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William Hogan: And it's a very tragic situation. Terrible. And when you're dealing with systems like this, you can plan for some things. And then, when you get outside the envelope, you're in trouble.

Robert Stavins: Welcome to Environmental Insights, a podcast from the Harvard Environmental Economics Program. I'm your host, Rob Stavins, a professor here at the Harvard Kennedy School and director of our Environmental Economics Program and the Project on Climate Agreements.

Robert Stavins: In mid-February of this year, a series of severe winter storms swept across the United States, apparently due to the jet stream dipping particularly far south, stretching from Washington state down to Texas and running back north, along the East Coast, allowing a polar vortex to bring exceptionally cold air across the country, and spawning multiple storms along the jet stream track. This weather phenomenon resulted in record low temperatures throughout the state of Texas, with temperatures in Dallas, Austin, and San Antonio falling below temperatures in Anchorage, Alaska.

Robert Stavins: In Texas, this led both to dramatic increases in electricity demand for heating, and at the same time, drastic reductions in electricity supply as natural gas, nuclear, and wind-generating facilities faced a variety of serious impairments. This severe supply/demand imbalance on the Texas electricity grid resulted in what has already come to be called, by the press, the Texas Energy Crisis of 2021. Which, according to my guest today, was of scale, scope, and duration that were "unprecedented."

Robert Stavins: We're delighted to have with us William Hogan, the Raymond Plank Research Professor of Global Energy Policy at the Harvard Kennedy School, where he is the Research Director of the Harvard Electricity Policy Group. Bill, welcome to Environmental Insights.

William Hogan: Thank you for the invitation.

Robert Stavins: So I'm very interested, of course, to hear your assessment of the causes, and for that matter, the consequences of the Texas electricity crisis. But before we get into that, our listeners are always interested to learn about how you came to be where you are and where you've been. So where did you grow up?

William Hogan: I grew up largely in Westfield, New Jersey. And then, I was an undergraduate at the Air Force Academy. And I served in the Air Force for a number years, worked

in the Pentagon. And then, later was back in Washington, working in the Federal Energy Office.

Robert Stavins: Tell me about your decision, though, to go to the Air Force Academy. What was the origin of that, and the nature of the decision?

William Hogan: Well back in the day, at least in my world, everybody thought they were going in the military. And so, that was just taken as a given. And the Air Force Academy was one of the few places where the fact that I could play basketball would help me get in, but I wouldn't have to become a professional basketball player.

Robert Stavins: Oh, that's interesting. Okay.

Robert Stavins: Now, after the Air Force Academy, which, I should say that my own connection with the Air Force Academy is also linked with you in another way. And that is that I have had the pleasure of succeeding you at Harvard in chairing our PhD Program in Public Policy. And on a regular basis, we have found that, among our very best applicants, and then graduates, are people who went to the Air Force or one of the other military academies as undergraduates. You may have also found that when you were chairing the program.

William Hogan: Yes. It's a very demanding program. And it does produce very good students for us.

Robert Stavins: Now so, when you graduated from the Air Force Academy, you eventually went to UCLA. Was that both for an MBA and a PhD degree?

William Hogan: Yes, it was. It's a little bit complicated story. But there was an accelerated program where you could start an MBA while you were still at the Air Force Academy.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: And then, spend basically the equivalent to one academic year at UCLA and get an MBA. And I did that. And then, I went to work in the Pentagon.

Robert Stavins: And you wound up working on energy policy in the US government before there was a Department of Energy, right?

William Hogan: Yes. I was in the Air Force for a while. And then, taught at the Air Force Academy. And then, I left there and I joined a small office in the Department of Interior called the Office of Energy Data and Analysis. And it was September of 1973, about three weeks before the Yom Kippur War and the Arab Oil Embargo.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: And I went from being the second person to joining the office to leading a task force of about 500 people.

Robert Stavins: Is it also correct then, that, from there, you eventually went to Stanford, where you actually, I think you founded the Energy Modeling Forum, if I have that correct?

William Hogan: That's correct. I worked in the Department of Interior, and then, the Federal Energy Office. And then, I left just before the election in 1975 and went to Stanford University. And that's where we started up the Energy Modeling Forum. And then, I left Stanford a couple years later to join the faculty at the Kennedy School.

Robert Stavins: So you've been at the Kennedy School as a professor since 1978?

William Hogan: Correct.

Robert Stavins: Let's turn now to the Texas Energy Crisis. That's what we're here to talk about. And you've described it as unprecedented. But there have certainly been previous electricity grid problems and blackouts in Texas, California. I remember New York State. And I assume, in many other parts of the world. What made this one so different, Bill?

William Hogan: Well I think it's, as you summarized in the beginning, and I can certainly connect it to these other cases. But it's just the scale and the scope. And it's a very tragic situation. Terrible. And when you're dealing with systems like this, you can plan for some things, and then, when you get outside the envelope, you're in trouble.

Robert Stavins: So let's burrow in on that envelope. First, on the supply side, and then, the demand side. I had said that natural gas, nuclear, and wind were impaired. How were they impaired?

William Hogan: Well, a lot of this is yet to be determined. There is a post-mortem analysis that is going on that will provide a lot of information. And the union of all of the things that people said, if you take all of those things, and then, you look at, could they all be true, the answer is no. So we don't really understand this completely. But let's take the nuclear plants. The reports are that, essentially, a cooling water line that was coming into the nuclear plant froze up.

Robert Stavins: Uh-huh (affirmative).

William Hogan: So its systems automatically shut it down. And then, it was out for quite a while. It's clear that some of the gas pipelines froze up, the gas wells froze up. It's clear that some of the pumps apparently lost electricity. It's not clear exactly why that happened. So then, now the natural gas supply was reduced. It's pretty clear that some transmission lines were knocked down by just ice and trees.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: It's pretty clear that a lot of the natural gas power plants, some of them had other freezing effects that caused them to stop running, even if they could get natural gas.

William Hogan: And it's clear that the unconstrained demand went up by well above what they had anticipated.

Robert Stavins: So you've mentioned natural gas and nuclear. What about wind power?

William Hogan: Wind power is a distraction in this conversation.

William Hogan: So, my colleague, Jesse Jenkins, you remember has...

Robert Stavins: Yes.

William Hogan: I've heard him coining the phrase that, "Wind and solar are reliably unreliable." So, the available wind power was quite low compared to its capacity, but that was expected. So that was just normal. So they weren't counting on it and they didn't get very much. They got a little bit less than they anticipated. And similar with solar.

Robert Stavins: It's interesting that you say it was a distraction. Because it was actually a very loud, visible distraction from some quarters, in quotes, in the press, that I was seeing in the early days.

William Hogan: Right. The governor, in particular, pointed to wind. And others, prominent figures, did as well.

Robert Stavins: Right.

William Hogan: And pretty quickly, it became clear that it just wasn't consistent with the scale of what was going on here.

Robert Stavins: I see.

William Hogan: Now this might be different in the future. That's a different question. But in this particular case, I mean, it would have been better if we'd had more. But it was, the real problem were all these other facilities.

Robert Stavins: Now in the reporting I saw in the press; and I guess, for me, that's probably the *New York Times* or the *Wall Street Journal*, the two newspapers I tend to read each day -- a lot was made out of the fact that some people quoted that Texas has essentially its own electricity grid of these various parts of the country. Was that an important part of the problem?

William Hogan: Well that'll be interesting, too, when we get more information. But I think the answer is, depending on what you define as the problem, is probably no. There are some connections between Texas and other places, and they were not constrained. So if more power had been available north or west, it could have come into Texas from these places. They would have certainly taken it. But similar problems were occurring at the same time in the Midwest and other parts, Oklahoma and so on.

Robert Stavins: Right.

William Hogan: So they were also having rolling blackouts. It just wasn't as huge a problem as we saw in Texas.

Robert Stavins: So that's the supply side. Now I want to turn to the demand side. You said that the demand for electricity also actually increased at the same time the supply was decreasing. Why did the demand for electricity increase?

William Hogan: Well what I've read about this, I don't have the data at my fingertips, is that it's basically electric heating of one type or another.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: And so, it's getting really cold. And you've got a reliance on electricity to provide heat, either through resistance heat or through venting, vis-a-vis the outside air. And that's something that occurred. And in the forecast, just before this, about what the peak loads were, those forecasts tend to be underestimates by quite a bit.

Robert Stavins: Now we're sitting, both of us, up in New England, where electric heating doesn't make a lot of sense. But electric heating has low up-front costs and relatively high operating costs. So at low levels of utilization, such as what one expects in Texas or the south more broadly, it can make economic sense to use electric heating in new residential construction. Is that right?

William Hogan: Right. And you can also buy a heat exchanger that is reverse air conditioner.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: And that'll also run. Although, I was talking to one of the people at the University of Texas who has such a device. And it's set up so that they can, this utility can shut it off in the summertime if they get in trouble.

Robert Stavins: I see.

William Hogan: And he can't use the air conditioning.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: It turns out, the same technology allows them to shut it off when it's cold.

Robert Stavins: Mm-hmm (affirmative).

William Hogan: And they did. So he was surprised to learn that he wasn't able to use that for periods of time, when they were trying to reduce load.

Robert Stavins: Now ironically perhaps, I believe that in the state of California, and maybe other jurisdictions in the United States, there's a lot of interest, and possibly movement toward, prohibiting new natural gas connections in new residential construction because of concerns about climate change. But wouldn't that tend to increase more reliance on electric heating?

William Hogan: It certainly would. And that's something that they're going to have to pay attention to here. And if you set up your system so that you're relying, everything is on the same basic source, then when you lose that source, everything goes out. So that's a problem, going forward.

Robert Stavins: Right. Now so, we've laid out the causes is on the supply side and the demand side, in terms of the changes that took place. The press coverage has certainly also emphasized, in some cases, that it's the nature of the market itself, that it is not regulated in the same way that electricity markets in other parts of the country are. What do you say to that?

William Hogan: Well that's a good question that has, there are multiple levels to what you could answer that. One of the claims that has been very popular in certain press articles is that Texas has a free market in electricity, and you can't have a free market in electricity because of problems like this. And that's a mischaracterization of what has happened in Texas. So there's no free market in electricity anywhere because of the physics. So, all of these systems are centrally coordinated.

William Hogan: Now there are differences in the level of choice. But there are also reliability conditions, operating reserves that are imposed, transmission constraints that you have to respect. So, it's a complicated mix of engineering and economics. And you have more choice, perhaps, in Texas than you have elsewhere. But I think it's a mistake to characterize it as just having no regulation.

Robert Stavins: So let me ask you about it this way, with an example. So natural gas lines in New England, I assume, are weatherized so that they don't freeze up. Natural gas lines in Texas, to some degree, were not weatherized and did freeze up. Is that difference due to differences in regulation between New England and Texas or is it due to differences in terms of reasonable expectations of what temperatures are going to be in all but a 100-year event?

William Hogan: Well, I don't know the rules precisely for natural gas pipelines in New England. And I know a little bit about Texas because of things that have been said

recently. I think it's mostly expectations. So they're not required to do very many things like this.

William Hogan: Now, there are proposals that maybe they should be. And there's more required by way of the electricity side than there is for the natural gas side. And that's going to be one of the subjects of discussion and debate in Texas.

Robert Stavins: I mean, to some degree, when an event like this takes place, then expectations change, which may or may not be appropriate, right? It's a biophysical question. But expectations will change.

William Hogan: Yes. Well, we'll have to see here. And again, it's going to depend on the, partly on the post-mortem. And then, partly on other things, going forward. But I think, if the answer of all of this, when we get all finished, is that, stepping back, when I said about the nature of market outside or in other electricity markets there are, for example, capacity markups. They don't have such a capacity market in Texas for generation. They have a different system. But the capacity markets are relevant here because they're planning, and the transmission expansion is planning, for the shorthand, is a one day or one event in 10 years kind of protection. And for things that are rarer than that, we recognize we're not going to be able to protect against those. And if that were true in Texas, then you would say, "If they had had this alternative standard, would they have been able to get through last week without much trouble?" And the answer is probably no.

William Hogan: So the stories that are coming is that it was a one in a 100-year kind of event. And, which is not getting enough attention, and it lasted a lot longer than events in other systems.

Robert Stavins: Right.

William Hogan: So that had a double effect, which were very problematic.

William Hogan: And there was a very interesting interview with the mayor of Oklahoma City. And the mayor of Oklahoma City, which is not in Texas, obviously. But they were having their own problems at the same time. And he said... Let me just read you the quotation. Because it's important here, in this case. "We are probably not going to build a city that is ready to have sub-zero temperatures for a week every year. That would be too expensive. Our taxpayers wouldn't want to do that."

Robert Stavins: Right.

William Hogan: He's not defending Texas because he wasn't in Texas. But he is explaining the underlying problem.

Robert Stavins: It's always the problem, in terms of doing a benefit-cost analysis, when one of the elements on either the benefits side or the cost side is small probability but high consequence event.

William Hogan: Right.

Robert Stavins: Whether it's climate change or it's this, it's always challenging.

Robert Stavins: So let's turn to the consequences of the Texas Energy Crisis. We've heard about some stories about incredibly high electricity prices that were faced by some of those who were actually fortunate enough not to lose their power. In particular, I think it was a provider that was called Griddy. Can you explain to us what happened there?

William Hogan: Well I don't know that Griddy's the only one. But certainly, they're the most prominent.

William Hogan: So in Texas, they have full retail access, as it's called, which means that final customers who are not part of municipalities, municipal utilities, but the large fraction of customers can sign up with anybody they want to buy their electricity. And they have a contract that they arrange. And these contracts are varied, there are a lot of variety. But essentially, most of them are a fixed price with some small degree of variability, possibly.

William Hogan: Griddy is an exception. And they offered a contract where for, I think it's $9.99 a month, you can buy power. And they will just take it from the wholesale market and deliver to you and charge you the wholesale price. So, you're floating with the wholesale price. That is a completely unhedged purchasing arrangement.

Robert Stavins: Right. Right.

William Hogan: And whereas most of the customers are on different kinds of contracts, which are hedged to one degree or another.

William Hogan: And then, there's a legal problem here, or distinction, which is, Griddy actually is the representative of those customers when they're buying from ERCOT. So as a legal matter, Griddy buys the power from ERCOT, and then turns around and resells it to their final customers. So this creates a financial obligation for Griddy to ERCOT. And they, I believe, are not able to meet that financial obligation. The customers that are with Griddy who were curtailed obviously don't face high bills.

Robert Stavins: Right.

William Hogan: The customers who were not curtailed and who continued to use the electricity, either because they wanted it and needed it, or because they weren't paying attention, were the ones who are going to get the high bills.

Robert Stavins: So finally, let me ask you. What's your advice? I know you're being very careful because I know that's the way you think. And you're very careful about what you say without having full data and analysis. But what's your advice for the path ahead, subsequent to this latest energy crisis in Texas?

William Hogan: Well I mean, at a high level of abstraction, it's make sure you learn the right lessons here and not get lost in something that isn't actually connected to the facts. So we want to find out what actually happened in detail.

William Hogan: So, for example, as I said, if a natural gas pipeline lost power for its pumps -- it was using electricity to pump the gas and it lost power -- it could have lost power for two reasons, at least. One is, it could have been just that they were curtailed.

Robert Stavins: Right.

William Hogan: Which would have been a death spiral kind of problem. So not a good idea. Or it could have been that the transmission lines were knocked down, in which case, that wasn't a decision that anybody made. It just happened. And things like that matter. So we ought to find out exactly what happened.

William Hogan: And then, when we go forward, we come back to this question of renewables and looking out into the future. And if we had another half hour, I would be happy to explain, in some detail, why the Texas electricity market design is what we need, going forward, much more so. And it's been much more responsive to changing supply and demand conditions up until last week. And you see evidence in the Western energy imbalance market that's expanding rapidly because of the pressure coming from renewables. And you see the Southeast electricity and energy market proposed a couple of weeks ago, which is trying to accelerate the amount of trading and the amount of market operations. All of these things are moving in the direction of the Texas energy market. So, they're going that way because of the intermittency problems and challenges that come from renewables.

William Hogan: And so, I think we need to fix it, to some extent, but I don't think it's as broken as, the market design, I don't think, is as broken as people have claimed.

Robert Stavins: And in fact, if I understood what you were just saying, what you're saying is that, with higher penetration of renewables in the nationwide electricity grid, which certainly most people would anticipate in coming years, that the Texas design becomes more attractive, not less attractive. Is that right?

William Hogan: I think that's correct, yes.

Robert Stavins: Yeah.

Robert Stavins: So let's end with that. Bill, thank you so much for joining us today.

William Hogan: Thank you, Rob.

Robert Stavins: I want to thank, again, our guest, William Hogan, the Raymond Plank Professor of Global and Energy Policy at the Harvard Kennedy School.

Rob Stavins: Please join us for the next episode of Environmental Insights: Conversations on Policy and Practice from the Harvard Environmental Economics Program. I'm your host, Rob Stavins. Thanks for listening.

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