CIO Council Presentation Transcript:

Stephen Schneider: "Understanding the Climate Change Challenges: CIO Opportunities in Carbon Downsizing, Enterprise Greening & Business Renewal"
Wednesday, Feb 10, 2010

Basheer Janjua:

Welcome to this exciting event of intellectually charged discussions about our planet, our business and our industry—the information technology. An industry that provides the total infrastructure for the age of knowledge, collaboration, and global connectivity. We are here today to look at the big picture of our world and focus on the heart and soul of our enterprise—infrastructure; and the ways to transform our infrastructure into most modern, most efficient, most economical, and most environmentally sustainable. Please take a long around you. You are surrounded by the greatest and brightest climatologists, information technologists, venture capitalists and enterprise infrastructure enthusiasts. Congratulations to all of you for being part of this great industry in this noble profession. I extend my heartfelt gratitude to all of you for being here. Also, I want to convey my thanks to the finest team of executives who made this event possible, especially Raj Patel, Jim McGuire, James Barrese, Ellen Pao, Andy Bechtolsheim, Sherrie Littlejohn, David Stanley, David Schlang and the Integnology / CTO Forum team. Now it is my utmost honor and pleasure to introduce one of the most respected climatologists, the leading author of IPCC reports that won 2007 Nobel Peace Prize, Dr. Stephen Schneider, a Melvin and Joan Professor of Interdisciplinary Environmental Studies, Professor Department of Biology and Senior Fellow of the Woods Institute for the Environment, Stanford University. Dr. Schneider.

Dr. Stephen Schneider:

Let me try to sketch out in 20 minutes some of the problems that many of you know about because you've been following these issues for a long time. I'm not going to give you a primer on climate change, but I will quickly and briefly talk about some of the problems that we have out there on the street. Then, we will quickly switch over to the following: if we have a problem that has significant probability then it needs to be fixed, which is why we need to have innovation, and you all have experience with a strong component of innovation that you could use to help us get there

So the first slide is on the title: understanding climate challenges. Every time I go anywhere, I am asked this question: 'Before we try to fix a problem, how do we know it's broken?' I love doing polls with my audience. How many of you think that humans are a main factor of the recent climate change is settled science? How many think it is not? How many think this is a stupid question? Right, and the reason for that is when you look at any complex system, whether it is climate science, health care, defense, how the entire computer network operates, or the smart grid, there are well established components that really are settled. There are also competing explanations. Later I'll show some of those on climate, and then, of course, there are the speculative explanations. And what is going on out there on the street, which is so annoying to those of us who do science, is you will never have complete information. Everything we do is to find sufficient new evidence to move the speculative up into the next category of

competing explanations, and the competing explanations up into the well established category. So you are going to find somebody from a deep ecology group grabbing the worst thing they can find from the well established and saying that's the truth; and you're going to get somebody from the Competitive Enterprise Institute who's going to cite some benefit of climate change that makes it "good for us" or some uncertainty and say we don't know anything. And then the media is going to dutifully give all of these positions equal status at the bargaining table though there is radically different credibility in each of them. Then everybody is confused. For example, you have three mistakes come to light that the Intergovernmental Panel on Climate Change (IPCC) made in the 4th assessment report—if you give me a swat team of scientists, I bet with 30 really good days and great people, I could find 25 more relatively minor mistakes. There is this whole debate out there that somehow science is supposed to be perfect, which is impossible. It is still an institution of people and there are errors. And in fact, we are going to have to work very hard to get those 25 errors down to 10. The idea that a few erroneous conclusions trump the whole report is outrageous; it's a media witch-hunt. The media witch-hunt is doing damage to the credibility of the field, which should be proud of the fact that it makes so few mistakes.

What do we know? The top curve is what has been called unequivocal by IPCC and that is global warming, nobody disputes that. I have not seen anybody who says it isn't warming in the timeframe of a century and a half. A much more sophisticated question is: 'How much is due to Mother Earth, and how much is due to us?' In order to answer that question, we have to look for what we call fingerprints. You have to see if the stratosphere is cool and the lower atmosphere warm. That is not a fingerprint pointing to the sun did it, sorry Wall Street Journal Editorial page, but in fact that is a fingerprint of the effects of increased emissions from human activities. Further the models predict that night warms up more than day, which has happened and that is a fingerprint of human activities. None of the anthropogenic global warming statements have ever been based upon looking at just one piece of evidence. In a system, you have to look at preponderance of evidence and multiple lines, and that's exactly what the IPCC groups do. It is why they have said that it is 'very likely,' thanks to me being a stickler for subjective probability, we've defined as greater than 9 out of 10, that most of the warming over the last 50 years warming is due to humans using the atmosphere as a sewer to dump our smokestack and tailpipe waste. It was not based on looking at two pieces of data or what happened in the last 50 years versus the last 1,000 years, it's based on looking at these fingerprints.

If you take a look at the ocean expansion, the middle one, you find that by warming the ocean, of course you are going to expand it and the sea level rises; it has to. It's like heating mercury causes it to expand within the tube—that is why the mercury rises. The same thing happens when the ocean water warms, it expands—in this case the tube is the continental shelves. So the sea level is up five or six inches (plus or minus some) because local variations can swamp that and you have to average the results. Now if you look at the last twenty to thirty years, you see that there is a doubled rate of sea level rise. That is because it is not just the heating of the oceans, but it is the now also the demonstrated melting of ice sheets, in particular Greenland, which is contributing. Plus, we certainly know that mountain glaciers are diminishing. Is every mountain glacier diminishing, of course not. We would not expect that until we warm-up quite a bit more than the eight-tenths of a degree Celsius. But 95% are melting and that's a pretty good conclusion that you could say is unequivocal.

Here is another thing that you have heard a lot of in the news: there is no global warming. Well, there is global warming over the last 120 years. The average dates are the dots, the five-year running mean on the red line.

I heard the following not long ago when I was in Congress, when Congressman Rohrabacher said: 'Oh, I falsify global warming. CO2 has been going up and temperature hasn't risen, therefore it can't be true.' And I said, 'Congressman you've cherry-picked. You picked 1998, the warmest El Niño year in a long time and then you ran flat.' Suppose we took the time period from 1992 to 2002, then we'd conclude that we are going to hell in a hand-basket. If you run a 25-year running mean, all you see is a slight increase in temperature above the longer-term trend in 1998 and a slight dip afterward, right on a track. And if you look at the far end, you will see that the second warmest year is last year, 2009. This year will undoubtedly break all the records because we haven't had an El Niño of any significance since 1998 and the sun has been relatively quiet and it has turned back on. So we are going to have a real record breaker in 2010, and it won't mean global warming is here either; all it is going to show you is noise superimposed on a 25-year trend, which is the underlying trend that the scientific community talks about. It is very difficult to get 25-year trends through the media when you have people saying, 'The snow storms in Washington are refuting global warming.' It is really frustrating for those of us in science to watch this false framing, because it really does damage when people believe it.

This is a protest that I really enjoyed and the next slide will show you who the protestors are. The reason I wanted to show you is that they have a tipping point. Tipping points are what worry us a lot. A tipping point could mean: if you warm up Greenland at a certain rate, will the melt-water cause a slippage that you can't stop. A tipping point means it's irreversible. We in science are confident that there are many tipping points; what we are not confident of is precisely how many degrees of warming it takes to cross them. So we are not looking at an absolute certainty. When people say, 'Let's make a science out of that,' meaning certainty, it is a complete misunderstanding of science. Science is a series of never-ending refinements and we are always changing our views. When you have a long-standing preponderance of evidence to support a view, you start calling it 'well-established.' It is a collective judgment of people looking at masses of evidence. No individual new study moves the directional needle much, whether it is in the direction of warming or cooling because the evidence is accumulative.

Tipping points are critical. Because if you wait for absolute certainty and you cross tipping points, then you get irreversibilities and that takes us out of risk. Risk is what can happen multiplied times probability, that is my profession's job, but risk management, which is your profession's job, is how to deal with these things before you have absolute certainty by looking at up- and down-side risk, alternatives, where are win-win strategies that help reduce the risk and at the same time give you opportunities. This is where I am heading with this group, and why climate change can actually be an opportunity for you to help us invent our way out of the problem.

Here is the big tipping point. Al Gore used this graph, and it is only ten years, so we have competing explanations. We know for sure that we are melting Greenland more than we used to, but was that Mother Earth, an internal fluctuation of North Atlantic climate, or was it global warming. How do you know? I will go through, very quickly, how we try to find out in science.

My wife and I flew up there, and looking out of the window you see little blue melt-water ponds and up on the top there is snow. How can sea level be rising if you are putting on more snow? That is because the atmosphere holds more moisture when it's warm than when it is cold. So you expect where it is way below freezing, warming is going to add more snow and that is going to lower sea level. So we have competing explanations; which one's winning? I'll show you how we figure that out. So, this is what the melting part looks like. Melting is down low, near the coast where it is warm, and it snows up high where it is cold. So there are these melt-water lakes on the ice, and there are rivers, which are the lakes' draining system.

As the water in these rivers goes down into the ice, it is going to take the temperature of freezing water, which is 0 °C. But what is the temperature of ice 2,000 feet below? It is about -20 °C. So therefore water at 0 °C causes a tremendous heat transfer that will cause melting. Plus, it is a lubricant which can cause the ice to flow faster towards the ocean if it reaches the bottom of the ice sheet. Now, run your hand over your other hand and it gets hot—friction. So if warm melt water and flow friction cause more melting, what is the point at which you can get a tipping point where you are now committed to large3-scale ice melt and at least four to six meters of sea level rise over thousands of years? Even though it might take centuries to play out, you won't even know what has happened until it has already been set in motion.. These are the kinds of risks, and this is why we need to do risk management. So how do you try to figure out whether the water is refreezing on the way down or whether it is making it to the bottom? NASA tried to figure it out and what they did was drop cameras. Well, the cameras got stuck on ledges; they couldn't get down more than 10% of the way. So then they had a really brilliant idea that they had last year. They literally threw in rubber duckies, and on the back of each duck was a phone number and they told the Inuit hunters that if they cut them out of the belly of the beluga whales then call us, it could tell us if we have a big sea level rise. So I was teasing the guys that did this, and they said, 'This year we are much cleverer, we have smart ducks. We put GPS systems in the ducks.' This is a good idea.

So what we are hoping to do is figure out, not by direct evidence because direct evidence means that we have to wait until it happens, but by process knowledge of steps in the process of how it works, and by validating and improving our information on them. What we are doing is revising our prior belief in the relative confidence. What scientific assessment is about, it is not about a consensus on the outcome, it is a consensus on the confidence in the conclusion. That is why we have such a mess out there in the media world, because they don't understand us and they find a suspect conclusion, that even we find suspect, and say, 'Aha, we've trumped your belief.' And we say, 'Oh no, you've just changed the odds.'

So this is a more recent picture from 2005 and you can see it is still continuing to melt. How do we tip out of competing explanations? That is what a good scientist named Konnie Steffen did. All the red dots are where he sank pipes into the snow; there are annual snow layers. If nature did it, every 20 to 25

years you should be finding melt-water layers down there. All of those red dots are where they found that was the first ever-recorded melt. That means that it is not an internal oscillation at those locations. We are looking at a preponderance of evidence that leans toward global warming; it is not just natural. This is driving towards climate policy, which is where you come in. And of course, you can calculate the sea level rise as real dollar effects.

What else is happening? The earth is warming; that's unequivocal. This is the summer temperature in Switzerland. As you can see there is a 2003 outlier, which is when there was a massive heat wave that killed over 40,000 people in Europe. How does this happen? Look at the left-hand bell curve—this is your standard distribution. Extreme left-hand is extreme cold but known. Extreme right-hand on the left bell curve is hot but known. Now you pull it to the right, which is what we've done, and you have fewer cold events and more hot ones and then you get things that you've never had before, like that 2003 heat wave. This is exactly what you learn, not by looking at one event because that proves zero, but by looking at the aggregation of them, which is what IPCC does. And indeed, number of record colds is down, number of hots is up and unprecedented events are occurring. And that is exactly the kind of thing you expect to be happening with more frequency. But any one event is just random, and slightly souped up by pulling the bell curve to the right. So you have to think like that to understand what the science knows.

What else of the science forecast? Well, if you're in a Mediterranean climate, in which it mostly rains in the winter and not in the summer, with higher temperatures, the snow is going to be melting earlier, and you are going to have a longer dry season. And if it is hotter, you have more vegetation exposed to burn and you expect more fires. This results a four to five times increase in the number of fires. But it is not due to just global warming. Do you see all those fluctuations? That depends on other factors. Plus, we've moved people into areas where they don't belong, so they create fires. We've fought fires as a result of people living in areas historically subject to natural burns and let the undergrowth build up. So there are multiple factors; we know that they are all important, but we don't know yet how much each has contributed to the increase in wildfires. The map of California from Tony Westerling , from UC Merced, shows that there is a huge fire risk here. He took the last thirty years and he stratified it according to the years, on the left when snow melted late; it's not climate change, it's just weather variability. On the right shows the years where the snow melted early, which, again, is not climate change. However, if you look at 100 years, it is climate change because nowadays snow is melting two weeks earlier than it used to, just like plants bloom two weeks earlier. So, when do you get the fires? When snow melts early. What is the main forecast? Snow is melting early. This is the kind of driver that allows a republican governor and a democratic legislature to actually agree. Because there is no such thing as a democratic wildfire and a republican flood.

So what is the characterization of the problem? Potential for significant risks—I hope I've convinced you of that—while there are still deep uncertainties in shown in the bell curves. This involves making normative judgments about how do you want to take risks. We have only limited resources; you can't spend all of your money fixing climate, you can't spend it all fixing poverty, and you can't spend it all developing new technologies. You have to divide up that marginal dollar into spare change and make a political decision about how to spend it. And I would argue this problem belongs on the radar screen,

and the best way to put it on the radar screen is to link solutions to climate change that also help solve other problems, like energy efficiency, sustainable development, and reducing air pollution in cities, which also keeps kids out of the hospitals with asthma and reduces your carbon footprint. Look for the win-wins. You guys know much better than I know, this is high leverage strategy. I have a hard time selling this to my environmental friends and some of my colleagues because they are not dealing with risk management every day, and of course, that is what we are talking about. Optimal solutions? Sorry economists, they don't make much sense when every input is uncertain and when we are trying to value the benefits for the shipping industry of the melting of the Arctic Sea ice versus the destruction of the Inuit hunting culture in the polar bear arctic system. Those are not 'dollarizable' and discountable; they are fundamental value arguments that are going to have to be played out in the political arena.

What does the future look like? It depends on how many people there are in the world, what standards of living they demand and what technology we are going to use. The IPCC projected a higher emissions scenario, which they called Fossil Intensive, FI. It is a business-as-usual mobilization of capital, no charges for pollution, and it is a tripling of CO2, which I would view as a very dangerous scenario. None of these scenarios involve 'mitigation'. Their best scenario was a world that put egalitarian sharing of technologies first. It goes through an overshoot, then doubles CO2 and comes back down, that's lower. Let's translate these into temperature...

Just to show you the historic, we were going up above the highest until we had the next recession, and then we went below. Do not extrapolate the last year and a half or the previous eight. We have to look at much longer term trends to figure that out and embedded in that is how are we going to structure society, and how are we going to have freedom to invent alternatives. We don't have to be committed to doubling and tripling CO2, but we do have to be committed to shifting away from traditional strategies.

So that is the first fan of uncertainty: human behavior. Low, medium, and high emissions, we have control over it but there are costs and there are special interests. So what that does is show you? that over the next hundred years you have a range from 1° to 3.5° C from human behavior. This is just from models, and we know that models do not have enough processes to encompass the range of uncertainty that we could imagine they could have from looking at ancient history. So the fan uncertainty number one is human behavior and fan of uncertainty number two is internal dynamics of the climate system, what we call climate sensitivity.

So the next figure maps, on the right, the bars, which is climate sensitivity. So now you are running somewhere between 1 and 6° C; between 'well I'd rather not have it, but it is relatively adaptable' and 'oh my God, an ice age interglacial cycle in a century, not in five thousand years'. I cannot come up here and arrogantly say that I know as much about this as anyone in the world. The truth is I would probably put a bell curve through it, but I wouldn't be that confident. I'm pretty confident in the range, but where is the peak; it is very hard to know. Remember, this is one of those complex systems, and we are insulting it much faster than we're able to understand the details, but it is pretty hard to get away without some trouble.

The next slide shows you what the whole climate debate is about. Mitigation is saying, 'We don't know which one of these curves we are on, but we want to pull them all down.' Because you are going to have fewer slots that are dangerous, and more slots that are less risky if you start reducing the magnitude. And again that is where high tech comes in.

I love using this metaphor. People don't understand PDFs. They think that PDF is something from Adobe, sorry if I insulted you. I got a PDF—sorry guys—I'm talking about a Probability Density Function. And that is a wheel of fortune. At the 1 to 1½ degree level we have some adaptive capacity. It takes money to adapt, and you can't adapt to everything, and we don't know if we're going to pass a tipping point for Greenland, even in that range. But you know you can adapt more. What happens if you start going out at the other end? So the whole climate policy is trying to get those slots on the right fatter and the slots on the left skinnier; and that is the risk management. When you get out to the other end, you have much less adaptive capacity. So, when people say adaptation and mitigation are trade-offs, this is true only at the beginning, they are not trade-offs over time. Because it gets to be cheaper to mitigate as you learn how to invent your way out of the problem and much more expensive to adapt as you add warming. So, they are really compliments. You have to adapt to what is in the pipeline that you cannot stop, and you have to mitigate down to the levels where you can adapt. We will not be doing that without action because we start to see an accumulation of damage somewhere between now and the next two degrees of warming. That is why people want mitigation.

In a little self-promotion, I've written up the 39-year failure of our capacity to get climate policy done. I also have my proposed suggestions, as well.

So here is the policy sequence. I already said, adapt to changes in the pipeline. Mitigation for what we can't adapt to. Performance standards: efficiency. That is critical, whatever it is, you want to be maximally efficient. Then, we could argue about how much that needs to be market-based and how much needs to be forced by regulation. California says, 'Hmm, there's the US per capita electricity use going up, and there is California staying flat per capita.' We're still going up because our population is increasing, but we can't touch that because it is a national issue. So why did California hold steady when the rest of the country went up, I think all of you know the next one, and that is because we have laws. We have Title 24 and we have building codes. And what California did through the Energy Commission is it said, 'Let's not impose any standards that don't have a payback that's better than the mortgage interest rate.' Better than 7% return, in quicker than an 11-year payback; you've got to make it mandatory and required. If you look at 15% as the marginal rate, and you say 40,000 gigawatt-hours, we are talking about $6,000,000,000 per year. We have republicans that say, 'It is a good thing that we are doing this; that is real money.' You are also reducing air pollution. The question there is looking for the win-win solutions and looking for the places where you can get reasonable returns from those investments and deciding what fractions need to be mandatory, what we are going to do for the market, and how to create incentives.

Step three: public-private partnerships. In other words, we need incentives to innovate. For example, your industry was preceded by DARPA. I was a college kid when I heard my first talk about the ILIAC and the invention of the Internet through the Defense Advanced Research Projects Agency. So when

someone says, 'No the government should not be involved with industry.' Well, if we didn't have government involvement, we wouldn't have been launched. But government is a terrible place to build it. Then what we have to do is find out optimal strategies where government helps provide incentives. Is that loan guarantees to venture capital, for example, so they can take a bigger risk to see who the next solar Google is going to be? That is where your community has to work together with the political world and the environmental world to try to find solutions where the government is not building technology, but is certainly involved in incentives. The Germans, the Chinese, and the Japanese do it; if we don't do it we are going to be left behind. There is no such thing as any development that does not start out with some kind of pump priming. What is appropriate and what isn't is not obvious, and that is where I think we need negotiation. What an opportunity for your industry to get into many of these start-ups and help them do it better and more efficiently.

So what are we talking about? RD&D. That is really the big problem; it is those incentives and coming up with deployment. We know a lot, the question is, how fast can we get down learning curves so we have a real chance for market replacement of the conventional risky technologies? That is where we need demonstration projects, and that, I think, is where we have to have a lot of public funding to get us going.

So I gave a talk in Washington about four months ago, and a guy in the back of the room in a suit asked, 'Well, how much are you talking about, Professor?' And I said, 'Well, I'm not a technologist, but I know a lot about the industry. Out of my head, I would say $20 billion to $30 billion per year in pump priming and loan guarantees.' He said, 'Are you crazy? We are in an economic meltdown, how are we going to spend that kind of money?' So the chair of the event said, 'Please answer the Congressman's question.' I said, 'Well, Congressman, let me guess that you voted for both the Bush and the Obama bailout, and you did it reluctantly.' And he said, 'As a matter of fact, you're right—both times.' And I said, 'I would have done the same thing both times reluctantly. Now how much did you spend to bailout a bunch of under-regulated greedy bankers? $750 billion in one year? I'm talking $20 billion or $30 billion for the next ten or fifteen years to give us long-term sustainable jobs to, in a way, buy out of climate change. Don't you think that is pretty cheap insurance?' And he said, ' Well, I actually agree with you but I'll have a real time convincing my colleagues.' And I said, 'Tell them to look in the mirror and ask the person looking back at them if they need a values transplant.'

This is the kind of issue where we have to be upfront. What are the opportunities that are the lowest hanging fruit to move forward and how do we get these partnerships?

Well, da Vinci knew a long time ago about Fresnel mirrors, not just David Mills at Ausra. The next one is one of David's and it is a great idea, but if we don't have storage it is not going to work very well. So now we really have to invest in storage. I saw a wonderful talk recently that there is another kind of solar thermal, there is also photovoltaic but the cells have a storage issue, which your industry could help us solve. Because we need heat and air conditioning at five in the afternoon when the sun is not too strong, if you don't have a few hours of storage you don't have an optimal fit for baseline load. People have been calculating based on what you need for baseline load; this is where you need out-of-the-box thinking because it turns out that if you want to have an 80% chance that you can have baseline

load out of a combination of solar, thermal and wind, you have to have a substantial over-capacity where they dump energy. And I said, 'Don't dump the energy—why not use it for desalinization, or producing hydrogen?' We've got to come up with systems thinking that gets out of these silos of individual industry and try to come up with a community wide approach. And I know of no community better than this one to do this out-of-the-box thinking and I'm sure there is very good money to be made.

Another one, underground storage, we've got to pursue that. Now the last one, it is not the only way to get carbon out. We are not absolutely certain about how the cost will work out, but we can do it biologically. Not corn ethanol because that drives up food prices and causes famine in poor countries. There are much better ways, whether you use biochar or algae. There are so many opportunities that we have to pursue. I have no idea who will be the winner. We need a learning-by-doing feeding frenzy. We need to let a thousand flowers, as Bush Sr. said, but in this case we'll only need 50. And then we let the market sort out competitively what is safe, what is cost-effective and what is socially acceptable. But we will have to get there with these public-private partnerships. And very badly, we will need people to make these as low cost and reliable as we can.

The last thing is shadow price on carbon. That is what we are all fighting about. Do we have carbon tax or do we have cap-and-trade? In the end you have to have a polluter pays system, but that also causes a problem. As soon as you do that, you raise the price of energy and that will send the right market signals for people to invent but higher energy prices also hurt poor people. We could do it through cap-and-trade, but then we have significant management issues, you have to watch out for phony derivatives and lots of little problems. We can do a carbon tax, but no politician wants to say the 'T' word and that is regressive. For me, if energy prices go up, it reduces the quality of my Pinot Noir. For a poor person, it could be the protein for their family. But you cannot hold the sustainability agenda of the planet hostage to that. So you have to have two acts of good governance. One, you have to protect the commons. Two, you have to be fair and make equity side payments or allowances for those who are hurt in the process. We're going to need to deal with getting those people into the green technology industry and out of carbon-intensive industries. Nobody mines coal because they want to screw up the climate, though they are screwing up the climate. So we have to try to find alternatives and that is why this becomes a difficult systems problem.

The last step in the policy sequence is geo-engineering. Ask me, if you want to know about it.

I am very easy to find, my initials: shs@stanford.edu. Or you can go on Google and you can find me on the 500 websites saying how I am trying to destroy the American way of life, and then many others who think that I am a great hero; both of them are wrong. And I am very happy to talk to any of you at any length about any of this.

The original transcript was kindly provided by Basheer Janjua, Founding-Chair & President of the CTO Forum, and lightly edited by Patricia Mastrandrea