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Hearings on

Geopolitical Implications of Rising Oil Dependence and Global Warming

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Testimony of R. James Woolsey

Mr. Chairman and Members of the Committee it is an honor to be asked to testify before you today on this important subject. I represent only my own views and not those of any institution with which I am affiliated.

There are many aspects of our dependence on oil for 97 per cent of our transportation needs that affect both our national security in a traditional sense and, via oilís contribution to global warming, our security in a broad sense as well ñ oil contributes over 40 per cent of the global warming gas emissions caused by fossil fuels.

I do not believe that we will reach a sound energy policy if we ignore any of three key needs: to have a long-term supply of transportation fuel that is as secure as possible, as clean as possible (in terms of global warming gas emissions as well as other pollutants), and as inexpensive as possible. Today oil meets none of these three criteria. The reason this is important to us is that oil is a strategic commodity today insofar as we are in near-total dependence on it for transportation ñ not merely a commodity. Until a little over a century ago salt was such a strategic commodity as well (I am indebted to Anne Korin of IAGS for pointing out this analogy). Wars were fought and national strategies driven in part by salt, because it was the only generally-available means of preserving meat, a major portion of our food supply.

Today we havenít stopped using salt, but no part of our national behavior is driven by the need for it ñ it has a market and is shipped in commerce. But because it has affordable and effective competitors for meat preservation -- refrigeration, among other technologies ñ its dominant role is over. No nation sways world events because it has salt mines.

For a number of reasons we must strive for a similar path of decline in influence for oil ñ away from being a strategic commodity and toward being simply a commodity. Oil will still be useful and valued for its high energy content and its relative ease of shipment for a long time. It will be used in heating and in the production of some chemicals as well ñ in those uses it is already, in a sense, no longer a strategic commodity

because it has competitors. Doubtless it will be used for many years to produce transportation fuel as well. But in the interests of our national security, our climate, and our pocketbooks we should now move together as a nation ñ indeed as a community of oil importer nations ñ to destroy, not oil of course, but oilís strategic role in transportation as quickly and as thoroughly as possible.

National Security

The national security reasons to destroy oilís strategic role are substantial.

Over two-thirds of the worldís proven reserves of conventional oil lie in the turbulent states of the Persian Gulf, as does much of oilís international infrastructure. Increasing dependence on this part of the world for our transportation needs is subject to a wide range of perils.

Just over a year ago, in response to bin Ladenís many calls for attack on such infrastructure, al Qaeda attacked Abcaiq, the worldís largest oil production facility, in northeastern Saudi Arabia. Had it succeeded in destroying the sulfur-clearing towers there through which about two-thirds of Saudi crude passes -- say with a simple mortar attack -- it would have succeeded in driving the price of oil over a hundred dollars a barrel for many months, perhaps close to bin Ladenís goal of $200 a barrel.

Royal succession in Saudi Arabia could also bring major problems. King Abdullah is a sponsor of some reforms in the Saudi system and sometimes works toward cordial relations with us and other oil importers, but he is in his eighties, as is Crown Prince Sultan. Prince Nayef, the Interior Minister, is one possible successor to the throne. His views are famously close to those of the extremely reactionary Wahhabi religious movement in the Kingdom. It was he, for example, who decided not to inform the US before the Khobar Towers bombing when ìÖ a few months earlier Saudi authorities had intercepted a car from Lebanon that was stuffed with explosives and headed for Khobar.î (Wright, The Looming Tower, 2006, pp. 238-39). Cordial relations with the US may not be at the top of his agenda.

Iranís President is part of a circle, the Hojateih, around Ayatollah Mesbah-Yazdi that is radical even by Iranian post-1979 standards. Indeed Mesbah-Yazdi was exiled to a school in the city of Qum by Ayatollah Khomeini because the latter thought Mesbah-Yazdi too radical. The Hojatiehsí views center on the importance of encouraging the return of the Twelfth Imam from the 10th century (the Mahdi) so that he may begin the battles between good and evil that they believe will end the world. The efficacy of deterrence and containment in dealing with Iranís nuclear weapons development program is not clear when Iranís leaders talk of the desirability of Iranís becoming ìa martyr nationî and shrug at the possibility of millions of deaths by saying ìAllah will know his own.î

In response to Iranís nuclear program, this past winter six Sunni Arab states,

including Egypt and Saudi Arabia, announced that they too would have ìpeacefulî nuclear programs. But since a number of these states have very plentiful supplies of oil and gas it seems unlikely that all these programs will be limited to electricity generation. We may be seeing the beginning stages of a nuclear arms race in the Gulf region between Sunni and Shia.

The US now borrows from its creditors such as China and Saudi Arabia over $300 billion per year, approaching a billion dollars a day of national IOU-writing, to import oil. This contributes heavily to a weakening dollar and upward pressure on interest rates (our annual oil debt is well above our trade deficit with China). For each of these daily billions of dollars that we can avoid borrowing and can figure out how to spend productively producing domestically for our transportation needs we create 10,000 or more jobs in the US. Another interesting perspective is that net farm income in the US is in the range of $80 billion annually. So by replacing about a fourth of our imports with domestically-produced alternatives, we create value in this country about equal to a doubling of net farm income.

If these IOUs we send abroad put a strain on the worldís wealthiest economy, think what they do to the economies of developing countries in, say, Africa that have no oil themselves. Debt is the central inhibitor of economic development ñ importing expensive oil is helping bind hundreds of millions of the worldís poor more firmly into poverty.

A share of our payments for oil, along with othersí, find their way to Saudi Arabia. The Saudis provide billions of dollars annually to their Wahhabi sect, which establishes religious schools and institutions throughout the world. Lawrence Wright in his fine work, The Looming Tower, states that with about one per cent of the worldís Muslim population the Saudis support via the Wahhabis ìÖ 90 per cent of the expenses of the entire faith, overriding other traditions of Islam.î (p.149)

These Wahhabi teachings, if one reads the fatwas of their imams (see Shmuel Bar, Warrant for Terror: Fatwas of Radical Islam and the Duty of Jihad, 2006), are murderous with respect to the Shia, Jews, homosexuals, and apostates and horribly repressive with respect to everyone else, especially women. They are essentially the same basic beliefs as those expressed by al Qaeda. The Wahhabis and al Qaeda do not disagree about underlying beliefs but rather, a bit like the Stalinists and Trotskyites of the 20ís and 30ís, about which of them should be in charge. The hate-filled underlying views of both, however, point in the same overall direction. Many Wahhabi-funded madrassahs, world-wide, echo and perpetrate this hatred and thus promote its consequences. Thus, as has often been said, when we pay for Middle Eastern oil today, this Long War in which we are engaged becomes the only war the US has ever fought in which we pay for both sides.

Finally, as Tom Friedman of the New York Times puts it, ìthe price of oil and the path of freedom run in opposite directionsî. Work by Collier at Oxford and other scholars has pointed out the link between commodities commanding huge amounts of economic rent, such as oil (or the gold and silver brought from the New World by Spain in the sixteenth century) and political autocracy. Such a commodity, unless it is acquired by a mature democracy such as Norway or Canada, tends to concentrate and enhance the power in the hands of a ruler. ìThere should be no taxation without representationî says

Bernard Lewis, ìbut it should also be noted that there is no representation without taxation.î If a country is so oil-rich that it doesnít need taxes it does not need, and often does not have, any real legislative body to levy them ñ and thus no alternate source of power in the State. And as for enhanced power from oil wealth, note the behavior recently of Messrs. Ahmadinejad, Chavez and Putin.

So the national security reasons to move against oilís role as a strategic commodity are substantial.

Carbon Emissions

Most of the attention regarding climate change has centered on reducing CO2 emissions from coal because of its central role in many parts of the world, including the US, in electricity generation. This testimony will not deal with these particular emissions except to note that oil use in transportation is only lightly affected by the steps that may be taken, such as carbon taxes or carbon cap-and-trade systems, to limit CO2 emissions from coal. An increase in price of many dollars per ton of CO2 will have only penniesí worth of effect in the price of gasoline. So while such methods of limiting emissions from coal combustion have much to commend them, they have little to do with reducing the over-40 per cent of CO2 emissions that come from oil, especially in its transportation uses. Other tools must be found.

Replacing gasoline with corn-derived ethanol provides a start, but only a start. As a general proposition, fuels made from renewable resources merely recycle differently the CO2 that is already in the atmosphere and that will stay there in any case, e.g. by unharvested grasses (which have fixed CO2 in the photosynthesis process) dying and decaying in the field. Thus compared to fossil fuels, which introduce into the atmosphere CO2 that could otherwise remain sequestered below-ground, renewable fuels typically exhibit much lower net CO2 emissions on a well-to-wheels basis. When ethanol is made from corn, however, the process may use enough natural gas in producing fertilizer and, (depending on the fuel used to fire the ethanol plant), on ethanol production that its use reduces global warming gas emissions perceptibly but only modestly compared to those from gasoline (although even corn ethanol of course reduces oil use). Also, beyond the range of replacing approximately 10 per cent of gasoline, use of corn-derived ethanol for transportation fuel begins to create problems with land use. Other fuels (see below) need to be utilized

In my judgment it is important to limit the CO2 emissions from oil used for transportation (somewhere around a quarter of our fossil-fuel CO2 emissions), but I find much of the current debate, couched in terms of belief, to be less than enlightening. Belief in a scientific theory, even one that has been accepted by many reputable scientists for many years, should always be held tentatively and, Karl Popper taught us well I believe, a theory should always be regarded as a candidate for refutation. Such refutation may be total ñ the late senior Saudi imam Ben Baz to the contrary notwithstanding, the sun doesnít rotate around the earth. Or it may be partial: Newton wasnít so much proven wrong by Einstein but rather his theories were shown to have limitations.

Today the clear weight of scientific opinion ñ e.g. the views of the US National Academy of Sciences -- is on the side of the proposition that global climate change is in part anthropogenic and that it is related to the release of CO2 and other gases such as methane. And although critics are right to point out that earlier predictions by others

have not occurred ñ global cooling, massive famine from population increase ñ this should not affect our judgment about CO2 and global climate change (except to give all of us a reasonable reminder about the importance of scientific theories always needing to be held tentatively).

I find most congenial the approach to these issues adopted by Nobel-Prize-winning economist Thomas Schelling, who points out that we insure against many phenomena which we are not certain will occur, but which we nonetheless take seriously. It is a question of the insurance premiumís appropriate size. With respect to coal-fired electricity there is a major debate because most steps to abate CO2 emissions have cost ñ e.g. moving toward carbon capture and sequestration ñ but no major benefits other than limiting CO2 emissions, at least none (e.g. pollution abatement) that canít be dealt with more cheaply.

But breaking oilís strategic role in transportation, I would maintain, is different. As discussed below, such an objective has modest costs (some of them indeed are negative) and substantial other benefits. Oil should thus be an early candidate for public policy decisions to speed its strategic demise.

Affordability

We have made some substantial mistakes with regard to affordability in the past. Ignoring cost in attempting to destroy oilís strategic role in transportation is not only expensive, it is self-defeating. For example, in the aftermath of war, revolution, and oil crises in the Middle East in the 1970ís the US initiated the very expensive Synfuels Corporation. It promptly went bankrupt in 1986 after the Saudis increased production from their reserves and drove the price of oil down to near $5/barrel. Something similar happened to various expensive petroleum alternatives in the late 90ís when, for a number of reasons, oil prices sank to around $10/barrel.

Our most recent mistake has been investing so heavily in hydrogen fuel cell technology for passenger vehicles. Hydrogen fuel cells have real utility in many fixed applications, in the space program, and perhaps, once their cost has been adequately reduced, for some types of fleet vehicles. Hydrogen production for chemical use may also be one reasonable way to utilize stranded electricity (electricity produced at a site for which no, or inadequate, transmission is available). But to install an adequate number of hydrogen fueling stations in our neighborhoods to support family cars driving on hydrogen would require a huge investment in infrastructure, by some estimates nearly a trillion dollars.

And then one needs to answer a few questions about creating hydrogen from either natural gas or electricity. Why reform natural gas into hydrogen for fuel cells and not just put the natural gas into internal combustion engines in the first place, especially since the conversion wastes about a third of the original energy? Many cities have natural-gas-powered buses and Iran is even modifying its existing automobile fleet to be dual-fuel vehicles of a sort that can use either gasoline or natural gas. Or why convert electricity (via electrolysis of water) into hydrogen and then via a fuel cell into electricity again, losing about three-quarters of the energy in the process? Why not put the electricity into the vehicleís battery, as with a plug-in hybrid, in the first place?

If we insist on expensive single solutions such as hydrogen ñ a platinum (not just silver) bullet ñ and ignore cost and the utility of building on existing infrastructure, we will fail. This is in part because in addition to oilís being a strategic commodity for

transportation from the point of view of us, the importers, it is also a strategically manipulable commodity from the point of view of those who control it. Chinese and Indian demand, and the possibility that the peak oil theory will prove out and the major Middle Eastern fields will see declining production capability, may keep oil prices high. But many investors will still be worried about a repeat of the sharp oil price drops of the mid-eighties and the late nineties. The world changed in important ways in the early 1970ís when the Railroad Commission of Texas was in effect replaced by OPEC as the arbiter of the worldís oil prices.

We need to convince our investors and ourselves that our economy is not subject to being manipulated by others based on their perception of whether we are being too aggressive in developing alternatives to oil, or supporting Israelís existence too determinedly. Instead we should develop a portfolio of approaches to breaking oilís strategic hold on us, building on existing transportation capabilities wherever possible and keeping in mind cost, carbon emissions, and national security.

Toward a Portfolio

Electricity

As modern battery technology has developed in response to the markets for electronics, communications, power tools, and a host of other uses, it has brought with it opportunities to substitute electricity for oil products in transportation. Hybrid gasoline-electric cars have now been provided with these advanced batteries -- such as lithium-ion ñ with improved energy and power densities. Dozens of vehicle prototypes are now demonstrating that these "plug-in hybrids" can more than double hybrids' overall (gasoline) mileage. With a plug-in, charging your car overnight from an ordinary 110-volt socket in your garage can let you drive 20 miles or more on the electricity stored in the topped-up battery before the car lapses into its normal hybrid mode. If you forget to charge or exceed 20 miles, no problem, you then just have a regular hybrid with the insurance of liquid fuel in the tank. And during those 20 all-electric miles you will be driving at a cost of between a penny and three cents a mile instead of the current 10-cent-a-mile-plus cost of gasoline.

Utilities are rapidly becoming quite interested in plug-ins because of the substantial benefit to them of being able to sell off-peak power at night. Because off-peak nighttime charging uses unutilized capacity, DOE's Pacific Northwest National Laboratory estimates that adopting plug-ins will not create a need for new base load electricity generation plants until plug-ins constitute more than 84% of the country's 220 million passenger vehicles. Further, those plug-ins that are left connected to an electrical socket after being fully charged (most U.S. cars are parked more than 20 hours a day) can substitute for expensive natural gas by providing electricity from their batteries back to the grid to aid in stabilization of the grid's frequency and voltage, and "spinning" reserves to help deal with power outages.

The economic savings that can result from these vehicle-to-grid (V2G) connections are very substantial.

First of all, V2G takes advantage of the fact, surprising to most people, that todayís light vehicle fleet has twenty times the power capacity of our electric power system and less than one-tenth its utilization. A relatively few vehicle batteries can thus store much larger amounts of energy relative to the gridís needs than most people realize.

Vehicles that are fully charged can be left plugged into electric outlets and serve useful, and profitable, purposes. I would refer the Committee to experts on this matter ñ particularly Professor Willett Kempton of the College of Marine and Earth Studies at the University of Delaware who, together with his colleagues there, has published widely on this subject. But one example is that if only 3 per cent of the nationís light vehicle fleet were plug-in hybrids, plugged into the grid, they would alone be able to handle the grid stabilization market, on which utilities today spend about $10 billion.

Second, major infrastructure changes are not needed in order to use V2G. Forty out of fifty states today have net metering laws which let homeowners sell power they generate, such as from rooftop photovoltaics, back to the grid ñ those who have solar systems on their roofs can literally watch their electricity meters run backwards. V2Gís flexibility will improve as the grid gets ìsmarterî but it can be done today. Professor Kemptonís work thus suggests that utilities can save a great deal of what is now spent on fossil fuels by substituting V2G connections and that this in turn can benefit consumers quite substantially. In his models the credits a consumer obtains from connecting his plug-in hybrid to the grid, after it has been fully charged, for several hours a day cover a substantial share of the consumerís monthly car payments. It seems too good to be true that both consumers and utilities could make money while together they reduce fossil fuel emissions, but such seems to be the clear logic of the economics of plug-in hybrids and V2G.

Once plug-ins start appearing in showrooms, (company announcements now make it seem likely that we will see the first production models within 2-3 years), it is not only consumers and utility shareholders who will be smiling. If cheap off-peak electricity supplies a portion of our transportation needs, this will help insulate alternative liquid fuels from OPEC market manipulation designed to cripple oil's competitors. Indian and Chinese demand and peaking oil production may make it much harder for OPEC today to use any excess production capacity to drive prices down and destroy competitive technology. But as plug-ins come into the fleet low electricity costs will stand as a substantial further barrier to such market manipulation. Since OPEC cannot drive oil prices low enough to undermine our use of off-peak electricity, it is unlikely to embark on a course of radical price cuts at all because such cuts are painful for its oil-exporter members. Plug-ins thus may well give investors enough confidence to back alternative liquid fuels without any need for new taxes on oil or subsidies to protect them.

Environmentalists are joining this march, and over time with increasing enthusiasm. The Environmental and Energy Study Institute has reported that, with today's electricity grid, there would be a national average reduction in carbon emissions by about 60% per vehicle when a plug-in hybrid with 20-mile all-electric range replaces a conventional car. Further studies are underway on this important subject, but it seems clear that replacing a conventional vehicle with a plug-in hybrid will show substantial reductions in carbon emissions today in clean-grid areas such as the West Coast and some reductions on an average basis nation-wide (coal fuels about 51 per cent of our overall electricity generation). In states where coal-fired generation dominates the electricity market there may still be some reductions in carbon emissions on a net basis by moving toward plug-in hybrids. In any case, if other public policies such as cap-and-trade lead to electricityís increasingly being generated from less carbon-emitting sources -- such as renewables, nuclear power, or coal with carbon capture and sequestration ñ this process

will further reduce net vehicle emissions as well.

And as far as infrastructure investment is concerned, some is indeed needed for plug-in hybrids: each family with such a vehicle would need an extension cord. Period.

Renewable Liquid Fuels

Because, as discussed above, renewable liquid fuels hold the promise of very substantial CO2 reductions on a well-to-wheels basis I will limit this discussion to them. It is of course possible that technological innovation will make possible a sufficient degree of carbon sequestration from other alternative fuels ñ from oil sands, oil shale, coal-to-liquid ñ that they will meet relevant CO2 emissions requirements.

In my view, even if the nation moves toward plug-in hybrid gasoline electric vehicles, and even with expected battery improvements, there will be a substantial market for liquid fuels. This is because in order for a driver not to be concerned at running out of electricity I believe there will be substantial motive to have liquid fuel in the tank. Liquid fuel will be necessary for road trips in a plug-in hybrid beyond the battery-charge range. And although over time we can probably expect battery performance to improve and the need for liquid fuel to decline, battery cost today (perhaps $500-600/kilowatt hour) substantially limits battery size for moderate-cost vehicles to the plug-in hybrid ranges rather than all-electric. In addition to battery cost reductions, wide availability of quick-charging could reduce the demand for liquid fuels over time, but those renewable fuels with a substantial cost advantage may prove particularly durable in the public market.

Cost advantages can accrue from a number of sources.

For example, the ability to grow feedstocks such as switch grass on many types of land effectively removes the land limitations frequently associated with corn-derived ethanol. We found on the National Energy Policy Commission in our 2004 report that, with reasonable assumptions about improvements in vehicle mileage and yield per acre of feedstocks, enough switch grass could be grown on the amount of farm land equivalent to the soil bank (about 30 million acres, or around 7 per cent of US farm land) to replace over the next twenty years about half of US gasoline.

Further, over time cellulosic ethanol and cellulosic methanol may exhibit cost advantages over corn-derived ethanol; for example, cellulosic ethanolsí production is likely to be simplified by the perfection of consolidated bioprocessing (so that hemi-cellulose and cellulose may be processed together). Its production costs may be lowered by rapid yield improvements using new genetic techniques, possibly but not necessarily including the genetic engineering of the feedstocks themselves ñ e.g. to simplify the breaking down of the grassesí or other feedstocksí lignin. And its shipping costs may be lowered by locating small facilities near markets ñ switchgrass will grow in more parts of the country than corn.

Bio-butanol may exhibit the above advantages and also profit from the fact that it is both more energy-intensive and more pipeline-friendly than ethanol.

Renewable diesel, made by thermal processes from many types of carbon-based waste -- from turkey offal to hog manure to used tires ñ and P-Series fuels, made from waste and biomass, may both exhibit cost advantages from environmental cleanup. Conversion of only a portion of industrial, municipal and animal wastesóusing thermal processes now coming into commercial operationóappears to be able to yield several million barrels a day of diesel, or with modest further processing, methanol.

In Europe the negative costs (ìtipping feesî) that a fuel producer can obtain while making fuel from such clean-up processes are substantial ñ approximately $100/ton in some cases. We may be about to see some of these processes that simultaneously clean up the environment and produce fuel leave the United States and migrate to Europe, particularly since the executive branch has recently decided to extend to oil refineries the $1/gallon ìrenewable dieselî credit previously focused on cleanup renewable fuel-producing technologies. (See IRS Notice 2007-37)

And one or more of the above processes may also find cost advantages in the production of high-margin niche products in biorefineries that do not produce only fuel. For example, today polylactic acid, a major ingredient in many plastics that is ordinarily made from hydrocarbons, is being produced from carbohydrates (corn) in Nebraska. In relative short order we may see other such products moving us in a transition from hydrocarbon to carbohydrate feedstocks for a range of chemicals.

In short there is a good deal of promise that we may be able to shift our liquid fuel consumption toward renewable fuels that radically reduce our reliance on oil products. A key policy step to enabling liquid fuel choice is to ensure that most new cars are flexible fuel vehicles, cars that can run on any combination of gasoline and alcohols such as ethanol and methanol. Every car sold in the U.S. is required to have seatbelts and airbags; similarly, every car should enable fuel flexibility, a feature which adds less than $100 to the manufacturing cost of a vehicle and provides a platform on which fuels can compete.

Materials and Other Fuel Efficiency Steps

There are a range of fuel efficiency steps that can be undertaken. I will mention here only one: constructing vehicles with inexpensive versions of† the carbon fiber composites that have been used for years for aircraft construction. This can substantially reduce vehicle weight and increase fuel efficiency while at the same time making the vehicle considerably safer than with current construction materials. This is set forth thoroughly in the 2004 report of the Rocky Mountain Instituteís Winning the Oil Endgame (ìWTOEî).† Aerodynamic design can have major importance as well.† Using such composites in construction breaks the traditional tie between size and safety.† Much lighter vehicles, large or small, can be substantially more fuel-efficient and also safer. Such composites have already been used for automotive construction in Formula 1 race cars and BMWs, Corvettes, and other high-end automobiles. Adoption by automobile manufacturers for wider use is underway. The goal is mass-produced vehicles with 80% of the performance of hand-layup aerospace composites at 20% of the cost.† RMIís investigations suggest that such construction is expected approximately to increase the efficiency of a normal hybrid vehicle by something in the range of 70 per cent without increasing manufacturing cost.† (WTOE 64-66).

A Portfolio of Programs and Criticisms Thereof

None of us is wise enough to be able to tell today how quickly and affordably, say, battery improvements will occur compared with progress in the production of bio-butanol, or when it will be more economic to produce family cars from carbon composites than to spend the marginal dollar on improving consolidated bioprocessing for cellulosic ethanol. This sort of decision is best made by the market, once access to it has been made possible. Indeed, as with the familyís investments, the nation is better off

putting stock in a portfolio of approaches rather than looking for any single solution. The search should not be for a platinum bullet such as hydrogen fuel cells but rather for a number of pieces of silver-plated buckshot.

Indeed I believe that the principal effort of the federal government on these issues should be to remove market barriers to entry for transportation programs such that oil, as a strategic commodity, sees vigorous competition. These steps will, if undertaken wisely, help introduce Americans and others sooner rather than later to practical alternatives in their daily lives ñ the ability to choose rather than the requirement to take what OPEC decides to give us.

Critics of Moving Away From Dependence

Broadly speaking there seem to be four main types of critics of developing a portfolio to move away from oil dependence.

The first, more or less characterized by a recent report by the Council on Foreign Relations, seems to be driven by a concern that in seeking to move away from oil dependence we will do foolish nationalistic things. For example, the report states that ì[t]he voices that espouse ëenergy independenceí are doing the nation a disservice by focusing on a goal that is unachievable over the foreseeable futureÖ.î But virtually no one who is working to reduce dependence on oil has as his objective a simple switching of buying patterns (e.g., we buy more from Canada and Mexico, Europe buys more from the Middle East); this, of course, would have no major effect on the essentially world-wide oil market. Nor are those who wish to reduce dependence fixated on achieving at any cost total energy autarchy ñ the straw man the report creates, then argues against. The American people have met difficult challenges before ñ there is no reason not to use our capacity for technological innovation to reduce our oil dependence decisively while at the same time avoiding fantasies of finding single perfect solutions. The Council Report amounts to telling someone afflicted with alcoholism that he needs to remember that a glass or two of red wine a day would be good for his health. There is truth in the point, but itís not the main thing he needs to fix right now.

The second type is a few car buffs who have not kept up with battery technology and are somehow infuriated at the suggestion that electricity could be a useful and effective method of fueling transportation in place of gasoline. It is indeed difficult to rev loudly a car using electric drive ñ it just persistently stays quiet. If performance is the objective, however, the acceleration of which an electric motor is capable can be quite remarkable. The new Tesla all-electric roadster advertises zero to sixty in 3.95 seconds. Iíve driven it. Itís true.

The third type of critic apparently prefers paying oil producing states in the hope that they will not generate terrorists rather than giving tax credits for producing alternative fuels in the US. For example, recently in the Milken Institute Review Messrs. Jerry Taylor and Peter Van Doren wrote that they didnít want to see greater use of alternative fuels lead to ìsmaller producer-state subsidiesî to the ìyoungî and ìunderemployedî of oil-exporting states since ìreduc[ing] revenues flowing to Islamic terrorists might perversely increase the recruitment pool for Islamic terroristsÖ.î This might be called the ìBillions for tribute, not one cent for oil alternativesî approach.

Finally, there is the new Satanism school. Writing in the Wall Street Journal columnist Holman Jenkins recently accused me personally of ìsurrendering [my] soul

upfrontî and ìrushing into a devilís bargainî by praising the use of ethanol rather than oil products, and then again that ìSatan will insist on his dueî even though I urge moving from corn to cellulosic biomass as a feedstock. I was really shocked at this allegation ñ not about me, since I would honestly have to plead guilty to at least second-degree ethanol support, but I was surprised to see Mr. Jenkins link the Devil to ethanol, even outside the context of excessive recreational ethanol consumption. So I communicated to Mr. Jenkins that I had given him a call and the Devil had assured me that it wasnít true: ìIím totally,î he said, ìinvested in geothermal.î

Legislative Programs

There are two that I wish to mention.

The first is that of the National Commission on Energy Policy.

The Commission, of which I am a member, is a bipartisan group of energy experts that first came together in 2002 and issued a comprehensive set of consensus recommendations for U.S. energy policy in December 2004. (full report at www.energycommission.org) The Commission is supported primarily by the Hewlett Foundation with support from several other private, philanthropic foundations. The Commissionís ideologically and professionally diverse 21-member board includes recognized energy experts from business, government, academia, and the non-profit sector.

Our final recommendations, which are described in our 2004 report, Ending the Energy Stalemate, were informed by intense discussions over several years, by dozens of analyses, and by extensive outreach to over 200 other groups. Those recommendations, I should stress, deal with a comprehensive set of energy policy issues including climate change, our nationís dependence on oil and the need for increased investment in new energy technologies and critical energy infrastructure. Two years later, although Congress passed major energy legislation in the summer of 2005, concerns about oil security and climate change continue to grow more urgent. The Commission has continued to explore options for meeting these central energy challenges. Just yesterday, the Commission issued an updated suite of recommendations focused on addressing the demand as well as supply side of the oil security equation as well as advancing a timely response to the problem of global climate change.

Focusing on the Commissionís views of the achievements necessary in the transportation sector to enhance oil security, the Commission originally called on Congress to ìsignificantly strengthenî and ìsimultaneously reformî the existing Corporate Average Fuel Economy (CAFE) program. It also proposed providing targeted manufacturer and consumer incentives to accelerate the deployment of advanced vehicle technologies and to address the competitiveness concerns of the U.S. auto industry. I am glad that we made these recommendations, but I was always disappointed that we couldnít pick a number in 2004.

A little over two years later, I am very pleased to announce that Commission is now calling for establishing a 4% per year fuel-economy improvement target. Despite promising advances on the technology frontóincluding substantial progress in developing vehicles, such as hybrid electric and plug-in hybrids, that could radically reduce gasoline consumption per mile traveledóI believe that improving the efficiency of the nationís light-duty vehicle fleet remains an important and as-yet-untapped area of policy

opportunity for reducing oil dependence and making the nation more energy secure. Further, it is an enabler for other positive steps such as a rapid transition to plug-in hybrids and flexible fuel vehicles (FFVís).

In addition to strengthening CAFE, I would urge on the Commissionís behalf that Congress establish a five to ten year tax incentive program for manufacturers and consumers to encourage the domestic production and purchase of plug-in hybrid, hybrid-electric, and advanced diesel vehicles that achieve superior fuel economy. Cost is always an issue, of course, in the Committeeís deliberations. I would only note that, in view the over-300-billion-dollar debt that we are incurring annually for oil imports, each billion dollars marks about a day of borrowing. Each day that we replace oil imports with domestic production of an alternative thus roughly equates to 10,000 or more potential new American jobs. Thus a $ 3 billion tax incentive program would be a major step, and the funds would of course have to be found for it. But in the overall context, it is only the equivalent of three days of oil imports as we attempt to satisfy our nationís 250-barrel-per-second appetite for oil.

The effect of encouraging a portfolio of approaches to destroying oilís role as a strategic commodity is that the programs can work together, and together they can give us a much better chance of succeeding than banking on one. For example, a 50 mpg hybrid, once it becomes a plug-in, will likely get solidly over 100 mpg of gasoline (call it "mpgg"); if it is also a flexible fuel vehicle using 85% ethanol, E-85, its mpgg rises to around 500; if it is made from light, crash-resistant carbon composites its mileage may approach doubling again ñ edging toward 1000 mpgg. Any one, or all, of these technologies may not work out as well as we hope, but a portfolio approach gives us a chance for substantial progress even if this is not the case. Suppose we achieve only 200 mpgg? Still not bad.

With a portfolio approach the market will likely operate to expand sharply the use of these technologies that heavily reduce oil use in the foreseeable future and are already in pilot operation. However, in order to speed their introduction into the marketplace, the government would need to provide targeted consumer and manufacturer incentives to promote their domestic development, production, and deployment. In conclusion, I believe that we need a combination of improved fuel economy standards coupled with the greatly accelerated adoption of transformative vehicle technologies. Incentives alone will not do the job: absent a change in standards, average fuel economy will continue to stagnate so long as gains from more efficient vehicles can be offset by a larger market share for less efficient models. As the Commission and I have argued in the climate and national security contexts, a combination of regulation and incentives is likely to be more effective than either approach in isolation because it generates a simultaneous market pull and market push for new technologies.

I have also appended to this testimony a point sheet setting out the provisions of the DRIVE Act, titled the Vehicle and Fuel Choices for American Security Act in the 109th Congress and re-introduced in the 110th Congress by Congressmen Engel, Kingston, and 77 other Representatives, including four Members of this Committee: Representatives Inslee, Cleaver, Hall, and McNerney. Among the important steps this legislation, based on the Set America Free Coalitionís Energy Security Blueprint, advances are: a national oil savings target of 2.5 million barrels per day by 2015, increasing over time; programs that increase fuel choice in transportation; and federal

manufacturing retooling incentives for producing efficient vehicles and the authority to set efficiency standards for tires and heavy duty trucks.

A key policy step to enabling liquid fuel choice is to ensure that most new cars are flexible fuel vehicles, cars that can run on any combination of gasoline and alcohols such as ethanol and methanol. Every car sold in the U.S. is required to have seatbelts and airbags; similarly, every car should enable fuel flexibility, a feature which adds less than $100 to the manufacturing cost of a vehicle and provides a platform on which fuels can compete.

A Surprising Coalition

You have not asked me to assess the domestic political dimensions of this issue, and such is far from my expertise. I would only conclude by noting that I continually find it interesting that there seems to be much more consensus on what needs to be done in moving decisively to reduce oil dependence than on the reasons for doing so. In broad terms the approach suggested above ñ using a combination of regulatory and market mechanisms to remove barriers to the use of oil alternatives, including electricity, and to promote the development and commercialization of a portfolio of such renewable technologies ñ can obtain, I believe, substantial support from a potentially rather wide coalition.

There are a number of reasons individuals come to be interested in moving the US (indeed the world) away from oil dependence. Some are interested in protecting the environment, including of course from climate change. Some are struck by the impoverishment of developing countries, a condition substantially exacerbated by oil debt. Some are particularly interested in improved prosperity for rural America, and indeed moving increasingly toward a carbohydrate-based, rather than hydrocarbon-based, economy for transportation and chemicals. Some are focused on the order-of-magnitude reduction in driving costs that can come from electricity. Some are especially worried about our increasing dependence on the Middle East for oil and resentful at the use to which an important share of the Middle Eastís oil earnings are put. Some are excited at the prospect of innovation in this field creating economic opportunities. Some in the business of providing electricity see the opportunity for reduced costs and increased earnings. Some believe that the Bibleís injunction that we should both care for the planet and see that it is used for human benefit points us generally in this direction. And some are simply struck by a sense of commitment.

With no disrespect intended, especially since I personally see merit in all of the above arguments, I have called this in the past a coalition of the tree huggers, the do-gooders, the sod-busters, the Mom and Pop car owners, the cheap hawks, the venture capitalists, the utility shareholders, the evangelicals, and Willie Nelson.

But what is interesting is that, as long as the basic criteria that our transportation be secure, have low emissions, and be affordable are kept in mind any one of these arguments suffices. So it is not necessary that people agree about the reasons for moving sensibly but decisively to reduce oil dependence, merely that each, for his or her own reason, is willing to work toward the same end.

Post-Script: A Further Evolution in Security and Low Emissions

Today electricity production and transportation fuel demands have little to do with one another. Unlike the 1970ís, when around 20 per cent of our electricity was

produced by oil, today only 2 per cent is so produced. So substantial changes in the way we produce electricity ñ with renewables or nuclear energy, for example ñ donít really affect our oil use.

We have seen above how the coming of plug-in hybrids can to a substantial extent replace gasoline with electricity as a fuel and that, for some time, this will put little added demand on electricity production because of the use of off-peak power for these purposes and the use of V2G.

There is a further development on the horizon, however, of which we should be aware. The security of the electricity grid requires attention. In addition to its heavy use of coal (without carbon capture and sequestration), a condition that contributes heavily to global climate change emissions, the grid has substantial security problems.

Three and a half years ago, for example, a tree branch fell in a storm in Ohio and the cascading grid failures quickly took about 80 gigawatts, the equivalent of eighty nuclear power plants, off line. New York, New England, and Eastern Canada were without power for over a day. As we require more and more from the grid, and refuse to build enough transmission lines, we contribute substantially to the gridís vulnerability. Whether it is resistance to electricity generation (such as wind farms), or resistance to power line construction we have almost gone past ìNot In My Back Yardî (NIMBY) to ìBuild Absolutely Nothing Anywhere Near Anythingî (BANANA). Also, our fragmented regulatory system hinders security measures. A National Research Council study in 2002 on which I served, and a number of other reviews as well, have pointed out grid vulnerabilities, including unprotected transformers and the easily hackable SCADA (Supervisory Control and Data Acquisition) control systems.

The point is that with the current grid tree branches are bad enough, but terrorists are much smarter than tree branches. They would know what parts of the grid to attack (much of this is, sadly, on the internet ñ this is a subject about which the US is, perhaps to our peril, quite open), and could produce outages lasting months not just days.

So, in addition to taking steps to improve grid security such as requiring the stockpiling of transformers and other key components and better protecting the SCADA systems, we need to build resilience into the grid by generating our own electricity when we can.

Fortunately the technology of both distributed solar generation (thin film, then nano-solar at the site where the electricity is used) and distributed roof-top wind generation that can operate in a light breeze are coming along, and costs are going down. Wind tends to blow at a different time of day than the sun shines, so distributed wind and solar operating together, with new technologies that can lower costs, show real promise. For example just last week I saw a solar electricity-generating blanket being assessed by the US Army. It is about the size of a pool table top and, once spread on the ground in the sun, generates about a kilowatt of electricity within five minutes. Several of these would power the needs for light, refrigeration, and communications within a home that was using electricity frugally (e.g. the right kind of light bulbs, and not too many turned on).

Especially when distributed wind and solar are combined with battery storage, say in the basement of a home, we are not that far from many residences and other buildings being able to generate a portion of their electricity needs themselves. Today if a tree branch or a terrorist takes out a major segment of the grid, once we have used up any

available diesel fuel for diesel generators we are back in the 19th century. But before too many years we may be in a position to have such an outage, for many of us, affect only, say, our homesí air conditioning. Losing air conditioning can be bad, but being shoved unceremoniously back into the nineteenth century would be considerably more bracing.

Finally, the advent of plug-in hybrids will affect these distributed-generation possibilities as well. If part of what I am replacing with the electricity generated on my roof is gasoline (by charging my plug-in hybrid), the overall security, efficiency, and lowered emissions of my evolving home electricity system could be quite promising.

There are some interesting opportunities coming if we will but grasp them.

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