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Mr. Chairman and Members of the Committee, I am pleased to have been asked to testify at this hearing on coal gasification, synfuels and related topics. What I will say today derives mostly from the brilliant work of Bob Williams and his colleagues at Princeton University. I am pinch-hitting for Bob since he is lecturing in China today. What Bob and his colleagues have concluded from their analysis is very important to the issues being considered by this Committee. I believe he is right else I wouldn't be here.

Since retiring from the Oak Ridge National Laboratory in 1994 I have had the pleasure of chairing a committee of people from 14 DOE national laboratories. It is called the Laboratory Energy R&D Working Group or LERDWG. We meet several times a year in Washington to talk about energy R&D policy and about what is new and exciting in energy science and technology. In fact staff from this Committee often come to our meetings.

At our April meeting Bob Williams talked to us about his idea for a coal/biomass gasification complex producing gasoline and Diesel fuel via Fisher-Tropsch synthesis as well as co-production of electricity. Bob is interested in addressing the coupled challenges of oil security and climate change mitigation. Of course, liquid fuels from coal can be produced using oxygen blown gasification and Fisher-Tropsch, but this will result in about twice the amount of CO_2 vented compared to producing the same quantity of fuels from petroleum. If petroleum costs $50/bbl or more this synfuels process can be competitive. If the excess CO_2 produced is sequestered instead of vented then the coal synfuels process can be equivalent to petroleum in net CO_2 emissions.

But Williams points out we can do much better than petroleum if we gasify biomass with the coal in the same facility, and if the excess CO_2 produced is captured and stored in deep saline aquifers or is used for enhanced oil recovery from depleted oil reservoirs. In fact, the CO_2 captured and stored can be sufficient to offset the carbon in the fuel product so that the overall system including the carbon released by burning of the fuel produced can be a net zero in emissions. This is because most of the carbon in the biomass is captured as CO_2 and is sequestered offsetting the carbon released in product fuel burning. Of course the carbon in the biomass is extracted from the air during its growing. Burning the fuel produced merely returns carbon to the atmosphere from whence it came, and the cycle is completed with no net additions to the atmosphere. So, Bob shows that if CO_2 sequestered has a value of greater than $25/t the process can be competitive with fuels derived from petroleum if petroleum costs more than $50/bbl.

Another important feature of this scheme is that the ratio of biomass energy input to product fuel energy output is of the order of unity. This means that 2-3 times as much

fuel can be produced per unit of biomass energy as from the cellulosic ethanol enzymatic process, for example. This remarkable result derives from the fact that much of the energy to run the process comes from coal. This means that the biomass resource productivity can be greatly expanded.

The productivity can be pushed even further by using mixed prairie grasses grown on carbon deficient soils as suggested in the recent paper in Science Magazine (Tilman, D., et al, Science, 314, 1598-1600, 8 Dec. 2006). These researchers from the University of Minnesota found that mixed prairie grasses sequestered up to 0.6 kg of carbon in roots and soil per kg of prairie grass harvested and this can happen year after year since the grasses are perennials. Using mixed prairie grass as the biomass feedstock in the process requires only about 0.6 GJ of biomass per GJ of product fuel is required. This biomass productivity is most important because the biomass resource is limited.

Williams makes a very interesting thought experiment. He asks what fraction of the transportation fuels for North America can his coal/biomass/sequestration route provide. The answer is that all fuels estimated to be required by 2050 for transportation of all sorts could be produced from the estimated 1.3 B tones per year of biomass potentially available on a sustainable basis as estimated by DOE and USDA. This resource includes agricultural and forest residues and municipal waste as well as biomass energy crops. The latter provides only about 30% of the total resource. This can only be accomplished, however, if the light duty vehicle fleet has an average fuel efficiency of 60 mpg or greater by 2050, not an impossible target. Also, such a synfuels enterprise would double current use of coal.

This is a rough summary of Bob Williams' great idea. I understand that he will submit written testimony to the Committee to supply details. He has done very elaborate and detailed calculations for many variations on his theme.

Finally, here is a set of policies, some suggested by Williams, that I believe could encourage innovation in developing solutions to the coupled problems of oil security and climate change mitigation. The policies are designed to be largely technology independent to avoid picking winners.

First, the greenhouse gas emission externality must be reduced by putting a cost on emissions by cap and trade or tax or whatever. The Congress through various pieces of legislation is actively considering this, and no doubt something will emerge.

Second, a low-carbon fuel standard such as is being developed by the State of California should be adopted and existing subsidies on low carbon fuels should be discontinued.

Third, regulations should be adopted to assure that no new coal synfuels plants are built without carbon capture and storage.

Fourth, an oil security feebate might be enacted to put a floor on transportation fuel prices. If oil prices crash, say to $30/bbl from $60, transportation fuel could be taxed and

part of the tax rebated to synfuels plants to help them compete and produce even with low world oil prices. Part of the tax revenues could be returned to the public.

Fifth, regulations (such as improved CAFÉ standards) to promote more efficient use of transportation fuels need to be aggressively strengthened over time.

Sixth, regulations and R&D to improve coalmine safety, worker health, and environmental improvement need to be periodically reviewed and upgraded if necessary.

Of course it is easy to make such a list. The hard work comes in sorting out the many options so policies are effective, fair and politically possible. I think that is your job, and it is a difficult one.

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