

CHALLENGES AND OPPORTUNITIES IN MEETING FUTURE ENERGY DEMANDS

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I'm excited to be visiting with you today. What I'm here to talk about today is really what we're doing up at the Energy Environmental Research Center (EERC). For me, it's a great place to work. Our mission is pretty simple, pretty straight forward. We've got really good people. One thing that sometimes we don't talk about is our history. We are basically a federal facility starting out way back when as a coal research facility. Under President Reagan, they de-federalized some of the facilities, basically, they would have been shut down Grand Forks, but President Clifford, UND at that time, pulled EERC under the umbrella of UND. So, I'm a state employee doing all the things that come with that.

But EERC—basically, we're a soft-funded organization, so we need to bring in the dollars that we do. We work with federal, we work with state, we work with straight commercial. It's a really good place to work, but we don't have any direct state funding on anything, so you've got to work hard to bring in the dollars and all that. It's one thing that we spent a lot of time with the business development arm, as well as when we do a product, a lot of times in academia. They pick on academia because they're doing that basic exploratory research, well, that's needed, but we're doing it for a period of time with a period of outcome, and it's usually to make a company more money or solve some regulatory problem. We've got good people, great partners out there.

The priorities we have I'll talk to in a little bit. There's a snapshot of our folks the last summer connect we had. The EERC went through a transition like everything else in the virus where we, everybody went remote except for our folks working out in the shop. And then as the virus ended a lot of folks came back in, but it really, for us, turned out to be kind of a—I won't say a good thing—but we had a travel clerk that, she moved to St. Cloud pre-virus and we said, well I'm sorry you can't work remote. And so we let her go, or she just left, but first thing we did—we started have remote workers. We hired her back, but now we've been able to get some really great talent from around the country to help us out. Somebody living down in Houston that's a really good oil and gas reservoir engineer, maybe they don't want to move to Grand Forks, but we've been able to bring them in as a remote employee.

* This transcript has been edited and refined for readability.

So we've actually opened up the pool of workers from all over the place. It's been very helpful. Our core is up at Grand Forks, but it's been an interesting transition how it's all gone. Pretty much everybody has a chance to work at EERC. You can see the very background all the way through because we have intellectual properties, we have an IP attorney, we've got contracting specialists, geologists, business accountants, anything.

One thing that some folks don't know is we have done work in over 50 countries around the world. That's one of the biggest reasons that I was interested in this job at first. We've done work, a lot of it was back in the cold days, cleaning up coal emissions, all different parts of the world, but we're still doing work around the world. If they're an oil and gas producing country, we're probably talking to them. If they have coal, we're probably talking to them. A lot of times when we find out something going in one area, you'll see if you can replicate it in another area. But this is where maybe I'll just segue a little bit, but that's what really interests me about the EERC, and it really ties into what Justin was talking about—about energy that's tied to national security. I really appreciate his comments. Somewhere in my career, I really became focused about energy security as national security, and I have to tell my two little stories on that.

I was a sergeant in Desert Storm, and most of you, or probably all of you, remember that. But, so, I had guard duty one night from midnight to two like I always did, but two in the morning went back, climbed in the back of the Humvee to get some sleep. I woke up and it was dark out, and I'm like, well, because usually you'd wake up and it'd be light out when you go to bed at two, right? But I woke up and it was dark as dark and I was like, well, I'll roll back over, woke up later and it's still dark out, and I'm like, okay, something's not right. So, I climbed out of the back of the Humvee and that's when Hussein lit the oil fields on fire. We're in the middle of all these oil fields and I'm like, what in the heck? We did what we did and that wasn't such a long deal, but it was the beginning of thinking like, boy, we better not be here just for oil. But you know what, I think we were there just for oil.

Then fast forward to when I was a major back in Iraq, whatever year that was, one of our first objectives was a Ramadi oil field. We're going into Iraq and our first objective is to secure this oil field. That's why I think I almost became upset that national policy is driven by energy policy, foreign policy. Why in the heck do we got people going all over the world for energy? We have all this stuff sitting back in the U.S. So that's what prompted me to go back to school, and that's the filter that I had, frankly, when I was in the [North Dakota Public Service Commission]. If you've got companies that need to move product, let's move it, and that's where I'm still adamant today. And more in the research and development side, but as Justin was talking

about, we're out with oil and gas and all the uncertainties in the world, isn't it nice that we can produce this energy here? So that's my bias and I just think we just have to keep doubling down on that because there's folks out there that don't want to for some other reasons. There are legitimate concerns that we need to work through but let's keep the end game in mind.

The facilities at EERC, massive facilities, what we are is really that medium phase. We've got an idea, we need to build a demonstration, so we've got great facilities there working with hydrogen, working with coal, natural gas. It's on the eastern edge of the campus of UND. If you'd ever like a tour of it, come on up we'll show you around. But really what we do is we take that idea that, that seems to work in the lab, it might be good in a computer simulation, we take it to the next level, and right there on the facility, and see if it could work. The next phase is bringing it out to the field and if it works there, then boom, you're into production.

So that early on exploratory phase, that's where basically somebody's got an idea in the lab or lots of ideas. It doesn't cost a lot, but you can figure out if it's going to work. As things move along, you can see that it gets smaller because some of the ideas don't make sense, and then you get into that middle phase where you get into basically the demonstration phase, and that's where the EERC comes into play. And they call it the "valley of death," where you've got to look at that business case scenario. If it's going to work, you've got to figure out how long it's going to take to get into production. One thing I learned when I was at the research and tech park at NDSU is a lot of companies they're, all of a sudden, they're like, oh great, this company just hit it big. Well, this startup company had been working for 15 years to try to hit it big. So, there's really no such thing as overnight companies making it. That's one thing I think that's challenging that in the app generation, hey, let's just build an app for that.

Well, when you invest in a coal plant, it's not something you shut off overnight. When you build a natural gas facility, there's a life cycle you have to run. When you get to that final phase, it costs a lot of money to get it going and once you're there, you need to make sure it runs its way through. There're different technology readiness levels you plug in in that area. But we spent a lot of time trying to advance that technology level three, four, five, so you can get to the commercialization phase, where enhanced oil recovery is an example. It was somebody's idea a few years ago, well, boom, that's been the stuff that's really helped unlock the block. This is something I refer to a lot when talking with different customers.

One thing that is unique about us is we have really good internal capabilities, machinists, welders, so we keep that internal to where the design engineer will come up with what he or she wants to do and then the next thing

you know, people will put it together, and it doesn't quite work, so they can MacGyver around a little bit, but really a good capability to have it in-house, on hand, so we can continue to improve every generation of it.

Laboratories, we take different core samples as we do our drilling. The laboratories will go in and figure out how much of minerals is in each layer, how much water is in each layer, what's the makeup of that, and then we go in and request a permit from one of the state agencies. We've got all the data that shows everything you need, but all that is internal evaluation, so very good capability.

Research priority, it varies a little bit, but coal is where we live, and I'm very excited about the work that we have done. I'm excited about the work that we are doing right now. I see some good folks from North America here, some of the other companies that we work with a lot that really—the future of coal, I think, is as bright as it ever is—but I'll tell you, we need to keep pulling in all the energy sources.

Carbon management is interesting to where we can manage CO₂ as a value commodity, enhanced oil recovery using CO₂, we can unlock the rest of the Bakken. If we somehow link those together, I think we're going to be in really good shape. And we're spending a lot of time with the natural gas and what we can do with natural gas liquids, natural gas fluids. Trying to figure out CO₂, the gases, trying to find that right formula and the right formation to get more oil and gas out. Spending a lot of time in that space. The alternative fuels, renewables, there definitely is a place for that. I think as far as the grid goes, I think once you get past that 10, 15 percent renewable, it gets pretty hard to manage a grid. But there is a place for all of these because our country's got different energy mixes, depending where you sit in the globe.

Justin did talk about, too, about generation transmission distribution as it dealt with pipelines. You can think the same thing with electricity. You got to have a generation source. The same challenges we're having building pipelines, we're having building power lines as well. You can't move power around a grid unless you've got the power lines in place.

The last one is the area Department of Defense (DOD) work that EERC has been trying to get into this work for a long time. And over the last couple years, we've actually made some really good strides on that. I think that's an area that North Dakota always has had really good bases here. There is a lot going on in the world right now. We had the base commander of Grand Forks speaking at one o'clock today in front of the legislature and talking about the challenges that the Grand Forks Air Force is now looking at. And it's always been looking north, but now they're looking at real north, right? The ability to move cargo through the north part of the globe, if you will, is real.

There are submarines that are coming and going back there. You might've actually saw the focus that China could easily come over the top as they could anywhere else. So, the globe is going to be very, very close to the top of the globe and some of those things used to look down, now they're going to be looking up at ballistic missiles. And so, Department of Defense is something that, they don't do a lot of R&D like they used to in the old days. Back in my Marine Corps days, we would take a radio, for example, and we'd try to improve it a little bit, but there never was the focus that there was following World War II and some of the others where you just had to do things out of necessity. But I think now the DOD is starting to really look at, hey, we have got to figure out a way to stay ahead of everybody. And some of that, the rare earth elements, right now, a rare earth element, so we can extract it out of North Dakota, lignite. We can get it out of produced water in North Dakota, but there's not a good business case scenario because it just costs too much. But we're trying to work an angle of getting some secure DOD buyers.

But you can't build fighter jets and all the things we're going to need, ships, without those rare earth elements, and if we're going to stay ahead of other countries as they build the next generation fighter jets, we're going to have to have those. So maybe it's time we do the same thing. Extracting some of these rare earth elements should start making it happen to meet those future needs. That's actually one of the lines I stole from the Grand Forks Air Force Base commander. He said the same thing, how are we going to build the next generation of fighter jets if we can't have the right rare earths because they're all coming out of China right now? So, we're doing work in materials in that space as it ties back into some of the materials that we have in North Dakota coal, as well as other products. I'm very excited about some of the things we're doing there.

And back to how we're built. It's companies we're doing work with, it's work we're doing with the federal government, it's work we're doing with the state of North Dakota. There are a couple of projects in North Dakota where we're looking at capturing CO₂. Right now it's coal, but it could be natural gas or other things, and then you have two options: you can store it under the ground or you can use it for enhanced oil recovery. But this is something that I'm guessing most of you have seen this, but I do think this is the secret formula for North Dakota. When we do the calculations of how much CO₂ we have, we will need to get the full oil out of the ground in North Dakota, we don't even have close to the volumes we need. We've got some projects that we're working on, pilot projects where we can't find enough CO₂ to do the work so we're having to switch to some other gases if you will, but this, to me, is a huge opportunity.

The subsurface work, the real good stuff, is in Western North Dakota. The more wells that are drilled for coring, the more we're able to look at what's actually down there. It just helps businesses make decisions about where they're going to put their next wells and ties into what Justin's talking about, that there's so much opportunity, but you've got to have some business certainty before they're going to do it. That's what we're trying to do at the EERC is reduce some of that uncertainty. We've got a project, we're just getting with Department of Defense, working with the hydrogen fuel cells. Hydrogen has been around. It's been the fuel of the future for the last 40 years. We'll see what happens there. But the fuel cell work is actually very promising. It's a combination of a project with EERC, with Department of Defense Army, and Roush Manufacturing. For those of you that don't know Roush, you've heard of those super fancy mustangs that say "Roush?" Roush is the souped-up component of Ford Motors, and Roush is one of the most popular companies in the world. And so, it's a really good consortium we're working with. The Army, Roush, who's done a lot of work in the front end of research and design on facilities. We're doing the work and actually testing the fuel cell to see how it works in different temperatures.

At some point in time, we're going to hopefully put in a tactical vehicle and then test that tactical vehicle out. And we're also working on becoming a cold weather test center, talking about the wars of the past have been fought and where it's pretty warm, minus Korea. Korea was pretty cold. But in the future, who knows? We could find ourselves in that northern tier. And that's one thing that the military is looking at a lot right now, is we've built a system around being in the Middle East. Well, I don't know if we're going to be there a lot in the future. We're going to be other places. Having cold weather testing of all this equipment, having fuels movement is always a big challenge in the military, I think it's the biggest challenge. You need food and fuel. Everything else seems like it works. If you can, you know, hydrogen you can produce on demand. You could put it in a fuel cell. You could do it. So, it would be cut down the ability of moving fuel around the globe.

Talked a little bit about coal, but this is where the value-added energy that we spend a lot of time with. And I think that's the key to continued improvements. The hit on rare earth element a little bit. But I think that it's just so important that we do that. And how can we get the word out? And we're actually talking to Senator Hoeven's office all the time about he's the key to help us out in a lot of stuff with Department of Defense and depending how things go, it's, to me, very interesting. Now, Secretary Burgum called us the other day sometime and said, hey, I need a bunch of information that you have on rare earth elements. So, we put together all this stuff we have. We give it to Secretary Burgum. Next thing you know, Trump's talking about it

in the State of the Union, or not State of the Union, whatever it was he talked about. But I was like, shoot, we're making a difference here in North Dakota. It's pretty cool, right? The way things are situated for us right now in North Dakota, Texas too, I know there's some folks from Texas, but we're in a good spot.

You can make hydrogen out of coal. That's one thing that one of our smart guys did, you can make graphite and graphene out of North Dakota lignite, and we've done some tests on basically a strand of graphene can lift the grand piano. So, you talk about military equipment, lighter and stronger is what you're looking for. We're trying to figure out ways you can scale that up again.

When companies look at things, this is just a snapshot of all the current tax incentives that are out there. So, if you can figure out, if you're, I know many of you are business, many of you are attorneys, some are bankers out there, but if you're trying to figure out whether you guys at Bravera should give somebody a loan, I don't know how to figure it out. Where are they at in the technology scale? What's the tax credits? What's the Trump administration going to do? Lots of uncertainty out there, but I guess I never realized probably until I got in the PSC, the amount of tax credits that are out there and how they tie into decisions, but it's for real, so policy matters.

This is my last slide, I call it "policy, politics, and reality." Once again, I have to tell a story, and as Chris knows, some of my stories are true, some are embellished. This is actually a true story where I'm on the PSC, and there was a time when [Senator] Kevin Cramer and myself and Tony Clark were there, and we were getting sued by a group that said we'd taken illegal campaign contributions. But what it was, it was testing if an individual has the right, or doesn't have the right to give money if he or she works with company X. By the time it got to the judge, it got thrown out, but it took a long time to get there, and it was interesting. The front page—when it finally worked its way through, and the judge looked at it and dismissed it—the front page of the *Bismarck Tribune* said, judge fails to convict Kalk. Then I'm like, what the hell, right? Then it gets better. Then my dad calls me back in Bottineau. You know my dad, right? He said, hey, Brian, what's the deal? It says the judge failed to convict you. I said, yeah, that's right. He's like, well, what did you do wrong? Dad, I didn't do anything wrong. The judge threw it out. But I mean, so dad didn't even believe me, right? That's where politics, policy, reality, people, I can't even imagine because the front page of the paper says something, they don't read the story, and all of you were dealing with that issue, but that was the one that just came back home. Back to the point of the power of media and politics policy.

I am just going to do a quick rundown here of my final slide. The EERC, we are not allowed to do work on nuclear now according to state law. There's a backstory there. Several years ago, the Department of Energy asked us to see if we could do a borehole down to the bottom of the bedrock, so we did that. We're in the process of doing the drilling all the way down and we proved they could do it. Somewhere somebody said the EERC is doing a test hole and to see then if you can put nuclear waste down it. We had people out from our office at the EERC, people protesting, people calling, and we're like, we're just drilling a hole to see how deep we can make it. There were stories that at night people were going out there dropping nuclear waste canisters down there. No. So the next round of the legislative session said, you cannot do work on nuclear. It's funny how that all went full circle, but we were doing no work with nuclear. I mean, I think nuclear power is good. I was in the Marine Corps, but the Navy has been doing nukes for years and they do good work with it. I've toured the nuclear plants in Minnesota and there's no emissions on it. It's 90 percent capacity factor or more. I think it's really good. You see companies like Amazon and Google buying nuclear plants to see if they can get going for data centers. I don't know how we're going to meet the future energy needs of the world or the U.S. without nuclear. I don't know how that's going to play. That's my thought.

Coal, we've done a lot of work with coal. Tyler Kern, he's one of our business development guys, working with the Lignite [Energy] Council has developed the lignite plan of the future, where basically you use the lignite coal for power, you take the part of it for rare earth elements, you make graphene and graphite out of it, you captured CO₂ for an ancillary recovery. I think we should build some of those. Now, it comes back to who can put up the money for that. I mean, you're not going to get a small regular utility going to build one of those. It's going to take a lot of dollars. I think somewhere in there, I think there's a good future for coal as long as we can tie it into a full value proposition. So that would be my thought process there, but they're perhaps not going to go technology, perhaps not going to build one unless there's a big, deep checkbook behind it and I think what Rainbow Energy [Center] is doing, I think there's some Rainbow folks here. What they're doing up north here is pretty good and if they can pull all that off, which we're helping them, I think that maybe becomes a playbook for what we can do in the future.

Natural gas, there's a lot of natural gas out there. North Dakota is built in the past of many peaking plants. I think natural gas wins in a lot of different areas. The challenge with natural gas is some of the pipeline infrastructure isn't there. When we had that disruption up in Canada, we had big gas problems, big gas spikes. So, winning across the board, I do think we should have

more LNG export facilities. Start thinking global. When my friend Tony Clark was on the FERC, they approved some LNG export facilities, and you start getting that wealth transfer. We're sitting in North Dakota, or U.S. energy to other countries. Their money's coming back to us. You flip the wealth transfer. It's been going on. I think that the ability to export natural gas, we should be looking at a lot more.

Hydrogen, it's a coin flip there. I just don't know. We're doing some work on hydrogen pipelines and embrittlement. How much hydrogen can you blend with natural gas? Can you do natural gas peakers with hydrogen in there? There're some companies that say you can, but there needs to be more work on that. We're working with some companies just to see how much hydrogen you can blend. I don't know, though. It seems to me that it's a strategic resource that if you use it in the right spot, it might work.

I'll jump back to nuclear. I thought of one thing on that. The military bases now, actually all of them have a mandate to be able to be off the power grid for, I don't know exactly how long it is, but I'm guessing it's a couple weeks. I believe they're looking at modular nukes to run these bases. And so what better way to make sure a base can be functional with the mission in Grand Forks and Minot, I think there's a chance there.

Jumping down to wind, it's funny, I think wind is where it's at right now. I don't see a lot of people going out there for wind up next there, energy's out there and the others, but I think wind's hit its peak right now for a while. We are doing a lot of work now with wind on the recycling of the turbines, and some of the work and what's inside the guts of them as well as the composite material. So, we'll see where that goes.

Solar, I think solar, there's a place for it. There's some of the southern states where you're able to get the capacity factor higher. I think there might be a good use for it. We have done very little work on solar, but we'll see where that ends up.

Hydro, we probably reached our peak in hydro. They're not going to let us build any new hydro dams probably in the U.S. It's funny, I got to go on a trip to China a long time ago, maybe 10 years ago, and I was part of a DOE delegation. We're talking about building of power lines and pipelines, and I asked the question, about like Three Gorges Dam, the largest dam in the world if you will, about geez, how did you get the approval from landowners to do that? Geez, first off, sometimes I'm not too smart, right? You guys all see where that went, right? But I was asking questions like thinking like a free person, and the Chinese who spoke English all did this right away, and then the guy that was a head guy that didn't speak English, the question got to him and he's like, look at the guy like, what? We don't have a problem, you just do it. I mean, so they just displaced three million people. They don't

worry about regulations and safety. I mean, you just do stuff. So that's the enemy adversary we're against, if you will.

Geothermal, North Dakota doesn't really have real good geothermal potential in the parts where you think the eastern part, the western parts got pretty good availability, but it just seems like nobody's interested in geothermal.

A couple of emerging issues. Tax incentives, we talked about tariffs. I have no idea what's going to happen with the tariffs and how that might affect future business decisions, but I know for us right now at EERC, we're in limbo right now. Where companies that we've been doing work with and certain things, they've called and said, hey, let's put things on hold for a little bit. We need a little bit more certainty. And so regulatory certainty is about as important as anything.

The data centers, boy, oh boy, the amount of power data centers use. I think North Dakota is situated for it, but I don't know how that all works because we've got cases now. There's a data center that's built northwest, North Dakota, but I think there's another data center that's down in the south-central part of the state. That's where there's transmission congestion. Everybody's happy down there. There's plenty of power that is locked up that can't leave the state. It can feed into the data center. Local people got the right briefings. There was the right setup. That seems to be working pretty well. But I don't know where it goes because I don't think you're going to have an investor-owned utility go in front of the PSC saying, hey, we want advanced determination to build a whatever to build, I don't know, a thousand megawatt system to do this data center without a guarantee that data center is going to be there for X amount of years. It'll be interesting if you've got somebody with a big checkbook that comes in like a Google or Amazon and says, you know what, we're going to build all this ourselves. We're going to build the data center. We're going to build the generation and we're just going to do it. I don't know how that all plays because to me, somewhere they got to tie into the grid.

The data centers, that might be the nuclear piece too. That's I think where Google and some of those are looking at the nuclear power.

Pipeline citing, I don't know that I could do any better job than Justin did other than it's needed.

Transmission lines, regional transmission organizations, RTOs, if you get your Southwest Power Pool, your MISO, PGM. When they started, I thought it was a really good idea. Frankly, I did the ability to have power, move around and have a big clearinghouse of energy. But then when I started seeing companies, investor on utilities saying, hey, you know what, we'll just buy it off the grid. Well, that's not going to work forever and that's where

some of the thing we've been buying off the grid for so long. Now, all of a sudden, the buying off the grid, I mean, there's a time, but I still think the more you can build yourself that you can count on, the better off.

Then all of you know better than me, the jurisdictional, and I'm going to call it uncertainties because depending who you talk to, they'll tell you it's certain one way or the other, but that was the biggest challenge I dealt with in the PSC. Two things I learned when I got the PSC quickly: the complexity of jurisdiction for pipelines, power lines, take your pick, and the next thing I learned was the power of leadership in the House and/or Senate. I remember talking to Bob Stenehjem one time and—rest his soul, a really good guy—said, hey Bob, I think this is a good idea, and he's like, it's not. Anybody who knows Bob, that's what he would have said, right? Bob harms, you know that, right? I gave him this good pitch. He's like, you done? He said, yeah, that's a bad idea and he walked away. Then I tried talking to some other senators and it quickly got back to me. Bob doesn't want to do it. The next thing he threw me out of the Senate chambers. So, I learned quickly, don't mess with House or Senate leadership. Then the last thing, like I said, the jurisdictional thing. You got a gathering line, somebody's jurisdiction, a transmission line, somebody's jurisdiction, which leaves the state, then goes somewhere else. But when an angry constituent calls you, you can't tell them that's not my jurisdiction. You just got to do your best to answer the question. Just for the record, nobody ever called me into PSC and told me I was doing a good job. So, you knew the calls that were coming in.

That's all that I really have. I think that looking at my notes here, just appreciate the chance to give you my thoughts on things. I'm excited to see where the next couple of years goes in North Dakota. Thank you all for what you do. Thank you UND for the opportunity. Happy to answer any questions.