

Senate Foreign Relations Committee Hearing
Testimony of Vinod Khosla
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Good Morning. Chairman Lugar and esteemed members of the Committee, I want to start by thanking you for allowing me the opportunity to speak to you today about our unique ability to secure America's energy independence. Since the President's State of the Union address and rising prices at the pumps, there has been a lot of talk about our oil addiction. I come here to talk not about what must be done but rather how to get it done, simply and pragmatically, in a manner aligned with the major political interests that carry clout in this country. We can not only do the right thing, but also the politically correct thing, if each interest group compromises a little.

If it were not for the rapid growth of our domestic ethanol industry, Americans would see gas prices approaching \$4 a gallon with no real alternative or hope in sight. In comparison, the Department of Energy estimates ANWR drilling would save 1 cent per gallon at the pump by 2025. (As quoted in *Fortune* May 15, 2006) We could be the architect of a global development plan, a Marshall Plan for our times that would support technological advancements and sustainable development of a global alternative to petroleum...and best of all it takes very little money to do so.

I come to you today with ambitious goals, but goals that are grounded in sound science, technology and business. I am convinced that we can replace the majority of our petroleum used for cars and light trucks with ethanol within twenty-five years. This is not an alternative fuel – it can be a mainstream fuel. More importantly, with a few simple policy changes, we can be irreversibly traveling down this path in less than 7 years.

You may ask, "why ethanol?" Ethanol is substantially cheaper to produce today than gasoline before all subsidies and taxes. For example, the cost to produce ethanol in Brazil is less than \$0.75 per gallon, while a US-based corn-to-ethanol plant's production costs are roughly \$1.00 per gallon. That equates, even with US costs, to about \$1.25 per "gasoline-equivalent" gallon of ethanol. Gasoline, on the other hand, costs \$1.60-\$2.20 or more per gallon to produce, depending upon the cost of a barrel of oil.

Why shouldn't ethanol sell for much less than gasoline at the pump? Oil interests distort the price to ensure they don't lose their lucrative profit opportunity or temporary supply/demand dynamics. As new technologies ramp up, ethanol can be cheaper than gasoline even if oil drops to \$35-\$40 per barrel – a level it is not expected to reach, according to the EIA. In addition to lower cost, E-85 reduces volatile organic compounds by 15%, carbon monoxide by 40%, NOX by 10% and sulfate emissions by 80% when compared to gasoline, according to an estimate from one environmental organization.

With ethanol, we get a fuel that is cheaper for consumers and automakers, cleaner and greener, and it takes Middle East terrorism-fueling dollars and moves them to rural America.

We capitalize on American technology to create more jobs and cheaper transportation costs for the American public. What is wrong with this picture?

What is the single biggest risk we face from the oil interests distorting the price to ensure they don't lose their lucrative profit opportunity? If you were making \$36 billion of profit per year like Exxon, would you want things to change? Reports of oil company executives lying under oath are reminiscent of the 1985 price manipulation episodes, Enron's energy price manipulation, and other examples, be they Iran, Russia or Sudan. I personally received a warning from a senior executive of a major oil company that they could drop the price of oil if biofuels started to take off. We cannot let this opportunity slip away again.

My friends from the Mid-West tell me ethanol is the talk of coffee shops there and may be the most important thing to hit rural America in thirty years. It may also be the most important thing for global peace and welfare, the climate crisis, and for consumers. Fortunately, at this time the environmentalists, the automakers the agricultural interests, the security and energy independence proponents, and even the evangelicals are all aligned. Finally, a cause all interests can rally behind. As Tom Freidman recites a *New York Times* poll: 89% of Americans favor a mandate of more efficient cars; 87% say no to a gasoline tax, but that figure drops to 37% if the tax is to "reduce our dependence on foreign oil" and to 34% if the tax is to "reduce global warming".

The oil interests keep propagating myths like insufficient land, poor energy balance and high production costs to curb enthusiasm for ethanol. This is reminiscent of the tobacco companies funding studies to prove that smoking does not cause cancer. The NRDC, more concerned about land use than the oil interest, estimate a modest 114m acres of land needs. Argonne National Labs and UC Berkley among many others have discounted the energy balance claims. In my opinion, these are bogus if not ill-intentioned claims and I will address these falsehoods one by one.

Crop land: Yields of corn are increasing in the US and Brazil. Brazil has had a 4x increase since 1975 and knowledgeable scientists are forecasting another 4x in the next 10 years. US gallons per acre yields can reach 10x the current levels even without the innovations that are commonplace in Silicon Valley. Based on my forecasts, I can see my way to yields increasing more than 10x to between 3000 to 5000 gallons per acre compared to 400 gallons per acre today, demolishing all land use and energy balance arguments. I agree with Rick Tolman, CEO of the National Corn Growers Association, who believes that corn can provide 14-17 billions of gallons of ethanol by 2015 without impacting food supply. Based on my forecasts, including the considerable upside afforded by technology innovations, biomass based ethanol can replace most of our gasoline needs in twenty years, using less than 60m acres of land.

Energy Balance: The only study that claims corn ethanol has an unfavorable energy balance is an outdated study performed by Professor Pimentel. Both USDA & DOE affiliated researchers claim that Pimentel's 2005 study overstates energy requirements. Professor Kammen at UC Berkley further states that corn ethanol results in a more than 90% reduction in petroleum use and a moderate 10%-30% reduction in greenhouse gases. The NRDC agrees,

stating that: (1) corn ethanol provides important fossil fuel savings and greenhouse gas reductions; (2) cellulosic ethanol simply delivers profoundly more renewable energy than corn ethanol; and (3) very little petroleum is used in the production of ethanol. From this information, the conclusion is that a shift from gasoline to ethanol will reduce our oil dependence.

Though a 25% mileage reduction is the reality today, it can be immaterially small over time as engines are optimized for a flex-fuel world. Saab sells a model in Sweden that adjusts itself to take full advantage of E85's higher octane — 100 to 105, vs. 87 to 93 octane for gasoline. Called the Saab 9-5 BioPower, its turbocharged engine generates 175 horsepower on gasoline and a whopping 215 hp on E-85. (USA Today, 5/4/2006). Even with the additional horsepower, the Saab 9-5 only has an 18% lower mileage on ethanol. If the engine was designed to provide the 175 hp on ethanol, we would get an additional substantial step increase in ethanol mileage. This proves that engines can be optimized for ethanol, thus substantially eliminating the mileage penalty which has been a convenient excuse for the oil companies.

In the US in 2000 the ethanol industry sold about 1.6 billion gallons of ethanol at about \$1.20 per gallon. By 2005, the industry more than doubled its sales to 4 billion gallons, at a price of about \$1.50 per gallon. In my view plants can meet all their cash flow requirements and pay off construction debt at prices in the \$1.30-\$1.40 per gallon range, given a cost of production of roughly \$1 per gallon without subsidies or tax credits. At today's prices of over \$2.50 per gallon, ethanol producers can pay off their plants in just eleven months rather than the standard 7-year payoff period. It is indisputable that ethanol is not only cheaper to produce than gasoline at about \$40/barrel, but also, that the returns can be outstanding. It is disturbing to me to see some factions calling for permanent extensions to the credits, instead of supporting a variable VEETC model, which is genuinely needed to prevent oil price manipulation by interested parties.

We have sufficient land and the energy balances and economics are favorable for ethanol as a transportation fuel. All we need to do is kick start the process!

Chairman Lugar and members of the committee, the time has come for us to ask ourselves: Do we want to feed our farmers or Middle-East terrorism? Do we want ANWR oil rigs or prairie grass fields? Fossil fuels or green fuels? Should we create farm jobs or Middle-East oil tycoons? Gasoline cars or cars that offer the choice of gasoline or biofuels? Expensive gasoline or cheaper ethanol? This appears to be nothing less than a Darwinian IQ test.

Risk capital from investors is the only solution to the oil stranglehold. Three simple things that need a little bit of courage, but not a lot of money are sufficient to get this capital flowing. These three are:

1. Mandate that at least 70% of the new cars sold in America be FFVs by 2014 with 10% annual increases starting with 20% by 2009, and that all such cars, old and new, be provided with yellow gas caps, with possible tax incentives of \$50 per car.

2. Mandate that 10% of all gas stations owned or branded by major gas station owners offer at least one ethanol pump. Alternatively, mandating a separate RFS for E85 and cellulosic ethanol, defined later, would serve a similar purpose. For the first 20,000 stations that convert at least one pump, an incentive can be offered up to \$30,000 per station in the first year, \$25,000 per station in the second year and \$20,000 per year in the third year, the proceeds being appropriated from the Leaking Underground Storage Tank Fund or through a special tax on oil company profits, up to a maximum of \$600m over three years.
3. Make VEETC credit variable with oil price varying from \$0.20 at current prices up to \$0.80 instead of the current \$0.51 credit as oil prices vary from \$70 to \$30 per gallon. This will insure that OPEC or the National oil companies cannot manipulate prices as easily, hence driving ethanol producers out of business. Such credits should expire once ethanol capacity exceeds 15 billion gallons in this country.

These three policies will assure investors that a permanent market will exist for ethanol and will not be subject to price manipulation by the oil nations. Billions of dollars will flow into the ethanol economy creating a permanent alternative to gasoline, without material government funds.

In addition, certain other policies can accelerate the process but are not essential:

1. Shift the \$0.51 blender's credit to an "ethanol producers' credit", preferably to be used only for plant construction instead of giving it to the oil companies as a "blender's credit". This will build permanent US capacity for new ethanol production, independent of whether the ethanol is US-made or imported. In fact, this format will supply all the capital required for plant construction the industry needs to replace all our petroleum and can be structured to be self-effacing when we reach appropriate plant capacity.
2. Allow imports of ethanol for consumption above the RFS standard without tariff, subject to switching the VEETC ethanol credit to one directed exclusively towards building plant capacity in the US. This will create permanent capacity for ethanol production in the US. It is likely that we will see WTO action challenging the tariff's legality. A proactive program is more likely to be effective than a reaction in hindsight to WTO action. Early availability of lower priced ethanol in the market will accelerate the switch to E-85 and take ethanol into the domain of a primary replacement for gasoline instead of just being an additive. Concurrent with this provision the ethanol RFS can be extended to 12b gallons by 2015. Based on the national security exemption of the WTO, an incentive or VEETC like credit is probably allowable if it is directed toward building ethanol fuel plant capacity in the US. An alternative would be to eliminate the tariff only for E-85 ethanol use, accelerating E-85 adoption while keeping the blending market protected against imports. This would allow US farmers to ease the learning curve on ethanol costs. Tariff removal could be coincident with funding of additional E-85 stations.

3. Institute a similar limited period credit for cellulosic ethanol or monetize the current “1.5 times” credit for cellulosic ethanol defined in the 2005 energy bill.
4. Institute separate RFS standards for E-85 (and possibly cellulosic ethanol) to kick start the E-85 market, which is currently being discouraged by the oil companies.
5. Reform and strengthen CAFE, replacing CAFE mileage with CAFE “petroleum mileage” to align and incentivize automakers to promote the use of ethanol and other gasoline alternatives, giving them credit for any technology used to replace petroleum; in addition to increases in mileage standards.
6. Provide loan guarantees for the first few cellulosic ethanol plants built with any new technology.
7. Institute a cap and trade system for carbon trading. This could effectively reduce the price of ethanol by as much as \$0.20-\$0.30 per gallon (based on the current trading price of carbon in the European Union) depending upon the ethanol production technology. This would provide incentives to make corn ethanol greener, and less dependent on fossil fuels.
8. Switch agricultural subsidies from row crops to energy crops.

As oil prices continue to soar in the U.S., I see the following. First, oil companies use big budget advertising, expensive PR firms and armies of accountants to prove they are not making too much money while making more money than any industry has ever made in the history of the corporate world. It is amazing what money can buy.

Second, Oil companies blame everybody but themselves, but more importantly are doing relatively little to invest in alternatives to gasoline, other than token investments and PR campaigns.

Third, they put obstacles in the way of their franchisees who want to offer ethanol instead of offering E85 themselves. Why don't we require them to sell ethanol at least 10% of their gas stations? We have CAFE standards for automakers, why not E-85 green fuel standards for the oil companies?

Finally, with a fraction of their oil profits invested in new ethanol capacity or ethanol distribution we could be producing tens of billions of gallons of ethanol and solving our addiction to oil. Instead they are sending these profits to the mid-east instead of creating jobs in the USA. Are they entitled to their profits? I believe they are. But that should not prevent us from developing alternatives to their stranglehold on our transportation fuel for the good of society. Here are some examples of why it is clear we need to reign in big oil:

1. Gov. Pataki proposed a new bill in New York. The bill would exempt renewable fuels from the provisions of “exclusivity” contracts between fuel providers and retail service stations, which only allow the service stations to sell specific brands of fuel. In most cases, these brands do not include renewable fuels. Since the “exclusivity” contracts

prohibit service stations from obtaining renewable fuels like ethanol (E-85) from other sources, these fuels are not available for sale to consumers. The Governor's proposal would exclude renewable fuels from these contracts if the distributor does not offer these types of fuels.

2. A Mobil gas station in St. Louis does not allow the use of credit cards for payment and warns against ethanol. This is typical of how oil companies discourage consumer use with scary notices. An Exxon in Brazil stated that for all flex fuel vehicles every third fill up should be with gasoline, another falsehood!
3. The Foundation for Consumer & Taxpayer Rights released a new study of rising gasoline prices in California that found corporate markups and profiteering are responsible for spring price spikes, not rising crude costs or the national switchover to higher-cost ethanol, as the oil industry claims. One can find the study at: <http://www.consumerwatchdog.org/energy/rp/6132.pdf>
4. The 1985 price manipulation & re-coupling of an economy that was decoupling from oil is well known.

Gaining independence from foreign oil would not be unique to the US. I just recently returned from Brazil, which has declared independence from foreign oil. Let me share some insights with you.

I got a very instinctive good feeling about carbon capture. As I looked at sugarcane varieties capable of producing 200 (wet) tons per hectare I could imagine the sound of carbon dioxide getting sucked out of the atmosphere. My estimates of less than 60 million acres required to fuel most of America's cars and light trucks by 2030 started to feel conservative as I saw Brazilian entrepreneurs developing technologies to produce over 3000 gallons per acre. Imagine what would happen if we let Silicon Valley entrepreneurs and American scientists and technologists innovate in this area! Some fraction of the land used for export crops could replace much of our gasoline needs. We must signal to our innovators that this is a long term, large market, as Brazil has done.

As I saw bagasse roll off the conveyor belts into heaps of waste for burning, it struck me that because of the preprocessing already done on this waste material it could produce cellulosic ethanol very soon. Even today's semi-developed cellulosic ethanol processes could make economic sense without waiting for full development. Orange peels from Florida and wood chips from our Northwestern forests would be next in line.

It became clear that America, Brazil, Australia, India, and Africa could each produce enough ethanol to meet their local gasoline replacement needs and then export enough to serve much of the planet.

It was surprising to learn that the average wage at Cosan, the largest Brazilian ethanol producer, was many times the average for similar industries in Brazil. Over a million jobs had been created in the ethanol economy in Brazil. Ethanol produces substantially more jobs per dollar invested than oil does.

Almost astounding was the claim by some entrepreneurs that they could see technology driving costs well below 50 cents per gallon. There is no reason US ethanol production costs won't come down too. The big manufacturers confirmed their ability to produce ethanol at below 75 cents a gallon today. Why are we paying over three dollars a gallon for our gasoline?

If ethanol supplies run low Brazilian producers can switch production in hours away from sugar to produce more ethanol. Consumers constantly switch back and forth between ethanol and gasoline based on cost and availability. Wouldn't it be nice if consumers here had a choice and were not held hostage by oil companies?

It was embarrassing to see Brazilian experts laugh at the myths US energy companies spread, like we cannot use the same storage tanks or tanker trucks or transport ethanol in pipelines. They have been doing this for years with no adverse consequences. Why do we let people interested in slowing down biofuels spread these myths by turning molehills into mountains? Surely, some issues exist but they are easily resolved in the context of a market as large as the transportation fuels market. I was passionate about ethanol before I went. Going there seemed to completely confirm the potential and opened my eyes to all sorts of new possibilities.

Finally, I will leave you with some thoughts on why now is the time to take action. We have a climate crisis, we have an energy crisis, and we have a terrorism crisis and they are all coupled. The price of oil is up, the cost of ethanol production is down and we have a visible climate crisis and an overwhelming terrorism crisis. Economics and the right thing coincide this time around. Consumer pull has been proven in Brazil. Our risks are minimal. According to the firm Expansion Capital Partners, clean, or green, technologies netted less than 1 percent of venture capital funds six years ago. Today, however, the figure has risen to 8 percent, the firm told TechNewsWorld. (<http://www.technewsworld.com/story/50076.html>) Recent news reports that the U.S. insurance industry has decided to formally study the relationship of global climate change to rising insurance costs and availability concerns.

Geopolitics & OPEC politics deserve a special mention. Venezuelan president Hugo Chávez is poised to launch a bid to transform the global politics of oil by seeking a deal with consumer countries which would lock in a price of \$50 a barrel, according to the Monday April 3, 2006 issue of "The Guardian". A long-term agreement at that price could allow Venezuela to count its huge deposits of heavy crude as part of its official reserves, which Caracas says would give it more oil than Saudi Arabia. A \$50-a-barrel lock-in would open the way for Venezuela, already the world's fifth-largest oil exporter, to demand a huge increase in its official oil reserves - allowing it to demand a big increase in its production allowance within OPEC. Venezuela holds 90% of the world's extra heavy crude oil - deposits which have to be turned into synthetic light crude before they can be refined and which only become economic to operate with the oil price at about \$40 a barrel. Newsnight cites a report from the US Energy Information Administrator Guy Caruso suggesting Venezuela could have more than a trillion barrels of reserves.

Saudi Arabia's oil minister scorned the popular notion that America can achieve energy independence as a myth (SF Chronicle, May 3, 2006)

Iran, China, India, Sudan, Nigeria, Venezuela, Argentina, and Bolivia are all responding to the scramble for oil. Rules and principles go by the wayside given the urgency of energy needs for each nation.

Asset valuation – increase in Venezuela and Saudi Arabia (each) asset values of over a trillion for every \$4 rise in the price of a barrel of oil. According to press reports, for similar reasons, the US oil companies have resisted inventory re-valuation methods proposed by FASB.

I came to you today with ambitious goals. I hope that you too are convinced that we can replace the majority of our petroleum used for cars and light trucks with ethanol within twenty five years. More importantly, with a few simple policy changes, we can be irreversibly traveling down this path in less than 7 years and achieve energy independence, reduce greenhouse gas emissions and create more jobs for rural Americans. I thank you for your time and attention.