Interview with Ikhlaq Sidhu

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Ikhlaq Sidhu is the founding director of UC Berkeley's Center for Entrepreneurship & Technology and the "2009 Emerging Area Professor" of Industrial Engineering and Operations Research at UC Berkeley. He is an authority on the process of innovation and technology management. Dr. Sidhu has held senior executive positions at several companies including U.S. Robotics Corporation, 3Com Corporation, and Cambia Networks. In 1999 he was the recipient of 3Com's Inventor of the Year award, and holds over 50 US patents in networking technology, IP telephony, and PDA functionality. Dr. Sidhu received his bachelor's degree in Electrical and Computer Engineering from the University of Illinois at Urbana-Champaign, and his masters' degree and doctorate in Electrical Engineering from Northwestern University.

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BSJ: Could you give a brief description about the Center of Entrepreneurship and Technology and talk about what the program is all about?

Sidhu: This is a center that's located in the College of Engineering. It was started in 2005 and the mission of the center is to educate engineers and scientists primarily, although we tend to get students from really all over the campus, including the business school and chemistry just, you know, broadly. But it is to educate engineers and scientists to be able to innovate, to lead and to commercialize technology, and we say it in a global economy. One thing that I've told people before is that all engineers and scientists want to innovate—nobody wants to fix old things, everyone wants to build new things—that's kind of why you go into the profession. But just innovating or thinking of new things by itself isn't enough, and there's other skills that you need along with this interest in innovating that lead to practice, that lead to whatever it is that you want to do actually becoming some sort of reality. In part, that includes explaining to other people what you think is worth doing and why you think it's a good idea and getting them to agree with you and to help you, and that's really what leadership is about. So it's innovating, leading, and then of course what you can do with technology, or what you can do with your ideas is so much more scalable if you can leverage the resources of investors because it's one thing just to build something, but it's another thing to build on all the finances and money that comes when you happen to hit something that

many people actually want. And then finally, the global economy piece is because that's just more and more a part of everything that happens today. So we have three big things that we work on, the question is how do we do those, if that is our mission, how do we do it? One thing, of course, is teaching, so that's maybe the most obvious or the one that you can find about the center most easily. We have something on the order of about eight courses and many of them are short electives, but there are a couple of core courses, which are very interesting. Our Distinguished Innovator Lecture Series is one of them, and then this core class on Engineering Entrepreneurship. We have literally hundreds of students, over five hundred students that take these courses in any one given year. It's something that there's a great demand for, so that's one category, just what we do with teaching. In terms of principles with teaching, we try, whenever possible, to bring in the best possible guest speaker for any given situation. If we're teaching a course on market or market promotion or market entry and you're going to do a case study of TiVo because that's a famous case having to do with this topic, quite often, we'll bring in somebody who's the executive vice president of marketing from TiVo. So you can do the case, but there's really any substitute from then having somebody who was either from the case or somebody from the same company to complement that. You can do that whether you do it with a case or whether you do it just otherwise on any given topic. You can always think of who the best possible person that you can bring in and Berkeley is such a good school that when you invite people, they will tend to come and share whatever they know if they possible have the time, they will. And so, that's been kind of the construct of how we operate the classes. We don't think that there's necessarily just one book or one reference out there that is the answer to everything, but instead it's how can we tap all of the expertise that exists both in the faculty and also the bay area and the whole ecosystem around us and bring that onto the campus. A second thing that we do is broadly what I call translational research. There's fundamental research where you're trying to understand the true nature of everything around you—in fact, that's probably the bulk of research that goes on in any university and the effects of that kind of work are profound, very deep, like if you are the person who discovered DNA or you're the person who figured out what you can do with a laser or coherent light or if you're Fourier and you figured out this very useful transform, those are things that 10, 20, 50 years, even 100 years later, people need to understand this thing and it's the basis of all kind of things that happen, so the University is very good at doing that and it's what the University should do—but there's another category of work which is basically connecting to the industry and here, when you look at industry projects, they tend to be much more experimental in that you believe that there's some group of people that want some thing and you're just trying to build something that they want. You run this experiment and if you happen to hit it, then it's successful, and if you've missed it, that's ok, you'll try to build another thing. It's generally not oriented to deep understanding, like academic work is. And the timescales are relatively shorter. It's like 1 to 3 years at most where you do these market experiments and so forth. But there's this category of things that are in the middle, and it's in two directions. One is, of all the people who are doing more fundamental work, occasionally they will come across something which happens to fit a market interest or need, they happen to crossover—that's kind of like a new venture—and I call that "bottom up." Basically, whatever's going on already here [at the University], can we support some of those things in industry. For that reason, we run competitions, like our Venture Lab competition. We find people who are working on projects; we have venture capital, investors, and entrepreneurs look at these things and help us filter down which are the most likely to be successful. Once we choose a set of teams that are working on these things, we give them some space and try to give them some money, and we give them use of our conference facilities and we introduce them to all the people that we know—basically connect them to the network. We basically support them however we can. We have some

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interesting teams that are doing a wide range of things: everything from interesting things you can do in electronic commerce and shopping all the way to improving the efficiency of solar cells to energy harvesting to drug delivery. We get various teams and they work on their projects. In a way, they are translating where they started to fit into the industry. There's another version of translational research, which I consider more "top-down." This one is beyond what a group of 2 or 3 people can do together. When you have a little group of people, you have to basically fit in to the world as it already exists. There may be people out there who have some need in you; maybe you will be able to fill that, you'll have to acquire some resources, and so forth, and that's fine. But there are some problems, which I consider more "platform" problems. They're really big problems and a group of 2 or 3 people aren't going to solve it. For example, oil independence for the U.S. or world hunger or cancer. If you solve it, there's no doubt that it will create industry, that it will benefit a lot of people. If you came to me today and said, "Oh, I have the cure for all cancer, right now," I guarantee you that the amount of money that you could make is far beyond the money you can spend, but the issue there is not just recognizing some need and solving it. To get to that point, there's a lot of other enablers, and in some of these cases, it's that you need the government to support you in some way or you need various kinds of help in different ways that are not just market forces. So, we also look for these big problems, the big world changing problems, and we try to get them to the attention of people or to put it on a nationwide or worldwide stage or platform, so that we can draw attention to those problems that would both help a lot of people and are also likely to create new industry. For that, we do this in a different way, we run a conference called the A. Richard Newton Global Technology Leaders Conference and we invite people who have ideas on these really big problems and we invite people from academics and industry leaders and entrepreneurs and government to all weigh in and to discuss what it would take to work on some of these big problems—what could actually be done? The idea is that, there [at the conference], we're talking about big platforms and not little projects, but both are important. The small teams are important, but the platforms are important too, just in a different way. In some ways, business people sometimes give this advice, "if you want to develop a new venture or do something substantial new, then you should find a platform that already exists." They usually use this terminology in a much more simpler context like windows is a platform. But you should find something that already exists and write your application or build something on top of it or you should create a new platform for other people. You always have this choice: are you going to build on someone's platform or are you going to do something new on your own. So in a way, this is the parallel of that. Are we going to buy into a big problem and figure out how we fit into its solution or are we going to build our own application? We are trying to expand the range.

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"When we teach students, we are not teaching them for a one-year period. We are trying to impart skills that a person can use in a 40-year career."

The third category of things is ecosystem. I mentioned this before and in all of these ways bringing people from the Bay Area, the executives, the entrepreneurs, the investors, experts from around the world, our global partnerships. All these types of things are designed to increase the network capabilities for students and faculty here. So, these three things: the curriculum, the translational research, and the ecosystem is basically what makes up the center.

That's the intersection of these things is how we teach people to innovate, to lead, to commercialize technology."

BSJ: That is fascinating. It sounds like a big operation.

"It is not that the economy disappeared, but how people spend their money starts to shift...There is still an economy going on."

Sidhu: In many ways, it is. And that is a high level, but if we went down into any one of these, we could not possibly have time to cover them all. But there are a lot of interesting things going on in the subsets of these things.

BSJ: So, we've talked about how this program can help prepare students to work in the industry. But have you noticed as a result of the economic downturn recently, how have attitudes changed? How has the program adapted to accommodate that?

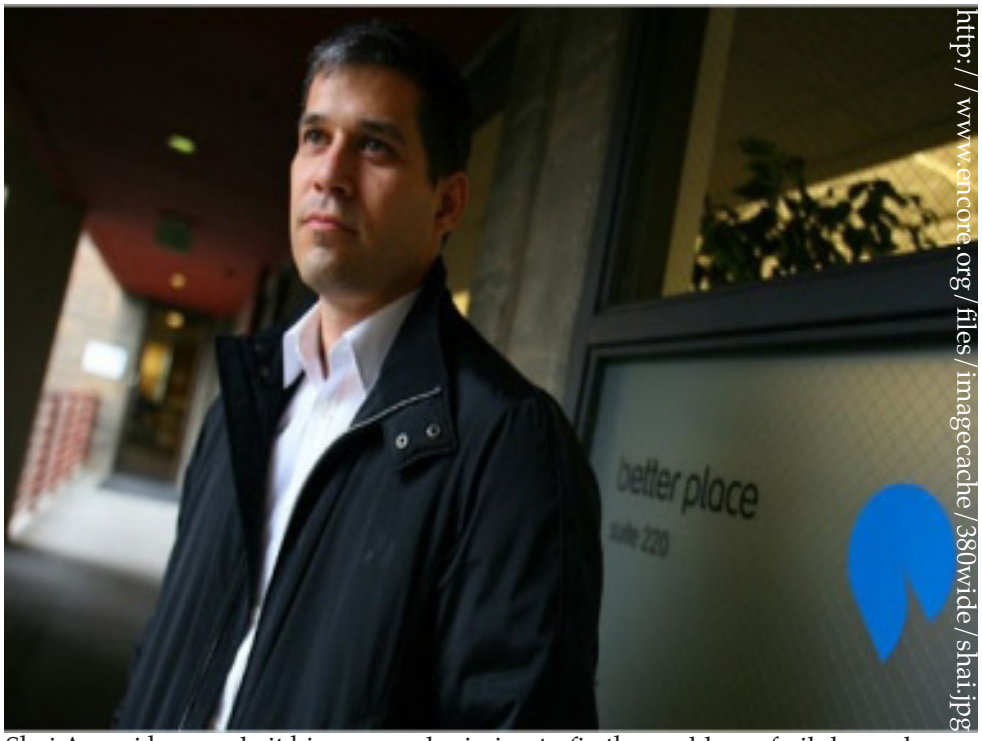
Sidhu: When we teach students, we are not teaching them for a one-year period. We are trying to impart skills that a person can use in a 40-year career. So, in some ways it's like going to the electrical engineering/computer science department, and saying, "Did you know a new release of Linux came out? How are you going to change computer science because of that?" It's a shorter-term thinking. Everything goes through cycles, and it's clear we are just on a down cycle. Now when you go through cycles, it doesn't really mean that all business is stopped of there is no opportunities left or things like that, but instead what tends to happen is that the types of businesses that get created often tend to be a little bit different or the ones that are successful. In fact, a lot of businesses that are very successful later on actually started during downturns. You may not realize that Cisco started in one of these downturns, in one of the worst possible climates to start a company. Now, what happens in a downturn is that usually those things that are the high-end luxury types of things, people scale back on those. And conversely all those things that are more basic, people tend to shift money from those luxury things into the more basic things. So, what you will see is Nordstrom's will have a bad year, but Walmart will have a good year. People who are shopping at some expensive bakery, that bakery may see a downturn, but the number of boxes of Kellogs Corn Flakes will increase. It is not that the economy disappeared, but how people spend their money starts to shift. Even if you have 10% unemployment, that still means 90% of people are employed. There is still an economy going on.

In terms of businesses, one thing that happens is just as people spend money in different ways, businesses start to spend money in different ways. They think about different things in the downturn cycle too. So, for example, one of the things that happens is companies tend to lay off people that they feel are not core to their business. In a way, it's also like the high end of what they were doing, and they'll refocus on what they think is really important or substantial. Sometimes when they do these layoffs and they reduce size, they actually reduce more than they wanted to or can really afford to because they are still operating. If you've cut a lot of people because you were very nervous about what was going to happen in the future, but you've still got a certain number of orders and you've still got things to do, usually what happens is they've cut a little too far. They'll end up compensating for it with consultants and they'll tend to compensate for it with projects they have to do outside or they have to contract a company to do something they used to do on the inside. The other thing is that the types of things that become in favor are cost cutting things. So, for example if you're starting a new business right now and your new business is all about how you can make more money, some sort of growth opportunity, that's less likely to gain the interest of a company that is worried about saving money right now. So, they're thinking, "How am I going to make it through next month or next year?" They're worried about just paying for the things that they've got. If you come to them, "This would be a good time to invest in this growth opportunity." It is a much more difficult sell. If your business is basically about cost savings right now, then it's a much easier sell. It's an easier sell right now than when the economy is good because you're basically saying, "If you were before paying x dollar s per job per whatever, if we could do that work for you for half the price, we can do it in some disruptive way or we can do it because we have lower overhead or we're a smaller group of people and we don't have to pay for as many thing as the company

that you work with right now has to pay for." These are the things that all of a sudden become attractive because everyone is just trying to figure out how to do what they're doing and save money at the same time without completely messing up what they're doing. Now when the economy starts to turn, if you go back to the very same business and say, "I've got an idea how you can save 10%." They're going to say, "I'm not really worried about saving 10% right now. I'm worried about losing this future market share when it's on the upswing." They're focused on different things too. My basic point is it doesn't mean business is dead, but that the interest of customers changes and you just have to take that into consideration.

BSJ: So, when you talk about how the interest of the customer changes, do you notice any particular trends, say with regards to certain industries blossom during these times?

Sidhu: That's hard to say. We know that a lot of things are cyclic. The auto industry has been cyclical on five-year cycles for a long time. Which things come up out of the downturn is very hard to say. The other thing is right now there's a lot of interest in what's happening with the stimulus money. I'm not sure I can really give you any insight into this either in terms of which areas are just about to change or who's about most positively affected by stimulus money. I don't think everybody is going to be negatively affected. It feels like that initially, but what happens in the contraction is that seven out of ten people are negatively affected. But there are still three people in some other area that will benefit somewhere. There is some change but it is not all completely down.



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Shai Agassi has made it his personal mission to fix the problem of oil dependence.

BSJ: So we're going to take a little turn and ask a little more about the projects you're working on and what sort of benefits are coming out of that.

Sidhu: Just in terms of an overview of projects, I think some of the things that I was talking about with the Global Technology Leaders conference, that's, you might want to actually just see the website and look at those 8 projects that we put on the roadmap. One of them has to do with oil independence and electric vehicles, but we also had Tom Segal with the Energy Free Home, there's some diagnostics for later things, this is more Berkeley wide, now, but synthetic biology was in it... But anyway you ought to take a look at that for an overview. We could go into the bottom up projects too.

I think the electric vehicle project is pretty interesting though. This was one of our 8 projects that we put on the roadmap. I don't know how much you know about this company, Better Place and so forth, but there's a fellow, his name is Shai Agassi, and he is, or he was the number two person at SAP, I think he had a title of President of New Products, a big part of SAP. One day he got pulled into a conversation where they asked him what would he do in the next 20 years to make the world a better place. Like most people who were asked that question, 5 minutes they think about it then they go on to whatever they're doing. But for some reason this really stuck to him. He somehow made it his personal mission to fix this problem of oil independence. I think he was originally thinking about Israel because he is from Israeli descent. And so he thought about all the ways that he could reduce the dependence on oil, and he went through bio-fuels and many other ways

[to obtain oil independence]. He basically came up with this realization that there is a real economic driver for electric vehicles. That is, that here in the US, when gas is 3 or 4 dollars a gallon, it costs 15 or 20 cents per mile to drive a gas powered car. If you just look at the electricity that it takes to drive an electric vehicle, it comes down to about 4 cents per mile. There's a big difference between the cost to power it by electricity and the cost to power it by gasoline. And effectively, there is this chicken-egg problem which is that this solution would work fine if there was infrastructure everywhere to be able to charge and to change back - he's got this idea that you could drive your car in for range extension and from the bottom a robot would come and swap a depleted battery with a fresh battery, and so just like you drive to gas stations today and in 5 minutes you have a full tank, you could basically have the same experience. So basically, he said that if this charging and changing infrastructure were there, then it would be no problem to adopt it. But this was never going to happen until the infrastructure was there, and the infrastructure wouldn't happen unless there was enough of a market to support the infrastructure.

He's looking at this situation, and said the cost of this infrastructure is basically less than how valuable it is to have it, because of what could be saved and how the world could effectively be a better place. He was able to raise 200 million dollars to roll out this kind of infrastructure to basically break this chicken egg problem in Israel. Turns out there is two major cities in Israel, they are separated by about the same distance as San Francisco and San Jose. They are not that far, the whole country is not that big, and to roll out this infrastructure there would not be, you know, certainly would not be as difficult as to roll it out in the United States. That was the starting point. They were able to get a partnership with Renault-Nissan, and Renault and Nissan, the combined company, basically would build a car that would work with this infrastructure, and three years from now they'll have electric vehicles with that infrastructure in Israel. Since they got started with that, they've been on this mission to get other countries to sign up to bring this kind of infrastructure to their countries. And so we have one of these transitional research projects with them, which was if they were going to roll out this infrastructure in the united states, and in particular, if they were going to do it in the Bay Area, how would they do that? Who would be the people who would buy it, what would all the technical issues be, what would be the economic impact to the area, why should we do it, all those kinds of questions. So we started this research project with them last year just after summertime. And we did three technical reports, you may have seen those on the net. One of them is where to place the charge stations and who would be the user, adapters and things like that. One what is the effect on the electric grid, at what point would it weigh down the capacity of the grid, and by how much, and what fraction of that energy could be done by renewables.

There is a really interesting case for renewables here, because it turns out that wind power is mostly at night, when nobody uses power, when all the lights are out, when nobody's driving and so forth. Cars that would charge could largely charge at night and so you could actually make use of most of the electricity that is generated from renewables and not actually tax much of the grid. So, part of our study was to figure out how much of the energy could actually come from renewable because of these charging patterns and in which ways

With the help of Renault-Nissan, Israel will have electric vehicles with the supporting infrastructure in three years.

could we optimize it so its even a greater percentage. There are interesting things you can do like delay people's charging until later or charge slowly and at certain times during peak hours so on, so that was a category. Then we did the economic impact study. Something interesting that came out of that is that if the automotive industry in the US [adopts this], even if we get a 10-20% adoption rate of electric vehicles the size of the battery industry becomes enormous. We got a projection for the battery industry in the US, assuming some significant adoption, of 180 billion dollars. I mean it's a really big thing. Common sense would tell you some of these things too. The battery is a fairly expensive part of a car, so if its 10,000 dollars, and it's a big part of the car, or even more than that, how big is the auto industry? Divide that number by a third or a fourth, that's how big the battery industry could potentially be. So to some degree there is some strategic information about who's likely to win and lose if we go down this direction.

This has all been very good. First of all it's very interesting, the whole project is very interesting. Secondly, this has been a really good opportunity for the students involved in it. Like other big platform problems, if you can become an expert relatively early, that's helpful to you, right? If this is going to happen, its better for you to be an expert in this than to be one more person that knows how to increase the efficiency of converting oil to gasoline from 99.2 percent to 99.3 percent. That's fine, a lot of people have looked at that, you are at the end of that line. So we had a summit meeting with executives and people from the Bay Area, PG&E and all the stakeholders that would care about this.

Our first set of 8 students which by the way, just to finish that point, presented what they had figured out and it's clear they had really interesting results. I think one of the PG&E people said 'Could we hire one of these guys?' They were ready to hire them on the spot because they basically were working on very interesting things. The topic goes a long way, I mean if you choose the right problems its valuable for everybody. Now the other thing that we did, we're doing these projects in a way that is not the same as most research projects on campus. If you go to the Business school and you look at a research project it's usually a research project on some market study, or how some industry is likely to evolve, or some economic study. If you go to the Engineering college you're likely to find a whole group of PhD students working on the chemistry inside a battery, or on like what we were talking about, a more basic and fundamental understanding of why things are the way they are.

But in this case what we did was we had two public policy students two MBA students and four engineering students and we combined them together to work on these studies. So we are able to tap knowledge across the whole campus because these students also have advisors in all the different schools, and we basically bring all of that expertise together to write one of these studies, so in a way this is more multidisciplinary than most projects can be because the composition of people is different. I think that is a fundamental change in what I call this transition research or even how we do it, it's very significant. So that was with the first eight students, now what we're doing is we've brought this into the management and technology program and we have thirty-three students that are in that class, and approximately half are MBA students, but some are battery experts from LBNL [Lawrence Berkeley National Laboratories], and some are electrical and computer science people and some are mechanical engineering people, some are experts in global sustainability and some are policy people, so we have this really broad mix of people and so out of this we have one group now working on "what are the main issues for the car industry if they were going to go down this road," and another one working on "what would the utility companies need to know if this is going to happen," and another one working on "what would the communication software inside the car be and what kind of services could it have in it," and we are thinking something like, what is the iPod for the car. In a way what new capabilities can you imagine once your car is a network element. So we now have six of these project teams and they are working to understand what I call the full ecosystem, the battery, the car, the communication software, the utility company, and the rollout or how you would do a trial. So it's actually grown into this and the fact that we have a company

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that has smart business people that are actually working on it, there's somewhere for reports to go. It's not that we are going to write this thing and it's going to go sit on some shelf. Ideally when these guys go and meet with General Motors to say what could you do, or what should you really be asking the government for a bailout that would be helpful to you as a company, look at this report by UC Berkeley. And so there's a channel now for these reports to get out into the world, a much richer channel than if we just posted it on the website and hope people Google it and download it. So that project I think has just been wonderful, but more importantly the model is reproducible so you can do the same thing in health 2.0. You could find the company that's doing the most clever and creative and disruptive thing in the health space and we can bring them here and we can partner with them and we can get students involved in what we think is the best possible solution and to give the independent and the credible work product from UC Berkeley that is self standing but can be used alongside whatever is happening in that industry.

BSJ: You mentioned Israel earlier and how they got this whole project going, has that actually been implemented now and are they actually using that kind of infrastructure?

Sidhu: So they have started to put the infrastructure into the ground, they have some number of test vehicles that are driving around and using it, and they are looking at a multi-thousand-car rollout in 2011. So basically they are doing a buildup. The other piece of this is how long does it take to make a car like this. And a new car platform is on a six or seven year design cycle, so it is possible to come out with one or two prototype cars but if you really expect this to happen you have to be able to make hundreds of thousands of these cars just day and night, every five minutes a car is coming off the line. They are working on a production facility in Turkey where Nissan is and my understanding is that it will basically come online at the same time as the infrastructure in Israel and then they'll have a steady supply.

BSJ: Is that something we can expect to see in the United States as well?

Results of a recent study suggest that the BART may complement the implementation of infrastructure for electric cars.

Sidhu: Interestingly enough, yes. Of course every country is different. Denmark signed up for this and California announced that they would put policy forward that would support electric vehicles, and that was with the three cities Oakland, San Francisco, and San Jose, their mayors did this announcement. Australia and Canada as well, so there are a number of countries all have announced some plans or incentives for this to happen. In California, it's going to have to go through the same process where it's going to have a trial and so forth. I can't predict exactly all of these things, and I also do not know what is private to the company, like what they would be okay with what to announce and what not to announce, but I do know that they are basically working on trials in this area and of course we are working with them on research results that will help those trials.

BSJ: That's really fascinating, sounds like an amazing project.

Sidhu: Well that's why it's worth looking at the big problems, especially if you can find these heavyweight

leaders that are trying to do something and trying to collaborate with them.

BSJ: Is the current target the Bay Area or are there other places in the United States that are possible targets?

Sidhu: They want to start with the Bay Area, and the reason is that something like half of the Toyota Prius hybrid vehicles in the whole world are in the bay area, so they think that the fastest adoption would be here. You basically have to prove it out in a few places and then it becomes a scale question.

BSJ: In terms of, for example BART, and how they are trying to expand and circle around the bay, how might that affect the electric vehicle implementation.

Sidhu: It's great, and public transportation is something that should obviously be supported. Now one of the results we've found in our study was that there are a segment of people that drive from their house to the BART station and back and they take the BART the rest of the way. So what we were thinking about is if you have charging stations in your house and charging stations in the BART parking lot, that would be one of the main segments to go after. So basically it is complementary.

BSJ: You mentioned earlier how we can tap into wind energy. Is that enough power, looking at the current power grid of California and of the Bay Area in particular? How much further development of the energy or electricity industry would need to take place?

Sidhu: Well this question has to do with how many cars, so if you say do you have enough wind for five cars, the answer is absolutely. Do you have enough wind for five million cars, I don't know. But that is not really the question. The question is what is the mix of wind energy that you'll be able to use, because there's an assumption that however many cars you have you can scale up wind or you can scale up some other source of power. It turns out that we are seeing numbers like 65 or 70 percent of the energy in to cars could actually come from wind, which is significant. So first of all the amount of energy is much less, the cost of the energy is very low, electricity versus gasoline. Secondly if you have clean energy then there is basically no carbon emissions from those vehicles, so then the question is only, where is the energy source. So there are a lot of energy sources that don't have carbon emissions including nuclear, but it turns out that two thirds of the energy supplied for the cars could actually be wind, which is as clean as you can possibly be.

BSJ: You would think that something that promising would have already taken place, and obviously your teams are working hard on this, but is there some sort of barrier that is holding things back?

Sidhu: Well yes there has been a barrier and this is the issue. This is where I started with that chicken and the egg problem. I think it could to some degree indefinitely go on because the infrastructure isn't there there's not going to be any adoption. However, the pain of this problem has just gotten to be enough that investors and governments are now willing to reconsider the cost of the new infrastructure.

For more information about the Center for Entrepreneurship and Technology and Dr. Sidhu's current projects, visit http://cet.berkeley.edu/

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