Senate Committee on Environment and Public Works

Hearing Title: *Building Back Better: Addressing Climate Change in the Electricity Sector and Fostering Economic Growth*

Statement of James F. Wood, Director, Energy Institute, West Virginia University: Chairman Carper, Ranking Member Capito and members of the Committee, thank you for the opportunity to give testimony and to answer your questions.

The WVU Energy Institute serves to facilitate collaborative and innovative solutions for the energy future of West Virginia and the United States. It also supports sponsored and grant funded research programs and seeks to commercialize university-owned intellectual property.

From 2009 to 2012, I was the Deputy Assistant Secretary of the Office of Clean Coal and Carbon Management in the U.S. Department of Energy's office of Fossil Energy. In that position, I was responsible for the agency's coal research program and the large demonstration projects co-funded with industry under the third round of the Clean Coal Power Initiative.

West Virginia University is a public, land-grant, research-intensive university founded in 1867. It is designated an "R1" Doctoral University by the Carnegie Classification of Institutions of Higher Education. Funding for sponsored research programs from all sources exceeded $194 million in fiscal 2019-2020.

Examples of West Virginia's innovative research activities include:

- Developing a rare earth oxide extraction process using acid mine drainage and other coal mine wastes. This research is being done with the support of the National Energy Technology Laboratory, and in collaboration with Virginia Tech and Rockwell Automation.
- Replacing high carbon-emitting steam methane reforming processes with catalyst thermochemical conversion of methane to $C0_2$-free hydrogen and solid pure crystalline carbon.
- Developing techniques and technologies to integrate state-of-the-art down-well innovative fiber optic and micro-seismic sensors to make improvements in data collection, and production tools with advanced big data and machine learning applications for accurate reservoir characterization and modeling of the Marcellus and Utica shales.
- In conjunction with the National Energy Technology Laboratory, we are developing tools and techniques and above-well sensors that detect even small releases of greenhouse gasses during the stimulation, drilling or production of operating shale wells
- Research into technical and economic advances of renewable geothermal sources of energy, and WVU in conjunction with Lawrence Berkeley, Cornell and the West Virginia National Guard are researching designs for the deep direct use of this source on campus.

There are a number of important practical considerations in addressing the challenges facing the electricity sector in respect to climate change:

First, is affordability: Just as manufacturers seek low cost labor, or advanced mechanisms to reduce the cost to produce a product, when electric rates rise, manufacturers will seek low-priced sources of electricity in order to remain competitive. This will slow economic growth in areas unable to attract manufacturing and will shift cost recovery away from industry and toward non-industrial consumers. Today, there are manufacturers searching, even demanding, low cost electricity from renewable sources.

Second is resilience and reliability. Most commercial forms of electric generation are designed, constructed and operated to be very reliable. A natural gas, combined cycle (steam and gas), can operate nearly 100% between proper maintenance periods. Wind turbines can operate 36 months between oil changes, but require preventative maintenance 2-3 times per year, scheduled when wind is not blowing.

Third is diversity in generation. The wind farms in West Virginia are on mountain ridges- because that's where the wind blows. Gas generation can occur wherever there is a viable pipeline. Coal-fired generation is the principal source of electricity in West Virginia, and the supplies of coal are plentiful. Solar generation may have a tougher time as West Virginia's terrain is pretty bumpy, and the northern parts of the state are cloudy from October until mid-spring.

Fourth, is grid stability. The grid operator must have a viable plan for providing power to offset the effects of intermittency associated with wind and solar electricity. Grid design and operations must be well-integrated with locations and amounts of renewable and non-renewable sources of generation.

Fifth, is energy storage. There is a 32 MW lithium ion battery storage project in conjunction with a 98 MW wind project near Elkins. The Energy Institute has begun discussions with the Army Corps of Engineers on use of its data which may point to areas that can be used for pumped storage. Storage technology will need improvements in order to provide effective and economical replacement energy during periods of renewable intermittency.

Between 1990-2018, West Virginia's CO_2 emissions declined 13.3%. (EIA data). The implication for us is the use of cost effective CCUS must increase in order to be able to retain some amount of coal and gas generation in the state to help offset the intermittency problem. Passage of 45Q tax credits was a boost to CCUS, but all-in capture costs still exceed the benefits available to CCUS systems, and in some parts of the state, the geology is unsuitable for sub-surface storage of CO_2.

I hope this information is useful. Thank you for your time and attention.