



Vinod Khosla at Milken Institute: Interview Excerpts

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Vinod Khosla (VK) recently did a lengthy interview at the [Milken Institute 2009 Global Conference](#). The interview was conducted by [Elizabeth Corcoran](#) (EC) of Forbes. You can see the video of the interview here:

[Milken: Khosla on the Shift to Renewable Energy](#)

These are excerpts from a transcript I put together from the recording. You can read the entire transcript (in three segments) on my [R-Squared Energy Blog](#). I have labeled my comments with RR.

EC (13:40): In the past 90 days we have seen something like a billion dollars being put into solar investments - whether in the form of equity or debt. Is that stupid money?

VK: The people who are putting in gobs of money, behind people chasing First Solar at billion dollar valuations - I won't say it's stupid but it's not something I would do with my money. (EC: That pretty much counts as stupid). A diversity of opinion is good. I am often wrong. (EC: Sometimes you are). You only need to be correct once in a while because in our business you only lose one time your money but you can make 100 times quite easily. I don't have to be very right.

(RR: I would like to hear that during his next congressional testimony where he is trying to drive the direction of energy policy: "I am often wrong." But this also gets to the heart of why I often object to what he is saying. If he uses his high level of influence to help put us down the wrong path on energy policy, then what are the consequences of being wrong? They could be severe.)

EC (14:38): How many companies do you currently have in your portfolio?

VK: Our clean tech portfolio has probably about 50 companies.

EC (15:48): Which was the biggest disappointment?

VK: We have not had any large cut-offs - I am trying to think - in our clean tech portfolio. When we have invested a lot of money, there's one or two places - well one we wrote off; one called [Altra](#). (RR: *Altra is a corn ethanol producer that is on the ropes*). There's one place we actually decided to change the plan - [Cilion](#) - and made it capital neutral, so they don't need a lot of cash. Got rid of the debt; the company is going fine, but sort of on the slow boat.

(RR: When Cilion was formed in 2006, they announced they would have 8 plants in operation

by 2008 and achieve an energy return of better than twice that of gasoline. Here in 2009 they have zero plants in operation. The formation of the company included much fanfare, such as this quote from VK: "**Cilion will be able to single-handedly produce all of the ethanol that the Governor has ordered for 2010 [900 million gallons], based on current consumption.**" So far, they have proven to be nothing but a money pit. So what if California had counted on that ethanol? These are the dangers of having someone unduly influencing energy policy and being "often wrong.")

EC (18:03): Last fall you said project finance was not an area you want to be headed into. Talk a little bit about where you see cellulosic ethanol going, and isn't that an area where you have been involved with project finance?

VK: It depends on what you call project finance. Cellulosic technology is something I am very interested in; I actually think it's the only thing that can replace the oil; I am fairly confident that within the next 5 years it will be cheaper unsubsidized than oil at \$50, \$60 a barrel.

(RR: *I would like to see the math on this. It's amazing that someone can believe this, despite there not being a single commercial-sized cellulosic ethanol plant in existence.*)

EC (18:48): Let's look at some of the numbers. You don't like plain ethanol, right; the kind that comes from corn and soy?

VK: Right. To be fair to the corn guys, they served their purpose. I have said for years that they are a good stepping stone. This is important. I will tell you a funny story that really makes a lot of sense. About two years ago, we said that corn ethanol would be a good stepping stone; they have raised a lot of visibility; there's a lot of pumps; cars are flex-fuel capable. It helped set up the infrastructure. The economics of corn will not work long-term relative to cellulosic.

EC (20:38): From your point of view, it's the 2nd generation ethanol (VK: Absolutely) that's going to make the most sense. What's had to go into that is a lot of biotech engineering, finding microorganisms that can efficiently convert. (VK: Sometimes, not always) Finding fuel stocks that will be cheap enough, whether you get them from trees or other brush or winter crops and so forth. Take us through the numbers. Where do the prices have to be in order to make that work, and what happens if oil declines in price? What happens if it gets down to \$30/bbl?

VK: What I would say is that unless there's a competitor to oil, I don't think oil is going to \$30/bbl. (EC: Even though [John Doerr](#) was in the Middle East, and people told him, "John, it's going to \$30/bbl?") I won't speak for John. When we plan for unsubsidized market competitiveness, we plan on \$50 oil. I suspect the price will be much higher, especially when economic growth resumes. And whether it's higher in a year or five years doesn't matter as much. Not only that, the problem isn't oil anymore, it's a carbon constrained world. And we are going to have legislation on that. It doesn't matter whether the science of climate change is right or wrong. Assume for a moment that we discover over the next 10 years that climate change science is wrong, and we don't have a climate change problem - not something I believe. We will still end up with legislation in the next five years. So, at this point it is fait accompli; it's going to happen.

EC (22:50): Doesn't that amount to government subsidies?

VK: No it doesn't. If you dump your wastewater into the river, is it a government subsidy if they require you to clean it up? In fact the nuclear industry is the one that's subsidized. They say we'll take your toxic waste, the government takes responsibility and subsidizes them. There is not a chance that you [nuclear] can compete in the market unsubsidized. Even if it had the toxic waste

subsidy where they took waste off, you still couldn't compete at market interest rates. There's not a viable nuclear plant at 15% IRR or 15% debt, which is what the solar guys contend with. It's only because of 5% loan guarantees from the federal government that keeps nuclear in business.

EC (24:30): Come back to the tax on carbon, though, because there will be a tax. Right? (VK: Yeah). What do you predict that legislation is going to be?

VK: I suspect...look it's hard to predict politics...I suspect it won't happen this year it will happen next year. Many people are pushing to have it before Copenhagen this year. I hope we do. There is a 50/50 chance the House can pass a bill by summer. The Senate will take longer, and it will get stuck in the Senate. Anyway, my expectation is that next year we will have a carbon cap and trade.

EC (25:30): Do we know enough about how to make cap and trade work? Isn't that market just an opportunity for fraudsters to come in?

VK: Any market will have fraudsters to begin with. Will it take 10 years to get a system in place where there is not too much fraud? Yes. (RR: *And during those 10 years another administration can come in and dismantle the whole thing*).

EC (39:00): Let's get to those electric cars. You don't like the Prius.

VK: Let me be clear, and I am going to sneak in my [Black Swan](#). I do drive a hybrid, but not a Prius. I drive a Lexus hybrid. Hybrids are an uneconomic way to reduce carbon dioxide. If you go to hybrids or electric cars, your cost of carbon reduction is about \$100/ton. If you have 10 ways of reducing carbon at \$50/ton, why would you spend \$100? My beef is not with hybrids; we are investing in hybrid batteries; there is a good market and we can make money at it. But do I believe it's going to solve the climate change problem? No. (RR: *None of the things that have been discussed are going to significantly rein in carbon emissions.*) Save yourself the five grand, and instead paint your roof white. You will save more carbon that way.

(RR: *He cited this paper by Art Rosenfeld at Lawrence Berkeley Lab: "[White Roofs Cool the World, Directly Offset CO2 and Delay Global Warming](#)".*)

(RR: *VK then explains his problem with electric cars, and says lithium ion batteries are too expensive, are limited by electrochemistry, and will be for a long time. I would say that while VK seems to have a clear picture in his head on the issues with batteries, he suffers from a blind spot about similar limitations of cellulosic biomass. He then cites all of his investments into different areas, and concludes that sheer numbers mean something is going to work.*)

VK: The chance that each approach will succeed is small. The chance that all of them will cumulatively fail is vanishingly small. Mark my words: Vanishingly small, and that's why we will have unsubsidized market competitiveness with fossil fuels. And the fossil fuel guys won't know what hit them. I don't see how by 2030 oil can compete. That's why I think by 2030 oil will go to \$30, because it will be the alternative cost of marginal technologies.

(RR: *I think he truly believes this. Yet it shows a failure to grasp issues of scale, biomass density, logistical challenges, and much more. If it were merely a numbers game, we could solve any technology problem by just throwing enough money at it. But there are fundamental issues here regarding biomass that will never - mark my words - never allow it to be produced for \$30/bbl. Sugarcane ethanol, yes, can be produced for that in Brazil. But you will never turn cellulosic biomass into a liquid fuel, at scale, for \$30/bbl - for the same kinds of fundamental*

limitations VK mentions for batteries.)

EC (47:40): So by 2030, what will be the primary fuel?

VK: I have a paper on my website that postulates about a technology race between biofuels and batteries. Whichever one makes the most rapid progress will get the larger percentage of the total passenger miles driven in the world.

EC (48:30): Does government risk factor in? There has been a cautionary tale in biodiesel, where there has been great interest, lots of money pumped in, and yet due in part to vagaries of how the environmentalists and government regulations have crashed into each other, you have got more than 100 biodiesel fuels (RR: Biodiesel plants, I presume?) around the country, none of which are producing fuel.

VK: You know, that's true, but you also have bankrupt financial companies. Look, failure is the natural mechanism of capitalism. But you are right. There is government risk. But we fixed a lot of that last week when the [Low-Carbon Fuel Standard](#) passed. It will force the right decisions looking back.

EC (53:25): I am going to open it up to questions in a minute, but one more question from me. Let's go back to nuclear for a minute. Aren't there Black Swans in the nuclear industry? (RR: *I was thinking the same thing earlier; Black Swans only appear to have been considered by VK in very specific situations. A positive Black Swan is going to make some of his technologies successful, but he seems to discount any positive Black Swans from other sectors*).

VK: There probably are. In fact, Bill Gates is funding one. The problem with nuclear, I think, is different. Because of the [NRC](#), it takes 20 years to build one. And I have to give them \$100 million to approve every step of the process. The problem with nuclear is that the innovation cycle is very long. If I am building a nuclear plant, I think of something, 20 years later I build something and see how it performs. If I am building a solar thermal plant, six months later I change my manufacturing line. I can even do it half way through building a power plant.

EC (54:40): And if you are building an ethanol plant, two or three years later it's ready.

VK: Yeah, though every six months people plan on changing the bug in their plant. Every six months you change the bug. Keep evolving it, improve the efficiency. The cycle of innovation - how long it takes - is a really important metric for judging how effective a technology will be in getting to market.

Q3 from audience (57:20): With respect to cellulosic ethanol, this question of [indirect land use](#) that has ended up in the standards; do you think that will continue?

VK: It's a fairly complex issue; the science is very uncertain. I think it is figured into the California Low Carbon Fuel Standard. The end result is a reasonable compromise. It's also something that is fairly uncertain right now. I think the California Air Resources Board (CARB) came up with something that's a reasonable answer on indirect land use impacts. The corn ethanol guys wanted to have zero. They didn't get that, so they are now complaining in Washington. I think CARB could have phased it in more slowly because the numbers are so uncertain, so I would not agree 100% with CARB. But I would agree 90% with them.

Q4 (59:10): That's corn. How about cellulosic?

VK: I think cellulosic should be measured the same way, but I think the impact will be fairly

small, and over time it has the potential to be the biggest opportunity to sequester carbon in the soil. I don't want to get into the details - there are papers on my website about this - but it is possible to change agronomy practices to raise biomass and sequester carbon at the same time. It is the annual crops, where you till up the soil ever year, that you have a problem. Perennial crops, and sugarcane is such a crop, you have a much better chance. Also, a lot of cellulosic crops can be grown without a lot of water and on marginal lands.

EC (60:20): So the amount of land we would need, if we were to truly replace gasoline, how much land would we need?

VK: Under optimistic scenarios we need zero land in this country to replace all of the gasoline in this country. (RR: He referred to this paper - [Where Will Biomass Come From?](#) - on his website for a detailed explanation). Look, this is really important. We can't do linear extrapolation of the past. (RR: Because it doesn't give the desired answer). If we do, we are sure to fail. We have to do things a new way. The best way to predict the future is to invent it, not extrapolate the past. (RR: Audience starts to applaud). And this is a fundamental difference.

Thank you all very much.



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