Oral History Interview of
Andrew H.P. "Andy" Swift Jr.

Interviewed by: Andy Wilkinson
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Lubbock, Texas

Part of the:
Wind Engineering Interviews

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Interview Series Background:

In addition to interviews pertaining to the National Wind Institute, oral histories have been conducted with various individuals whose lives have been impacted by wind engineering in the Southwest. For example, interviewers have spoken with farmers and ranchers who witnessed the rise of wind turbines on their properties and adjacent lands, employees of electrical co-ops, and engineers who helped logistically create the large wind farms.

Transcript Overview:

This interview features Andy Swift. Swift discusses his time working with Wind Energy around the state of Texas. He discusses the history behind wind research, where it is today, and where the future is headed. He also discusses his time at Texas Tech developing programs for Wind Research.

Length of Interview: 01:19:16

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Keywords
Wind energy, Wind Research, Wind Turbines, Texas Tech

Andy Swift (AS):
—something like that—rather than schedule another whole thing. How's—how's—how's Ian doing?

Andy Wilkinson (AW):
He's doing well. I—

AS:
I miss him.

AW:
Well, he misses—

AS:
He's so good at his job. Yeah, you tell him that for me. He was so good with us. We don't have any kind of support over here.

AW:
Well, he really missed that outfit, but as you know, it was—everybody—he lived in the right spot. He had a chance to go to a place that Juan Muñoz runs, which I'm sure would've been fine, but he's working essentially for Sam Segran now. It's a real—it's much like what he left in terms of people treated like a big family.

AS:
It's with Carissa, over at TLPDC? Yeah, she's great. There are a lot of nice people over there. Anyway, say hi to him and Merry Christmas, because I probably won't see you over the holidays.

AW:
I will do it. And let me say this is Andy Wilkinson with Andy Swift, it's the eighteenth of December in the morning, we're in Andy's office at the National Wind Institute, we'll be talking about wind, which is a great west Texas topic. But let me start by getting just some basic information. When we put this in our records, do you want it as "Andy Swift," is it—

AS:
The more formal is Andrew. More formal.

AW:
Middle initial or anything?

AS:
What name? I've got two middle names, so my official name is Andrew H, as in Howard, P as in Potter, Swift, and I'm a Junior.

AW:
Oh. Great. And what is your date of birth?

AS:
January 21, 1946.

AW:
Headed for a birthday, that's great. And where were you born?

AS:
Troy, New York.

AW:
Did you grow up there?

AS:
Grew up in Troy. In the area.

AW:
How did you—where did you go to school? How did you—how did you get interested—

AS:
How'd I come to Lubbock?

AW:
Well, eventually, how did you get that way?

AS:
Real quickly, went to a school in Massachusetts actually for high school, then Union College, Schenectady, New York, for undergraduate, studied engineering, mechanical engineering, then Vietnam was going on, so it was ROTC, Air Force ROTC, signed up for pilot training, and got assigned to Reese Air Force Base, Lubbock, Texas, met my wife. We didn't get married while I was here, but I met her. She's from Shallowater, and then served during Vietnam, I was an instructor in Oklahoma in T-38s. Then graduate school at Washington University in St. Louis in mechanical engineering, got the PhD, went to UT El Paso for twenty years, served as an academic administrator and faculty member in mechanical engineering, and in 2003, I responded

to a[n] opening here at Tech for the director of the Wind Science and Engineering Research Center at the time, taking over from Kishor Mehta—resigned or resigning, I guess he retired, he went part-time, so I took over as director here. Do you want me to just keep going and take it into the present?

AW:
Yeah.

AS:
Took over as director in 2003, served in that role till 2010, and then moved to University College, where we had the Texas Wind Energy Institute housed, funded by the Texas Workforce Commission to develop education programs around wind energy, and then came back to the renamed Wind Institute in January of—it's been a year since the institute was formed. We moved over here in July, but—

AW:
So in January 2013?

AS:
January 2012.

AW:
Twenty-twelve?

AS:
No, 2013, yeah, '13, yeah, this is going to be—yeah, you are correct.

AW:
All right. What was your— in your education. What was your interest in mechanical engineering? Were you already interested in wind?

AS:
I was—I had an interest in energy conversion and energy in general, and then in graduate school, for my PhD work I got into wind turbine rotor aerodynamics and dynamics specifically. Worked with a well-known helicopter person at Washington University who was with McDonald-Douglas there, and then joint appointment with the University. And he was German. Very well-known. Kurt Hohenemser.

AW:
How do you spell that last name?

AS:
H-O-H-E-N-E-M-S-E-R. If you go back—

AW:
K-U-R-T?

AS:
K-U-R-T. If you go back to the very first papers on helicopter technology back in the thirties, before they were even flying, he was writing papers and working with Crandall, I was very lucky to work under him. And so he had some innovative designs and that became my PhD dissertation at Washington University. Do you enjoy humor in these?

AW:
Yes, I do.

AS:
It's not that funny. So by that time—this is now in the early 1980s, I was married to my wife Linda, who's from Shallowater, and—I'm going through and we had an atmospheric test site in St. Louis, Missouri, out in a research station about twenty miles out of town, and every time the wind blew a little bit, I'd get a call from Dr. Hohenemser, "Okay, Andy, it's time to go raise the tower and get some data for our research." And so every little puff of wind that was back-and-forth driving, and after six months, my wife said, "Why are we doing wind testing in St. Louis, Missouri, when we could do this at Texas Tech and you could get all the data that you needed in a week instead of three years?" And eventually, that's what happened.

AW:
What's your wife's maiden name?

AS:
Grissom. Linda Grissom. Her dad was a high school teacher in Shallowater.

AW:
Turbines. People don't just wake up saying, gosh, turbines are interesting. Was it something new with your flight?

AS:
Close. Interest in aerodynamics and the blades, the large blades that they have in these wind turbines are actually just like the wings of airplanes or aero-foils, and so it's all the principles of lifting rotors from airplanes, helicopters are just applied in reverse, if you will, and so it was—and I already had an interest in that, picked it up in the Air Force with flying. So that was a direct

application—and a lot of the people in the eighties who got interested in wind at that time, and of course, it was a very boutique thing in the United States—

AW:
I was going to say—I mean, that was going to be my next line of questioning—this is early that you were studying this.

AS:
Yeah. Started in the late seventies. Well, the government got involved in the United States in the late seventies because of the oil embargo situation and they started looking for alternative sources of energy and they formed the energy research and development administration and that was about the time, we're getting into the mid-to-late seventies, I got an interest in both solar and wind. I did some solar research and then some wind, focused in the mechanical engineering rotor aerodynamics under this professor, so that put me more on the wind side. Although I did some other solar work at El Paso when I was there and then got back into wind when I came here to Texas Tech. But you're right, that was very early when the machines were very small, it was a very basic industry, a lot of problems. The Europeans picked up on it much quicker, and they invested a lot more money, government money, and they really kind of set the stage for modern wind energy development.

AW:
And why is that? Why would they—you would think that the United States—and the reason I've had people in wind energy say the United States is the perfect wind energy country because we have five time zones, the need and the ability to produce it moves, and if we can figure out how to get the energy from one place to another, we don't have the same problems that smaller countries have. Why would it be that this interest developed more quickly, or earlier in Europe?

AS:
I think it's two reasons. One, even in the seventies with the oil embargo and things, you know, we had so much coal in this country. Back in the seventies, nuclear was coming on. So, you know, for electricity generation, kind of, who needs wind? We had to really look, kind of from this country's point of view—plus, people didn't think the resource was there. We can come back to that. The early people didn't understand the resource at all. And it was—let me go ahead an answer the question because otherwise we'll get distracted. The Europeans on the other hand, much more constrained in coal, they didn't have the oil, they didn't have the energy, the indigenous energy resources, but they had wind. Denmark and the Netherlands, especially had—

AW:
We're talking about off-shore in particular, right?

AS:
Well, we're talking about their history in wind back from the 1600s.

AW:
The Dutch and their windmills—

AS:
And there were few people—right—the Dutch windmills—and the European—the English, English from the twelfth century, very interesting history in all that. But anyway, I'm going not going to go there so much, because that history isn't what totally drove it, but there was this fundamental thing, what we do, we do wind and it can make a big difference, and then they had some people who started in the electric technology and then a couple of countries, the Netherlands, Germany, and Denmark just really picked up on this because they had pretty good wind resources both on-shore and off-shore and they made one very interesting decision that was key in this: when they got ready to build their first prototypes and things, they went to the farm implement builders. They saw this as rural development, not so much an energy play, but individual turbines and individual farms—

AW:
So distributed generation.

AS:
Distributed generation.

AW:
As opposed to—

AS:
As opposed to wind farm generation.

AW:
Yeah.

AS:
And that evolved later in the eighties. And so, well, who builds rural equipment? Well, farm manufacturers. They make good, tough, rugged stuff. So they went to their implement manufacturers and began designs and things and these were pretty small. But all of a sudden, five or eight years later, in the United States, simultaneously, we had this path of light, flexible, high-tech, NASA-engineered wind turbines. And—so you had these two paths. When they got introduced in the marketplace and the first wind farms in the eighties in this country, anybody

that was doing the light, flexible, American approach, okay, the stuff was unreliable, was cheaper initially, but it wasn't reliable. And I'm not slamming our country here, people didn't understand the technology. There's a famous quote back in the early eighties, they put some NASA people on this, and the guy said, "gosh, I'm going for working on space stations to twelfth century windmills. How hard is this? Yeah, it's aero foils, but by God, this is trivial." Their machines lasted six months, they got up in the atmosphere, they didn't understand the atmosphere, the turbulence, and they ran for six months and were destroyed. Meanwhile, the ones built by the farm implement companies in Europe were rugged. Overdesigned, overbuilt, little more expensive, but they kept working. So if you got in the business, what kind of equipment did you want? I'd want the European stuff, because it's going to last. Oh yeah, but this is cheaper. Yeah, but it's going to last six months. So it's a very interesting thing, and it's that energy security piece simultaneously with the Green party development in Europe that I think drove that indigenous resources, clean, green. Global warming stuff started a little bit about then, and even beyond the global warming, just the whole emissions thing from coal and all this. People—

AW:
Yeah, because they were recognizing it at that time. If I recall correctly, the interest in acid rain—in—

AS:
Yes. That was a hot topic.

AW:
It was a very big topic.

AS:
Yes. And then you had Chernobyl, so all the nuclear people got a huge wake-up call. I mean, Three-Mile-Island was bad enough for this country, but you know, there was very few deaths. It was close, but Chernobyl was—people, really—deaths, radiation—wait a minute here, so we've issues with coal, we've got problems with nuclear, what are we going to do? So I think we wanted to import less oil, where are we going to get our electricity from, so I think the governments really got behind it and then they built this rugged equipment that worked, so if you look back in the early eighties, it was Denmark, Germany, the Netherlands that really got this industry going. And then they started importing equipment over here in the United States, and the idea of a wind farm, because of our large expanse began to come on instead of the onesies, twosies distributed that they had in Europe.

AW:
I also picked up from—in my interviews with the folks in electrical engineering about the Crosbyton solar power project, which was a distributed generation project that already by that time, there was a strong—at least from their point of view—there was a strong bias with the federal government, at least, toward centralized generation as opposed to distributed generation. Was that—would that have made a difference in how it was picked up over here, you had these machines built, and we were already thinking that we would want to build big wind farms as opposed to trying to come up with a distributed-generation approach?

AS:
You know, my sense—because I was going to all the meetings at that time, so I've got, I think, a reasonable sense, I don't have all the answers here or anything, I'm just going to give you my perspective at the time -- was that the—it's the business community that got into this. California—California was the leader in wind in this country back in the eighties. I think the businesspeople there—I remember the first meeting, the word wind farm is used for the first time and that came from a guy I'm pretty sure named Jim Dealson, one of the first entrepreneur developers. I think that came and I think then the government kind of came on. The government was building in onesie, twosies. They had the mod 1, the mod 0, the mod 1, the mod 2s, they were trying to build these big, light, flexible two-bladed machines, trying to drive costs down—

AW:
And the helix, the spirals, I remember seeing one of those out northwest of Amarillo very early on. Vertical—

AS:
Vertical axis. That was all driven—there's a link to Tech here, of course.

AW:
Really?

AS:
Oh, sure. Back in the eighties, I came through here looking for a job out of graduate school in St. Louis, and there were no openings. I talked to all the mechanical engineering folks here. Walt Oler was here, Jim Strickland was here then, and they were doing vertical axis tow-tank tests in mechanical, and they had a small vertical-axis machine out—what ended up being the wind research site just west of the hospital. You know where that site is? There's a tower—

AW:
Where the—and where the observatory was.

AS:
Right next to the observatory.

AW:
Yeah, I remember that.

AS:
That's the first wind engineering site. And that started as a vertical-axis, you know, Darius machine and Sandia had their test site linked with the USDA Bushland, and that's where they built the first large test facility to do vertical-axis. But Tech was involved in that pretty heavily.

AW:
I didn't realize—

AS:
They didn't have any openings here, or I probably would've been here from the eighties.

AW:
I didn't realize that Walt—

AS:
Yeah, Walt Oler and Jim Strickland.

AW:
I'll need to—if I can find him—didn't he and Catherine get a boat or something and float off into the—

AS:
Walt? Oh, he retired—they moved to Spain, was the last I heard. They said, "we're moving to Spain."

AW:
Yeah, I heard at one time that they were going to get a boat and sail.

AS:
Oh wow, okay, sail around the world.

AW:
Well, good, maybe I can get Texas Tech to send me to Spain to interview Walt. That would be terrific.

AS:
If he's—well, maybe he did the boat thing, you got to helicopter in, I don't know.

AW:
So when you went to El Paso, what was there for you to study?

AS:
Yeah, so they had a department chair [for] mechanical, it was very much doing renewable energy. I told them I wanted to try and do some wind, and I did do some wind work down there. I had some students. It was pretty modest, and it was really a carry-on of work from St. Louis, I kept the relationship with Kurt Hohenemser, we got some DOE money, we built a small test site down there, the winds weren't very good, but simultaneously, I picked up work on another technology called solar pond technology. Salinity-gradient solar ponds. And this is—you take heavy salt brine and you make it with fresh water, the Israelis were big on this in the eighties, and you—these heat up. It's not like an evaporation pond, I mean, you literally can boil this. It's very interesting technology. You have this fifty-acre pond all reach boiling temperatures down in the bottom. They're about maybe ten feet deep.

AW:
Tell me the name of this again?

AS:
Salinity-gradient solar pond. SGSP.

AW:
I need to learn about this, I don't know a thing about it. That's interesting.

AS:
We're writing a textbook here, me and Rick Walker who I've known for a while, and so we put other technologies in there—if you want to unzip it, I'll Xerox a page or two for you.

AW:
Yeah, I can probably look this up on the web.

AS:
Yeah, you can look it up on the web too. Let's see—I can't remember which volume it's in now. Let's keep going and I'll find it. It's just a one-page summary here.

AW:
And so you were doing—

AS:
I did both solar—I did that work for ten years down there in the solar area as well as getting a wind project going down there to carry out that work on these turbines that I just mentioned. I'll keep looking while you ask questions.

AW:
That's all right. And you mentioned when you were outlining the steps in your career that you got into administration.

AS:
Yes. I was dean of engineering at UT El Paso for seven years. And of course—that really put—I tried to keep my research going and I stayed involved with the solar pond, but it became very, very difficult.

AW:
I would imagine.

AS:
Yeah, it's kind of tough to do both. But I kept enough going so that when I finally was—when I was done with that—actually, when I got done with that, I ran—I was director of a small research group there and then the opening came at Tech and so I took that.

AW:
And your research group, was it back in wind or was it in something—

AS:
I had—I had two research groups. One doing wind and one doing solar ponds.

AW:
Great. Well, when you arrived at Texas Tech, what—what was the lay of the land when you got here?

AS:
This is here—it's very frustrating. I'm flipping it—it's just one page here, but I can—I can get it.

AW:
There's no hurry, I just—

AS:
As soon as I say no, there it pops up. That's the technology, here's our insulation down in El Paso, and we used it for providing heat to a food canning plant and we looked at desalination and electricity production using what's called a rec[?]-and-cycle engine, so it's a—it's an interesting technology, but it hasn't really taken on very much with the lower price of oil and gas, there are cheaper ways to get—so what was the lay of the land here at Tech when I came in '03?

AW:
Of course, you knew what you were getting into, you knew something about it, and you had—you came out here to interview and all. What was the—

AS:
My mandate when I came was to introduce wind energy in a larger way into the wind science and engineering research center. And you've gotten this from others, so I won't go in—you know, there's forty windmills—a forty-year history that was in, what, twenty, two thousand—what—is May 11—

AW:
Nineteen seventy.

AS:
Nineteen seventy. So in 2010, we had the fortieth anniversary. Okay, so I'm here in '03, and the tornado, the hurricane research, the wind hazard research was all very, very strong at that time. There was a nascent start in wind energy. And so it was my mandate to grow that part of the center. There was some concern by others, or some thought that this would become a wind energy center at the exclusion of these others.

AW:
And concern by people in those other centers.

AS:
In those other areas and by other administrators here would ask me, "oh, is that where you plan to go?" et cetera. I didn't know at first, but it didn't take very long before I realized that we should kind of have a tagline of everything. You were crazy to—you had this, at that time, thirty-plus year history in the technology, and you realize—this I think is one of the things where we are now, and I'm sure—Tech -- probably was Kishor Mehta and others, Jim McDonald and Richard Petersen and Ernie Kiesling -- all recognized that you had to have a meld of atmospheric science with engineering to make this work. I picked up on that and realized that in the wind energy field from a national perspective, that was not happening. The turbine, mechanical engineering turbine construction field was totally isolated from the atmospheric science field.

Wind was just this thing that was kind of used, and it's just a number. "The wind's ten miles an hour." So I put a thing that makes—no recognition of the complexities of the atmosphere. Part of the reason some of the first designs in this country didn't work was because they solved it well for a flight condition, but not something tied to the ground in that boundary-layer atmosphere, which is very, very complex with these large, you know, devices. The devices were small, which didn't matter, but you get these devices larger and larger, they became exposed to this and I don't think the Europeans understood it much better than we did, the atmospheric part of this, but they overbuilt their machines so that it didn't matter.

AW:
Yeah, so they wouldn't recognize what they had done right because they didn't have the problem—

AS:
This is early on, and then as machines got bigger, they began to understand, "wait a minute, this atmospheric thing is a big thing." And I think that's still helping today, that science and engineering multi-disciplinary approach to the problem focused around wind. And there's not a lot of other places in the country doing that, or made that recognition. So I think that was—that was important. I also brought in a somewhat controversial figure, his name is Jamie Chapman, and Jamie Chapman was the—he had been the vice-president of engineering of Kenetec wind power, one of the first large wind farm developers in California, so he had—he was electrical engineer by training but had been in wind a long time and understood the community, the research opportunities, et cetera. But he was not a classic academic.

AW:
Yeah, in fact I heard him described as he's a builder. He's a developer. He's a—you know, he's in the outside world, as opposed to—

AS:
Yes. Yes, yes, yes. Much more of a—now, he appreciated research, but at a practical level, not for the sake of research. And he's used to building stuff, making stuff happen.

AW:
Did you bring him here because he's used to building stuff?

AS:
Because I knew him and he knew the industry, and he knew—he was connected. He knew—he knew where the hotspots were and kind of what was going on, turned out he was an excellent teacher. He loves the students.

AW:
I have a friend—well, she's a friend now, she was my student when I taught in Honors, Crystal Maeker.

AS:
Oh, Crystal Maeker? Yeah.

AW:
And she just adored him as a teacher.

AS:
She's still in the industry.

AW:
Yeah, she's down—down in—

AS:
In Houston, yeah. Dallas or Houston.

AW:
Houston. Yeah, I call her periodically to get her to give me the update on what's happening. Bless her heart, she's spending most of her time on the finance side.

AS:
Yes.

AW:
Yeah, but it's—

AS:
Doing very well in it.

AW:
Oh, yeah.

AS:
And with training as an engineer, what she really is financial engineering, and there are a lot of people like that—

AW:

Anyway, she was very, very much a fan of his teaching in the classroom. One of the things that really strikes me about the wind institute—the way it's developed since you've been here is this combination of things that—you know, because we always talk in the university setting, "we need more interdisciplinary work," they give a speech and go on to their own turf and nothing happens.

AS:
Andy, you're exactly on target.

AW:
But you're doing something different. And how do you make that work? Or how does it work?

AS:
All right. Step one: Kishor Mehta—he probably told you this—writing four times, if I remember, I think they tried, and it wasn't him alone, there were other people, John Schroeder, Ernie, a lot of support. But I think he was—he was a key driver. I want to give him credit for that. At least I give him credit. More than others, because I think he provide the persistence to go back four times to the National Science Foundation to give him the integrated graduate education research and training grant that led to the wind science and engineering PhD program. And it wasn't just a research grant, it was an education grant to put together this, and that grant—it was millions of dollars over five or six years, and the purpose was—from NSF, they said, "we want to change cultures at university and put interdisciplinary, multidisciplinary"—there's many words for it—"programs into university. And this is hard and when you take this money, you sign on to change the culture, or try to change the culture, at the university, starting from the PhD level to bring in multidisplinary research programs, research and education." And so I think Kishor was turned down, turned down, turned down, all of a sudden he kept making it better and better—when I came in '03, it had just been awarded. They finally hit it after three or four years of trying. And so one of the first things that he did—he was struggling, his wife died, she got sick, cancer, died during that time, it was really very, very difficult—he hung in there and he set up the PhD program while I ran the research program in wind science and engineering research center with the help of Richard Petersen, Ernie Kiesling—Jim McDonald had retired by then—and Doug Smith was another key player I think at that point. One the organization of the center, this whole multidisciplinary approach, well then I brought in Jamie and I tried to bring in some other wind energy people to get that going kind of under that same umbrella. So that was all going on at that time. It was all out of Civil Engineering. Then—actually, that's not true. It was a combination of civil engineering—we were housed in civil engineering and Kishor was a civil engineer, but John Schroeder and Mr. Petersen were now becoming bigger and bigger players at that time. John's research was becoming very successful on hurricanes, he got the radar stuff going, we hired a radar guy out of A&M, so that—that piece kind of kept going. Meanwhile, we're building a PhD program, we've got twenty students eventually in that program, now you were—

you couldn't just dissolve the center all of a sudden, you had twenty students you had to deal with. So all of a sudden it became very, very real. I think that—those things and the setting up of that program—I remember going with Kishor. We'd pull all the deans together. We'd take them to lunch. We would talk about the multidisciplinary and the Dean of science, and the Dean of engineering, you've got to work together on this. These departments have to work together. Jane Weiner was Dean of science at that time and she agreed to a couple of science hires focused on wind. And we brought in a couple of folks from inaudible[32:25] in atmospheric science, we brought DeLong Zo in civil engineering, those were two hires that were specifically hired to contribute to wind, so that helped, because you had the PhD and then there was money and bringing students. That money went through—gosh, I think it was '10 or '11 before that project finally ran out of funds. Because it was a big fellowship for students that we could recruit nationally, bring in students. So that was—that was a key, key step in the multidisciplinary—

AW:
Who was Dean of Engineering at the time?

AS:
First it was Jim Smith, then it was followed by Pam Ibeck, and then—let's see, was there an interim between them? There may have been. Al Sacco took over—did we have an interim?

AW:
I—I don't know.

AS:
I can't remember. And then Jean Wyner moved to the provost's office, and Lawrence Schovanec was Dean of Arts and Sciences, and then he went to the Provost's Office, and so there were—I think they're about ready to name another permanent dean.

AW:
I just wondered about the same time. Well—just one quick question, preceded with a—why it would have the question to start with—when I got the charge of the assignments starting to do some oral history interviews on wind engineering—are we doing okay on time? I set out to talk to developers, wind farmers, how is this going. One of the first things I ran into were people opposed not to wind farms so much, although there is some of that in the larger world, there doesn't seem to be much of it in Texas, but a lot of opposition in Texas to transmission. And so I wound up doing a whole series of interviews with folks who in fact had a contested case with the PUC on a transmission line going from the San Angelo area down to Comfort, and so I started studying a bit about the cultural impact of wind engineering, how that all figured in. Was that—which amounts to, I don't know, sociology, but social science certainly—was that ever a component ever discussed as part of wind institute? Because you also have social components I

know when we were—when we went through the tornado in 1970, there was—there were practical and physical things, but there was a whole lot of that piece of work that was social as well. How do you warn people, how do you train them to do what they need to do—for that matter, if you know how to build a building that's tornado-resistant, how do you get builders to build it and homeowners to pay for it, all those kinds of things.

AS:
And use it?

AW:
Right.

AS:
No, there's social impacts for sure—in fact, the title of our book: Wind Energy Impacts. Okay?

AW:
Do we have a copy of that at the Southwest Collection?

AS:
I doubt it because we—it's published in draft form, we're using it in our classes, and we just signed the contract a couple months ago with Wylie, so it should be out in book form hopefully in the next six months to a year.

AW:
Okay, if you let me know when it is, we'll order a copy.

AS:
Great, that'd be great. So it's me and Rick Walker who's here. We'll end up probably talking about that in a minute, but that's—that's later. Social impacts. I remember when I came here and I gave my lecture to—you know, for the faculty to see if it's—what do you call it? Interview lecture, if you will. I remember talking at the time, here we are in '03, and a lot of things that are now here in Texas weren't here, I'd met Rick Walker when I was an instructor here. He was working for central and southwest power, and they did the first wind farm in Texas in the late nineties in Fort Davis, using Zahn[?] turbines and things, and then he stayed involved and they started some of the first larger projects down in the McKinney area and the Trent Mesa area, eventually Roscoe. So he's had a long involvement in the development of wind in Texas. But in '03, that stuff was just kind of getting started. So my observation of it and why I thought it was good for the center to go in that direction was that it was going to—it's just going to happen. You could just see it. My—my impacts that I listed at the time was people in Texas, and a lot of the Great Plains—number one, we're used to wind. All the way back from the water pumpers in

the early days So there's a historical connection there. People are used to extraction of energy from land. They're used to having land developers come through and getting oil rights—wind rights are a little bit different -- they had pump jacks on their land, yes, okay, so there was that history already there. You had the workforce, because you had people who were used to climbing towers, working with heavy equipment, doing all this energy stuff, it's just another piece of energy equipment, so that infrastructure is all in place. There was a lot of money. You talk to these folks who've got turbines on their property, I mean, it's not the same with transmission lines.

AW:
No. Very different.

AS:
Very different. You have to do the easement—I don't know—Rick knows the details about how much money a land owner gets for a transmission line, but compared to a piece of the revenue off a wind turbine, it's—fractions.

AW:
They get a one-time payment, most of them. The other thing that I noticed in the contrasting and comparing farms versus transmission was that transmission was done by and large as a utility function. So they had different laws and rights and regulations and essentially they could tell a landowner, "too bad."

AS:
Eminent domain.

AW:
Right. So far, that hasn't happened with wind generation.

AS:
That's right. That's an interesting point.

AW:
And even in some of the early transmission lines, when FPNL came in Texas and did lights—they were used to operating—they weren't a utility in Texas, they were a utility in Florida, but when they built their transmission lines in Texas, they treated them like a wind farm. So they paid what they had to pay to get the line through, so they were building lines very quickly and without much fuss.

AS:
Interesting. One-time payments, or did they give them a piece of—

AW:
One-time—no, they—and that's been interesting to me, that no one has said, "gosh, why don't we do a"—

AS:
[inaudible] charge.

AW:
Yeah.

AS:
--give a piece of it to [inaudible].

AW:
And I think it's because most of that industry—the transmission industry—is based on utilities, and they are—they're driven, it seems, almost exclusively by cost. I mean, they—like one of the big arguments against the transmission wasn't so much the transmission as it was the kind of towers. They were building these giant lattice towers and would not entertain the idea of the monopole towers, and landowners said, "well you put those single poles up here, that doesn't bother me. That doesn't affect my land usage like the lattice towers," but the utility would say, "we're going to save three percent by using the lattice tower." And it was like they're—I think it's a cultural thing as much as a legal thing, but the utility was so focused on, "if we have a less-expensive alternative, that's our mission in life, is to do that." Whereas the commercial transmission line, they went from one landholder to another and said, "What does it take?" and they paid it and went on, and I thought that was a real interesting difference.

AS:
Yeah, that is interesting. I've never heard that story before. Back to my little story, there's one piece, as I was going over it in my mind, that I didn't emphasize: you've got to have wind. And Texas had the wind. And that even has changed since—even since I've been here. I made the comment twenty minutes ago when we were talking: no one understood, when wind was getting going, oh my gosh, you know, the great example, counterexample is nuclear power. You know, you don't talk about all the earth we had to move to get there, but eventually, we find it comes down to this one pellet, and it'll make enough energy for five years, ten million people, I don't know the numbers. But you can imagine. So you've got this concentrated energy, and the problem with wind, back in the seventies, is to—it's the same as solar. It's so dispersed. And oh, my gosh, can you imagine trying to run our country on these little generators like they had back

here? I don't care how many you put around, they're these little things. Nobody really realized, until they started getting into the higher levels of the atmosphere, okay, really above about forty meters, about one hundred and twenty feet, the atmosphere changes and becomes much more energetic throughout the Great Plains. Especially at night. You start looking at those resources and then tapping into those—I mean, the numbers just, you know, quadruple. You look at the early wind maps that NREL – National Renewable Energy Labs -- did, natural renewable energy we have, you know, back at ten meters, because you know, that's where the data was. Ten meters, thirty feet, okay? And then you start seeing—then they start getting the taller towers at fifty meters, and then they start doing eighty-meter maps. Every time they did these, the amount of extractable wind energy—and you took away cities, you took away national parks, you took away pristine areas, and then look at what resources you have left, these numbers just kept getting bigger and bigger. And then you went off-shore, oh my God, pretty soon you can run the whole country fifty times over with the amount of energy in the wind. Now, you're not going to cover the country with wind turbines, you're not going to do that, but the resource argument got just pushed aside with real data. And Texas turned out to be one of the just prime locations. And Texas has both off-shore sites and on-shore. You look at a lot of the states with on-shore—or off-shore resources, they can't do anything on-shore. Maine has great off-shore resources. I'm sure it's all trees and mountains and—

AW:
And it's expensive putting in a wind farm—

AS:
Exactly. And not even just the wind resources, just, you know, there's great winds on the tops of mountains. Well, you know, how do you get the turbines up there and how do you get the power down to the Great Plains—and you can still farm around them, you know, and things. You can ranch, farm—there's a visual impact, but the land use impact is pretty minimal.

AW:
Did the fact that Texas had its iconoclastic homegrown power grid make any difference?

AS:
You bet. Absolutely. And that's the next step. And it just started—came out in the Senate bill in '05. So I started this thing in '03, all of a sudden '05. They started talking about the competitive renewable energy zone. Long story short, Texas has led the nation. Because everybody realized you cherry-pick the good sites, connect it up to transmission, there's none left. In fact, the lines are full, you have to turn off the wind turbines because you were melting the lines and all this kind of thing. So they said, "if we're going to keep going to wind, we need to invest." So you know, that's at seven—started at five, I think it's now a seven billion dollar investment in transmission, infrastructure—

AW:
So people expected to wind up being more than the seven?

AS:
Maybe, by the time it's done. But that opened up, of course, all kinds of additional wind resource. That's a tricky one because those lines run into a different utility area. We're under the Southwest Power Pool, but those lines come in and they're connected back to Ercot, so you've got wind energy flowing over the top of people here in the form of electricity that you can't tap into.

AW:
Right.

AS:
That'll be interesting how that all plays out over time.

AW:
One of the more interesting interviews I've done is with a fellow who's spearheading the Tres Amigas switch project.

AS:
You've interviewed him?

AW:
Mm-hmm. Yeah, it's been two years. He's been so busy. I think the financing has been more difficult than what he thought at the time when I interviewed him. He's an interesting fellow. West Point grad and a native of Colorado, grew up on a ranch.

AS:
What's his name again?

AW:
I'll think of it in just a moment.

AS:
I've met him, and I can't think of it either.

AW:

But he ran that—director of that grid in—that was headquartered in Philadelphia, I think. Northeastern—what is the name of that grid?

AS:
TJM, I think?

AW:
Yes. Exactly. But his—it was extremely interesting to hear him describe the importance of not only that switch, but other switches like it that would make the United States the premiere place to have wind because of having a whole continent to spread the energy across. So I've been trying to follow that. But they've yet—I mean, they expected to have broken ground almost a year ago, and they—I don't—when I drive over—

AS:
Interesting.

AW:
Yeah, when I drive over there, I don't even see anybody.

AS:
They ought to talk to our class, or one of the folks with him and talk a little bit about it. Interesting. All right. So I can't remember what we were—we were multidisciplinary at the university, and then we got off on the other dudes. You want to go back any more to the university, or—

AW:
Well, yes. Well, I mean, I'd asked a question, how come social sciences haven't stepped up and said, "Gosh, we want to be part of this. There's an issue of culture here." You know, I know—there's been some interest from the geographers, you know, looking at the—sort of the industrialization of the plains from the point of view of first-center pivots and now wind farms, transmission and so forth. That's still a step removed from people going out into communities and saying, "how is this affecting you?" etc.

AS:
There's been some of that. Because I've been on some committees. It was a master's thesis done—gosh, I can't remember his name, it's been four or five years now and I'm trying to think what department he's at. There'd been spotty things in that realm. Also, on the economics side, you know, we'd be multidisciplinary. The leaders are science and engineering, but the economists are in there. We have Bob McCullom who's been a player in the center for a long

time. Brad Ewing, from the college of business. We haven't connected up very well with the energy commerce folks. We've talked to them a little bit but they're mostly oil and gas.

AW:
Yeah, there's one guy over there who's interested in electricity.

AS:
Michael Giberson

AW:
Giberson.

AS:
We've met with him and talked some over time. So—but we haven't really drawn in the social scientists, you're right, any economists at the same level as the science and engineering, and I don't know if it's a money or, you know, they just don't see that they can fund research in their areas. There's some disconnect. I'm not sure what it is.

AW:
One thing that strikes me is that your world is moving at a very fast clip.

AS:
Yes.

AW:
I think it takes a while for people not in that world to say, "oh, look what's happening." And by the time they look at it—for instance, OU Press sent me a book to look at last year, and they were just bringing it out, and it was—it's a new book, and it's fifteen years old—I mean, the information in it was fifteen years old. And I've looked at it and said, "guys, this is—"

AS:
It wasn't Bob Ryder's book, was it?

AW:
Yeah.

AS:
Did he do it through OU? He's done two: *Wind Power in America* and then he did another one. *Wind Run* or something like that.

AW:
Well, he had an early one that I found really interesting, it was essentially the papers presented at a conference in Europe, and I thought those were—

AS:
Yes. Yes, yes. Yes, he did that. They funded one that was kind of a land-use architecture thing. Yeah, we've had some work with them and that kind of died off. What's the guy's name in landscape architecture here? He's a blond guy, a little heavyset.

AW:
Oh, yeah. Yeah, no, I know exactly who you're talking about. Well, I was really interested—

AS:
He and I kind of did some things. And we've done some—we tried to do some things with agriculture. Natural resource management. One of the guys died there who'd really done some stuff. He got sick—it's horrible, I can't say his name.

AW:
Well, I talked to Jeff Johnson before he left. He just recently left—

AS:
Oh, and Jeff left, too? Okay.

AW:
And I talked to him about—they were using an interesting research tool, using it on oral histories, and we'd talked about doing a joint project with our oral histories and let them do the analysis with this particular software that aimed at getting quantitative results from qualitative data, which I thought was an extremely interesting approach. But—no, the Ryder book, I was really disappointed, you know, I was reading things in there that I knew from going out and talking to people that were just way out of date. It almost sounded like as if you were recycling what you already had.

AS:
Was that his latest one?

AW:
Yeah, this latest one—

AS:
I had him come guest lecture for me. I knew—he was in El Paso with me. So I knew him from El Paso.

AW:
Because he's been involved in this for a long time.

AS:
He went to SMU, and then he and his wife—they wrote another good—actually, one of the better ones I thought was—*Southern Plains*, was it *History of the Southern Plains*? *Future of the Southern Plains*? I used to have it.

AW:
His wife was involved in that as an editor, right?

AS:
His wife I think led the research piece, yeah. Sherry—

AW:
Yeah.

AS:
Okay, so you know the one I mean? And there was s section in there on wind. Really, it was pretty good. And they could see that coming there. They made the parallels in that one. Bob's stuff seems to be more on the technology side and the development. Yeah, this is a hard industry now. I'm writing a chapter on—Wiley actually told us when we got done with this book, they said, "we really want you to write a chapter on international policy. Don't just make this Texas-centric, even U.S.-centric. We want it international." So it's forced me to get in and look a little more internationally what's going on. It's—it's mind-blowing. China. China. And India is pretty close behind. I just put it in my paragraph this week. China and India have one third of the population of the world, and they use, right now, and it's driven—if you went back ten years, it'd probably be a smaller number—they're using twenty percent of the electricity of the country. And if you go back ten or fifteen years, because China's growth on that has just been—if you get them back a few years, India is very, very low on the energy use scale. In fact, there's millions of people who don't even have access to power. China has tried to ramp that up. And their renewables growth is huge, and they're coming here. We've got two or three Chinese companies, I can't give you names, they're talking to us, they want to research, they want to come in the market. Of the top ten manufacturers in the world of wind equipment, four of them are now Chinese. Ten years ago, there were none.

AW:
I had—when I was doing interviews on the transmission controversy, one of the persons I interviewed was a retired fellow who had headed the transmission side of Houston Light and Power, which I thought was very interesting, because he represented one side of the argument for his whole career and retired to the Hill Country by Junction, didn't want the transmission line coming through his property. But he said something very, very interesting, that—and I don't know, I assume he's accurate because he certainly has a background. But he said—and in fact, the fellow in Santa Fe that I interviewed about Tres Amigas said the same thing—that we, our major weakness in America was the sorry state of our transmission facilities. That we had both politically, with the government regulation, and then with the infrastructure we were behind, and the example they both used, was China. They said, you know, parenthetically that it helps to have a totalitarian government where you don't have to worry about what the states say in terms of doing regulations and so forth. It struck me at the end of those conversations that the Chinese were poised to really be able to move very quickly, whereas we still have hurdles of our own making to overcome.

AS:
I'm going to dampen that just a little bit also in that reading because I don't want to leave the record here. They've had problems. You do that rapid growth, and I've heard it with several sources of—

AW:
Problems with the infrastructure?

AS:
Quality of equipment.

AW:
Got it, yeah.

AS:
They don't—they didn't—it happened so quick they don't have the workforce, they don't have the infrastructure—you want to go out and build transmission lines and just throw 'em up, you go just do that, you're going to end up with all kinds of problems because you haven't figured out the interconnection problems, the grid integration problems, you just—you just can't make this stuff happen instantly. And that's what they've done, and I think there's now—whether the quality of the equipment that they're putting out, and the people to maintain it, and—I mean, you put something up and it starts breaking. You may have somebody who can build something, but if they don't really understand it and it starts breaking and they don't know why it's breaking, you know, what are we going to do? So I think they've suffered under some of that. It's kind of of

too-rapid growth. You can't just legislate these things. Some of it has to grow organically. That's John Schroeder's work—grow organically, I'm going to come right back here to Texas Tech, that I believe, and that's John's—those are John's words, I'll give him credit: that's the success of this wind institute. We didn't have somebody come in and say, "Oh, this is a big deal, we need a wind institute! And here's *x* amount of dollars and do it." This whole thing has grown all the way back with some people, just year after year. It's like Kishor with his four times to get that NSF grant and then finally getting it. There's an advantage to doing that. You get better every time you write the proposal, you re-think it, you bring more people into the thing, when it finally gets funded, you've built an organic infrastructure to implement that grant in a way that if you just write a few lines, get it, it's a hot topic, here's a bunch of money, go do—

AW:
In fact, that's a great point, because the opposite occurred with the Crosbyton Solar Energy project. It began as a project, and the money was there from the start. One of the things that seemed clear here at the university level was how that money came into the university and who got to say grace over it was as much an undoing of the project as anything else.

AS:
Yes. It didn't have that organic growth over time. It was a hot topic that just—you know, this is built—if we were trying to do just the wind energy, if I came in from just nothing and tried to get—because other schools are doing this around the country, and they're struggling. They're struggling, struggling, struggling.

AW:
That's a great point. I'm so glad you mentioned that. How are we doing on time? Couple more?

AS:
We've got a few minutes—yeah, ten more minutes or so.

AW:
Okay. Couple of questions. One is I also got to interview a fellow, retired guy from General Dynamics who grew up in California, got his PhD in physics, I can't remember what branch. Went to General Dynamics, made a killing in General Dynamics because he came up with one of these solutions to a problem that saved a bazillion amount of dollars and he got a big wad of money and he quit to be a ski instructor in Aspen. So. But then he gets a call from a fellow grad I think from graduate school who was in the wind energy business on the east coast and was concerned about the low reliability of the farms that they had. Talked this fellow into coming in and putting together a team of people to say, what's the issue. And his conclusion was that the horizontal axis turbine was a fundamentally flawed idea. The torque that was—and he talked mostly about the torque—it was a thing that he didn't think wouldn't be solvable from a financial

point of view in a way that compared to, say, doing a vertical turn, and he developed since a vertical turbine that's lightweight, sits on top of buildings, and so it goes back to distributed generation. What is the current state of engineering in turbine design? I know it's got to have changed and moved—particularly from those northeastern wind farms. Where are we in today's world?

AS:
I'm going to take a shot. I don't claim to—you almost have to go out to the GEs of the world, if they ever opened up to you to say what's going on? So this is kind of outside looking in. I don't do turbine design, but I have watched it. So where are we now? We are understanding the loads better. It's all about the loads. Anyone builds something, you got to build it to withstand loads. We are getting better and better at understanding loads as these machines have gotten bigger and bigger. We understand the atmosphere a little bit better. There's still a lot to do, but I think we understand it better. There's—there's really a law in turbine design, which I'm going to give myself a hard time in a minute with a personal story. It's this: the—if you take a sheet of paper and start looking at things, the fundamental physics tells you that as you build a turbine, the energy captured is a direct function of the area, the swept area of the turbine. Because that's—

AW:
That seems to make sense, yeah.

AS:
It's where you're getting your energy from, you're catching the energy in that air and you're converting it. So if you double the area of the turbine, you double the energy capture. But the area—

AW:
Let me ask—is that independent of the number of the blades in that area? Is it strictly—

AS:
Blades don't matter.

AW:
Blades don't matter, okay.

AS:
You get one blade or five blades—now, blades matter, but not on the three—you can extract almost as much energy with one blade as you can with three because you make the blade a little thinner. It depends on how fast they turn, and that's called rotor solidity, is what you're asking. And the old water pumpers had a rotor solidity of almost one. The entire swept area was almost

all blades. Now the solidity is like five percent. You've got five percent of the swept area's cover of the blades, and yet, actually, you're more efficient. You get more of the energy out because they run faster.

AW:
Yeah, because intuitively, I look at, you know, the intake of a turbine on a jet engine and the fan, and I say, gosh, there are a lot of blades, that must mean it's more—pushes more air through than with fewer blades, but what you're saying is that the—

AS:
Those are two different things. One is the compressor trying to compress air in a total fan, this is trying to extract energy from the air, okay, and it's—the aerodynamics, that's turbine—wind-turbine aerodynamics is an interesting field and it has to do with what's called the solidity and the tip-speed ratio. How fast your turbine runs compared to the wind speed. There's a maximum that you can extract of energy from the air. It's about sixty percent. You can never—you can't get it all, it's called the Vex [?] limit. Some guys back in the twenties figured that out. So—and there are people, you can do things with inductive turbines, okay, we're going to get off on another topic. We're going to get off into rotary aerodynamics. Let's stay focused on the state of engineering as we are now. So I was giving you this fundamental law, if you want to—if you double the radius of a turbine, the area of a circle is the number pi times the radius squared, so if you double the radius, you get four times the power because the area goes up by a factor of four when you double the radius because of the pi r-squared. However, the weight of the blade is a function of not only how long it is, but how thick it is, and how—it's a three-dimensional thing. So it goes with—the weight goes with the radius-cubed. So if you build a bigger blade, okay, let's say you double the radius, everything else being equal, the weight goes up by a factor of eight. So now, you've got—you say yourself, wait a minute here. If I keep building bigger blades, I'm only going to go up by a factor of four as I double on energy capture, but I'm going to go with my costs by a factor of eight. This is not going to be a winner. So I wrote a paper back in the nineties, and I concluded that the optimal size for wind turbines was about half a megawatt. They won't be a bigger, because this law is going to overtake it. Completely missed the whole thing, they're building seven megawatt wind turbines now. And they're still—typically, they've become more cost-effective because there's other stuff going on. First of all, manufacturing technology is such that the weight doesn't go with a cube, there are ways to get the strength and yet keep the weight down, keep the costs down and build longer and longer structures, so that—the square with the energy is still there, but you don't have that weight going as one. And secondly, the atmosphere becomes more and more energetic as you get bigger blades into all our towers and go up. It's a huge factor. So the economics, my little economic thing, it was a big deal when it came out, I worked at NREL as a fellow and I published that, everybody was getting all excited, it's the optimal size of a wind turbine, I was totally wrong.

AW:
That's all right. That's what science is about.

AS:
Yeah, I guess, I guess. You just—you miss a few things. In fact, most of the people who have tried to predict anything on energy have been—have been, you know.

AW:
Well, three-dollar gas. It would've—talked about that.

AS:
We couldn't make electricity with natural gas twenty years ago. It was banned. Federal law. Can't do it. Stop! No more gas! We got to save it to heat homes. Along comes fracking here now, we've got gas coming out our ears. It's interesting. So where are we on turbine technology? The turbines are getting bigger and bigger, we're understanding the engineering behind it. Is the current design going to end up being where we are fifty years from now, these three-bladed large structures? I don't know. I'm smart enough to learn from other experiences. I'm not going to try and tell you where we're going to be. But these things are pretty reliable now, they run most of the time, and these bigger rotors, I can't give you the numbers, we're working with some companies out at Reese here, they're putting some new machines, the capacity factor, which is: you buy this machine, how much energy could this put out over a whole year if I put it on a perfect site and it ran at full capacity all the time? That would be a hundred percent. Twenty years ago, you were lucky if you could get twenty percent capacity. Then it got to be twenty-five. Then thirty. These new ones are coming along, individual turbines, up in the sixties.

AW:
Wow.

AS:
Yeah.

AW:
That's a huge change.

AS:
With twenty-year life.

AW:
That's a huge change.

AS:
Yeah. Huge, huge difference. So there are some things going on, of course it's all about money and things, so yeah. I don't think we're done with horizontal-axis, three-blade turbines yet. It may end up going to two-bladed machines. There's a lot of work. That's where I did my work, but there's some dynamic problems. And I'm not going to predict that's where we're going to go, but that's where we could go. And then people looking at vertical axis again for off-shore. That may take off. It's hard to know. The arguments are compelling for those vertical-axis turbines, but there's other problems that people don't think about. There's fatigue problems, mental fatigue, it's my professor who told me that, he said, "You always have one blade that runs in clean air in the front, and when it goes around behind that tower, it has to run through all of that wake of the tower and the other blade, and it just—every time it makes a turn, that thing is getting beat up, beat up, beat up." Three-bladed horizontal machines, sees clean air the whole time. You never get tired. They tried to do downwind turbines, but that blade hit in the wake, turned out to be a problem, and so—is that the total reason? No, there's other things. But anyway—

AW:
Good. What should I have asked you that I didn't?

AS:
I will—I will do a Texas—I think we talked a little bit about the global thing—I mean, I think this—everything I'm reading says this stuff is poised to go globally because the electric demand, we've got a population still growing—do you know that since the year 2000, we've added another billion people on the planet?

AW:
My goodness.

AS:
Take a look at population—go to census and take a look at the population.

AW:
That's frightening. It's not only that they're using energy, but they're polluting and they're eating.

AS:
They need food, and water and energy. You just think of those three as this population grows and people want to try to get better things. Right now, there's projected to be 1.2 billion with no electricity, there's lots of effort to get those—India is one of the prime countries, Africa is another -- to get energy to those people, get electricity, plus Fukushima really scared—Germany

said, "That's it! No more nuclear plants! We're going to cut them all down." What are you going to do? "We're going to build wind turbines!" What? You know, people go, "What?" I mean—but it's not wind turbines only. They're putting in natural gas, it's a combine. You got to have a portfolio of energy. Wind is not going to be the dominant energy in this country. But if it's twenty, thirty percent and hydro's ten or fifteen percent, and then you bring in solar, and that's another ten percent—

AW:
Yeah, because solar costs are really going down, and if everybody in my neighborhood puts a solar panel in their house, you address the demand side.

AS:
It's a whole different ball game. And so I see—it's evolving. And you can kind of see, you say, well, this isn't going to work. I don't know. I don't try and predict anymore, but certainly there's a lot of impetus in this right now. So it's worldwide, I think there's opportunities in this country still. You know, you look at what's going on here in the Center—I'll come back to one topic that maybe we didn't go through enough, and that is how hard it is—and I think it's the organic roots of this institute, been here for many, many years, support of administrators, Kent Hance has been a huge proponent of this moving forward, as have other administrators, I'll mention him because my tenure and his have kind of overlapped -- but how difficult it is to put something between colleges. You know, engineering wants a piece of this, science was a piece of this, if you start talking to the people in agriculture, they want their piece of this, and to actually try and build the multi-disciplinary institute that sits requires huge amounts of time and effort and talking to people. I think we're getting there. The PhD program was critical. We now have a bachelor's program in wind energy, we have a hundred and thirty people majoring in wind energy. Tech—there's no other school in the country that has that. We would not have that had the Workforce Commission not come and said, "Here is some money, go build a bachelor's program and do it by distance, on-site, and a graduate certificate program." And we did that because we had the organic—you couldn't have started that from scratch. We had the people there to do it. But it's been very, very difficult. We're getting there, but the shared faculty concept is difficult, so—I just don't—I just don't want to leave that, "oh yeah, you get a few people in it, in a few years I'll have it." It's a continuing struggle.

AW:
One thing that strikes me too in talking to people in other areas in higher education is that that is a fundamental problem with the university system as we know it, that we've probably outlived the day of the college. When you look at the—although they're on the periphery, the University of Phoenix approaches, the MOOCs, the online—and of course, you were fundamentally—right in the thick of the online development. Those are going to make changes, not just in how people

get degrees, but where does money that they spend for the degree go, and how's that allocated? And so some—you're on the cutting-edge—

AS:
Yeah, I always get nervous. All these predictions get me nervous, but yeah, I think the distance thing is huge, we're into that, and this is a worldwide business. We have a global component for our kids, we try to send them overseas or work with a global company. I like to think we're focused on jobs. Especially for the undergraduates, we're trying to get them—sure, we'd love some of them to go to graduate school, but we also are doing everything we can to connect them up with companies and get them employed. I think that's—these days, that's critical. School is expensive. Kids are taking loans and things. They need to get out in the workforce. I hope we're doing something that's relevant, you know, from an industrial point of view and they go out and make their own way and be successful. So I think there's that aspect to it. And then, of course, our research, those people who want to go to graduate school, there's—I'm going to blow—one other thing—we're going to blow the horn of—when I was director—I'm going to tell a quick story, may I?

AW:
Sure, you bet.

AS:
Be interested to see over the years where this goes, but one of the things that Tech has—we talked about—we named the people and things—I want to name John Schroeder here, who's the current director. Back—I mentioned before, he started doing hurricane work, and he was teamed up with what they call smart radars, and he realized that this was an important tool to be able to measure the wind. You know when we watch TV we see those color pictures? Those are clouds. That's precipitation. John's been working with radars that actually measure the speed of particles in there, and so you actually get a picture of the wind. You get a picture of the wind.

AW:
I'd love to be able to get that on my iPhone instead of the precipitation cloud. I want to know what the wind's doing.

AS:
You may get that one day. As we walk out, I'll show you one. So back—I came in '03—about '05 or '06 I knew John was doing this hurricane work. He came to me and he said, "I want to hire this guy from A&M. He's going to retire in a couple of years, but he's a radar expert. We want to get him here, we want to build our own radars." And I said, "Wow. This hurricane stuff is neat. You know, you guys are really doing some good stuff getting some very interesting things about the wind characteristics and everything." We had the only record for hurricane

Katrina that exists. I was sitting in my office one day and a federal marshal walked in and he said, "You Andy Swift?" I said, "Yep." He said, "You the director of Wind Science and Engineering." I said, "Yep." "Here's your subpoena in the federal court of Mississippi, bring all of your wind records from the data that your team collected down there, show up at such-and-such date." I said, "Oh, man." Luckily, I got—we went to the attorneys, and John ended up going and bringing the data and everything, but it was—Tech is in a very, very prestigious position because of the radar and the other data that those folks—anyway, he said, "I want to hire this guy and move forward this radar." I said, "That's great. Do you think that you can—in wind farms, you've got these other turbines—even if you just have a small cluster where they run in the wake of the ones up-front, and nobody understand these wakes. You know, you put a little pole up and it measures a thing, but what does it look like? What does it do and all this kind of stuff?" And he said, "Well, we might be able to see something. I think there's a lot of uses." So they build the first K-band radar, this guy from A&M. This is about seven or eight years ago, John would know the exact date. They built the first one, then they built the second one, so now you've got two of them so you can get the full wind field dual-Doppler effect. And they went out -- and I'll never forget—they began to get good stuff from the hurricanes, and then they would outlook the tornados and thunderstorms, they'd really get some cutting-edge data. But other people had done radar stuff, but nobody had applied it in wind. He went out to one of these turbines, these big turbines, and took the first one. Nothing. I said, "Oh, John, I'm so disappointed. I was hoping we could get something." Then they went out on a misty day, when there was some moisture in the atmosphere, this thing just lit up like a Christmas tree. You could see these wakes. I'm going to show you here. John has now been going around the world, literally—cutting edge—

AW:
Kind of the same idea as putting smoke in the wind tunnels so you can see what it does?

AS:
So you can see what it does. Now, we have the whole—a picture of the whole wind field. No one in the world can do this. And everybody's got wind farms, turbines running these wakes, they don't know what's going on, they want to try and fix them, and we've got the technology right here. It's cutting-edge, world-class, credit to John—persistence.

AW:
Yes.

AS:
Persistence started in '03, '04, built from scratch, very, very impressive. That's my last story.

AW:
All right.

AS:
Multi-disciplinary is hard, we've got the radars, cutting-edge stuff, grow organically.

AW:
Yeah, that's perfect. Thank you.

AS:
Sure. Enjoyed it.

AW:
Me too.

End of interview.