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Energy Transformation

I have had the pleasure of speaking at majority of these annual symposia since, through John Ritch's leadership, the Uranium Institute was transformed into the World Nuclear Association. Since this may be my last time at this podium I want to personally thank John for his leadership in developing WNA into such a strong and relevant force for nuclear energy.

During the past few symposia we have heard much talk about a nuclear renaissance. I have hesitated to speak of a renaissance in the United States until we actually see construction underway on newly ordered nuclear power plants. However, I do have confidence that that day is not too far off.

What I see taking shape is much larger than just a nuclear renaissance. I believe we are on the cusp of a transformation in the way we produce and consume energy. The industrialized world is addicted to relatively inexpensive fossil energy. No country has a greater addiction than the United States. However, as the worldwide growth in demand overtakes the worldwide growth in supply and the price of fossil fuels spirals upward, energy has finally reached the front page of national agendas. The "man on the street" understands that energy security is important and energy dependence can pose unacceptable risks. Add the growing concern about global climate change - that could have devastating effects on our planet - and conditions are right for fundamental energy changes. Historically, the United States has been somewhat slow to respond to impending danger. We tend to wait until a crisis occurs before our national resolve mobilizes and responds. We are near that point now.

Some obvious changes are already underway. Automakers are retooling pickup and SUV factories to produce smaller, more fuel efficient cars. And they are racing to roll out plug-in hybrid automobiles, a move that will bring use of electricity for personal transportation into the mainstream. The increased substitution of electricity for fossil fuels is key to many aspects of our energy transformation. Electricity can be generated without greenhouse gas emissions today by wind, solar, hydro, geothermal and nuclear energy. If carbon sequestration is proven feasible in the future we can also use our fossil energy resources to generate electricity without releasing greenhouse gasses into the air. But, it is unrealistic to expect that electricity can totally substitute for direct use of fossil fuels.

You may have heard of the Pickens plan to use wind to produce our electricity and natural gas to substitute for liquid petroleum products for transportation. Good ideas as far as they go, but not the total answer. We will need to rely on coal and oil resources for as far as we can see into the future. The question is how best to use each of our energy resources in the near term. The answer to that question will vary from country to country. For the U.S., my answer would be, if it is domestic and we can make it clean, we need to use it. The answer to the quiz question about which of our domestic energy resources (including conservation) we should use to achieve energy security is "all of the above".

What can be transformational is how we combine our various energy resources for the greatest good. As one example we have traditionally looked at coal and nuclear as being competitors for the production of electricity. We have not focused on the hybrid use of proven coal and nuclear technologies to produce liquid fuels and other hydrocarbon products without generating greenhouse gasses in the conversion process. The technology to convert coal to liquid fuels has been around for almost a century. Germany used it to power its military in WWII. The problem with the process from an environmental and conservation of resources point of view is that it uses a lot of water and two-thirds of the coal goes up the stack into the air, or must be sequestered back into the ground if and when it is possible to do so. The reason so much excess CO2 is produced is that coal is both the feedstock for producing the liquid product via the Fischer-Tropsch process, and the feed stock for generating the

hydrogen that is required by the process. If we were to use electricity from commercially available nuclear reactors to produce hydrogen via proven electrolysis processes we could produce three times the liquid fuels from the same amount of coal without emitting greenhouse gasses in the process. In the future, when they are available, high temperature gas-cooled reactors could be used to produce the hydrogen with much greater efficiency.

Let me try to anticipate a few of your questions:

Q. Is it possible to use the coal-nuclear hybrid system to totally eliminate U.S. importation of foreign oil?

A.Yes, it is "possible", but unlikely we will ever go to that extent.

Q. How many reactors would be required?

A. About 400 LWR's or perhaps 250 or so HTGR's.

Q. Could wind power and solar power be used to supply some of the electricity for hydrogen production?

A. Yes.

Q. How long would our coal reserves last if used to totally substitute for foreign oil imports?

A. More than two Centuries.

Q. Is it possible for the U.S. to build that many non-CO2 emitting electricity generators by the middle of the century?

A. Yes. In 1973 the U.S. had firm orders for 200 nuclear power plants from 5 domestic manufacturers. Projections in 1970 were that we would have up to 1000 plants by the year 2000, and we were on our way to developing the domestic capacity to do so. We can do it again!

Q. Without considering powering the coal to liquids process or other process heat applications, how many new nuclear plants would have to be constructed for the U.S. to have 50% of its electricity supplied by nuclear power by the year 2035?

A. About 165, assuming an average of 1400 MWe per plant. That is an average of 9 new plants coming on line per year from 2016 to 2035.

Q. Is that possible?

A. Yes, if adequate capital is available.

The greatest transformational effect of bringing U.S. energy supply and demand into equilibrium will be the effect on the U.S. economy. Building all of the capital intensive nuclear, synthetic fuels, wind, solar, geothermal and other related facilities together with improving the energy efficiency of our factories and buildings required to achieve energy equilibrium means we will have created millions of high paying jobs and reestablished a strong domestic manufacturing capability. We will have strengthened the engineering education programs at our universities and expanded trade schools to supply the skilled workforce. At the same time we will have put a tourniquet on our balance of payments drain and strengthened the Dollar by eliminating the expenditure of $700 Billion per year we now spend to import oil.

Many nations, both existing nuclear states and emerging economies, are considering increased reliance on nuclear power as a means to provide for their own energy security. The Global Nuclear Energy Partnership (GNEP) is currently engaging all these countries in an equal, voluntary, and respectful way to harmonize a framework that ensures the global expansion of nuclear energy is done in a safe, secure, sustainable and well planned and executed manner. A joint statement in support of GNEP was issued by 5 leading nuclear fuel cycle countries in May 2007. Subsequently, the number of countries involved in the Partnership has increased to 37, plus 3 international organizations. 25 additional countries have been invited to join the Partnership during the next meeting in Paris on October 1st. A key founding principle of the Global Nuclear Energy Partnership is to ensure that any expansion of nuclear power around the world is done safely, securely, and intelligently with adequate infrastructure support.

My remarks today have been focused on the energy picture as it exists in the U.S. However, I suspect we can find similarities in several other nations represented in this audience. My main point is simply that we have the technology today to make the U.S. energy secure, and over time to bring supply and demand into equilibrium. We don't have to wait for new technology to be invented. We can get started now! To be sure, we can look forward to improved technology in the future that will make processes more efficient and do an even better job of managing our resources. HTGR's and Fast Neutron Reactors may prove to be more

efficient than today's LWR's, but LWR's work very well. Advanced recycle systems may prove to be more effective in dealing with used fuel, but existing fuel storage and recycle methods are a bridge to the future. New and better technologies for wind turbines and solar panels are being developed, but what we now have can do the job.

It is my opinion that we do have an emerging crisis and it is not going away, it will only get worse unless we take action. The era of cheap imported oil is over. It is time to stop talking and start building clean energy production facilities! To do so requires sound, sustainable government energy policy. While I believe that private industry should lead the way in implementation, Government has a principal role to play in energy transformation. Some actions are underway, but we have a huge task ahead. Thank you for listening. Best wishes for a productive symposium.