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Biofuels in the Energy Mix
Transcript of remarks by Helena Chum
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Transcript:

Thank you very much Adrian, thank you for the introduction. It is a big pleasure for me to be here talking with the audience, principally because this is a policy talk and I have been involved in policy, the policy setting, for some time. Now lets see, what happened here? Yes. And it's really wonderful to follow Sue Tierney in this really productive hour learning about energy policy in the United States. And what I would like to do is take the opportunity to look at biomass and renewables. Let me see if I can stay more or less here, talk and you can see me. I'd like to make some comments on Maine in particular, because in the biomass field Maine has a lot of resources. And national policy, regional action: the regional actions aligned with national policy is what can do the best, okay, whenever we had, in past, federal and regional and state actions aligned, we did so much so fast.

What I'd like to do today . . . let's see, I probably have to use . . . is talk a little bit about where I come from, just very quickly. The National Renewable Energy Laboratory is one of the Department of Energy laboratories. It belongs to Energy Efficiency and Renewable Energy. You probably hear about many national laboratories, and they belong either to the science part of DOE or nuclear security. There are several laboratories that do that as well as fossil energy. But the National Renewable Energy Laboratory has always been a dedicated lab with a mission dedicated to renewable and efficiency that goes from science to technology solutions and that rests on the collaboration with industry and university so that the research is linked to market opportunities and we help industries emerge. In the twenty-six years that I have been there I have seen a lot of progress and I'm going to share some of the progress that I have seen with you. We also have had quite a number of ties with Maine, the University of Maine, and several people in the audience. You can see Scott, Scott Christiansen is over there; Mike Bilodeau was here, as well.

Charlie Slavin whispers: Would you prefer to use this so you don't have to. . .

Chum: I would, yes. I would like to do that, thank you. And you saw here the photos of the Representative Michael Michaud and what they were doing here was actually witnessing a memorandum of understanding of collaboration between the laboratory and several organizations in Maine. That's in May of 2004 and we still continue to work and refine what we're doing together, and it's wonderful to be here introduced by Adrian and we are continuing to have interactions and collaborations and we hope to increase those as time goes on.

I'd like to talk about a little bit of history. The history is great to help us think about the future. Not to make a projection, linear projection, but to actually go beyond that, learn from that. Then I'm going to talk a little bit about today, today's status and a little about the future of renewable energy. Sue, coincidentally, we choose exactly the same two sentences which are equally valid today, but technology, markets and policies have made progress in the right direction, just not as fast as they thought that it would go.

Now, here's just a simplified look. This is a slice of six percent. People may say six percent is not very much. U.S. consumption is enormous, obviously, six percent is very important. Let me give you examples. See, biomass and hydropower are about the same. Have more than 9 gigawatts. That's sixty terawatt hours. Folks, that's more than Portugal uses, the whole country. That's three quarters of UK. Okay, so let's not think renewables is small in the United States. The geothermal is a fraction following those two. Wind is growing, double digits now. Again, policy is aligning and so technology is reaching. Commercialization maturing. Solar is moving as well. I'll come back to that in a little.

I would like to cite a reference. One of the things I really loved after my stay in Washington, DC for over a year, in helping put some things together, is doing the history, doing policy's history in the biomass and bioenergy, and I'll just give you a little bit of that study. Look at accumulative investment of DOE in bioenergy, bio-based products. You know, very large, and I'll show you what that relates to. This time we were really trying to scale up this and move to commercialization. That’s when we didn't have ready technologies. We invested a lot. We learned a lot. But you see what happens here, and I'll come back to that, but look at the level 1.4, 1.5 billion dollars in 2000 terms without including the loan programs. You almost double that if you include those.

What happened from a policy point of view during this period? Right here we were reducing dependence of energy imports. Mainly oil, we still continue to need to do that. We’re developing alternative fuels from a variety of sources. We're supporting RD3, research, development, demonstration. We've had outreach, enormous outreach which was very good. Pioneered plants, some of which succeeded and some which didn't. We've had a wide range of technology options. It was mostly tech-push, okay? We had multiple progress approach, which is reasonable. Now then the era changed very dramatically because the issue was one of supply and demand imbalance. Well, we went back into research and development. What have we done in this period? We started lots of business, lots of activities. And they say now the role of government is not that but it is to do R and D long term, high risk? We left a lot of people behind. But this part did continue to develop technologies to reduce the risk and it did do a lot for production of demand to increase efficiency, and did focus on the high risk r and d which did collect significant learning which was important, and did focus on liquid fuels, and how to solve municipal solid waste issues effectively. Then, I'm going to turn political on the next graph. The increasing renewable energy and efficiency was a higher priority in this part, okay? We were doing now the R and D with public/private partnerships. We were trying to actually mix a little more of tech push and market pull. We were also doing some more outreach bio-plants demonstrations of integrated biomass production in emergent systems. We're beginning to look at lifecycle. We're beginning to look at systems and we actually have, in energy, in biomass, we have to look at the overall system we cannot look in isolation.

So, this is then what the scenario from a political point of view and a number of laws and regulations what were necessary that came true. So, the Carter era we had a very important act, the Public Utility Regulatory Policy Act. It set in movement the beginning of deregulation. What we had here was a certainty created for certain markets. When you have certainty then investment follows. So there's an electricity market for certain qualified facilities, they follow. The Crude Oil Windfall Profits Tax, and all of this package we really started the ethanol, but you see ethanol took a longer term, time to get through. Then Clean Air Act Amendments we have the Clean Act-er over there. Then conservation. The major Energy Policy Act here which was much more of a technology push, okay? Over 2000 we had a Biomass Research and Development Act. For the first time government telling, Congress telling all sides of government, all government that has anything to do with biomass please, you will work together? Not please, you **will** work together. That is very important because USDA controls the, the biomass. DOE knows how to do technology. So the two of them together, and EPA does the regulatory actions it needs to do. So this is extremely important and was a very good start.

Now lets see, all these policies, all these acts, what did they do to the marketplace? See this is a, for those of you in non-metric scales, this, this is that in petajoules. A thousand petajoules is one exajoule, and that's very near a quad, okay? So you can look at this and think in watts. Look at the use. The industry here is primarily pulp and paper, independent power producers. This part in black is the municipal solid waste and landfill gas. The yellow is what happened to residential. The red is commercial, and the blue is ethanol. So as we went on, look at how bad this was. Here was an industry that could have been self-sufficient in energy. It is, in Europe. Here, it wasn't. In fact they were buying oil and burning oil in their recovery boilers. So, this was very quickly the price signal was sufficient. This, this was a change time. This was another change. A lot of the states here, Northeast states, changed to biomass in the heating part. Maine state is there, that heating oil needs to go, we need to replace it. Now, as time went by, as many households went into wood heating and the independent power producers increased, the way to handle the municipal solid waste… Some of those combustion facilities have emissions that are regulated so much stricter than any coal plant you wanted to see. So those are in fact quite, quite reasonable plants right now. And then look at what happened with the Clean Air Amendments and look at what I say when policies, regulation actions, and technologies aren't aligned. Each one was looking at their sphere. And energy would say stop using oil. The Clean Air was started but then the Amendments then tightened up the emissions. We have had back here the desire, like Cohen admitted, do your multiple purposes, do all of it combined. We spent a lot of time and energy doing a lot of conversions and then we had to step back because we had to go pay attention to Clean Air Amendments. So that's a little bit of history, but just to say that if you do multiple objectives from the start you're much better off. Next one, you see the, this group, the independent power producers group because they had certainty of how long they could sell electricity at very favorable conditions.

Past, future. We had looked and the question for biomass is: is there really enough to make any difference? So, we in the laboratories—and the National Bioenergy Center includes five laboratories—we looked at supply curves when the Clinton Administration was issuing the biomass R and D activities that led to the Biomass R and D Act. We're looking at what is the supply, how much biomass could be had at different prices but preferably some relatively low price so that we could convert it to fuels and energy. Or, fuels, energy and product. So, you see here this, at various prices, and then we had to try to put our arms around how much? What's the potential? This is the gigaton study, the gigaton vision. The gigaton vision says, okay, we take those projections, we go further in time, we do an analysis of what's reasonably obtained. And this is the first time USDA and DOE are together. So this vision of a gigaton of biomass, which in principle could produce the equivalent of three and a half billion of barrels of oil equivalent of thermal energy. This is huge. That's the first time we've had that kind of information. Oil companies never looked at us very well. They started saying, well maybe we should talk with you a little more. Because if the opportunity were one percent, one percent is what we have, or two percent, of the current fuels market, they're not interested. But thirty percent? They're very interested. They're talking.

So, the study that I referred to is this feasibility study. You can download it from the web. It really looked at a large range of agricultural land, forest lands, and maybe thirty percent is what our target is. This is important to understand, so this is that heating value I was talking about. This is what it could produce. Now, let's look at today, the 6.4, 6.5? How much we import today. How much we produce today, how much we produced before. Now, the energy content is what we produced before in the peak 1970s. If we convert, so this is ethanol, it's not just ethanol. It's whatever fuels made sense. But lets suppose we're doing ethanol, making ethanol and other fuels from gasification, other alcohols. We have to use all the biomass. There is no refinery that works throwing away a large fraction of their materials. You have to use every little bit. So we have to get to the ninety-five, ninety-eight percent. So this, this is still not as good efficiency as we can get with the R and D. But, look now. This is the same size of what we produced from a resource we control. These people are now, this is very, very recent. We've been studying and been working with many people to come to those conclusions and again, this is all going to be available if you want a copy.

So, if we have to think about ethanol and biodiesel, but there are many other fuels that can be available for biomass. That's an advantage. Biomass is carbon, hydrogen, oxygen. Everything we can do with natural gas, everything we can do with petroleum, we can do with biomass. It's a source, a building block for building other things.

Here's what the Energy Policy Act of 2005 does. It's growing from 5 billion of corn to ethanol, and that goes all the way to seven and a half. The projections or the expectations is that some cellulosic ethanol would go in conventional, is all starch derived. And this will help. This will give more certainty. Cellulosic ethanol is not here yet. There's just pilot plants. There's a lot to go. See, we didn't get to this point without the twenty-five years, plus the USDA policies granting loans to people who wanted to build dry mills. We didn't get there. So, we are now in a position that we will put investment to flow in the direction that it might increase and surpass that mark.

This is on track. We still have barriers. We still have technical barriers, and I'll talk a little bit about that. I'm not going to talk, we don’t have time to talk about the vehicle side, but there's exciting things on hybrids.

I'm going to address that issue on the net energy balance, and I'm not going to use net energy balance, I'm going to just try to explain the situation so you can understand it. That kind of debate has been on people talking different languages about different things. So let's see if I can succeed on this. This is a life cycle of production of ethanol from corn. And that's using .74 million BTUs of fossil energy. The production of gasoline obviously consumes 1.23 million BTUs of fossil energy. All of those for you to see a million BTUs of gasoline at the refinery station, okay?

Now, I'm going to put this in very, what I think are simple terms, but help us, if you don't think this is simple, let us know. Okay, here is your billion BTUs that's going to be available at the pump. We have the gasoline situation here, that's the energy in the fuel. To make it from gasoline you need more. Of course, from corn or from cellulosic, we will need energy, okay? To produce the same. Sure, the process is only forty, forty-five percent efficient. You will need energy. You may not use fossil energy, but you need energy. When you are done with the process really good, it will be less and less. But here's what it does. What does it save? It saves fossil energy, because this is what you would need, this is what you need and the cellulosic, which is ligna cellulosic and that ligna is important because the ligna is the heat that provides to making that refinery go. This is fossil energy, could be coal, it could be natural gas. Now here's how much petroleum it saved. Okay? Quite a bit. This is the savings. So, H__ Tell is talking many times above this, and aboat many different things. He's thinking about the system of using renewables, compared to coal. And he's saying, "Coal is better. Coal is not using this much." It probably is. It probably is using even more. But many times we don't have everybody talking about the same piece of information. In his life cycle analysis he used some data that were extremely old in farming practices. So he penalized a lot. The data that we generated and most everybody else generated is above. So there is more, it's 1.2. Twenty percent, twenty-five percent more. The ligna cellulosic is five times more. But I think putting it in these terms, you can understand that I can't say that we have the best process today, we're still doing R and D, we're still doing R and D with industry, to bring this down, to bring this down in total energy used. Did I confuse you more than I clarified?

Okay, more on the research side. When we started working, okay, the conversion part, this is awful. Almost three dollars, more than three dollars. That's what research does. Research does, and development, lowers the cost so that at some point you can project that you would be at a much lower total cost. Okay? So, this is why we still need the research, we still the development. There are many times when the development, they have to go hand in hand, and in that sense the national energy policy is helping, or the Energy Policy Act is helping. The biodiesel situation, this is a very small amount and it is becoming more available. Now, biomass is what I said before, it's a very wonderful material because you can do almost anything. If you take an approach which is based on gasification, and that's just really heating the material and having some air or airs, steam, or it could be oxygen, and you take those polymers that are really hard to get apart but nature created that way for other purposes. But we can separate them and go back into the building blocks, carbon monoxide and hydrogen, which are building blocks of the whole chemical industry. And we know how to do this, we're improving more and more, and in fact it's similar technology that clean coal technologies are using. Biomass is more reactive. So when you heat up biomass, 18% volatilizes. When you heat coal what happens? Very little volatilizes.

Now you can take that synthesis gas and make almost any fuel that the industry wants. So Shell is doing Fischer Tropsch, other companies are interested in other pieces. You can make methanol. In fact, some people like DME to substitute propane. You can actually make ethanol as well. You can make diesel additive, you can make chemicals, the ones that we use almost every day, and by having hydrogen you can actually put in refiners and you can go into the ammonia, urea which are part of all their fertilizer base. So, yes, biomass opens opportunities. For instance, this is a slide we borrowed from BP, we've been talking with BP, and that's how they see it. Here's biomass, this is not just all that biomass can do, that's one thing that they can do. Or, very appropriate for our visit here is the biorefinery. Remember that we are only doing pulp and paper and a little bit of energy in it. In some countries, Finland, Sweden and so forth, they get a hundred percent of the energy that they need. We still don't. But in fact if we were to extract some portion of one of the components of the wood material, we could convert this hemi cellulose fraction into ethanol or chemicals. This is research that's ongoing here at the University of Maine in terms of removing that portion before you go into pulping. You can actually do very well getting pulp if you can do the pulp of the same quality and you can still use it there.

The other line of research which Del Raymond and other people in the forest industry like is the black liquor, which is a real difficult material to handle. Instead of doing a conventional recovery of energy and chemicals to go into a higher technology, which would be gasification, get steam, more power and chemicals. So you have an integrated forest refinery that now gives your pulp and paper, use energy cells, electricity, if you want, make chemicals; make fuels, because it's in the same cycle of having the building blocks of the chemical industry.

There are other approaches. In fact, I mentioned that the beginning of the gasification you're volatilizing. When you volatilize you make an oil, and in fact you can get seventy percent of the wood that has a black oil, which is about 4,000 compounds. You can upgrade that. So there's also an interest in that because that actually could be done in multiple occasions and could bring them by rail and go to a centralized refinery. Could be a biomass or it could be a biomass and oil refinery. So you can have a part like you can have ethanol plants close to the agriculture. You could have pyrolysis and gasification in other plants. What have you got now? You have multiple processing capabilities to deal with the multiple feedstocks you had in the different parts of the country. That's the beauty of it. There are many options. By having many options it's also more difficult, so I hope you understand in these very simple terms that there are opportunities, there are also the ability of trying to streamline, so you have many kinds of biomass, you have many kinds of fuels and products in Maine. Please, this is the message. We can turn part of the biomass into your heating oil. Don't pass up an opportunity to do a very low technical entry point. That's not a very demanding fuel. The fuel for your cars is much more demanding. Heating oil isn't. So, in the middle are the things that the R and D, that the government has invested. Those are technical barriers to get you to make your products and this, because you are dealing with products and market, you really have to work with the industry very closely.

Situations that have changed beyond what we thought--the natural disasters, the wars, national predicament. Yes, it's a big predicament. We have an infrastructure that's slow to turn over. Look at the time that it takes us to turn over. We have to put the best power plants we can right now. They will be there for forty years or more. Electrical distribution, if you don't have to build it, don't build it. Distribute it. Houses, yes. There are many, many smart ways, and I didn't bring the slide, but you can today make zero net energy homes, homes that produce as much energy as they use with today's technology. Now, we have to look at the security of the supply and with today's technologies we can already do a lot of progress. In the Shell, Lord Oxburgh really does have a very good point that we have to choose well and we can turn that over effectively. Sue explained very, very well the issues that we have in the energy challenges. In the situation we currently have is that a third of our energy is really transportation, a third is industry and then forty percent is buildings and part is electrical, part is natural gas. We're losing an awful lot, look at our overall efficiency. Sixty-two percent we're rejecting?

Again, we have to repeat because this is the truth—no silver bullet, we need many smaller silver bullets, and there are. Efficiency, renewable, a number of non-polluting transportation fuels. The separation and capture of CO2 has a lot of technical problems we have to start addressing. Some of us may not personally agree but next generation nuclear fission. What is very interesting is this transition to smart, resilient distributed energy systems, and this is where hydrogen and electricity as the carriers for the future would be a very interesting approach.

So, renewables will play a very key role in the more diverse and secure energy supply. I've got to share with you some of these goals, and I think this is actually moving very well. Costs are coming down for almost all of these technologies and biomass now with new technologies it's more mature so the costs don't go down as much but they can actually. Look at what the states are already doing. First, let's look at wind. And we see the blue states, it's actually moving, the wind capacity. This is even better than the data I showed you at the beginning, so three times or almost four times better. So it's growing double digits. Solar energy. There's very interesting studies, recent studies on parabolic trough plants. We're exploring the mid temperature region. If we can explore the mid temperature region with fluids, we can get to lower, lower costs of electricity.

Photovoltaics. This is 340 megawatts. That's small, but again it's growing in smart places. PV in the built environment inside of a house is a very interesting proposition. PV in a building as part of your external wall or as part of the material of your roof. Biomass. Again, we go from a good base here. We are increasing here as well.

What is not going well? Capital mobilization. This is my number one, and the reason I started showing you very, very weird plots. We haven't had these consistent and stable policies. Imagine, in Europe they have the __ works of five years. Can you imagine if we had five years to do R and D, or for a policy to be stable for five years? We don't. The electricity pricing, we don't value externalities. We recognize some technology advances, but we don't follow through with consistent, stable policies so many of our real nice developments are in the hands of Japanese that invested the rest of the way or other countries that had the guts to do it.

So we need to do a little more creative business partnerships. That's what we're trying to actually do. Capitalize entrepreneurs, enhance partnering, and part of my visit to Maine is enhance partnering. Attracting a corporate entrance. We spent more time in the past three years talking with each of the major oil companies to see, now are you going to talk with us? And trying to invigorate private equity in venture capital. And states, you have the action. Okay? And your policies are opening the market for renewable energy. Thank you. Look at this. Renewable energy electricity standards. Maine, thirty percent. This is where the action is going. I'm only sorry we don't have the catalysis of federal aligned with state. Okay? At some point they may have it. But this has already shown progress and it's already driving industry. They know there is a market.

Something that I don't know if the eastern states have an equivalent, but we've been working with the Western Governor's Association in their clean and diversified energy initiative. In this one, you see, the western states are really reaching fossil, hydrogen, renewable. And they asked us, we need thirty thousand megawatts, clean energy by 2015 and we have a clean sheet of paper. You can use solar, wind, geothermal, biomass, clean coal. And we also want to increase the efficiency by twenty percent. How do we do this? What do we need in transmission? This study is actually on the web and the beauty of that study is that we are putting resources at county level, we are counting things and looking at where are resources, where is available, where does it make sense to put what? And the biomass is clarifying a lot of things. Close to some load centers in it’s really easy to put a biomass processing plant. Okay? But that kind of study is what we need actually for the whole country. And I don't know if there is an eastern states equivalent, because that's where the rubber meets the road. Know your resources at the local level. In the conversation we had yesterday with the River Valley folks, looking at resources. Industry says, well, no we can't buy that cheap, where'd you get this number? Well, as we make our infrastructure less and less available, it's harder and more expensive to get a resource like wood. Solar, wind and others, a slightly different situation but, we need to have infrastructure and know what it can generate, and this will really give an upfront idea of do you always need transmission. In some cases you don't. And biomass is very nice because it can be made in small sizes and large sizes. What we're seeing is that we can put a lot of added capacity locally on the distributed manner, and larger sizes where the load centers are.

So, we really value, should value the externalities, but that’s very hard. It's very hard to quantify. So this is probably where that conversation where people sort of agree that this is the value of something, that's a little hard, but I'm hoping that other people will actually step up to the platter and do. And the future is really bright. I think we have a lot of those resources, and the beauty of it is that we have state led RPSs, we have production tax credits, we have unsubsidized goals that are in a very good region. They can't compete with coal already installed. But they can compete with new capacity.

How big is big? Anybody care to guess how big this is? Try this. That's a three and a half megawatt plant. It's the size of a 747 two hundred. Now, this is an ideal kind of location because you can generate so much, there's so much more winds offshore, and there's, it's a tie of technologies. All this offshore drilling, all of those things combined with very high tech. I have colleagues that have spent their lives basically looking at how to make the controlling systems for these wind turbines. And we're now seeing yes, that industry's moving, and it's going, and not just in the large size, we're beginning to look at the smaller size, and by the way, there are some very interesting new technologies coming up there.

The solar outlook is also very, very good. And I couldn’t resist. This is the area you would need if you would map the solar. Obviously, nobody's going to try to take a hundred by one hundred miles. But they could take smaller areas here and there, and smaller areas that in fact, vacant land, parking lots, doing the building integrated, which is one of my preferred. And, if I take this, this is how it has grown. On a central basis only twenty megawatts, on the distributed basis, off grid and on grid, we are growing.

Learning curves. How is the price going? Nice, very nice. See, we're being the two cents. Those are your cents.

Biomass is also moving and we are glad that this is a junction of policies that can value the resource, and can allow the public sector to couple with the private sector, and hopefully will not do the same mistakes we did before. In the pathways, DOE has been looking very much at corn. Why? Because it's an industry that's here. So they can do expansions. And then later, for the future, is the cellulosic, lignocellulosic pathway.

So, the end of this talk. Technologies, yes. Policies and markets together really can drive it. For renewables, mass production is a need. Okay? And this is happening. The wind mass production is really working. The smaller ones are going to be very nice. In the biomass, we're seeing mass produced little units that are just, push a button and you start, like an appliance. So that's the direction, incentives, mandates or incentives or some sort of policy. And then, the markets. Green markets would be very helpful. And the conventional energy prices going up, I think we're going in the right direction.

So, finally, if you are curious, go to the website. This is one our facilities, the solar energy research facility, and I really thank you very much for your attention. It's been a pleasure to do it.