies. So do you see any likelihood that this meeting, that Rio is going to make any progress on this issue? It has certainly been a very unattractable one and politically difficult one. And since the private sector also has such a large stake in this, has there been any example of successful intervention or contribution by the private sector to the very difficult problem of how you reduce these subsidies?

MS. SIERRA: Thank you. So I think this will be out last set of questions. So I'm going to go down the line and I'll just quasi-direct the panel. But also I'll ask the panelists to make any concluding remarks. Let me just start with Nate. Perhaps you can take on the role of government issue. And also, what do you expect for Rio+20 in terms of the fossil fuel issue?

MR. HULTMAN: Sure. I'm try to keep very brief.

The role of government, that's a big question. And I think it's an important question. It actually ties into some of these other ones. Currently, the question, if you imagine innovation happening there's all these ideas. There's all these seeds of ideas going out and falling on the soil and some are going to sprout into helpful technologies and others are not. Government sets the soil in many ways. Right? There's a subsidy system that really heavily biases against a kind of cleaner, greener technology because it keeps prices artificially low. Whether there's just flat out subsidy below market or whether it's just the fact that we're not including externalities in the prices that we're charging for energy or something, or water for that matter, then that means that innovations actually will maybe fail because they're just not -- there's not the right market condition for it. So that's an important role of government, is correcting for market failures. Right? So that's one big one. We didn't address that very explicitly here but that's a big one.

And then on the opposite side, I've given a lot of ideas, you know, sort of options today in terms of what collaborative efforts might be done, but there are, in fact, more as well at the national or even municipal and state levels that could be done and I'd be happy to talk afterward about that.

On the Rio+20, will Rio+20 fix the subsidy problem? How about let's say maybe we should look to things like WTO or any kind of other, you know, maybe alternative venues to fix those kinds of intractable problems. I'll leave it at that.

MS. SIERRA: Thank you. Dr. Murenzi, Mr. Murenzi, please, maybe this issue of government's role, but any final words that you'd like to leave with us.

MR. MURENZI: Thank you. Government, as everywhere, is very

important in setting the standards and the policy. And then from there you can work out. But if the government is not involved that will be very difficult. Even just understanding. If the government doesn't understand the issue of green growth, the issue of sustainable development and understanding that it is a long-term investment in science and technology, the right science applied to the right problems, then becomes a problem.

If you take a country like Rwanda but it is the same whole of the tropics, the population that lives around the tropics -- Rwanda, Burundi, Congo, and then they go to India and Latin America -- these populations, the people there, most of them don't have access to energy. You wake up in the morning, you take a shower and these people don't have that. You have electricity. That will not even happen in the next decade or two or three decades. Don't forget the electricity that we have here. In 1997, with the fixed line, this means the wire, Rwanda had only 5,000 subscribers. Five thousand. Now they have 4 million. So the wireless technology that universally, it made a huge difference. So in terms of energy as such, the cooking in the house, which is a major, major problem for us in terms of in-house, what do you call it, inhalations, you have a problem but because you cook with the wood inside the home. These guys are there. They have only one room and everybody sleeps there and then they cook there. And then after they cook, then they sleep. Okay? That's most of the people who live in those. That is real.

How do you do an energy that makes these people -- that is clean? So what Rwanda did a few years ago, they did what they call (inaudible). Efficient cook stove that will -- it's a mud cook stove, better than using 10 wood to to cook the beans, you use probably one wood. And that makes a huge difference. Rather than cutting

down trees, you can get one. Don't forget that these guys, they are aiding the family so they need to eat. So they can use at least one tree a week. For one million families in a year, one tree per week is 50 million trees. Do you plant 50 million trees per year? This is just Rwanda. That is 10 million. But don't forget about the Congo. That is 80 million. And then you go down. Nigeria has 150 million and then you go to other countries, you go to India, et cetera.

So thinking about this issue of green growth is so important. The issue of fertilizer to be able to feed all these guys, that's very important to think about. How do you come up with that? So those are very important issues. So government is very important to be able to link with that. If the government doesn't understand that, if the government doesn't make an effort, then that's a real challenge, a real problem. And sometimes you may not see that in some countries those things happening.

MS. SIERRA: Thank you, Tim. Any of these issues and also final.

MR. RICHARDS: Sure. I'll start with this role of government question also.

I think the energy sector is all about interaction between government and the private sector. And it's just a matter of ratios, about how much is government and how much is the private sector in different countries. But when you're talking about application of green technologies, it is almost -- it's almost impossible to imagine in any country that you will get that combination of cleaner, lower carbon and affordability without some form of government framework that directs -- that actually permits private investment to occur in the spaces that are cleaner and greener and lower carbon and more affordable. So it's really about creating the frameworks. I don't believe that

government can in many countries -- in most countries I don't believe government can do it all because I don't believe it's possible to get to the scale and maintain the scale that's needed. I think only the private sector can do that. So the government creates the framework to make it work.

On the question about franchises, I mean, I love the idea and I hope Al has great answers to that because he talked about, you know, the ideal model which I think follows exactly on this. You have the right framework and you have companies which I hope include our company that develop the technologies that can be applied to solve the problem but you need the investors. You need those small companies that are going to go and operate in a thousand Nigerian villages and bring the technology and make it a business. And that's how it really -- that's what we dream of. Right? That this becomes truly self-sustainable because all the investment is occurring by small companies that are operating in that environment and making some money at it and bringing a better lifestyle to people there.

And finally, on the question about the likelihood that Rio will address subsidies, I doubt it very much but there are people working seriously on this and the World Bank has done a lot of work on advising countries about how to restructure their electricity and energy sectors to shift toward a better outcome. It's tough though. I was in Indonesia a few weeks ago and they had allowed the gas price, the gasoline price to rise not even all the way to market levels but they just allowed it to rise somewhat and the whole town, Jakarta was shut down because the rioting was so severe. I mean, people were bussing around and throwing rocks at government buildings because people start to believe it. It's just become a political problem. People start thinking it's a God-given right

to pay less than the cost of production for gasoline or electricity. And it's a cycle that's hard to break. The only suggestion I would have on that is the solution almost always is going to involve, number one, truly talking about the issue so people understand the consequences. And that obviously somebody is paying for it. And then secondly, you can't just stop it. Phasing out is the only way that these sorts of things can be changed. But I don't think the private sector can do that. I mean, I think the private sector can only comment about it and highlight the issues. Ultimately, that's a governmental decision.

MS. SIERRA: Thank you. Al.

MR. WATKINS: Franchising. Thank you very much for that question.

This is one of the topics we're going to really push on at the Global Innovation Summit. And I'll say that. What I will do is I can tell you very quickly what I've heard from people that I've talked to who are going to speak at the summit. So, for example, you have a technology. I don't know who developed it but it basically allows you to take water and purify it to a standard where it's much healthier for drinking at the village level than it is what they're currently drinking. So it's greatly improved. And you also have attached to this technology, using satellite technology you can monitor what's actually going on at the well head, if you will. And so there's a company out in California which can receive the telemetry and realize this is working well or it's not working well and sort of notify people that it needs to be improved, changed, something needs to be fixed, the filter or something like that.

So it's working in one village. How do you then scale this up to 100 villages? Well, one thing you could do is try to create one company where you've raised enough capital and you have a management structure in place that can manage this in

100 places simultaneously and start from scratch and build up a management structure to manage it at 100 places. The alternative is to follow the McDonald's model where each individual McDonald's that you go into is an individually owned business and they meet certain standards and they meet certain, you know, every McDonald's looks like everyone else and a Big Mac is a Big Mac. But that's important because there are quality. Or Marriot, the same sort of thing. There's quality. You know what you get when you go there but they're all individually owned. And so taking that model, now you've broken down scaling up to 100 villages into the question of can you find some financing for 100 small and medium enterprises rather than one big enterprise which is going to try to do something risky in 100 villages simultaneously. And when you then combine this with -- in this case it would be some technology coming from the U.S. -- with Ex-Im financing, because it's supporting U.S. exports, and then some social enterprise venture capital money, you begin to see that -- and some, you know, start up weekend type of activities, you begin to see that it becomes doable. And these people that I've been talking to have been talking about doing it like this in the water sector. They also have, you know, solar power devices that can sort of provide some LED electricity to a village and running that on a franchise-type of basis.

And then there's a woman was at a number of conferences I've happened to have met where she actually is a distributor taking -- it's called Solar Sister and she has these women selling solar devices, going basically door-to-door in villages and selling it to the other women in the village. Well, can you take that model and franchise it? Because she can do it in five or six villages. She's one person. But if you want to spread it out, can she with some guidance turn this into a franchise model where

you branch out to a thousand villages? And then maybe the solar devices and the solar panels, which GE is producing, suddenly become -- it becomes an interesting model because for GE to sell a solar panel in a village, well, you know, that's not what GE does as its business model. I'm not speaking for GE here but --

SPEAKER: Fair enough.

MR. WATKINS: But as a generalization. But when you're talking about GE or someone else may find this to be an attractive opportunity.

MS. SIERRA: Well, with that I want to now take this and close. I want to thank our panelists. Before I do let me just make a couple of remarks.

One, I want to thank Nate for presenting the research that we're doing here at Brookings and ask people that are interested in this to provide comments. You have a copy of our paper. We're still in the stage of finalizing our research and so we're open for business for hearing comments, questions, and pushing us even further down this.

We heard a number of things today. We heard the importance of enabling framework and the importance of government in all this, not just in terms of putting in place the science and technology policy, innovation policies, but also setting the framework through pricing, subsidies, water pricing, fossil fuel pricing, and the like to draw the demand so that there's something there for the researchers and the business community to be able to see as a market.

We heard about different ways to build science and technology capacities in developing countries but some of the specific barriers that countries in the least developed world are facing, but we also heard about a number of types of

partnerships like corporate government partnerships like those with the international community, whether it's multilateral or bilateral.

We talked about entrepreneurship and it's not good enough to just stop at building great universities but actually building an innovation culture and entrepreneur culture that bridges those inventions and those new inventions into something that actually can go to market. And the fact that in many developing countries you don't have the capabilities and the practices that have been developed in this country and Europe and emerging in places like Brazil. How do you push that forward so you can start building and pushing that type of capacity at the local level, not just for the global players but also for local entrepreneurs?

We finally talked not as much perhaps on the finance side. How do we provide the financing package that can then pull those new ideas? You've got the research. You've got the innovations. You've got the business incubation but they need finance. How can you start replicating some of the venture finance practices and principles and can international finance help by de-risking some of that capital, especially in those areas where capital does not flow? Maybe it's not needed for China but it might be needed for Rwanda.

We talked about scale and the importance of scale. Moving from pilots into different places and the final comment on franchise may be one of the kinds of ideas as we go forward.

So with that I want to thank our panelists, Nate Hultman, Minister Murenzi, Tim Richards, and Al Watkins for joining us. It's been a really interesting panel and I've appreciated it. Thank you very much.

(Applause)

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