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**Testimony before the Committee on Energy and Natural Resources,
Hearing to examine the importance of energy innovation to economic growth and competitiveness.**

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Chairwoman Murkowski, Ranking Member Manchin, and members of the Committee, I serve as Director of the Bureau of Business & Economic Research at West Virginia University. Thank you for inviting me to appear before you to discuss the importance of innovative energy-related opportunities to economic growth.

I focus my comments on West Virginia. However, these points apply to many energy-producing regions across the nation.

Coal

The recent decline in coal production had a devastating effect on our state's economy. Coal production dropped to around 80 million tons in 2016, down nearly 50 percent from its 2008 level. This led to a loss of 13 thousand coal jobs and a direct loss of \$4 billion in economic output. Production has bounced back over the past two years, finishing 2018 with an estimated total of 95 million tons. This rebound can be attributed mostly to international coal demand. As such, the state's coal industry is becoming more dependent on volatile export markets.

These losses create a vicious cycle where job loss is followed by out-migration, which typically leads to an aging population and a population with lower levels of educational attainment; drug abuse follows in economically depressed areas; altogether making it even more challenging to attract new business, thus perpetuating the cycle.

The effect of the national drop in coal demand has been felt most strongly in Central Appalachia, which includes Southern West Virginia. Consider Boone County, our state's largest coal-producing county for many years. There coal production and employment stand at less than one-fourth of 2010 levels. Other job losses in the county have followed as less money flows to other local businesses.

The industrial mix in Boone County also lends to the crisis. In 2010, coal accounted for 55 percent of all jobs in the county, making it difficult, if not impossible, for many laid-off coal miners to find alternate employment locally.

The concentration in coal job losses, a lack of industrial diversity, and this vicious cycle that has been sparked give rise to the question of whether these affected communities are sustainable over the long-run.

Natural Gas

The natural gas boom that West Virginia has enjoyed in recent years has helped. The boom has created around 1,000 high-paying jobs directly associated with natural drilling and exploration. The numbers are even larger when one factors in other industries that provide transportation and other services and pipeline construction activity over the past two years.

In terms of natural gas production, West Virginia's position in the Appalachian Shale Basin has exposed it to the industry's volatility: Between 2010 and 2014, the volume of natural gas extracted in the state increased at an average annual rate of 42 percent, but posted only marginal increases in 2015 and 2016 amid a supply glut. Since late-2016, however, infrastructure development has helped to boost output nearly 15 percent on average annually.

While the natural gas industry's overall growth is beneficial in many ways, the upstream stage of production is a very capital-intensive process and gains in this aspect of economic activity will not be enough to afford broad employment prosperity. Indeed, natural gas extraction generates similar economic output as coal, yet does so with an employment base that is roughly half the size.

Given this high level of capital intensity in natural gas, truly broad prosperity will require more downstream activity, creating more value added in the state. This would begin with ethane crackers, an ethane storage hub, research labs, etc.

Recent Growth

Since the 2012 to 2016 recession, West Virginia's economy has enjoyed a rebound in economic activity, adding more than 11 thousand jobs and \$4 billion in economic output. However, this growth has been highly concentrated from both a geographic and industrial perspective: Seven counties in the state account for the lion's share of recent job growth and essentially all of this growth is related to energy extraction and pipeline construction.

Industrial Diversification

Many call for industrial diversification as the solution to West Virginia's economic crisis. I myself make this call routinely in speeches and discussions across the state. It is crucial for West Virginia to cultivate strength in manufacturing, tourism and other industries. However, industrial diversification is a long-term proposition which requires long-term action on the part of businesses, entrepreneurs, government, and community leaders. In other words, broad diversification is a difficult proposition.

A more viable path for West Virginia's economy in the short-term is through strengthening our state's energy sector into energy-related areas beyond raw extraction. As these figures indicate, this is desperately needed. This can include jobs in energy efficiency and renewables. For instance, we might find ways to leverage abandoned surface mine land for use in solar energy.

We might find ways to introduce pumped storage hydroelectric facilities. In other words, our strength in the near term may lie in diversifying out from our existing comparative advantage in raw energy extraction into innovative energy-related industries.

And while many of the factors affecting energy in West Virginia are outside of the reach of policymakers, I hope that the information provided today can help make for better policy to move West Virginia and areas in similar circumstances move forward through innovative energy-related diversification in cooperation with the Department of Energy, the National Energy Technology Laboratory, universities, and industry players.