-WRITTEN TESTIMONY-

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Energy is the lifeblood of society. It fuels our cars, our industries, and our homes. It also represents our ability to effectively defend our country. With so much at stake, it is of the most utmost importance for our country that the US maintains a strong energy supply now and long into the future. Over my entire career until now, energy independence was a lofty goal and one that did not seem to be obtainable. However, with the emergence of shale-based natural gas and the maturation of deep water drilling, the US is on the verge of being energy independent. What a remarkable change. Almost fantasy to those of us who have been active in this area for the past 30 years or so.

I applaud the vision of this meeting. I would like to thank Secretary Moniz and Deputy-Secretary Conner for their leadership and the organizing of this timely and important meeting. The information gained through these meetings should provide an excellent pulse on how and where the US stands with managing its future energy resources.

Most importantly, I want to thank Senator Mary Landrieu for her tremendous service to our country by working hard to ensure that the United States remains energy secure. However, as a Louisiana citizen, I also want to Senator Landrieu for her great efforts to ensure that Louisiana remains the "Energy State" for the US.

Energy infrastructure represents so many facets worthy of discussion. It ranges from exploration to transportation to processing to workforce. None of these factors are really independent of each other. I will focus mainly on workforce, but will initiate this testimony with my thoughts on some issues pertaining to exploration and production.

I believe that we need to increase our R&D funding in the area of petroleum-based energy. For some years, the federal funding directed toward this area has been decreasing. Yet, as we begin to realize energy independence due to petroleum, we surely have great opportunities for developing and optimizing petroleum-based technologies that will make this energy source safer, cleaner, and cheaper. It is only responsible to focus reasonable

R&D funds in this area. For the foreseeable future, this energy source will be our primary energy source and we need to continue to develop and optimize technology in this area to reduce costs and increase safety from both the human and ecological perspectives.

Oil is likely to increase in cost because reserves are not envisioned to dramatically increase beyond our current estimates; hence, transportation fuels in the US will increase in price unless we aggressively focus our efforts toward developing and optimizing liquid transportation fuels from natural gas, such as GTL fuels. I would also be remiss as we meet here in Louisiana, which is one of the most biomass-rich states in the US, and not mention that we should also focus on the development of Biomass to Liquid (BTL) fuels as well. BTL fuels represent drop-in feedstock options for GTL processes. The integration of GTL and BTL would keep us on a path toward increased energy sustainability yet utilizing the tremendous domestic resource that we have on hand with natural gas.

While a lot of the discussions today have been rightfully been directed toward petroleum energy, we should not overlook the immense long-term opportunities that renewable energy options represent. For far too long, renewable energy development has been somewhat crisis-driven. I urge that we take advantage of our recently developed large natural gas reserves to utilize this given time to find economically viable renewable energy options. This is our time to do this right. I am hopeful that we have learned from the "scares" of the early 1980's and the mid-2000's. This is the time to find a system of renewal energy that is domestic, reflects regional capacity, provides distributed sourcing, does not threaten food stocks, and does not impart significant environmental damage if it is cultured as an agricultural crop.

I believe that we are lacking sufficient technical expertise in the form of engineers, scientists, and technologists with knowledge of the energy industry. With regard to providing future energy professionals and advancing our portfolio of energy options, I suggest that we offer more joint university/industry R&D opportunities using federal funding that focus on petroleum-based fuel processes, like GTL fuels and deepwater drilling. Unleash the power of university/industry collaborations. This approach has been very successful with renewable energy R&D. It has also been very successful in graduating a large number of well trained professionals with specialized skills in the energy sector. The two groups are quite complimentary of each other. Universities tend to be the “What if?” folks and industry compliments with their rightful “So What?” approach. These collaborations offer a very powerful team that can position the US with not only stronger energy independence but also allow the US to entrench itself as the clear leader in the production of energy equipment and technology utilized by the entire world.

As I referenced earlier, with regard to fuels production infrastructure, focus on drop-in feedstocks for developing renewable options. This concept is similar to that of drop-in fuels, except in this case, the feedstocks are a drop-in option with fuels production. Examples would be lipids to green diesel that uses many existing refineries or biocoal for

electrical power plants that currently use pulverized coal. This approach provides flexibility and easy transition potential as feedstock pricing and inventories pose challenges to maintaining affordable energy for our citizens.

Focus on more bench-scale and pilot-scale R&D projects that both educate students and provide the basis for increased private sector investment to commercialize at the full scale based on promising discoveries made by the proposed R&D efforts. The trend for federal programs toward funding large commercial scale R&D and/or commercial start-ups using federal funding simply devours large pools of funding that could have been used to support a large number of smaller R&D efforts that likely would yield tremendous discoveries leading to viable energy concepts. If the concept is valid, it will get commercialized by industry. Rarely is policy a good way to initiate a viable, long-term industry.

Here in Louisiana, economic development is actually being hindered by the lack of engineers, computer scientists, and technologists. Recently, Governor Jindal, using data generated from the Louisiana Workforce Commission and the Louisiana Department of Economic Development, announced that if Louisiana graduated 30% more engineers and computer scientists each year for five years, we would only address our current needs and not address the soon-to-be needs of the over $50B worth of new industry construction in our state. And almost all of this new production capacity is directly or closely aligned to the energy sector.

At the University of Louisiana, we have literally doubled our student population in the College of Engineering over the past few years. We have grown from a medium sized college to a large college – yet this is not enough. We need more graduates to be appropriately responsive to the state's industry needs. And, our college does not reflect the common growth trend seen at most of the other colleges of engineering in the US (they are not growing nearly as fast as ours). The only complaint about our program that I hear from industry is that we are not graduating enough engineers and technologists. We simply need more engineers, computer scientists, and technologists.

To stay competitive in this technology-driven global market place, we must increase the number of students entering and finishing in the STEM majors. A chilling report by ACT states that the number of high schoolers interested in STEM is decreasing. They found that the number of kids interested in majoring in STEM decreased from 16% in 1996 to less than 6% in 2003. This is chilling data. The US has been graduating between 70,000 to 90,000 engineers each year for many years, yet other global regions like China, Europe, India, and Korea have increased their annual engineering graduation numbers by as much as two and threefold. We are simply falling behind.

The Big Crew Change in the energy sector is real and it is coming. The average age of the energy sector engineer is around 60. I can understand why industry is concerned. And, it is also important to keep in mind that the great need for engineering talent is not just for petroleum engineers – it’s all engineering majors. This new industrial revolution in

the US fueled by cheap and plentiful natural gas has not only resulted in a serious lack of engineering talent for the energy sector but also for many other industry sectors tied to the energy market such as the chemical production industry. They are also badly needing engineers and scientists due to the increased production capacity being constructed that is spurred by cheap domestic natural gas.

We need to change our approach to educating future engineers by better incorporating sustainability into their curriculum. However, sustainability is not simply renewable feedstocks and the carbon recycle, it includes project economics and product life. New products must be sustainable not only in terms of carbon molecules but also with regard to longer market runs. Engineers need to better understand both the science and business of industry.

Graduate school, particularly the PhD degree, has now become the rich ecosystem for innovation in the US, yet it also educates future energy professionals. I believe that having an energy-targeted R&D program funded by the DOE that supports PhD students would be a great investment in our future. It is noteworthy to mention that the majority of today's graduating PhD level engineering students are taking jobs in industry and not academics. I like this trend. I believe it is good for industry.

We also need to continue to increase opportunities for under-represented minorities within the STEM fields. I suggest that we try some pilot studies – such as facilitating 2+2 or 2+3 programs between historically minority institutions and the PhD granting programs. And remember, that with the T&E of STEM – that's technology and engineering, women are grossly underrepresented as well.

I will end by suggesting that we need to increase the number of skills retooling or reeducation programs for engineers to better address industry needs. Having a manufacturing engineer utilize project management skills toward complex drilling operations or pipeline management would be very powerful. However, avenues to educate them about the principals of energy engineering are not in place. But they need to be. I along with many others believe that the energy industry will have to reach out to the other industrial sectors for engineering talent. These retooling programs will help with this shifting of the technology workforce.

In closing, thank you to the organizers for this exciting meeting and thank you for giving me the honor of proving some input into this very important process.