TEXAS TECH UNIVERSITY
Office *of the* Vice President
for Research

Good morning Chairman Weber, Ranking Member Veasey, Chairman Smith, and Ranking Member Johnson, and members of the Subcommittee. I am the Vice President for Research and Professor of Chemistry at Texas Tech University. I am pleased to address you today on behalf of the Texas Tech University System.

The Texas Tech University System's original mandate was to serve the educational needs of the citizens of West Texas, but its ambitions, as framed by its first president, have always been to make a mark in education, scholarship, and innovation for the nation and the world.

Today, the Texas Tech University System – or just "Tech", as it's often referred to – boasts a student population of 37,000 and is the largest public research university in the western two-thirds of the State of Texas. Tech has been recognized as a Tier One public research institution, the highest classification offered by the Carnegie Foundation. Lubbock, home to our main campus, is one of the fastest growing communities in Texas. Reflecting the changing demographics of Texas and the nation, Tech has recently been recognized for attaining the threshold required for Hispanic-serving institution status with over one-quarter of our undergraduate enrollment reflecting Hispanic heritage. Tech truly embodies the promise of the future of public higher education in the nation, and we aspire to lead in the quality of our educational experience; the prominence and impact of our research, scholarship, and creative activity; and our service and engagement in the community, the United States, and the world. As many of you know from working with research universities in your states and districts, these institutions play a critical and innovative role in defining the future of energy grid research.

Both natural hazards and actions by our adversaries can pose significant threats to our grid. The 2017 hurricane season was a harrowing reminder of the intense suffering and economic loss that natural events can inflict on regional scales. Communities in Texas, Florida, and Puerto Rico were – and in some cases continue to be – devastated in the aftermath of these storms. Based on modern scientific models of future weather events, the world can expect more frequent and more intense disruptions of this nature. At the same time, there is a growing consensus that future conflicts among major military and economic adversaries may involve preliminary skirmishes in cyberspace, with grid infrastructure as a prime target. Indeed, some recent cases provide indications that both state and non-state actors have already targeted and demonstrated an ability to threaten the grid. On top of this, any grid of tomorrow must be developed with the assumption that the market for renewable energy generation will only continue to grow and, in turn, provide a more decentralized – and therefore resilient – system.

In light of these challenges, and with generous support from the State of Texas, Department of Energy, and partners in industry and at the National Laboratories, Tech has been hard at work addressing a central question – how we can make the U.S. energy grid more secure, reliable, robust, and, perhaps most importantly, resilient when under threat?

Through the pioneering work of faculty at Tech, we are providing answers. This morning, I am pleased to present the range of collaborations that Tech has developed to create a lasting national impact in ensuring the development of communities reflecting more resiliency and efficiency in energy grid technology.

In 2015, the State of Texas provided $13 million through the State of Texas's Emerging Technology Fund to create the Texas Tech-led Global Laboratory for Energy Asset Management and Manufacturing – also known as GLEAMM. GLEAMM is a world class distributed generation micro-grid located at the Reese Technology campus (formerly Reese Airforce Base). As part of the Emerging Technology Fund award, TTU collaborated in the creation of Group NIRE, a 501(c)(3) corporation, whose mission is to partner with industry on the creation and certification of new grid technologies. Mark Harral, CEO of Group NIRE, is partnering with X-Fab Corporation, a regional silicon device manufacturer, and National Instruments Corporation of Austin, Texas on the project. Together, Tech and Group NIRE are developing $30 million in facilities at the Reese Technology Center site, including a new research-grade micro-grid and Phasor Measurement Unit (PMU). These new facilities will become operational later this year. GLEAMM is being constructed under the direction of Dr. Annette Sobel and will optimize conditions for the integration of solar and wind technology into grid systems, develop new hardware and software solutions for managing grid function, and enhance the cybersecurity of grid systems. This important work would not be possible without the support of Secretary Rick Perry. His vision as the Governor of the State of Texas was critical to making this facility possible.

Dr. BeiBei Ren is a faculty researcher in TTU's Whitaker College of Engineering studying micro-grid control and energy grid integration. In collaboration with Syndem, Inc., Dr. Ren is developing synchronized and democratized architectures for next-generation smart grids. This novel architecture will allow diverse power suppliers to interface with the grid as virtual synchronous machines, playing an active role in the regulation of system frequency and voltage. Dr. Ren's micro-grid control technology received the 2017 TechConnect National Innovation award. Dr. Ren's group is collaborating with Syndem, Inc., Group NIRE, Inc., the Puerto Rico Telecommunications Regulatory Board, the National Renewable Energy Laboratory, the Pacific Northwest National Laboratory, and the Oak Ridge National Laboratory to develop photovoltaic storage inverters to generate reliable, resilient, and affordable grid integration to rebuild Puerto Rico's infrastructure following damage from Hurricane Maria.

Dr. Stephen Bayne, a senior faculty member in the Whitaker College of Engineering's Department of Electrical Engineering, has a long history with power grid research. Dr. Bayne worked with Alstom, Inc. (now GE) to model wind turbines under steady state and transient conditions. His group developed advanced wind turbine control algorithms to minimize overvoltage and overcurrent conditions and created a battery model for a 1MW/1MWh li-Ion battery connected to the distribution grid at Reese Technology Center. Dr. Bayne has studied a range of control techniques for grid integration when incorporating high penetration of renewable energy. Dr. Bayne's group has deployed a number of PMUs across Texas to monitor and potentially control energy grid systems in near real-time. Dr. Bayne's group has also developed model micro-grids to determine the performance of systems relying on distributed generation and loads.

This research, when coupled with innovative models that determine and predict the performance of systems relying on distributed generation such as wind, is critical to a more resilient and reliable grid.

Tech is a leading institution in grid research, but it also focuses heavily on advancing research in renewable energy technologies. Since the 1960s, Texas Tech University has been a national leader in wind damage research, collaborating to create many of the standard storm-resilient building codes in use throughout the U.S. today. This expertise in wind research led Tech's National Wind Institute (NWI) into collaborations with wind energy researchers in the early 2000s. In cooperation with Sandia National Laboratory, NWI helped establish a wind turbine test facility on our Reese Technology Center campus that boasts three test windmills just outside of Lubbock. This facility is fully instrumented to support the analysis of wind patterns and lightning events across the turbine farm. Under the direction of Dr. Michael Giesselmann, a pulsed power researcher, Tech has capitalized on this experience to collaborate with Pantex, Inc. in Amarillo, Texas to optimize the unit commitment of their wind farm. Dr. Giesselmann is collaborating on the development of a model to take wind forecast and other load forecast factors and to use artificial intelligence (AI) to derive locational marginal pricing information (LMP) with training datasets using historic data. This will enable operators to predict when it is not economically feasible (negative LMP) to feed wind power into the grid.

The innovative team of researchers across Tech is committed to a research vision that enables an electric grid of the future. Over the next four years, we intend to invest a minimum of $8 million dollars in research into cybersecurity and energy grid resiliency to enable the creation of a sustainable and diverse energy economy. We are confident this investment will help the nation attain its goals in energy security, traditional and alternative energy utilization, and a 21st century energy grid.

I am proud to have this opportunity to share Texas Tech University's capabilities, our expansive vision for the future, and serve as a resource to the Subcommittee. I look forward to answering your questions. Thank you for this invitation, and "Go Tech!"