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Panel Discussion - Climate Change and Economy

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PANEL DISCUSSION –

CLIMATE CHANGE AND ECONOMY: IMPACTS, RISKS, AND STRATEGIC THINKING FOR THE FUTURE

Moderator: Richard Cunningham

Speaker: David Terry

Speaker: Grant Goodrich

Speaker: Karlis Vasarais

MR. PETRAS: All right. Ladies and gentlemen, if everyone can take their seats, we are about to start on this next panel. One thing that I would like to ask everybody to do now is to take out your calendar and mark April 16 and 17, 2020, as the date of the next Canada-United States Law Institute Annual Conference, April 16 and 17, 2020.

More information to follow. Thank you.

Now, we are going to have our panel on climate change and economy, impacts, risks and strategic thinking for the future. To chair this panel is a member of our executive committee, Richard O. Cunningham, international trade partner at Steptoe & Johnson.

Dick has been a longtime supporter and member of our executive committee. He is one of the leading international trade lawyers in our country. He is always traveling off to places like China and South Korea and Japan. He just spoke yesterday on Brexit and China trade issues, and he is here today to lead this panel.

Dick?

MR. CUNNINGHAM: Okay. Thanks, Steve.

The British television show "Monty Python's Flying Circus" always used to begin with John Cleese sitting at a table like this with a microphone like this, and he would say "and now for something completely different." And this will be different.

We have talked about climate change and what it is. We've talked about the broad binational-national policies of climate change. Lots of things have been going on with climate change taking place at the state level, at regional levels, and among the corporations of Canada and the United States that have to deal with these issues, and we have a panel to address this major issue from those standpoints.

I am going to introduce -- and by the way, we have a particular unique -- you only get this from CUSLI aspect of this panel, which I will tell you about -- we have three panelists who couldn't be better for this purpose.

David Terry has 25 years of experience with wind, solar, and other energy issues. He is Executive Director of the National Association of State Energy Officials. He participates in energy policy discussions at the highest levels of Congress, at the White House, and internationally.

Grant Goodrich, hometown boy makes good, is Director of the Great Lakes Energy Institute here at Case Western. Previously, he managed the international research project and the Earth Institute at Columbia University, and earlier in his life he was Olmsted Scholar and studied international relations at Slovenia. I mention that last for a particular reason, which I will explain in a moment.

And finally, Karlis Vasarais will present some perspectives from the private sector. He is a low carbon energy entrepreneur with particular focus on emerging process efficiency technologies, on the innovation of fuels and on specialty chemicals produced from waste.

He is of Latvian descent and serves as vice chair of the Latvian credit union, and therefore, I can confidently say this is the only climate change panel that will give you perspectives of both Slovenia and Latvia. So let me turn the panel over to David.

MR. TERRY: Thanks, everybody, thanks Dick.

As Dick mentioned, I am Executive Director of the National Association of State Energy Officials, and just to give you a moment of a lens of sort of where I am coming from or how I view things, our members are the 50 governors, energy directors around the country. We represent all of them as well as the territories.

They have an economic lens as much as an energy lens. These are not regulators. These are folks that are developing policies. The typical governor after life, health, and safety is worried about jobs in the economy in an energy context. So I guess I would say, in short, our members have been at this confluence of climate energy, technology, and the economy for the last 30 or so years.

We have been heading that direction. I think we are finally there in earnest, and I guess the other sort of preface to my remarks is that there are some people that are glass half empty, some are glass half full. Fair warning, I tend to be glass overflowing, so it is an upbeat message for the states.

There were really three areas that I wanted to hit on, and a little bit is the context of climate environment and energy technologies and where we have been. For a very long time, many of the states didn't say the word "climate." There were political connotations to it that were challenging. At the same time, they were moving energy policy ahead in many places in pretty fascinating ways from an economic development perspective and also from a climate perspective, even though we really didn't think of it that way. I want to talk a little bit about that.

Secondly, some of the things that we see on the horizon right now, just the change that has occurred in the last six to twelve months, both politically and economically, in some of the states I think are worth touching on.

And then, lastly, a little bit about what we see coming down the pike in the relatively near term that I think is worthy in terms of climate, clean technology policy, economic development, and some of the costs associated with it.

I guess at the outset, when I think about cleantech and climate and innovation, in the late '80s, early '90s, our organization started one of the first combined government -- state government-federal government private sector cleantech investment programs that had never been around. It was early risk capital and venture capital before venture capital really called cleantech "cleantech".

It didn't go very well. It was not very successful, quite frankly. We learned a lot from it. We did it differently ten years later, but we invested in things like trying to make wind power cheaper through various technological investments, trying to improve various materials involved in efficiency, manufacturing, and so forth, a whole variety of things, and some good things came out of it but from a commercial perspective not so much.

About ten years later in the mid '90s, we started a joint cooperative research development demonstration investment program among states, the private sector and the federal government, and it was focused on particular cleantech areas. Again, we didn't call it "cleantech," but it involved very high end building efficiency technologies, transportation chemicals, et cetera.

A few of the things that came out of that are interesting, the country's first plug-in electric hybrid school bus came through a joint investment between the state of Ohio's Energy Office, North Carolina, Washington State, Oregon, New York State and the Department of Energy and a couple of private sector companies, and that model is still on the road today.

So that was sort of the round -- really weren't aligning policy very well, but we were trying to align research and demonstration dollars, and I think we had some good success. So there is this past kind of collaborative activity that I am going to return to at the end of my remarks that I think are relevant for some of the challenges we have today.

The other piece that was happening at the same time were policy actions by the states. We haven't had a federal climate policy as everybody knows in any serious way. About 15 years ago at a Nazio (*sic*) meeting, I made a very flippant remark. It wasn't intended to be. It got a little bit of a laugh, and it got me in a little bit of trouble.

But I will say it again for context, the Congress, U.S. Congress would probably act on climate in a serious way when we had a polar bear and an ice cube in the Potomac River. And it was meant for effect, and it really wasn't meant to be disrespectful, but we tend to act at a crisis level at the federal level even as states move forward.

And we think often of the Californians, the New Yorks, et cetera, that are maybe taking progressive actions in this area for quite a number of years, but there are other states as well, and I think they are instructive about how we move forward.

If you look at Iowa, Governor Bransted, who left a couple years ago to be Ambassador of China, longest serving governor in the country, he started in the late '80s with the first renewable electricity standards in the country, it was voluntary, but it was the first one.

You fast forward -- he was a great energy governor -- Iowa has no discernible coal, natural gas, or oil. He knew that. He understood the economic implications

of it. He also understood the environmental attributes of some of the technologies and resources they had in the energy space. That led to the policies that supported ethanol development.

Iowa produced 40 percent of its electricity last year from wind. And now, they are moving forward with solar with Governor Reynolds' leadership; places that you don't expect.

We see the same thing in Texas with wind and storage and a variety of other areas, and I point those out only because those haven't been done under a climate umbrella, but they have been critically important to moving those states forward, and when we look at where things are -- okay. The rate, I will try to speak up.

The other points I would make are more recent. We see a number of states now moving in new areas of grid optimization, the activities. North Carolina, for example, is looking at their grid in earnest. The new governor has called for a climate plan, which the energy director is undertaking there. Massachusetts is moving full bore on offshore wind as is nearly every state from Virginia north to Maine. This is a tremendous resource.

The early leaders in Rhode Island, Massachusetts, some of the other states are bringing the costs down rapidly. So the opportunities that we see, they are all happening at the state level in technology, are economically driven. I think the climate crisis and the cost associated with it, our ability to solve those are not only dependent upon international relationships and coordination, for example, between Canada and the U.S. but on our ability to turn ourselves, our companies, our states into technology leaders.

So this technology policy is virtually a circle that we see at the state level. We think it is critically important to support. The other thing that I wanted to focus on a little bit is looking forward. The election last November left us with 22 new governors, a number of returning governors.

When we did our list of where energy policy and the governor commitments that were made during the campaigns are, 26 of the governors have some combination of hundred percent renewable goals, 80 percent renewable goals, large climate goals, zero emission vehicle goals in their campaigns that they ran. They are headed in that direction.

Whether the state will or not, we shall see, but that's more than half the states. It is not the geography around the country; it is much broader. That change last year, which I think changed politically also in Congress, irrespective of the change in leadership of the house to the Democrats, there was a change in the air.

I think there is finally that movement at the national level that I referenced earlier about the polar bear, I think we are seeing that shift, and it is that alignment between federal and state policy that has been missing, that we hope that we move toward, and I think we will see more of that.

What we are hearing from our members from private sector companies that we deal with are to better align research development demonstration, so we have states that are doing that now.

Florida, for example, they are coordinating their public research institutions, cleantech research on a regular basis, what are their strengths, weaknesses, where

they can derive private dollars, draw on federal dollars, et cetera. We see it in work force.

We just completed the third installment of the U.S. energy employment report at Nazio. This is something we do in combination with the energy features initiative. That's an organization operated by former Secretary of Energy Moniz. These are the first employment numbers in energy that are reasonably accurate in every sector.

If you look at the Bureau of Labor statistic numbers they are wildly off for every sector, not just the efficiency and renewables and things people think about in that category but in nuclear, in power plant operation. We don't understand the work force that we need. We are finally getting those numbers after decades, and that's having a big impact on work policies and work force development, having a big impact on companies that tell us the biggest impediment they have to advancing technology, to advancing in this area is work force.

So it is another decomponent, and I think the last item I want to touch on is just noting the coordination we have had from a state perspective with the government of Canada, with international companies, also with other exchanges we have done, with France, with China on efficiency programs, on renewable programs, joint R & D activities. We haven't seen that at the federal level.

We do see it at the state level, and I think it is very heartening, but on the major issues we have, whether it is something to address adaptation and ports as was just discussed, we have to have that collaborative nature.

We can't do this alone, but I think it is the cleantech activities we see at the state level supported by the combination of policy, some investment. Frankly, I think the private sector investment is probably adequate in that regard, but more the policy alignment and bringing that together at the state level, at the regional level and hopefully a little bit more coordination with the federal government in that regard I hope will push us over the finish line.

We are optimistic about that, and last two things I will leave you with are just some glimpses of federal policy for the reason that I am optimistic.

Last year we saw the passage of the Disaster Reform Recovery Act, something nobody really noticed, frankly, but it is a huge amount of resources every year that go to disaster recovery and rebuilding.

Until last year we had to rebuild, whether it was a structure or whatever it was, to the standard that it was originally built at. So fairly ridiculous idea. You take federal dollars, you have a house that isn't built well, and you rebuild it but not well again; doesn't make much sense, and that applied to infrastructure broadly ripped. So that has changed finally.

Congress voted that out bipartisan basis; president signed it; all is good. The other aspect to that was a predisaster mitigation fund. We used to not plug the holes in the bucket in energy infrastructure, physical infrastructure before a disaster, and we would pay more for it afterward. Now, roughly a billion dollars a year starting this October will go out to the states, to the emergency management agencies to undertake infrastructure projects of all kinds intended to be more

resilient, finally getting the message that maybe we should do some investment before things happen. It is a good sign.

Congress understood -- Republicans and Democrats understood what they were doing, and climate was a part of it. They didn't say it very much, but they knew it, and that's why they did it. So it is a bit of optimism.

We have also seen some changes to the flood insurance program along the same lines by the Trump Administration in the last six weeks. Again, I think it is a heartening sign to, at least, we're beginning to address some of the problems.

Thank you.

MR. CUNNINGHAM: Thank you, David.

I hope you are glad all of you stayed here this long to be cheered up a little bit now that we got this panel.

So let me turn now to Grant.

MR. GOODRICH: Thank you very much, Dick. Good afternoon, everyone, and thank you so much for taking some time to be with us today. I enjoyed our last speaker up here. One thing Dick didn't mention about my background. I am a Naval Academy graduate. My first summer cruise was a joint multinational exercise with the Canadian Navy off the coast of Washington State, so collaboration with our Canadian partners is something important, and I am glad to see that that is something in this room that would continue to develop and take forward.

I am Director of the Great Lakes Energy Institute here at Case Western Reserve. We are an energy research related institute that helps support our faculty in developing partnerships, find research funding, and make the research programs even more successful than they already are.

And I certainly -- as I talk a little bit about technology and maybe build up with some of David's remarks and focus on opportunities, technology, and emphasis in research and development is certainly one of the opportunities that I see.

I do want to rehash some training that some of you have already covered this morning and earlier today. In talking about the science, I always think it is important to make sure we are on the same page.

I would like to focus a little bit on the Great Lakes Region. That's certainly important to all of us here in Ohio and certainly important to our Canadian neighbors to the north.

So what does the science anticipate to be the climatic -- I'm sorry -- climatic changes affecting the Great Lakes Region for the next 20 to 30 years and again just very simply hitting the high notes? More ice free days on the lakes, and that certainly has economic impacts and opportunities for those who count on the lakes for moving goods and services; more rain for the region to include more intense storms, and I would like to spend a little bit of time talking about that.

We just mentioned flooding insurance, and that's certainly something I would like to spend time on. We have seen the losses this past week in Nebraska and Iowa, especially with the flooding and the impacts that we will see not just on livelihoods but on farming and what that means for agriculture and for food security and food supply.

I think for our nation one of the important things that we haven't spent a lot of time talking about is the impact on the jet stream and, more importantly, the disruption to the jet stream.

As we see that straight line that we knew growing up for so many years become kind of this wavy co-sign or sign signature that is leading to incredible unpredictability in our weather pattern, so unpredictable frost freezes, the occasional polar Vortex, this Pacific river as some people have called it that is pounding the West Coast this past year, nationally, we will continue to see a drying of the U.S. plains in the Southwest.

Water will increasingly become a scarce resource in parts of the country, and that may create economic opportunities for the Great Lakes Region as we talk about economic opportunities as part of this panel.

So it is the unpredictable nature of our weather patterns, which is certainly one of the challenges that we face, and certainly, it is one of the challenges that we will need to be reconciling with as part of what we might call the new norm.

I know a lot of what David just talked about are the investments that we are taking to try to mitigate against climate change right now. I hope we continue to take those actions and invest more, frankly, in those actions. But I do think it is important that we also start investing in adaptation, and that everyone understand that so much of the warming that we have already experienced is baked in, and by baked in meaning, you know, when you look at where the warmth has gone, it is in our oceans.

When we look at changes in temperature with that warmer ocean that we have today, it is going to take a long time to -- with any amount of mitigation -- to see a stop in the rise of CO2 parts per million in the atmosphere. So again, addressing adaptation to me is an important topic.

Moving on to some of the economic issues, again, the panel on economics, strategic thinking, risk, so we talked a little bit about flood insurance, and I do think about flooding as a new norm and something that we will be talking about much more regularly in this part of the country, is something that I hope we move into panel conversations and we start addressing with more regularity.

The question really becomes if your property floods three years out of every 20 instead of one out of every 100, what is the flood plain, and whose responsibility is it to address that? And who is addressing that?

And it leads to this really interesting intersection of responsibilities. At the local government level, it is your county engineer and often ignored in most places an elected position that most political parties have not paid attention to and are just starting to realize that that is the person who ultimately decides whether or not you are going to be able to build in a certain location or not.

At the federal level in this country, there is pressure from FEMA to say wait, wait, wait, you can't build here anymore. The designation for this stream or creek or river needs to be amended based on what we have seen for the last 10 or 20 years.

This raises some exciting questions for, especially for the legal community. If FEMA or your county engineer decides that the piece of land that you bought to build on a nice -- whether it is a development or a supermarket -- on is not buildable

because they are changing the flood plain, is that taking your property in some respect, or its impact on its economic value, and if we start to see whole scale changes to the floodplains, what does that mean for real estate or for other purposes?

Again, if your property floods three years out of every 20, if you are the property owner, do you want flood insurance, and if you are the insurance company, do you want to offer that insurance, and I think, again, I think these are very important questions that we all should be talking about much more frequently, and I expect if you are the property owner the answer is yes.

And if you are the insurance company, the answer is maybe or no but maybe at the right price. So these are important changes that are coming. The same thing can be said for agricultural or crop insurance. Again, if your farm is flooding three years out of every 20 instead of one out of every 50 are you as a crop insurance broker or crop insurance provider going to sell that insurance. And I think it is a greater question that we need to look at, and it certainly starts to speak to the vulnerability of our agricultural lands, both from flooding as we have seen this week in Nebraska as well as to drought and drying as we are seeing in the areas above the Ogallala aquifer, which, you know, depending on who you talk to, has got 20 to 50 years of water left, not enough for the youngest people in the room, and that's for sure. And if you look at the drought conditions on the West Coast, you know those are expected to continue.

Obviously, this year has been quite wet, but long-term trends suggest increased drying out there. Again, when we talk about economic opportunities for this region, obviously, Canada and Ontario in particular is known for the greenhouse growers in this region. That may even continue to become a greater opportunity for like produce for the Midwest and the East Coast and maybe a new opportunity for Ohio greenhouse and other greenhouses around the Great Lakes Region.

We have talked a little bit about offshore wind, especially the opportunities that we are seeing explode on the East Coast of the United States. Great Lakes based offshore wind may finally be harnessed and may lead to increased opportunities for Canada-U.S. cooperation on this front.

Certainly, this is something at the Great Lakes Energy Institute that we have been involved in from some of the research and development aspects of putting these structures into the lakes and what kind of structures would anchor the turbines to the sea floors.

On the R & D & T's, research, development, and technology front, I do think that continued investments by both our governments by the venture community that we will hear about here momentarily are important opportunities.

I do think that we are looking to the technology community, to our engineers to help develop solutions to some of these most pressing problems that we are facing.

And part of what's exciting is that some of the investments that we have already made are starting to reach the kind of maturity that we need to provide a runway going forward. One of the success stories that I think we have seen here in

Ohio, First Solar has moved a lot of their U.S. based manufacturing in Perrysburg, Ohio, over in the Toledo area.

They are a manufacturer of rigid thin film solar panels. There are over five gigawatts of solar panels this year ramping up to ten gigawatts within the next four to five years. Almost like some of the aircraft manufacturers, they have -- they are sold out for the next two years, so it is exciting to hear that the technology is that mature and that investors have that level of confidence that we are buying and installing at a very, very high level.

Again, for scale, Davis Besse or Perry Nuclear Power plants here in Ohio, each of those is about one gigawatt. So we are seeing one of those being installed annually just from First Solar alone.

The last thing I will mention is some more of these risks, and again, in the Great Lakes Region, you know, as we talk about warming water and some of that warming being baked in, obviously, we talked a little bit about toxic algal blooms in Lake Erie and how that impacts our water supply.

Again, there are other economic impacts of that. Obviously, Lake Erie is known for boating, for recreation, for fishing. It is a billion-dollar plus industry as we are reminded here in Ohio all the time, and if the water is filled with green goop, people are not fishing for walleye, they are not going to the parks and to the beaches in the summer on either side of the lake and, certainly, something that we should be concerned about.

I do think there are opportunities. I know we have friends from some of the Great Lakes organizations in the room. These are operations for greater cooperation between our countries that we should certainly invest in but looking forward to having a robust conversation about these or many other topics here this afternoon.

Thank you.

MR. CUNNINGHAM: Thank you. That was great.

Before turning to counsel, I want to make a personal comment here. When I told my wife I was coming to Cleveland to participate in the climate change program, she thought for a minute and said, "well, let's see, we have got a beach house on Barrier Island on the Jersey Shore, our two grandchildren in Portland, Oregon. We just bought a small condo, which is right on the edge of the river in northern Oregon. Thank God our home is on a high hill just outside of Washington, D.C. because it may be the only thing we have left," so pay close attention to the comments.

So let me turn to you fellows and what's going on with business, particularly with the entrepreneurial side of this whole equation.

MR. VASARAIS: Thank you, Dick.

My name is Karlis Vasarais. I am a carbon entrepreneur from Canada. I have Latvian roots, so that that plays in how I feel about an oppressed former group from the Soviet Union, but what I do in my day to day is create and breed clean technologies.

Between me and my business partner, we have raised over a quarter billion dollars for six different ventures. They are Canadian dollars so the northern American peso. But we have brought four of them to commercial revenues. We

have sold two of them. We bought them back, and I am apparently CEO of one of them, and he is CEO of the other.

And climate change is near and dear to both of us. My business partner did serve in the Army, in the Armed Forces. In his mid 20s, he was diagnosed with leukemia, and while he was recovering, he came to the idea that he wasn't in the business of defending someone else's oil. He wanted to make his own, and that's his lifelong learning, and he has been my mentor and started off as my CEO and became my chairman, and now we are business partners.

Climate change, I hate the term. I think it is a suitcase term. It has got too many meanings, depending on who you are talking to, and it plays to conscience, it plays on your emotions, and plays on morality, plays on thinking, and unfortunately, it also plays to political discourse and the ties of change in the political environment.

If someone asked me do I believe in climate change? I refuse to answer the question because it legitimizes the climate changes for the question. If someone asks me, do you believe in climate change? I ask, do you believe in protecting water that you drink? Do you believe that you and your kids and your grandkids should breathe smog?

On a more economic level, I ask myself globally, do we have enough resources to feed the world? Do we have enough resources to bring the rest of the world to the living standards that we all want to see the world live in?

And at the end of the day, if someone is still really stubborn with me about that, it is all back to markets. I mean, the first presentation this morning you see temperature like this.

If that was a talk and every single analyst on Wall Street is saying buy, buy, buy because everybody is seeing that that stock is still going to go up by 1 to 4 Celsius over the next couple of years, you are going to buy that stock.

And frankly, if you want to finance that stock, Shell is selling its refinery business. The Norwegians are getting out of early stage exploration, and if you really want to go for it, there is a whole bunch of coal plants for sale across the U.S.

So that's how I kind of view climate change, so I don't see it really as risk any more. It is more about one of the hurdles of preventing us from overcoming the policy discourse and the businesses first that is preventing the advancements we are looking for.

The reality is oil and gas is the biggest industry the world has ever seen. It has captured regulation and regulatory bodies at every level of government around the world. So how do you deal with that? It is a big question.

Yesterday's question, are we waiting for events to happen? Well, we have seen it has happened, but they are not happening locally for the most part or at least not happening in a way that is really making us want to do anything differently.

You know, you look at the insurance industry now, places in the U.S. you can't get insurance for your home, for instance, Florida. You are seeing these massive floods over in the West with the bailouts at the federal level. We are going to allow these people to live. We still see a huge disaster in Puerto Rico from one of the greatest hurricanes ever to hit the island.

So these are events that are not helping. It is really not helping. So we have a lot of lawyers in this room, and what do you do in this sort of place when you look for cooperation? Well, you look for precedence, right?

I guess that's what you guys are supposed to be researching all the time is precedence in this sort of world. The reality is most of the precedence is in climate change, and precedence is in making good work. It happened by accident, or it happened by opportunistic industry.

For one, we look at the Montreal protocol, one of the greatest legislation that was written to protect the ozone layer. It was a very foreign concept. To many people, there is a hole in the air, and nobody really understood it and it failed a couple times. Why did it end up working?

Well, the head of HFC, nobody else in HFC, so they were more than happy to eventually phase out and ban CFCs because that gave them a competitive advantage over their local peers. The next one is the German feeding tariff, currently burdening the German economy with over a hundred billion dollars of additional costs to bring electrons to the grid. How did this happen at such a massive scale? Well, Germany had the same problem as the U.S. They were going to lose manufacturing to the Chinese.

If you look at manufacturing as a percentage of GDP, Germany has been at 20 percent since the early '90s. The U.S. was at 20 percent at that same sort of period. Germany is still at 20 percent manufacturing percentage at GDP, even though their cost and labor rate is higher than the U.S. Since then, the U.S. has dropped to 12 percent.

So the German government was more than happy to help recreate industry. They took advantage of the German Black Forest that was also acidifying. They took advantage of time in nuclear and nuclear uncertainty and meltdowns around the world to scare the population into action, but they also have a different form of government; that they get a level of proportional representation.

So once a green party -- I was able to join a coalition government, they pushed for more of these tariffs. The other reason it worked in Germany is that lobbyists, like they lobby differently in Germany. Here in the states, you can independently as a company hire lobbyists and go talk to a political figure. In Germany, the government will only talk to industry associations.

And so the industry associations for utilities is actually quite disorganized. They didn't have a counter plan to deal with this. Very different with German cars. We think the German cars are so progressive with regards to their environmental regulation. Not true. Look how far they are in electric vehicles because the German car industry is very organized, and they certainly protected themselves in this realm.

China again, they did exceptionally well in their solar development. Why is that? Well, we had a huge recession globally in 2008. They decided they are going to invest in R & D. Chinese have no idea how to do R & D for multiple reasons, mostly because they like to steal other people's R & D. But so at the local level, people still have economic targets, the local governors and economic targets. They took R & D, and they built factories, and they justified we need a full scale solar panel manufacturing facility, so we can figure out how to make them cheaper.

Well, it paid off to the local industries' incentives, but it did drive the cost of solar down tremendously as a result.

And the last one, which I will touch, is biofuels. Biofuels, of course, did have a lobby here, which was first corn to make ethanol. That is a different than mine, but when that first came out, it was -- you could comply or industry could pay a fine. That worked for corn because they had other markets for corn.

When biodiesel came around, they said that's not going to work for us because if oil and gas can pay to get out of compliance, they may not do it, and we don't have secured demand. So in Ontario a lobbyist by the name of Lynn Baker, a colleague of mine, he actually lobbied and eventually changed the Clean Air Act and made CO2 a pollutant under the Clean Air Act. That made it illegal not to comply with blending mandates.

Back to an earlier question: How do you get directors involved on a legislative basis? Very clear, a very good example of how you get that to happen. Biodiesel has since expanded, ethanol has expanded. They live under the umbrella of oil and gas, but they don't need to compete with oil and gas. It is still more expensive to create biofuel than it is traditional fuel because there is no price on pollution.

So if you can do that, all the players in the biodiesel, all the players in the renewable fuel business, it is not about outcompeting oil and gas; it is just outcompeting your peer.

There is a famous example of, you know, if there is a bear chasing you, you don't need to outrun the bear. You need to outrun the guy next to you. So but there is a policy evolution here.

I think for most policymakers, it is okay to make mistakes at the correct time. The original biofuels legislation were not great; they were not perfect. We continue to modify. The U.S. has introduced carbon, low carbon fuel standards. It is not just renewable fuel. It is how much carbon reduction your fuel delivers that is becoming more of market.

In the states, you have rings. That's different than Canada. You can only make your blending mandates by actually purchasing the fuels. In the states, you can buy the credit, not just the fuel; makes it easier to comply. It is a more efficient market. People are continuing to change how to make these policies work. It is not written in stone. These things have to be figured out over time. They have to modify it as we learn how the CL industry is reacting.

So, you know, what's the future of this? I am optimistic in this sort of thing. My girlfriend thinks I am a horrible private citizen, but I am a realist. If you look at where the world was a couple decades ago, horrible, was surrounded with famine.

The world was impoverished by several billion more people than they are today, and now a couple decades later, there are relatively good living standards around the world. Climate change and the topic of a transition to a low carbon economy is next on the list here because there is enough -- there is a critical mass in the world now that finally has the luxury to pay attention beyond food, clothing, and lodging for themselves.

I see the future a little differently in terms of how climate change happens, and it has to happen because of mitigation and adaptation all happening at the same

time. We also still have a major component of cyber security, going on at the global level, and we have tariffs at a very localized level, and that can be delivered in vessels that were not imaginable decades ago.

So I see the transition to a low carbon economy, this small scale. If you look at Shell, Shell just announced last week that they want to be the world's largest produced distributor of electricity. They see the world in decentralized local grids; makes for a huge challenge for an industry like nuclear, any sort of large power plant.

If you are not responsible for the grid around your asset and that grid is getting hit with freezing rain every year, with wind storms, with thunderstorms -- up in Muskoka or maybe parts of Michigan. When you get these wild thunderstorms all summer long and you are out of power, you look at the cottages on the lake, and there is still power to them.

They are going to test their battery and solar panels on their roofs. I also see the transitioning happening to these first. Climate change you have to see for it to work. People in cities, you are closer to the problem; you are closer to the solution. Cities also send out the type of population that wants to see it happen faster.

And capital, and this is the toughest part of the market, the capital chunks that go out to these projects are small scale. I can talk about any of the projects that we are involved in, and I say build five, then come to us, and prepare a portfolio of 40. Then we will give you a billion-dollar check, but I can't do anything under a half billion-dollars. And they are like, you know, the scale time and again, it is the world's largest industry. But those are the actors that we have to deal with, and those are real constraints in our environment. But there is a hole here. Nobody -- unfortunately, cleantech as a term has been soiled. There is too many losses -- there are too many early losses in the industry. We don't call it cleantech anymore; we just call it an energy efficient economy, a resource efficient economy.

We are going to be resource efficient with the sun; we are going to be resource efficient with the wind, and we are going to be resource efficient with all of our existing processes to make our industry more cost competitive in the whole context.

If you sell that story at the policy level, sell that story at the industry level, well, now, people are listening because it means more in the bottom of their pocket.

I also think -- and I hope without too much policy backfire here -- that what we are really trying to do -- and I don't see climate change as the biggest threat facing the world today; I see the disparity of wealth as the greatest threat the world faces today, and I do believe that if our hypothesis is true, that small scale is going to work, that small capital is going to work, and transition of the sea level is going to work. I believe that it can lead to the wealth redistribution, that this is now you need to try and survive again.

I believe that if we can find ways to release energy and processes at the local level, you can reinvigorate the investors. You can reinvigorate Thunder Bay, Ontario. You can reinvigorate the maritime in a way that you can't do if you keep thinking it has to be huge, it has to be made centralized, and we just need the rest of the world to buy our stock. We have to teach people how to fish.

And so a little bit about we only go after the hardest problems in the world. Half our carbon reduction is moving us around. We are looking at transportation fuels. If you look at the IA standards about 30 years from now, gasoline is supposed to drop by 25 percent consumption.

But distillate is the thing and diesel fuel, jet fuel, marine fuel, distillate, and I mentioned the chemicals derived from it. That's supposed to go up by 35 percent in terms of global demand. That's the market we focus on. It is a much harder market. We have proven pretty efficient to make good electrons, renewable electrons. We have not yet found a way to make good and renewable hydrocarbons. That's what we focus on.

So in conclusion, I believe that we have all the technologies that we need to achieve our 2030 targets under the Paris climate change. I think that that is a question of policy, not a question of technology to achieve our 2030 targets. If we want to achieve our 2050 targets, though, we have ten years of R & D to do and then ten years of deployment to do in testing and scaling before those technologies are going to be ready.

So we still have a dual problem. We need policy on line to get the short term goals, and we need business and R & D and government support at the basic science level in order to achieve our long-term goals.

Thank you.

MR. CUNNINGHAM: Wow, that was really interesting.

(Applause.)

MR. CUNNINGHAM: I am going to ask our panelists to comment on each other's presentation, but first, I want to take the prerogative of the chair and make an observation on this.

We talk about this in terms of mitigation and adaptation. And I think you need to talk about a third thing, which is compensation. And we heard, for example, earlier one of our panelists said that she got beaten to death working for a carbon tax, and it was called a job killing tax. We have heard another panelist earlier today say that, boy, you can't have -- I think it was a gas tax, maybe a carbon tax -- because it will hurt the people who have to travel substantially for jobs in the heartland of America and all that sort of stuff, whereas people in New York City walk across the street and don't travel for jobs.

And what that says to me is that you have here one -- the whole climate change thing has a policy issue and as a pragmatic issue is not conceptually different from the other elements of major rapid change that are happening to the economy and society today.

I deal in trade a lot with the people who are concerned about technology change, that technology is going to wipe out jobs, and people aren't going to have jobs.

One of my clients says the story about what's the factory of the future going to look like? It is going to have two employees, a man and a dog, and the man's job is to feed the dog, and the dog's job is to keep the man away from machines.

(Laughter.)

MR. CUNNINGHAM: And the difference between technology and climate change is that there is, I think, an assumption, almost universally shared technologies are just going to happen. It is not something you are going to stop.

Climate change is something that is there. It is not only debated as to whether it is going to happen, but it is something that we have to take action to stop. And the compensation flows from the action we take, not from -- the need for compensation for people who are losing jobs flows from the action we take, not from the change itself, from climate change or the technology change, for example.

And what it seems to me you have to think about and your comment on the Germans and how the German manufacturing employment has stayed at 20 percent, whereas the U.S. has gone down to 12 shows a country that has looked at it from that standpoint, which is that you have to deal with the change, but deal with it in a way that is holistic enough to affect both the prevention of the adverse -- that it complies with the mandate to change but also deals with the consequences on some group in society that is affected by how you deal with the change. And that's something we have trouble dealing with in point because we deny there is climate change and, in part, because it is hardly -- I think it is intrinsically harder in the climate we live to say government needs to spend more money to do compensation for the change.

So I think -- I find the discussion -- all through these discussions in one way or another sort of focused on that. And I find that very interesting. I am not sure that I have the degree of optimism, but we will address that, but it does clarify in my mind a little bit about how we need to address that. Now, let me ask each of you to sort of discuss a little bit of what the others said for a moment to the extent you want to do so, and then, let's have questions from the audience. So let me begin with you, David.

MR. TERRY: Sure.

I guess a couple of things. I think the compensation comment you made is right on. I think in my mind that presupposes it is likely a federal climate solution and again going back to my crisis comments, although you would think we would be there, I don't think we are quite there yet at the federal level to have some kind of compensation scheme. It is just where we are.

The other piece of that, though, is from a very narrow either individual state lens or very narrow U.S. lens. The technology and economic element of this is what, in part, pays for that. That doesn't make everybody a winner, and it is very narrow in its view but that is how you get from A to B politically I think with that.

MR. CUNNINGHAM: It helps significantly.

MR. TERRY: It helps significantly, exactly.

And I think the other piece, though -- and unfortunately, we have spent all the money as a country, so it is not as though there are many more checks that can be written, that's one piece, and the other part is -- and you see it reflected in legislation that is being passed either directly in this area or indirectly. I will give you an example.

The Obama Administration Republican house or Republican Senate passed a unanimous consent in both Houses reforms to the flood insurance program to make it market rate and to redraw the flood plan. It was in law and signed into law with

full Democratic and Republican support for six months before it was rescinded. And it was rescinded because everybody who was in the flood plain lost their minds when they realized their home and condominiums and businesses would have lost a great deal of their value. So that happened, and it was rescinded.

And I think it is an example, if we are not prepared for those shifts, the transition, the compensation, and you need the economic development to go with it, in part, and it probably means a reordering of priorities.

In that sense, I think it is one of the bigger challenges we have. It tends to be policy and economic. I think much was said earlier, it is not a technology problem in your term, but it is this policy crisis.

I think the state level we see some of that, and I will give one example and then wrap up. In Florida, they faced the prospect of no private insurance for wind insurance and hurricanes a decade ago, no private insurer except Lloyds of London will insure your house in Florida for wind insurance; no private insurance, of course, for flood insurance, either one.

So the state began ratcheting up the building codes and standards. Every time there is a hurricane category III, a team goes out from the universities, and they look at the building code, where did it fail, where did it work and they rachet up the standards again and call the insurance, the state-owned insurance company, and they make an assessment of what is done right and wrong.

You buy a house, the company or the company they hired goes out and looks at the house, see if you made the provisions, and your insurance is either very high, or it is some measure lower. That's where we are headed with this, but it is about the exception piece and readjusting where people live.

I do not think it is going to be -- there may be a lot of legal issues around it, but I think we are so rapidly by the economics of flooding that it may be a moot point.

MR. CUNNINGHAM: When there was an earthquake in San Francisco a number of years ago, many of you remember Dan Rather after the earthquake interviewing the mayor of San Francisco and pointing out to him there are still being buildings built in San Francisco without earthquake reinforcement, and the mayor looked at him and said "well, Dan, you have to understand that our people would rather live a lifetime of fear in San Francisco than a lifetime of heavenly bliss in Sacramento."

(Laughter.)

MR. CUNNINGHAM: So you next, Grant.

MR. GOODRICH: Dick, that's a tough comment to follow right there.

Just to reflect on a few thoughts, I loved Karlis' point that cities and individuals are in many ways leading the charge to both mitigation and adaptation. We are seeing so many cities doing incredible things as they are looking towards the future. They are designing adaptation plans. They are preparing for a warmer or weirder future for their inhabitants, and I think that's important.

And I would like to see more states give their cities the resources to act on those plans, and I think that's an area where we can see the greatest bang for our buck in terms of how we invest precious taxpayer resources into providing for a more secure future.

On the individual side, I think it is really a great challenge and question. And so many of us know someone who has -- they put solar on their roof. They got a battery in the garage, and they are looking to go off the grid, and this is something that I think in our countries speak so much to this heritage of self-reliance and individualism.

But I don't know that that's a feasible solution for population as a whole, and that's something that I think we need to evaluate. I do want to mention the Japanese example, especially as we start talking about liquid fuels as, you know, a huge need that we are looking forward to.

So the Japanese right now are looking at the hydrogen economy as a potential path forward. And I agree with Karlis, we are talking about 20 years of intensive investment in R & D & T in deployment if we are going to get some kind of new energy future, but Japan, because of recent history, the Fukushima nuclear disaster and the typhoon that caused it, their lack of land, their lack of shallow water for offshore wind right now and so limiting access to renewables, they moved by population away from nuclear and very, very limited oil, gas, and coal resources as they look to meet the Paris Accord requirements. They are saying the only way we can do this is with hydrogen as an economy moving forward.

There is technology that would allow them to do that today, so that gives them a starting path, but they are looking at massive investments in research and development technology to get to more efficient ways to manufacture hydrogen and hydrogen becoming that fuel to power vehicles, to power trains, to do much of that heavy lifting and moving that we rely on gasoline and diesel to do today.

I will stop there and turn it over to Karlis for his comment.

MR. CUNNINGHAM: Karlis, I will call on you next, but I warn you, you are not allowed to say something so controversial that makes the lights flicker and go out.

MR. VASARAIS: Sounds pretty good.

The inside point there, you know, this whole area and the economy is cash poor. It is true, but this company here is also very asset rich. There is huge amounts of Brownfield projects and Brownfield sites as well as manufacturing expertise in this area, which sits on the balance sheet, and for companies like one of our previous ones, we raised capital, green mantra, depulverized plastics and created glasses out of those and had an uptick value.

We picked Bradford, Ontario. Bradford unfortunately, is a city which was decimated by the loss of one of the largest tractor companies in the world, and we found a building that -- Cascas (*sic*) I guess where they used to build egg cartons. Egg cartons are very energy intense electricity wise.

And when we looked at setting up our process, our actual equipment was only $2 million dollars, but when we looked at doing a Greenfield site, we needed to spend $3 million to do a grid connection, so we worked closely with the city of Bradford to secure the site.

We were able to use their existing grid connection to draw up our capital costs, also increase our timelines, never mind an entrepreneur to work in that sort of town. Policymakers, permanent agencies, everybody is on board to make that project work and make that project work fast.

So I understand that a lot of these companies do not have cash, but let's remember they do have assets, and they do have expertise

MR. CUNNINGHAM: So by my -- actually, it is not my watch, but it has been loaned to me, we have about ten minutes of questions.

Can I invite the audience to raise their hands and ask some questions?

MS. POLLACK: What's the main technical challenge with hydrogen?

MR. GOODRICH: The main technical challenge with hydrogen, as we are looking at it right now, is making it far more efficiently, and then I would say it is building the infrastructure system to realize that at scale so that it could power infrastructure.

So right now we are using essentially an electrolyzer to the reverse of a fuel cell to make hydrogen as one mechanism for doing that. What we have seen suggested as a pathway forward is, if you have curtailment in place, either with wind or with solar where you are pushing too much on to the grid, instead of pushing it on to the grid, if you were able to on site use electrolyzers, essentially pull that electricity off grade into the electrolyzers, generate hydrogen on site, you can use that as a long-term storage, and that's primarily how we are looking at it as a mechanism within the United States.

That hydrogen becomes fuel, chemical fuel essentially that can be used for autos and for other purposes. Again, the infrastructure for that right now is minuscule and not at the scale, not at the level of investment, and it is viewed as a competing future in the United States.

So we have right now the pathway forward that is scaling is with electric vehicles. You know, where we are seeing people saying we are going to go with chemically based, you know, lithium ion battery storage for operating our vehicles as short term storage for our homes, the problems for battery storage right now is you are looking at durations for storing electricity of somewhere of two to six hours maximum, and for your vehicle it is roughly a 200 to 250 driving mile radius. Hydrogen gives you more power, longer duration, but the infrastructure and the investment is not there.

Also, you know, I mentioned First Solar and solar panels, I think a lot of people look at the electrolyzers and hydrogen based kind of fuel cells that are in place as still being relatively early stage technology and would like to see that advanced and see greater reliability with the systems before we start to see scalable deployment.

MR. VASARAIS: One more thing from the investment side, so traditional hydrogen is made by a steam affirmation. Sounds complicated, but basically, you spend a lot of energy that activates a catalyst, and you smash it with natural gas.

MR. GOODRICH: Right.

MR. VASARAIS: The carbon is released, and you have hydrogen. You have to do it at a huge scale, a half billion-dollar starting point for a plant and you cannot turn it on and off. What's the future of that? Well, one of the technologies we have invested in can actually create, do that same process using microwave technology.

So we can take something the size of a pop machine, opt in every single transportation parking lot, and when you need to fuel your vehicle with hydrogen,

it can do that same process at a very local small scale. The problem with hydrogen is that it is storage transportation and production.

Are we still emitting? Yes, but we are doing half the emissions of traditional hydrogen.

MR. CUNNINGHAM: Governor Blanchard?

GOVERNOR BLANCHARD: Yes. To David Terry, how many states in the U.S. have a renewable fuel standard, and what's kind of the range of what they are requiring these days?

MR. TERRY: Not many have a renewable fuel standard as in liquid fuel, so think of some of the Midwest states for biofuels. But the federal RFS and RFS largely replaced that on the fuel side, and on the electric side, about my last memory of that is like 38, 39 states have a renewable electricity standard of some kind.

Pennsylvania, for example, is a clean fuel standards, which is a bit different, but renewable electricity standard, about two thirds of the states, and then there are voluntary levels beyond that. That's really what has driven the renewable power market more than anything else.

If you take that, combine it with the federal tax incentives, which are largely in the processing of phasing out, those have been the two drivers at work. I would say the third one, though, that is really interesting beyond the RASes as we think of them is corporate buying.

If you look at some of those states, certainly coastal areas East-West Coast, Northeast West Coast, climate policy is driving that to a great extent. The many other locations, whether it is Facebook, Google, or Proctor and Gamble, whatever major corporation it is that has a renewable requirement or stainability goal, they are requiring that of economic development and job location in states, and that has a huge impact.

And it is really the combination of those three, and frankly, the federal tax incentive is at the tail end of that now. So lots of great progress. The liquid fuel side of the equation is quite different, however.

And I would say that one follow-up on the hydrogen question, I think the relative infrastructure cost of hydrogen for light duty transportation, it is very hard for me to imagine how we go from down that path versus an electric vehicle as we are starting to see them. It is just the cost is enormous.

We have two states that are investing very heavily in that, California and to an extent New York, to a lesser extent New York, and the numbers are just staggering. I mean, I am not sure how you get there.

MS. POLLACK: Two states investing in --

MR. TERRY: In hydrogen infrastructure, but it is staggering. I mean, for light duty transportation, it is really difficult to imagine, at least in the U.S.

MR. CUNNINGHAM: Speaking of power sources that pose difficulties, this one I am about to talk about is political difficulty, and you mentioned Japanese now are not interested in nuclear, and the Germans, of course, shut down all their facilities.

The Chinese, on the other hand as I understand it, are building nuclear plants, specifically because that's the way they want to reduce coal. What does this panel feel about nuclear energy?

MR. TERRY: I'd be happy to take that. We have -- we are not an organizational policy, but many of the states are very supportive of nuclear. I guess they come in two flavors, one being Ohio, Ohio being one of them, and Pennsylvania, New York and a number of other states that have enacted policies at the state level to compensate existing nuclear plants to keep them up.

Part of that is jobs related as much as it is reliability. I would say New York is a good example of that. It is mostly about keeping the jobs in those communities. On the smaller side, forward looking side, we have a number of states, Idaho, Utah most notably investing in modular nuclear reactor demonstrations.

MR. CUNNINGHAM: Right.

MR. TERRY: And those are quite promising. There are three or four companies that are further ahead on the private sector side, Gates Ventures, Bill Gates Venture Fund has been backing new scale for sometime, so there are good opportunities there.

I think there is a lot of receptivity to the new technology. The flipside of this, if you look at the plants in South Carolina and Georgia, the cost overruns on traditional nuclear plants, I think that pretty well closes the book, and you know there is a lot of state sensitive politics there.

But the bottom line is too expensive and not enough future opportunity on the larger scale. Smaller, wonderful opportunities.

MR. CUNNINGHAM: We have about two, two and-a-half minutes left. Do we have any more questions about this?

Our master, Stephen Petras.

MR. PETRAS: Yes. This is a question first for David and then to the others.

In the projects and initiatives that you see, how are they started? Are they starting by the state energy officials coming up with the ideas, or is it private industry that has the idea, then they are looking for support?

MR. TERRY: I think it is largely private industry, and the only hesitation in my voice, there are broader policies, and good examples are when Minnesota and Iowa, the first states that did wind resource maps, before there was even a glimmer in a federal person's eye about doing that on a national level, they saw entrepreneurs, technology entrepreneurs coming into their office, small companies heavily subsidized by state and federal dollars looking for a way to deploy.

And there were some smart state folks that, frankly, I think mostly career state folks at the time that said let's build the infrastructure if you will. They did their wind resource maps or paid for them to be done. Universities did those somehow for the national labs.

I think that's more often the case where you have some private entrepreneurs coming in, university R & D folks that have an entrepreneurial sort of edge coming into the state. They see an opportunity in the state, and the state begins to react at a very micro-level. We have a lot of incubators around the country, for example, that operate in that way.

And then, you begin to see some ground support at the state level for a policy that somehow helps that along. And I think that's the more common one. I think it is very rare that it is the reverse.

MR. CUNNINGHAM: Let me ask you about one method of financing things when you -- it came to my mind when you mentioned infrastructure. One of the things that is somewhat controversial in financing infrastructure projects is private public partnerships, and the argument, as I understand it, is they appear to work as to a project, let's say, like a toll road that produces a flow of income but not like an airport, which simply has to be -- re-do the runways and things like that.

It would seem to me that a number of the projects here would generate flows of income that you could finance by the public. Is there any interest in applying that sort of financing in this area?

MR. VASARAIS: Well, I mean, in the Canadian example, we haven't quite seen how it has gone to establish -- the Canadian infrastructure bank would be a good example of capital. The problem is that so much of the infrastructure is a public good, so you know, at least on the Canadian side, I don't think there is too much policy desire, at least, to have private hands in public goods.

MR. TERRY: Quick stab at that: I guess a couple things: There are certainly a lot of public private partnership examples in, I think, more conventional areas, building efficiency, energy savings performance contract. It is a $5 billion-dollar a year industry where you are using the efficiency savings to pay for it.

I think the more interesting area that will have a bigger impact, and it is very thorny and it is happening in roughly half the states and that's really going to reimagine what the electric regulatory impact is with the public, and it is complicated.

If you think about, at least for me, the two most heavily regulated sectors of the U.S. economy, healthcare and electricity. And it has delivered a lot of good on both counts, but you have, at least in the electric sector, an onslaught -- and in a good way -- of new technologies wanting a piece of that, and we are going to have to figure out how we are going to pay for the stranded assets that are left and for how that impacts people that have to pay for that.

And a really fast example, if you are pulling people off the grid, the people that are left have to pay for the same extra structure as they did before, or they are going to be paying more for it.

And if you think of parts of the country where population is flat or down, likely down because of efficiency, good, waste production, a variety of things, you have the same infrastructure to pay for it, and that's a heck of a challenge for the state, the regulators. It is as big of a challenge for the policymakers, distinction between the two.

The other state legislature has to decide, well, you know, we have to wave our hands and decide what we are going to do about this that is positive. And I think that's the bigger public private partnership opportunity but incredibly complicated, and my hats off to the regulators -- I know there is at least one in the room -- to figure those things out because it is not easy.

MR. CUNNINGHAM: All right. At 2:30, the termination time. I would like to say thanks to a terrific panel. This is really interesting stuff, stuff that I emotionally have never come across before, and let's give them all a big hand.

(Applause.)

MR. PETRAS: All right. We will take a break. We will be back here at 2:45.

(Recess had.)