

Mr. Chairman, Members of the Committee:

It is an honor to be invited to appear before this distinguished Committee on the important issue you are addressing today. I would like to speak to two aspects of it: the strategic context of the current dependence on imported oil; and in that context the potential role of American agriculture in improving, inter alia, our security by becoming a major source of our transportation fuel. I will not address the use of biomass or other agricultural sources in the production of electricity - a separable and, in my view, much less important issue. There are many ways to produce electricity, and only two per cent of our electricity, headed down, is produced by oil. Insofar as fuel supply is concerned, the security issue, in my view, is dominated by the question of dependence on imported oil.

### **The Strategic Context of Oil Dependence**

The headlines of recent weeks pointedly emphasize the importance of today's hearing: two Americans and three others killed by terrorists in Saudi Arabia within the last week; terrorist attacks on oil facilities in Iraq, as well as elsewhere in the Middle East; OPEC production cutbacks, leading to rapidly rising prices at the gasoline pump here in the U.S.; and uncertainty about the future of our effort to bring stability in the form of democracy and the rule of law to Iraq, illustrated by the recent turn of events in the streets of Fallujah and Najaf.

The location of the world's easily accessible oil supplies in the volatile Middle East frames the picture of our current dilemma. I would note at the outset that all oil-importing nations are in a real sense in this together - there is, to a first approximation, one worldwide market in oil. Given the integrated nature of the world economy and the degree to which our economic fortunes are intertwined, we accomplish nothing particularly useful if we merely shift our own purchases of oil from one of the world's regions to another and thereby re-shuffle the existing buyers and sellers. Under current circumstances, an oil crisis will affect all our economies, regardless of the source of our own imports. We must think in terms of the world's dependence, not only our own.

As oil fields reach and pass their halfway point in production, their costs of production rise substantially. Some production is inherently high-cost, such as that in Russia, because of factors such as weather, environment, and transportation limitations. Other production, such as the huge deposits of heavy oil in Alberta, are potentially quite promising if technological progress can continue to reduce economic and environmental costs. But a very large share of the fields outside the Middle East have reached their halfway point in production and are seeing rising production costs. So for a number of years into the future those who control the low-cost production in the great oil fields of the Middle East and also the majority of the world's swing production capacity will be in the driver's seat with respect to the world's oil supply and oil

prices. Through such control they will have a major hand in the world's economic future.

I should add that the current state of affairs in the Middle East should deepen our concern. It is true that if the region were at peace, and if the regimes controlling the lion's share of Middle Eastern oil were stable and reliably moderate friends of the world's democracies, then we might expect a steady flow of reasonably priced oil to help the world's economies grow - even considering the added demand that will come from increased Indian and Chinese oil consumption. But is there anyone who would assert that this is the condition of the Middle East today, or that it is likely to be the case any time in the foreseeable future?

One potential source of disruption of oil supplies is of course terrorism. We have recently seen attacks on the Iraqi oil port of the Persian Gulf, there continue to be many attacks on Iraqi pipelines, and there were earlier terrorist attacks on oil tankers. Al Qaeda terrorists and Baathists both know that disrupting the resuscitation of the Iraqi oil industry is central to their efforts to defeat the Coalition and either restore fascist totalitarianism to Iraq or, for others, to introduce theocratic totalitarianism there.

The terrorist threat to oil supplies is not limited to Iraq or to the high seas - for example, the opening pages in *Sleeping With the Devil*, by former CIA officer Robert Baer, centers on the unfortunately plausible scenario of a hijacked 747 being flown into a vulnerable and crucial part of Saudi Arabia's oil refining complex, taking millions of barrels per day out of production for a number of months and devastating the world's economy.

We must also be concerned about the potential instability and potential hostility in more than one major Middle Eastern oil producer. The key country is Saudi Arabia, and I would first point out that the picture there is not entirely bleak. Crown Prince Abdullah is trying to respond positively to some of the calls for reform in the Kingdom, and over the long run that could enhance the Kingdom's stability. He has made efforts to promote nationwide local elections, for example, and he has limited the role of the religious police in some matters. He has not been nearly as much a reformer as others, such as the Emir of Bahrain, but his actions seem to me to indicate a positive effort.

The Crown Prince is, however, an octogenarian. If the ailing King Fahd is succeeded instead by one frequently mentioned candidate, the Interior Minister, Prince Nayef, it is not only the outlook for reform that will be bleak. Prince Nayef regularly imprisons reformers and fires newspaper editors who call for reform, and the last time the Prince, who is in charge of the Kingdom's counter-terrorism efforts, spoke publicly on the issue of 9/11 he opined that it was the Jews who had executed the attack. Cooperative efforts with a King Nayef could, to put it gently, be quite challenging.

And of course one cannot ignore the possibility of a terrorist takeover of the Kingdom by Islamists of the stripe of Osama bin Laden. It is sometimes said that whoever is in power in Saudi Arabia, the Saudi Government will have to sell substantial oil to the world. This is not the case, however, if those who take power wish to live in the 7th century. We can hope for movement in the Kingdom toward reform and subsequent stability under the sort of policies advocated, in however limited a fashion, by the Crown Prince. But we certainly cannot prudently count on such a course of events.

### **The Role of American Agriculture: Utilizing Agricultural Waste to Produce Fuel for the Existing Transportation Infrastructure**

I have submitted to the Committee two articles that deal in whole or in part with this issue. One, ["The New Petroleum,"](#) published in Foreign Affairs in 1999, I was privileged to co-author with the Committee's then-Chairman, Senator Lugar; it followed from testimony he asked me to give before this Committee seven years ago. The second, ["Defeating the Oil Weapon,"](#) I published a year ago last September in Commentary. Both make the case for concentrating on using inexpensive feedstocks or, even better, waste products from our nation's agricultural sector to produce transportation fuel that can be used within our existing transportation infrastructure.

The ability for such fuels to be used within the existing infrastructure is the key to making rapid progress - and speed is now essential in light of the critical situation in the Middle East described above. Thus the highest priority should be given to encouraging the production of alternative fuels that require minimal or no change to today's transportation infrastructure.

In light of the likelihood that they will require substantial infrastructure changes, for example, I believe that far too much focus is being placed on automotive fuel cells, and far too little on more quickly available approaches. For fuel cell vehicles to be purchased by consumers, reformers (producing hydrogen from, say, natural gas) would need to be present in a large number of filling stations so that the family car could fill up with hydrogen whenever needed.

But who goes first? Detroit, producing fuel cell cars, or energy companies installing reformers? Making such large and complex infrastructure changes takes a good deal of money and time. (If, in order to avoid this problem, the reformers were put in the vehicles so that consumers could fill their tanks with gasoline and then have it reformed into hydrogen to produce electricity, all inside the car, the weight and economic cost would likely be very substantial.)

Substantial fuel efficiency technologies are already available that can reduce the overall amount of transportation fuel required and thus multiply the effect of alternative fuels. For example, if we were producing ethanol from biomass and E-85 fuel (85 per cent ethanol, 15 per cent gasoline) were thus widely available, a 20-mile-per-gallon vehicle would be getting nearly 100 mpg on the gasoline it used when it burned such a fuel. But if the same fuel were used in the 60-mpg hybrid gasoline-electric car that I drove here today, that vehicle would be getting nearly 300 mpg on its gasoline. (If the capacity to burn E-85 rather than only E-10 is added to a vehicle during production, the modification and cost are both trivial - there are already millions of such flexible-fuel vehicles (FFVs) on the road.)

To obtain the amounts of ethanol that would be necessary to make a substantial dent in our oil imports, we will need to move beyond grain as a feedstock and use agricultural waste products such as rice straw and bagasse or such crops as switchgrass, a process that will require the use of genetically modified biocatalysts. Progress has been made on this technology since Senator Lugar and I wrote about it in January of 1999, and a Canadian company, Iogen, has just entered commercial production.

Another form of agricultural waste, from animal carcasses and manure, can also be used to produce vehicle fuel for the existing infrastructure: high-grade diesel fuel that can either be utilized directly or refined into gasoline. Such diesel fuel is currently being successfully produced commercially by a joint venture between Conagra and the company that developed the technology, Changing World Technologies, using over 200 tons per day of waste from a Conagra turkey processing facility in Carthage, Mo. The same technology can be used to process cellulosic biomass into diesel fuel.

I have been familiar with the work being done on the technology of these two processes for years - conversion of biomass into ethanol using genetically modified biocatalysts, and thermal conversion (involving high-pressure de-polymerization) of organic wastes of all sorts into high-grade diesel fuel - and have advised companies utilizing them. There are other processes,

using other-than-agricultural waste products such as strip-mine waste, to produce diesel and other fuels; these deserve attention as well. But whatever the technology, I want to stress the opportunity, for both substantive and political reasons, provided by the prospect of utilizing waste as a feedstock for such fuel production.

First of all, capital is often a coward, particularly the first time new technologies are brought to market. If we want to encourage new technologies to be used promptly in commercially viable production facilities to produce transportation fuel, we will have to find a way to recognize the cost of waste disposal as a reduction in the cost of producing the fuel.

Farmers and others who help produce agricultural products must dispose of such wastes as rice straw and bagasse somehow, and it costs them something out-of-pocket to do this. There are other costs to society (e.g., air pollution from burning) that are often not recognized by the market. These costs make such agricultural waste ideal feedstocks for the production of transportation fuel. If the fuel producer took care of conversion of rice straw into ethanol or diesel, was paid by the farmer whatever it now costs the latter to dispose of the rice straw, and the reduction in pollution was recognized by a tax credit or in some other fashion, I believe that a number of waste-to-fuel technologies would begin to thrive.

Where such costs are monetized, the effect of bringing on line technologies that use waste as a feedstock can be dramatic. For example, in Europe, because of concern about BSE, a negative cost ("tipping fee") of well over \$100/ton is recognized for some animal carcasses, since the type of disposal now required there means that such waste cannot be used to produce feed for chickens or for other such purposes. At tipping fees of that magnitude, the thermal conversion process now used at the Conagra turkey processing plant and applied to cattle carcasses would produce diesel fuel that could be given away free, and the plant operators would still make a substantial profit. Since Europe recognizes and gives credit for disposing of such waste more than is done on this side of the Atlantic, the deployment of these waste-to-fuel technologies is beginning in some cases to migrate to Europe - for example, the turkey-offal-to-diesel process at the Conagra plant is not recognized as producing "bio-diesel" as the term is defined in U.S. law and thus is not financially encouraged in this country. We are inventing in the U.S. ways to make the world less dependent on oil and watching our inventiveness migrate to Europe to be used by Europeans to reduce their oil import bill.

The volume of what we import and what we could save - while creating jobs, largely in rural

America, to produce our transportation fuel - is staggering. Last year we paid the outside world about a billion dollars every three days for imported oil. Even replacing a share of this with domestic production of transportation fuel could create hundreds of thousands of jobs.

How much domestic production of fuel from waste is plausible to produce substitutes for imported oil? According to those who manage the process at the Conagra facility, EPA estimates that there are approximately 6 billion tons of agricultural (i.e., plant and animal) waste created every year. Of course major shares of this do not need to be removed from the field as must be done with rice straw and may be left there to decompose. But the overall volume of fuel that could theoretically be produced from such waste is interesting because the amount is so large that even a small share would be significant. Discounting for 50 per cent moisture content and assuming a conservative yield of 20 per cent diesel from the rest of agricultural waste, using thermal conversion our total agricultural waste would yield nearly 11 million barrels/day. Production from a new domestic source of conventional oil, such as the Alaska National Wildlife Refuge, would be dwarfed by conversion of a very small share of this agricultural waste into fuel.

Another benchmark for potential volume of production is provided in Senator Lugar's and my article, mentioned above. (Our figures are from the work of Professor Lee Lynd of Dartmouth's Thayer School of Engineering, who will be testifying later today.) If our CRP lands were planted in switchgrass (as a substantial share already is) and legislation were passed which permitted such lands to be harvested solely for the production of biomass feedstocks to produce fuel, then at the mileages being achieved by today's hybrid gasoline-electric vehicles this amount of switchgrass plus a reasonable portion of agricultural wastes would produce enough ethanol to replace all of our current gasoline consumption. Other analysts have used lower switchgrass yields than Professor Lynd in looking at the issue. Fine, halve the assumed yields, and for a fleet of hybrids we could still get enough ethanol - with no land taken out of its current uses - to replace the approximately half of our gasoline that comes from imported oil.

### **A Possible New Coalition**

The final point I would make is a political one. Important change often requires a shock to the system of the body politic, and also the formation of coalitions that previously had not existed.

I would suggest that the shock should have been perceived long before, but for many it came

on 9/11. The subsequent events described above, including the terrorist attacks in Saudi Arabia within the last week, should have supplied all that is necessary in that regard.

As for coalitions, for the past two years, I have been a member of the National Commission on Energy Policy and have served on the Advisory Council of the Energy Future Coalition.

The potential coalition here is an interesting one. Senator Lugar and I alluded to it in our article of five years ago.

First are the farmers, indeed rural America as a whole - an extremely important part of our country and a sector of the economy of great interest of course to this Committee. To have rural America be able to take over a major share of our production of transportation fuel would mean substantially enhanced prosperity for our farms, rural areas, and small towns.

The second group in the potential coalition consists of those concerned about the environment. The two technologies I have described not only get rid of noxious wastes but, unlike incineration, are themselves non-polluting. Moreover for those concerned about global warming and climate change, the production of transportation fuel from agricultural wastes essentially recycles CO<sub>2</sub> that has been fixed in the photosynthesis process and turns it loose again - the experts in this field agree that burning fuel produced from biomass adds essentially no net CO<sub>2</sub> to the atmosphere. And to the degree that using agricultural wastes to produce diesel or ethanol means that those wastes do not decay anaerobically, this prevents the formation of methane, which is more than twenty times worse as a contributor to global warming than CO<sub>2</sub>.

The third group consists of those who are interested in promoting economic growth and stability in developing countries. Even apart from the obvious humanitarian concerns, this group should include all of us, because to the degree that such countries, say in Africa, can experience greater rural prosperity from the production of transportation fuel domestically - and can avoid the accumulation of dollar-denominated debt to pay for their imports of oil - they will be less likely to produce instability and terrorism.

Finally, there should be a substantial group under present circumstances who are quite concerned about our nation's security and who want to do everything possible to protect it -

hopefully without back-breaking costs.

We might say that there is a prospect of the farmers' being joined in a political coalition to promote the use of agricultural wastes to produce transportation fuel by three other elements: the Tree-Huggers, the Do-Gooders, and the Cheap Hawks. I must admit that I personally see nothing incongruous in this since, now that my wife and I own a small farm, I regard myself as a member of all four of these groups. Such a coalition would require some compromises among its members, but I would suggest these would be neither major nor prohibitive. Cooperative efforts among these important constituencies could bring substantial new support to a vital cause.