



September 29, 2011

Good morning.

I am Tom Murphy, Co-Director of the Penn State Marcellus Center for Outreach and Research (MCOR). In my 25+ years with Penn State, I have been primarily involved with the managed use of our natural resources in Pennsylvania. This has included agricultural production, timber resources, soil, water, and now the large quantity of natural gas being extracted in the state and in states contiguous to us. It has always been important to my work that science-based, fact-driven information is the cornerstone of discussions during outreach sessions promoted by our efforts and in the research facilitated by many of my colleagues. The overarching goal of our Center, or MCOR, is to provide a common entry point at Penn State University for Marcellus-related projects and to advance research-based outreach on gas shale development and issues associated with it in the Commonwealth.

So a little background on the shale first:

Geologists tell us that the natural gas reservoirs of the Marcellus Shale formed 385 hundred million years ago when much of present-day Pennsylvania was covered by a vast sea swarming with algae and plankton.

As those early life forms died, they settled deep into an oxygen-poor sea basin, creating layers upon layers of organic carbon-rich sediments. Over millennia, the sea bed became packed with deposits, the water disappeared, and the sediments were compacted into black shale beneath sandstone and limestone formations. A further transformation occurred through temperature and pressure to change the sediments' carbon and hydrogen into natural gas.

Since the mid-1900s, geologists knew about the natural gas trapped in the Marcellus Shale, but oil and coal dominated America's energy landscape, and Marcellus gas was mostly an afterthought.

That changed in the late 1990s when advances in horizontal drilling technology and well completion techniques combined with better understanding of geologic formations

made drilling economically viable in another gas play, the Barnett Shale in Texas. Not long after, gas companies began looking at the Marcellus.

Today, the Marcellus Shale is considered one of the largest known shale deposits in the world with production data indicating that it may be the most productive shale play in the nation. This resource may be augmented by hydrocarbons occurring in black shales above (e.g., Burkett/Geneseo Shales) and below (Utica Shale) the Marcellus Shale horizon in the Appalachian Basin. An important part of the shale's economic value is due to the fact it is in close proximity to the major markets of the northeastern U.S.

Key issues related to shale gas development in Pennsylvania where Penn State has applied expertise include:

- geosciences and technological applications
- workforce development
- water quality and baseline testing
- wildlife and environmental
- infrastructure including roads and stream crossings
- leasing and legal considerations connected to Marcellus
- community/socio-economic impacts
- municipal planning, land use and planned development
- business entrepreneurialship

On an issue such as water quality, a new Penn State research paper will be out Friday that surveyed private water supplies in close proximity to well sites in north central/northeastern Pennsylvania along with sites in the southwest portion of the state. The research was funded by the Center for Rural Pennsylvania and will help us to have a more science focused discussion revolving around recently collected data. Several studies have been done by other entities over time but this new work will further clarify the current state of groundwater in areas where drilling is taking place in broad regions of Pennsylvania. Previous Penn State research done in 2006/07 indicated over 40% of 701 sampled private water wells were impacted by one or more pre-drilling water quality parameters. Often the well owner was not aware due to the low level of testing done in PA. The level of testing has increased dramatically due to landowners

working to get baseline data with funding and encouragement provided by the respective gas company anticipating drilling near them.

In a similar manner, in Sullivan County, MCOR is assisting a group of landowners prepare for when drilling begins by undertaking a multidisciplinary research project aimed at protecting the area's natural resources. This past July, the project kicked off when David Yoxtheimer, MCOR Extension Associate, collected samples from almost 60 private wells and the Laporte public water supply system which serves more than 300 residents in the Lake Mokoma area. Those homeowners now have baseline, pre-drilling water-quality data, including pH, chlorides, methane, and metals such as barium and strontium, for comparison to future water quality once drilling occurs. The project also includes the drafting of a model plan for gas development that aims to minimize environmental and aesthetic impacts once gas exploration begins. This project is facilitating partnerships with the Lake Mokoma Association, the state Department of Environmental Protection, The Nature Conservancy and the Audubon Society and is serving as a model for other communities in the Commonwealth.

Although there are many aspects of economic impacts associated with Marcellus development, the increase in jobs being produced in Pennsylvania is undeniable. Anecdotal evidence shows increases in help wanted ads, billboards soliciting new workers, educational training programs to develop key skill sets, and companies approaching institutions looking to establish training programs and centers for the long term. I have worked closely with the Penn State and Penn College of Technology efforts in that regard and have now watched over 3000 workers go through just one of those new programs that was not in existence just 3 years ago. Our research indicates there will be up to 30K direct jobs created due to Marcellus in the next two years. Many additional others in indirect and induced positions. This employment impact, combined with other economic spending associated with Marcellus, is being attributed to the recent Federal listing of Williamsport having the seventh highest GDP increase nationwide in 2010, at 7.8%. Questions of sustainability related to this growth are common. To that end, we have been working to look over the horizon at the industries that will utilize large amounts of the gas and the workforce that will be employed there. Several studies are underway with high energy use industry participants in PA to evaluate the economics of utilizing the gas and expanding based on this lower cost fuel. A similar partnership is looking at establishing a linkage between manufactured components currently used by the gas industry and the production and sourcing of those same goods in-state. Job growth associated with that effort is an obvious driver.

Although those are just a small sample of a large number of issues in the dynamic conversation surrounding Marcellus development in Pennsylvania, it is indicative of the importance this new energy source will have on our State. Nationwide, shale gas produced less than 4% of our natural gas three years ago. Now the number is almost 30% and trending higher quickly with the advancement in technologies and techniques being applied to develop the resource. Waste water generated by the process is now

being recycled at a rate of over 70%, something that wasn't happening at all three years ago. Collective thinking, thoughtful regulation, and economics are evolving this process quickly in the State and many other states and nations are looking closely at our successes.

On a personal note, I am originally from this area and lived and worked half of my life in this corner of the state. I graduated from Central Bucks West High School. I have watched with great interest the change occur in the last 30 years here including increases in population and the associated development pressures. Currently I reside on a farm in a rural location of Lycoming Co near where gas development is occurring. The impacts I mentioned previously are not abstract to me, as I reside in a community where it is common to observe. And as a volunteer local planning commission chairman, I deal with issues related to this development now on a regular basis.

The need for energy is projected to cumulatively increase yearly over the next 25 years. The portfolio of the energy sources we utilize will keep changing as the evolution of energy production advances. But it is reasonable to expect that there will indeed be a portfolio and no one "winner". Marcellus shale gas will be a sizable share of that mix here in the northeast. Safe production of all types of energy will be important going forward, as it is today. The issues associated with shale production call for additional research, application of advancing technology, and the minimization of any assumed risk. Thank you for your time and attention to this historic issue impacting the Commonwealth.