SESSION I. GLOBAL PERSPECTIVES

October 18, 2007 – 8:45 – 11:50 a.m.
Speaker: **Zhangliang Chen**

Nina Fedoroff
Science and Technology Adviser to U.S. Secretary of State Condoleezza Rice
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Could I ask our next two speakers to come up? I will ask all of the speakers to rejoin us on the stage at the end. The next speaker is Professor Chen. Considered China's foremost authority on agricultural biotechnology, Professor Zhangliang Chen completed his Ph.D. at Washington University in St. Louis in 1987 and returned to Beijing to establish the National Laboratory of Protein Engineering and Plant Genetic Engineering, which he still directs.

He is also president of China Agriculture University, which is a leader in biofuel, research and engineering in China and was honored on *Time* magazine's Global 100 Young Leaders for the New Millennium. In 2007 Professor Chen joined the World Food Prize Council of Advisors and is joining us for the first time today in that capacity.

Professor Chen will outline China's current activity and interest in the area of bioenergy and will also review some of the research and innovations that have come and will come out of the University in the future.

Professor Chen.

Zhangliang Chen
President, China Agricultural University
World Food Prize Council of Advisors

Thank you very much, Nina, and Nina is a real pioneer researcher for GMO. When I was a graduate student, I read quite a few papers that were published by Nina.

It is my great honor to be invited to join this important dialogue, this important symposium. And as you know, China is a big country and people worry and are concerned very much about energy consumption and CO_2 emission and other things happening in China. So I'd like to summarize the status of the energy situation in China and the status of biofuel or bioenergy in China and the challenge, the difficulties, and the solutions that we are seeking now.

As you all know, energy demand has increased dramatically. China is the number four largest economical body in the world, and so we need a big amount of energy. Energy needs rose 47 percent in the year 2000 and will continue to increase annually 3 to 5 percent after the year 2005 until the year 2020 because our goal is, in the year 2020, our GDP is supposed to be four times as high as in the year 2000.

So China is the second-largest consumer of primary energy. As you know, we consume about 1420 million tons standard coal equivalent, called TCE, and we are the second-largest importer of oil. Population trends are very important, and are also key factors for energy consumption. As you all know, 80 percent of the population were farmers before, but now it's a little bit over 60, because of urbanization, more people have moved to cities. 150 million farmers moved to cities in the past 10 years, and we expect another 100 million farmers will move to cities. And you know, that needs energy. More and more buildings are being constructed in Beijing and in major cities, and people need air conditioning. Like the first speaker mentioned, we need air conditioning – that needs energy.

This data shows you that so far the country, the primary energy we use. Obviously, the biggest one is coal. We use a large amount of coal as you see from the chart. In the year 2005 this is the biggest energy resource, and then petroleum and wind energy. And then people expect that we are going to use a large amount of energy from water or hydropower. This is the petroleum that we use. Since about the year 2002, you can see that we've increasingly continued importing oil from the world. In the year 2006 it gets close to 50 percent, the oil that's actually imported.

This is a prediction of available energy reservation in China. Some people predict that we can afford to use coal for 60 to 100 years more. And for oil, people expect 20 or 40 years to use up all that coal and oil.

Government, indeed, pays so much attention to energy consumption, as has been mentioned by previous speakers. There are many new policies being made for saving energy and to create new energy for such a big country to use. Recently, in a congress – I'm in the Congress – we even passed a renewable law, and this passed two months ago, called "Renewable Energy Law in China," to encourage citizens to use renewable energy, to produce energy, and also to subsidize the price for renewable energy. This is a national law.

This is the situation in China today for energy consumption. You see, as I mentioned, the biggest one there is from coal, petroleum, hydro-nuclear-wind power; this is all non-biofuel energy. But then for bioenergy, in terms of renewable energy, you see there for modern bioenergy and solar energy, hydroenergy. Then you see 59 percent of renewable energy came from household stove fuel – especially for gas, which I would call biogas. This is very significant, and China's the largest country in the world using biogas. And I'm lucky enough because one minister, Mr. He Kang, is in the audience. He's the one that actually pushed very hard for the application of biogas in our country.

So for bioenergy approaches in China, there are three major approaches. Number one, for direct combustion; second for physical conversion; and number three, for chemical conversion. Those are three major approaches today and in the future.

The resources for bioenergy production, we're lucky enough, as Roberto mentioned in Brazil – Brazil is as big a country as China – and we are quite rich in terms of resources to use in generating bioenergy. And for one, we used organic existence from agriculture, forestry and industry sector, and also use energy crops in other cities, and solid waste.

This is the table, the data to show you about biomass material, not including energy. We have urban organic waste, agricultural industrial waste, firewood, forestry residue, animal and poultry waste, and also crop residue. So, most of our bioresources came from crop residue.

This is a structure for bioenergy today in China, in the year 2006. You can see that major one came from household stove fuel that almost equals to 97 percent. Then we have biogas, bioethanol and bioelectricity. So this is the first approach for direct consumption. And this is always the major energy for rural areas. We actually have the technology to produce pellets, and then we have gasification, biomass gasification.

This is the first plant – we call it biopower plant – in Shandong Province in the year 2007, just newly built. This one we actually use 100 percent from crop straw, and then mix with coal to generate electricity, so we call it biopower.

I mentioned to you for biogas – this is the largest country that uses biogas. And this gentleman I mentioned, the former Minster of Agriculture, He Kang, he is our World Food Prize Laureate. He's the one that pushed very hard to encourage farmers to use biogas.

It's been ten years already, and by year 2000 we had 15 million households using biogas. And by the year 2006 we have 20 million households using biogas. And Mr. He Kang distributed a paper, so if you would like to read his paper, it's outside to view – his paper for bioenergy in this area. And we expect that by year 2010, 27 million households will use biogas, and this is very significant to China in terms of biofuel or bioenergy.

We also have plants, and factories for food, using biogas, the large and medium, from 1996 to 2005. So you can see that there's continuing increase in building biogas plants. By the year 2010 we expect to have 8,600 plants for producing biogas in China.

Our third approach is liquid biofuel. This is a very new one. They have a lot of experience in Brazil, and we have had so many people sent to Brazil to learn how to grow, especially how to generate ethanol and diesel from those energy crops.

Starting in 1986 we had the technology available; in 1999 we started to build four factories that had been approved by the government, big factories. So in 2001 China was in production; in 2002 it was really functioning both in Henan Province and Heilongjiang Province. In 2003 we expanded to several other provinces, so altogether in about seven provinces we're using blended gasoline – about 18 percent of our gasoline.

This is a kind of history to show you how the Chinese government and policy has encouraged biofuel, bioenergy, in use. I mentioned to you that we have four major factories that produce ethanol from corn, that are approved by the government, and since 2003-2004 they've been in action. However, you see here, in 2006, we've got a problem because somehow we see

the competition for food with ethanol, through the corn. So then, in the year 2006 in November, all those four plants were ordered, "Stop using corn to generate ethanol. You have to use other resources to produce ethanol" – because the price of corn increased quite significantly in China, and also in the world market. So a new technology was needed to grow other energy crops or to have the technology to produce ethanol from other resources.

This is a map to show you – a map of China to show you those four major, huge plants to produce ethanol, and that was starting in 2004, and we have also production in a limited amount of biodiesel.

But I mentioned to you that starting in 2003 and 2004 you can see on this chart that ethanol production in China increased geometrically to 2004, 2005, 2006. Now, November 2006, the government ordered those four factories to stop producing ethanol from corn. So you see the amount of ethanol increased much slower. This is the situation at this moment.

There's competition for land, for corn used for ethanol, and also the problem of the competition the land for agriculture, because as you know, we can feed 1.3 billion population with about 8 percent of arable land. I admire Brazil a lot because they have plenty of land to use for agriculture, but in China it is only 8 percent arable land to feed a 1.3 billion population. We have enough food, but we actually are importing major crops, as you know; we import the biggest one, that's soybean.

We imported almost 28 million tons of soybeans last year, and this year, in May, we signed an agreement with the U.S. to import 8.3 million pounds of soybeans from the U.S. this year. And it grows in this area – Iowa, Wisconsin and other places around this area. So 8.3 million tons of soybeans will be imported to China.

I still remember the chairman of the soybean organization, Mr. Niemann, saying, "We're happy that the Chinese could purchase such a big amount of soybeans, and we'll be happy to provide more soybeans to China. But we cannot use too much land for those if we planted corn for bioethanol."

So then we have a new policy. We know that there can be no competition with food for people and no competition with land for crops. So we need new producers with new products. Any new factory built, it's an order, or it's a policy: don't use food for resource to generate ethanol or diesel and other things. And they had to switch to think about some other crops, new technology, called cellulose-to-biomass that's being established in China.

So recently it's being invested in by other companies, international companies also, to build a new factory in China for producing bioethanol from other resource. For example, 2007 we have two factories built and then to use sweet potato and also other plants.

People are thinking about using not only corn, as you can see there. This is a map of China, where we can grow corn, sugar, cassava and sweet sorghum – those are the energy crops – but then we're thinking of the sugar cane, cassava, or sweet sorghum. This is a map to show you the area where we could grow sugar cane, the area where we can grow cassava, and the area where we can grow sweet sorghum.

So far in our university, a major university for research in biofuel, we believe that sweet sorghum could help to generate a larger amount of ethanol. And it's easy to grow. It can grow in areas which do not compete with normal sorghum or corn in the fields.

Other biofuel material that is in the fields is now basically experimental. And then we have several new plants that are being considered; one is jatropha, and some others related to those energy crops and plants that are being considered to grow in China. It could grow very well in some places more related to crop production.

And also more technology is needed for bioenergy, including new energy crop breeding and cellulose technology, and also for engineering innovation and engineering for biogas and utilization. That's been strongly supported by the government program.

The challenges for biofuel: We know that we need to develop this industry for sure. And we know that we cannot compete to use crops to generate those biofuels. So then we have so many challenges in China. We know that.

Number one is motivation, because you have to have it cheaper in terms of cost, of benefit. So the motivation to the citizens and to the industry is very important.

The second challenge is water stress. We tried to convince that we can use other alternative energy crops to produce more energy, which is true. But then, we understand the problem. Luckily enough, in Brazil they don't worry too much about water there. But the water is a big problem in China. We really need water in terms of irrigation in agriculture. If you plant more plants, even in some rural areas, it needs water. So water is just obviously the second challenge.

Number three, people worry about plant diversity. We are thinking about growing some other energy crops in some mountain areas or hills in southern part or western part of China. But then that means we might have some effects for plant diversity if we grow in large scale those energy crops.

There's some uncertainty, including for greenhouse gas emission reduction and also for positive energy generation. So some uncertainty in this area. For biogas, in those rural areas, we know it has saved lots of carbon dioxide in terms of pollution. But then for growing such alternative crops or plants, we have lots of uncertainty.

Another one is that people always say food and fuel balance – no meals for wheels. That's the general conclusion. At this moment we cannot sacrifice the meals to feed those cars on wheels.

In the university, it's been over 20 years that we are in the area of bioenergy research. And in 2004 we even established BEC, the Biomass Engineering Center, to do research for bioenergy, especially for plant breeding, new crops, and for some other policies, and to study all those technologies, including engineering technology and new technologies for cellulose.

And we have lots of international cooperation, and we encourage more international cooperation. We have many training programs. At this moment we have about 55 African scientists, they are on our campus – we're together for this training course for bioenergy.

And this is a business. We know it is a big business. We are number four in terms of the largest economical bodies in the world. We'll be maybe number three soon. So we need lots of energy, and we know that we cannot just continue to use 50 percent imported oil, petroleum – 50 percent imported, we cannot do it. And for coal, we cannot use that much because people worry about carbon dioxide.

So bioenergy, obviously, has a very important future in China. And you can see the prediction here, in 2010 and 2020, the amount of bioethanol we are supposed to use, and also biodiesel.

We encourage joint ventures today in China. I know we have two companies in the audience that have a joint venture this year and last year in China to produce bioenergy and biodiesel. And this is just a start. I know there's big business there, and I encourage more people to get involved in China for producing those biofuels.

Finally, I'd like to acknowledge again the World Food Prize for the invitation, and also I'd like to acknowledge my colleagues Cheng Xu and Dong Renjie – they are professors – for providing enough material to give a talk here.

Thank you very much. If you need any information, I will be happy to answer, and I have e-mail here. And thank you very much.