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# Forbes/Wolfe Emerging Tech

## REPORT

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### The Insider

Josh Wolfe, Editor

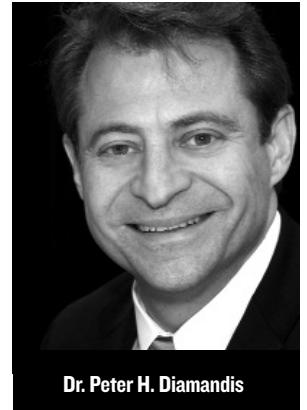
**L**everage got us into this mess. Leverage will get us out—just a different kind of leverage. More than 2,000 years ago, Greek scientist Archimedes said, “Give me a lever long enough and a fulcrum on which to place it, and I shall move the world.” This is the mantra of the entrepreneur, the innovator, deploying small forces (small teams, small funds) to exert large forces.

Consider Peter Diamandis, son of modern Greek immigrants, asserting the power of the prize. Take a big challenge like private manned space flight, and let

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## Peter Diamandis: Fostering Innovation

**D**r. Peter H. Diamandis is chairman and chief executive of the X PRIZE Foundation, which awarded the \$10 million Ansari X PRIZE for private spaceflight. The foundation is focused on developing large incentive prizes to bring about radical breakthroughs for the benefit of humanity in fields such as Genomics, Automotive, Education, Medicine, Energy and Social arenas. Diamandis is also the co-founder and managing director of Space Adventures, the only private company to send private citizens to the International Space Station aboard the Soyuz. Space Adventures also operates a commercial weightless flight operation, having flown more than 7,000 members of the public, most famously Professor Stephen Hawking in 2007. Diamandis is a co-founder of the Rocket Racing League and co-founder/trustee of the International Space University. He attended MIT, where he received his undergraduate degree in molecular genetics and graduate degree in aerospace engineering. After MIT, he attended Harvard Medical School, where he received his M.D. In 2005, he was also awarded an honorary Doctorate from the International Space University.



Dr. Peter H. Diamandis

### What was your inspiration for the X PRIZE?

The inspiration stemmed from my personal childhood desire to want to fly in space. After meeting with many astronauts, I gave up on the notion of going the government route, as it became clear that the chances of being selected are one in a thousand, and even if you are selected, you get to fly only once or twice over a decade. On top of that, there was no innovation coming out of the government space program—the costs were going up, and reliability was going down. For

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Erwann O. Michel-Kerjan

### Erwann Michel-Kerjan: Dealing with the Extraordinary

**E**rwann O. Michel-Kerjan teaches Value Creation in the University of Pennsylvania's Wharton M.B.A. program and is managing director of the Wharton Risk Management and Decision Processes Center at the Wharton School, which for 25 years has been at the forefront of research into extreme events. He advises top decision makers around the world on these issues and his views regularly appear in

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Tim Vail

### Tim Vail: Creating Advanced Fuels

**T**im Vail is the president, chief executive officer and a director of Accelergy Corp., a multinational integrated coal-to-liquids (CTL) technology company with operations in China and the United States [Full disclosure: my venture firm Lux Capital is an equity investor]. The company has developed proprietary technology that cleanly produces a wide range of advanced

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people compete. A single prize for \$10 million can have 10 times or more money chasing that prize. That multiplier effect is leverage. Incentives matter and the pursuit by many for a prize won by one is what I call “innovation leverage.” Markets generally work this way, as lots of companies compete to commandeer scarce resources and talent in pursuit of winning share. In the process, society succeeds even as the majority of companies fail.

The odds of success are always against the entrepreneur. But it is the low probability, hugely positive outcomes from **Genentech** [DNA] to **Google** [GOOG] that change the world and make fortunes.

The mirror image of this is the low probability hugely negative outcomes from Krakatau to Katrina and 9/11 to 9/15 (the start of the current collapse). These so-called Black Swans dominate life and are often the rule, not the exception. We have an exclusive interview with catastrophe expert from Wharton, Erwann Michel-Kerjan, on planning, modeling and risk management.

An immediate form of risk management is diversifying our transportation fuel sources. Our exclusive sit down with Accelergy CEO Tim Vail is a must-read. [Full disclosure: my venture fund Lux Capital is an investor]. I’m skeptical of many alternative energies and most biofuels, which I dub biofools, but on the way to all electric vehicles, I’m bullish on converting our vast domestic coal resources into cleaner liquid fuel, mostly because it would help reduce emissions of a more pressing kind than carbon. I mean the dollars spewing from the presses of the Fed. Cleaner technology for converting coal to liquid can help reduce our deficit.

As always, here’s to thinking big about thinking small...and to the emerging inventors and investors who seek to profit from the unexpected and the unseen....



me, the issue was how to jumpstart innovation in the industry to spawn a new generation of vehicles that would ultimately allow for a commercial market to come into existence, with the notion that a commercial market would bring new capabilities, bring the price down, and so forth. I was reading a copy of the book *The Spirit of St. Louis* by Charles Lindbergh, and in that book I learned something new, which is that Lindbergh crossed the Atlantic for a \$25,000 prize. And more importantly, I learned that the prize sparked a whole population of new aircraft and an increased interest in aircraft travel. So, the notion that a prize could really drive the sort of breakthroughs I was hoping for came to mind. That idea, combined with my personal desire and entrepreneurial nature, was really the early motivation for the X PRIZE.

**How long did it take you to launch the X PRIZE once you had this inspiration?**

I read the book in 1994 and we launched the first X PRIZE in May 1996, so it took about two years for me to get the support needed to have some capital to get it started. We launched it under the Gateway Arch in St. Louis, with the head of NASA, the head of the FAA, 20 astronauts and really a tremendous amount of support. At the time we had all of the rules and regulations set, but it took us a while to get the money. Once we announced it to the media everyone assumed that the money was going to be there or forthcoming very quickly.

**How did you decide to have a \$10 million dollar prize?**

When I first came up with the prize idea, \$10 million was the number that popped into my mind. I had actually come up with the basic rules and the prize amount by the time I had finished reading the book. \$10 million was enough money to inspire entrepreneurs, but not enough to attract the traditional aerospace industry. I really wanted people taking a fresh new look at how to do this, so \$10 million was the figure that seemed about right. I remember a NASA administrator saying, “Peter, I really think that’s the right number,” and as it turns out, it was! Burt Rutan (winner of the prize) thought initially he could do it for \$10 million. It ended up costing him \$26 million, and that’s the thing about a prize—it incentivizes optimists and risk takers to try new approaches.

**One of the clever ideas I’ve heard you talk about is the concept of “philanthropic leverage.” That is, the output you get from a \$10 million prize far exceeds the value of the prize. Explain how that works.**

One of the beautiful things about incentive prizes is that they have three key attributes: leverage, efficiency, and diversity. Leverage: Typically, with a properly designed incentive prize, it drives teams to spend, in aggregate, 10 to 40 times the prize value attempting to win it. Each of the teams thinks that they can win, and what we also do is design the prize so

**“When offering a prize, you are basically able to back an entire population of approaches rather than any single one.”**

there’s a back-end business model—that is, when the prize is won, these companies can go into business. So individual teams are willing to invest the amount of the prize or more in an attempt to win the purse, and you have dozens of teams competing. Efficiency: You only pay the winner. You don’t pay just anyone with a good idea or anyone who wants to try; you only pay the person who has accomplished the objective. Diversity: As a venture capitalist trying to invest in a new industry, you typically get just a single play or one company to invest in. When offering a prize, you are basically able to back an entire population of approaches rather than any single one. You are literally backing all teams.

**How do you go about setting the criteria for the prizes?**

The first prize was one that I put forward because it was something I understood in my heart and wanted to do very badly. Now we have a Board of Trustees and our largest donors, called Vision Circle members including Larry Page, Sergey Brin, Eric Schmidt, and the Ansari family, provide the financial support we need. We meet twice a year to discuss where we should be launching prizes and debate over what are the world’s biggest problems—the grand challenges. We’re looking for existing market failures, so if capitalism is doing a great job, we don’t worry about it. But

if there are issues around clean water or distributed energy, then we might look at creating a prize. So once we have clarity around a particular area, we start asking: What is this particular market failure and what is the underlying root cause? Why is it that way? Is it disbelief that it's possible? Is there a lack of capital coming in? Then we design a prize around addressing that root cause. If we do our job right, it's inspirational and clear and measurable and objective as a set of rules.

### **So after the space prize, what were some of the grand challenges you identified, and what are some of the potential areas under consideration now?**

After the Ansari X PRIZE we've launched three prizes so far. The first one is called the Archon X PRIZE for genomics. It's a \$10 million prize for the first team that can sequence 100 human genomes in 10 days.

### **Who's involved with that?**

Craig Venter, who was the first person to sequence the human genome (in 2001 Craig sequenced his own genome for \$100 million and it took a year's time). A single genome is interesting, but it's not until you get to a large population of genomes—thousands or millions—that you can have medicine become predictive and preventative. It allows you to provide someone treatment in advance of them coming down with a disease, instead of spending a huge amount of money after they've come down with it. So that's the first prize, we have a dozen teams competing for it, and we expect it to be won as early as late 2010 or 2011.

### **Do you have a deadline for winning the prizes you announce?**

We do. The next prize we launched, for example, is the **Google** [GOOG] Lunar X PRIZE, with a deadline of December 31, 2014. The prize is designed to inspire science and engineering and bring about a breakthrough in the cost of space exploration. It's a \$30 million purse; Google has put up the prize money, and a team has to build and land on the surface of the moon a robotic explorer that can roam on the lunar surface and send back photos and videos.

### **If I were an independent entrant, presumably I would only do this if I thought it could happen for under \$30 million. If you had to guess, what would be your estimation of how much an entrant would**

### **spend privately working towards a \$30 million prize?**

The beautiful thing in the way we structured this prize is that what will come out of this competition would be of tremendous interest to NASA and all of the world's space programs. So teams are probably willing to actually spend more than the \$30 million. I expect some teams will try and do it for \$10 million or \$20 million, and other teams may spend \$50 million or more because they believe that when they demonstrate this capability and win the prize, they will be in a position to offer very low-cost flights to the moon for governments and companies around the planet. We have 19 teams from 12 countries competing for this particular prize.

### **And what is the third announced prize?**

The third is the **Progressive Automotive** [PGR] X PRIZE, which unlike the other two is not a prize for the first to achieve, but rather a scheduled competition. We have a 4-city Tour de France-like race that will occur in the summer of 2010. Progressive Insurance, one

**"Our goal is to bring about a new generation of vehicles and demonstrate you don't have to choose between beauty, affordability and MPG—you can have it all."**

of the largest automotive insurance companies in the world, has put up the prize money. To win, a team has to build a car that is manufacturable, affordable, safe and will win a 4-city race while still maintaining over 100 miles per gallon or the energy equivalent. Our goal is to bring about a new generation of vehicles and demonstrate you don't have to choose between beauty, affordability and miles per gallon—you can have it all. We closed registration on this competition and have 111 teams from 11 countries registered and 136 different vehicles competing.

### **What other future prizes are being considered?**

We've organized our prizes into four group areas: exploration (space and underwater), energy and environment, life sciences, and edu-

cation and global development. In the exploration arena, Eric Schmidt has provided us some seed money to look at Ocean X PRIZES for mapping the ocean floor or a new generation of deep-sea submersibles that can carry people down to the ocean bottom. We're also looking at cleaning up the Great Pacific Garbage Patch—the large accumulation of trash in the Pacific Gyre. In life sciences, we are working on launching a health care X PRIZE to reinvent the U.S. health care system. We're in the middle of an aggressive design strategy to try and pull that together to potentially launch this year. One of my favorite prizes that I am working on right now I call the AI physician. It's an artificial intelligence physician, where a team would have to design an artificial intelligence that could speak and listen to a patient, and the competition would be won by the AI that's able to diagnose a patient as well as any panel of 10 Board-certified doctors. Imagine you had an AI that could listen to your woes and ask you questions and go through a process of diagnosis like a doctor does—you'd end up in a scenario where the AI can speak Mandarin or Swahili and anyone with a cell phone would have access to first-tier medical support.

### **Have you had any discussions with the White House or the new administration that you can share?**

We have had discussions with the White House and we've had a tremendous amount of support. Recently Tom Kalil, who is the deputy director for policy in the Office of Science & Technology Policy, wrote a nice blog about how the Obama administration should be using prizes to promote breakthroughs. We have been talking to them about administration support in our current and future prizes.

### **Is there something people can help you with as you advance the projects you're working on?**

Well, this is still a new idea. We're trying to get visionary individuals to help support the X PRIZE and what we're doing—it's still not easy to raise the capital. One of my goals is to reinvent philanthropy. Rather than giving money and hoping you get the result you want and achieving 50 cents on the dollar, I'm trying to get people to use their philanthropic dollars to design, create and launch prizes—whether it's with us or on their own. People who want to get involved and help what we do they can go to [www.xprize.org](http://www.xprize.org) or send me an email at [peter@xprize.org](mailto:peter@xprize.org). **ET**

transportation fuels directly from the world's abundant coal resources without the harmful emissions normally associated with coal. Before joining Accelergy, Vail was the president and chief executive of **Synthesis Energy Systems** [SYMX], a global developer of coal gasification facilities that cleanly produced high quality transportation fuels from low rank coal resources. During his tenure at SES, Vail raised more than \$200 million for the business and successfully listed the company on the NASDAQ stock exchange. Prior to joining SES in 2005, Vail's entrepreneurial career spanned nearly two decades in the alternative energy business working with technologies from fuel cells to clean coal. These efforts included serving as a director of commercialization for fuel cell development for **General Motors** [GM], where he closed the world's largest fuel cell commercialization deal with **Dow Chemical** [DOW] and developed a fleet of fuel cell vehicles for the U.S. Postal Service. Prior to his position at GM, Tim was the vice president of product development for the New Power Company, a start-up subsidiary of Enron Corp. From 1995 until starting work for the New Power Company, Vail was a vice president at Enron Energy Services, focusing on alternative energy opportunities. He was also a securities lawyer with Andrews & Kurth, LLP from 1990 to 1993. Tim holds a J.D. from the University of Houston Law Center and a B.A. in Economics from the University of Texas at Austin. He actively supports many charitable endeavors, including the Houston Star of Hope Mission and the Juvenile Diabetes Research Foundation. Tim Vail is a member of the State Bar of Texas. He resides in Houston, Texas with his wife, Elizabeth, and seven year old twins, Peter and Alexandra.

### Can you describe the path that led you to join Accelergy?

I've been in the alternative energy business since the mid 1990s. I am actually a securities lawyer by training and was doing securities work for primarily energy companies in the early '90s. I was intrigued by the growth potential of the alternative energy space and ended up forming a small energy venture with a client in 1993. We sold the company to Enron in 1994, and then I worked at Enron as a specialist in alternative energies until the company's demise in 2001. We looked at everything from advanced metering and communications to remote building management before anybody else was talking about it.

### Where did you go after the collapse of Enron?

I was one of the early founders of a company called New Power, which was a spinoff from Enron. It was for residential and small commercial customers. We raised more than \$750 million in three rounds of investment, and grew to become the largest provider of non-utility residential electricity. Unfortu-

**"We can produce a product that has a much wider band of temperature stability, enabling the new breed of stealth fighters that are flying faster and higher than traditional airplanes have ever flown."**

nately, Enron was our major counterpart, so with Enron failing the business couldn't stand on its own. That's when I received a call from the head of General Motors' fuel cell group. GM had the world's largest fuel cell program (and still probably does today). They hired me to be the director of commercialization in 2002, and it was a tremendous job. We saw all kinds of firsts: the first fuel cell vehicles, the first fuel cells in China, and many others. I left in 2005 to join Synthesis Energy Systems. SES was really focused on taking low-value coal resources and turning them into high-value liquid products.

### After more than 15 years working within many different facets of the alternative energy business, what excites you about Accelergy?

Accelergy has the ability to create advanced fuels from unconventional resources through a very powerful technology called direct liquefaction. The technology was developed over the course of 12 years by one of the world's largest energy companies (our partner to be disclosed in the near future), and it has the ability to convert carbonous resources (such as coal or other feedstocks) into a distillate stream that can be turned into a wide range of high-quality liquid fuel products. This includes everything from jet fuel down to high-octane gasoline.

### What's important about producing high quality fuels from "unconventional" resources?

One of the dreams of alternative energy is to be able to reduce our dependence on imported oil, and this technology allows us to use domestic resources for our fuels. So, from an energy security perspective, it's important. But what's also important is that from our perspective, this is an economic play as well. We can actually produce these fuels at a lower cost than what's currently available in the marketplace. We've seen some pretty wild price swings on oil, from a peak of \$140 a barrel all the way down to \$32 or something crazy like that, but I think we're going to see more sustainable prices going forward in the \$90-range as opposed to prices down in the \$40s. If you can sustain oil prices at \$70 a barrel or above, it opens up the door not only to our technology, but to a whole host of alternative energy technologies that are out there. And I think it's incumbent upon us here in the U.S. to find ways to use our indigenous resources, and use them economically. China is attempting to do the same thing with its coal reserves. The beauty of our direct liquefaction technology is that it is very efficient in the conversion of our resource to an end product.

### Just how efficient is this new process as compared to existing methods?

You may have read a bit about Fischer-Tropsch type processes. These represent the majority of the current coal-to-liquids and biomass-to-liquids technologies, and they produce, on average, two barrels of product for every ton of introduced material. Our technology has the ability to increase that figure by 50%, so for every ton of input, we can produce three barrels or more of product on the back end. Some of the challenges with traditional coal-to-liquids technologies are that even with oil at \$70 or \$80 a barrel, the economic benefits are fairly marginal. But with our technology, adding that extra 50% vastly improves our economics, which makes it a very compelling story with \$70 per barrel oil.

### How much did it cost to develop this technology?

One of the world's largest energy companies spent over \$1.5 billion and more than a decade developing this technology. This wasn't just on paper, either—they built a demonstration-scale refinery taking standard bituminous coal and converting it into high-quality jet fuel. Accelergy has been able to not only license this technology, but also transfer all of

the expertise they acquired in developing the process and building that facility.

### **What do you mean when you refer to “advanced” fuels?**

I'll give you an example. For the jet fuel we can produce, the actual chemical nature of the fuel is far superior to traditionally derived petroleum-based fuel (hence interest from the Air Force). We can produce a product that has a much wider band of temperature stability, enabling the new breed of stealth fighters that are flying faster and higher than traditional airplanes have ever flown. The need for a thermally stable fuel has become paramount and that is just the type of fuel that we produce. Another interesting fact is that we actually achieve a higher energy density per gallon of fuel, so planes will fly farther for the same weight of fuel

**“That’s the holy grail—to take unconventional resources such as coal or biomass and convert them into useful fuel with no compromises in regard to greenhouse gas emissions. We are on path to do that today.”**

on board. Being able to have a higher density fuel to extend the range of their aircraft is a real benefit for the Air Force. So, going forwards, I think you'll find that synthetically derived jet fuel that allows planes to fly higher, faster, and farther is going to carry a hefty premium.

### **Can you comment on greenhouse gas emissions?**

No matter what feedstock you're using, you need to have a plan to manage greenhouse gases when you begin any sort of project like this. One of the great attributes of our technology is that our direct conversion process produces 1/3 of the CO<sub>2</sub> of competing, indirect coal-to-liquid processes. So, right off the bat, we have a 70% advantage in the output of greenhouse gases and that goes back to that same efficiency I spoke to earlier. That alone is extremely helpful, but it's not enough. The technology also has the ca-

pability to utilize biomass in the process. With the introduction of biomass into the direct liquefaction technology, we achieve what we call an integrated coal-to-liquid process (ICTL). With the integration of the biomass, you can actually create an end product, be it jet fuel or gasoline, which is on par with traditional refining from a CO<sub>2</sub> standpoint. That's the holy grail of this business—to take unconventional resources such as coal or biomass, and convert them into useful fuel that requires no vehicle or aircraft conversion and no compromises in regards to greenhouse gas emissions. We are on path to do that today.

### **What do you see as some of the biggest risks facing the business?**

It comes down to capital risk and technology risk, and these are the things that hinder all small companies with a big technology. From the technology perspective, we have a great deal of data and we have a small army of scientists who have been working on this technology for years, so we feel we have a great head start and vastly diminished risk. However, we've still got to move forward and build the next steps of this technology, which includes a demonstration unit that can accept biofuels and is better and cleaner than the previously built model. In regards to capital, we need to ensure we can continue to raise the funds necessary to move this technology forward. So while we face both financial and technical risks, we feel confident that we can manage them.

### **What are some of the next steps in the company's development?**

Over the next several months, we're going to produce a comprehensive study, backed by a government lab, on the comparison between indirect and direct coal-to-liquids technologies. It is going to be very important to demonstrate the efficiency and emissions advantage that we have over traditional technology. The next thing is to actually build our demonstration unit, which we'll hopefully have up and running within the next 12-14 months. We'll be taking a blended feedstock of coal and biomass and turning it into jet fuel, which is a big proof of concept for our technology. Concurrent with the development of that project, we're going to be out looking for a partner to help us build a commercial project.

### **What do you hope to bring to the company based on your past experience?**

The “been there, done that” mentality is a

big advantage. This is something I've done with a number of different technologies in a number of different areas. I'm very bullish that we have a unique capability here with the direct liquefaction technology, it just needs to go through the commercialization steps, and there's no way around that. But having done it before, and being able to take a technology from the lab to actual early commercial use, is what the Accelergy team is good at. We've also demonstrated the ability to raise money for these types of efforts. Both David Eichinger (Accelergy's CFO) and myself have been successful in raising hundreds of millions of dollars in both private and public rounds for these types of technologies.

### **Has the new administration been supportive of your efforts?**

It's been a mixed bag. Within the alternative energy realm, the administration seems to have its pet projects, and if you're not on that list of pet projects, you don't receive the amount of focus that you'd like. That being said, Accelergy recently received a nice grant from the Department of Energy for some of its research in CO<sub>2</sub> mitigation. Hopefully we will be a beneficiary of more funds in the future. In general, I'd like to see the administration take a more active role in alternative energy, broadly defined.

### **If Accelergy is successful in demonstrating its technology at a commercially-relevant scale, do you see the company as an actual producer of fuels or a provider of new technologies to the industry?**

Definitely a provider of new technologies. We are not a project developer; projects of this scale require billions of dollars and long lead times. Our goal is to get these technologies ready for the market, and work with the large-scale companies that can actually build these plants. If you look at the past missteps alternative energy companies have made, it's that they've gone out and tried to be everything to everybody, which means building these large plants, and that's just extremely difficult to do. We're going to focus on licensing technology.

### **Where do you envision Accelergy in five years?**

It'll be either a publicly traded company with a suite of advanced fuels technologies, licensing these technologies to some of the biggest companies in the world, or we'll be a subsidiary of one of those companies. It could go either way.

**ET**

leading media. In 2007, Dr. Michel-Kerjan was named a Young Global Leader by the World Economic Forum (Davos), a five-year nomination bestowed to recognize and acknowledge the most extraordinary leaders of the world under the age of forty. He serves as elected chairman of the OECD High Level Advisory Board on Financial Management of Large-Scale Catastrophes established by the Secretary-General of the OECD. He also serves as a member of the World Economic Forum's Global Agenda Council on "Innovation and Leadership in Reducing Risks from Natural Disasters" and the WEF Global Risks network. He is currently co-leading, with Howard Kunreuther, the multi-year Wharton Extreme Events initiative on the future of natural disaster protection and risk financing on U.S. coastal states, in partnership with over 30 leading insurers, reinsurers, banking and defense companies, trade associations and government entities. Dr. Michel-Kerjan has authored or co-authored more than 40 publications at the crux of financial management and global risk governance. He is the co-author of several books, including *At War with the Weather* (MIT Press, July 2009); *Seeds of Disaster, Roots of Response: How Private Action Can Reduce Public Vulnerability* (Cambridge University Press, 2006); and *Treatise on New Risks* (Gallimard 2002). He has studied at the Ecole Polytechnique (Paris), McGill University, and Harvard.

### For starters, how do you define "risk"?

Risk is a combination of an event/outcome and the likelihood that this event actually happens. Obviously, risks could have either a good or a bad outcome. For instance, on the bright side, when you buy a lottery ticket, it is because you consider that the event—"my numbers are selected"—can happen. On the negative side, someone who decides to live on the coast of Florida knows that this is a hurricane-prone region and there is a risk that their house will suffer losses from hurricanes in the next five years.

### Often people consider risk as exogenous (something from outside that could happen to them). What do you have to say to them?

Sometimes, the probability is outside of our course of actions (that is, whatever we decide or do will not be able to affect it). This is the case with the lottery ticket: there is nothing one can do to influence what numbers will come up. But more often, our behavior can influence the risk itself. When you drive your car there is always the possibility of an accident. In most cases, the probability of having an accident depends

mostly on your own behavior as a driver. In this case, the probability is clearly endogenous.

Regardless of the case, your own behavior can always impact the consequences—if you suffer a car crash, you are more likely to be alive if you wear your seat belt.

### What attracted you to study catastrophe risks?

I don't like working on ordinary things. With extreme events, you are always in the extraordinary. Two elements here: the scale of the problem and the strategic level of decisions it requires.

First, catastrophes are by definition large-scale events. Think monster hurricanes, floods, earthquakes, mega-terrorism, international pandemics, financial crises, failure of our critical infrastructure, nuclear proliferation. All of these extreme events immediately affect a large

**"Decision-makers should ask themselves: Are we doing enough to make sure our organizations will be among those that are still standing after the next crises?"**

number of people, business and even countries. If you can manage them adequately so they do not happen, or reduce their consequences through mitigation, the economic and social value you create is enormous. There are major business opportunities here to assure we are more resilient to future extreme events.

Second, because these events can have severe consequences, they are (or should be) of prime interest for key decision makers (C-suites, president and prime ministers' offices). I just returned from the World Economic Forum meeting in China and was in Davos earlier this year: the question of global risk management is climbing extremely fast on the agendas. More and more companies realize that one single event or the combination of two events can create the perfect storm and have severe impacts on their business. And as the world is becoming more interdependent, even risks that materialize thousands of miles away can affect you tomorrow. Elected officials also realize that poor management of a disaster can

cost them a reelection. We have seen a few in the past five years. Even royal families have started looking at these issues more seriously.

### You have been working on these catastrophe issues with companies and governments all over the world for more than 10 years. For most of us, this seems like a "niche" expertise? Is that still the case?

As more extreme events are unfolding, demand for expertise is growing fast. Still, the number of people working diligently on these questions at a high level is limited. So in a way, you are right, that remains a niche. Most likely it is because these events require efficient synergies from multiple kinds of expertise at once, including the ability to work in a very uncertain environment. These kinds of problems also require you to have a very international view: we are becoming more and more interconnected as a result of globalization of social and economic activities, and so are global risks.

You will certainly find many books written on deadly scenarios, or post disasters/crises, or even preaching the end of the world. While several of them are fun to read, rare are those providing a strong analytical basis, understanding the strategic decision processes of people in charge of managing those risks and proposing real innovations to create long-term value.

But that's precisely what is urgently needed! Historically, the Wharton Risk Center has played a leading role in doing just that. As our team celebrates the 25th anniversary of the creation of the Center this year, we continue to do so even more today—as a neutral party—as the U.S. and the rest of the world see many more catastrophes. One figure is eye opening: of the 25 most costly insured catastrophes in the world in the past 40 years, 2/3 have occurred since 2001.

### Is this a sign of what the 21st century has in store for us?

Most likely. Those who have not realized this are still living in what I would describe as the Middle Ages of risk management, or Risk Management Version 1.0 as I like to refer to it. On the other hand, those who know we have already entered a new era of catastrophes have not only started to reposition their organization to reduce exposure, but have also started to think about what new products and services they could develop and sell in the coming years. For instance, after Hurricane Katrina, there was a boom in the alternative catastrophe risk transfer market (financial products that

transfer exposure to natural disasters/terrorism/pandemics directly to investors on the financial markets).

Put simply, market opportunities are huge. Risks need to be better diversified; one needs to develop appropriate incentive systems to induce people and enterprises to invest in cost-effective risk-reduction measures. Welcome to Risk Management 2.0—it's all about value creation.

**Your latest book, *At War With the Weather*, is arguably the most comprehensive study of insurance and mitigation of natural disasters published in the U.S. over the past 30 years. What findings or conclusions may surprise people?**

The book, jointly written with my Wharton colleague Howard Kunreuther, and other team members Neil Doherty, Marty Grace, Robert Klein and Mark Pauly, is indeed not just another book on natural disasters.

Because we worked for three years with leading companies and government entities across the country and we were able to access very large data sets from many sources, the first significant contribution of *At War with the Weather* is analytical. Evidence, evidence, evidence.

We also made sure that the reading was not too technical so anyone interested in these questions would learn a great deal from it.

In terms of surprises, I think it is fair to say that even those of us who work on catastrophes every day had not necessarily measured how vulnerable the country had become to future large-scale hurricanes and floods. Do you know how much insured value is sitting on the coast of Florida? \$2.5 trillion! For the state of New York? Same amount. If you consider insured value on the coasts from Texas to Maine, it's more than \$8 trillion. Realizing that the next series of severe hurricanes to make landfall—and the resulting flood surge—will have devastating impact is not Ph.D.-level economics, it is mostly common sense.

The second surprise (though I should say “confirmation” because we already knew this to be the case), is that even after the seven major hurricanes in 2004 and 2005, an overwhelming majority of people (about 80%) living in high risk areas have not done a thing to make their house more secure. What is urgently needed is to find ways to nudge people so they invest in cost-effective risk reduction measures, thus saving lives as well as significant insurance payments and government relief. *At War with the Weather* also has detailed discussions about insurance, reinsurance and alternative risk transfer markets, proposes innovations to enhance the financial coverage of catastrophes

and how we can win the war against the weather and other extreme events.

**You are also recognized as a leading expert on national security. What is the main difference in thinking about risk & consequences in terrorism vs. natural disasters?**

While both terrorism and natural disasters can cause severe economic, social and political disruption, they present one major difference: in the case of terrorism, we (federal and state agencies, private sector, citizens) can all unite to go after terrorist organizations and make the nation safer. We are at war with an exogenous common enemy.

In the case of Mother Nature, this might actually be a war with ourselves. Natural hazards have always been part of our environment. But we often choose to ignore these hazards, or believe we are immune from them. In fact, one of the main reasons why the war against the weather has escalated is the desire of so many people and businesses to locate in high-risk areas. The concentration of population and value has gone exponential. For example, the population of Florida, highly exposed to natural disasters, has increased by 600% since 1950!

The paradox in waging a war against the weather and other extreme events is that we might very well be our own worst enemy.

**How can society reduce the costs of future catastrophes?**

First, by realizing these catastrophes are not low-probability events anymore. As a top decision maker, you cannot simply pretend they don't happen and hope they will not occur under your watch. Moreover, in a more global and interdependent economy, silo thinking is outdated. Solutions exist, but we need to be proactive. And here it's all about leadership. As the balance between normal times and disaster times evolves toward more of the second, society will have to reallocate time, energy and resources toward more capacity to deal with those.

**We've had scares over pandemic flu, climate change and financial crises. What catastrophes are looming ahead? Viruses? Crumbling city infrastructure? Nuclear detonation? Meteors?**

All of the above, and a few others.... Your readers can contact me if they want to be scared... but rather than listing potential threats, what we can do is to provide them with solutions on what to do and how to do it to assure a good return on their time and financial investment.

**How is our innate understanding of risk flawed?**

As human beings, we tend to overestimate the likelihood of small risks we are familiar with and underestimate the likelihood of large-scale risks. The reality is that our lives are already filled with many things we need to consider when making our decisions: our family, our job, our religious beliefs, our health, etc. Many would say that they don't have the luxury to think about extreme events. That's the same thinking by high-level decision makers in the private and public sectors: too many day-to-day crises to manage already.

One thing we have to remember though: if one single event can have long-standing negative impacts on our lives we'd better think more about it. I'd hate to be in a position after the fact to have to say: “We told you so.”

**What is the role of insurance in protecting against mega-catastrophes?**

Insurance plays a major role in most developed countries by allowing people and firms to take risks they would not necessarily be able to assume by themselves should they suffer from it. No surprise that insurance (underwriting and asset management) has become one of the largest industries in the world.

If well designed, insurance can play a critical role in signaling how risky a location or activity is, in providing the necessary safety net that people and firms will need after a catastrophe, and by providing incentives to proactively invest in risk-reduction measures. To be able to do so, however, private insurers need to be able to charge rates that reflect the exposure and the cost of capital. The recent series of large-scale disasters that hit the U.S. have seriously challenged this ability since regulations are much more stringent; several coastal states keep insurance premiums artificially low in order to enhance the local economy. As we clearly demonstrate in *At War with the Weather*, this is an unsustainable posture in the long run. What is the appropriate role of the public and private sectors in dealing effectively with the financial management of future catastrophes? This has become one of the key questions on the table today.

**A last word?**

Given what we have seen in the past few years the question is not *whether* future catastrophes will occur but *when*—and *who* will pay for them.

And decision-makers should ask themselves: Are we doing enough to make sure our organization will be among those that are still standing after the next crisis? **ET**

# The Emerging Tech Portfolio

Company[symbol]	Coverage Initiated	Current Price	52-week range	Mkt Cap (\$mil)	Buy/Sell/Hold
<b>Intellectual Property Incumbents</b> <i>Leading researchers in the physical sciences, with big potential for spin-offs and revolutionary breakthroughs</i>					
<b>GE [GE]</b>	8/07	\$16.37	\$5.87-\$26.05	\$173,960.00	Buy
<b>Hewlett-Packard [HPQ]</b>	3/02	47.02	25.39-48.58	111,490.00	Buy
<b>IBM [IBM]</b>	3/02	121.08	69.50-122.88	158,720.00	Buy
<b>Materials</b> <i>Companies producing materials with novel properties that have applications for a wide range of industries</i>					
<b>Symyx [SMMX]</b>	3/02	6.68	2.39-11.15	229.80	Buy
<b>ShengdaTech [SDTH]</b>	8/08	6.80	2.52-8.10	368.57	Buy
<b>Life Sciences</b> <i>Companies that are working at the cutting edge of medical technology</i>					
<b>Life Technologies [LIFE]</b>	11/05	46.00	19.56-48.85	8,110.00	Buy
<b>Nanosphere [NSPH]</b>	11/07	7.43	2.71-11.10	165.16	Buy
<b>Electronics</b> <i>Companies that have corralled the key intellectual property that will be the foundation for next generation electronics</i>					
<b>Nanosys [private]</b>	3/02	n/a	n/a	n/a	n/a
<b>NVE Corporation [NVEC]</b>	7/03	51.63	16.56-63.64	241.73	Hold
<b>Energy</b> <i>Companies that are developing high-efficiency, low-cost alternative energy technologies</i>					
<b>First Solar [FSLR]</b>	8/07	152.87	85.28-226.39	12,940.00	Hold
<b>A123 Systems [AONE]</b>	9/09	19.60	16.56-21.44	1,924.34	Buy
<b>Enabling Technologies</b> <i>Tools and instrumentation that enable critical science and technology discoveries</i>					
<b>Veeco [VECO]</b>	3/02	21.93	3.22-23.76	713.69	Buy
<b>FEI Company [FEIC]</b>	1/03	24.50	11.36-26.50	920.47	Buy
<b>Accelrys [ACCL]</b>	3/02	5.55	2.63-6.28	152.20	Buy
<b>Investment Vehicles</b> <i>Funds that have investments in promising emerging technology companies</i>					
<b>Harris &amp; Harris Group [TINY]</b>	5/02	6.48	2.65-7.62	167.57	Buy
<b>PowerShares Lux Nanotech Portfolio [PXN]</b>	8/07	10.57	5.25-13.64	52.90	Buy
<b>PowerShares WilderHill Clean Energy [PBW]</b>	8/07	10.75	5.78-17.20	789.98	Buy

## Word on the Street

**GE:** General Electric advanced more than 15% on the month, on stronger industrial production and the company's new initiatives in smart grid, electric vehicles and clean power generation. GE also got a visible boost from its more than 10% ownership in nano-enabled lithium ion battery leader A123 Systems, which surged nearly 50% in its Nasdaq IPO.

**HPQ:** Hewlett-Packard shares gained over 5% after the company issued guidance in-line with Wall Street forecasts. HP expects to earn between \$3.60-\$3.70 a share for its fiscal 2010 fiscal, which would represent 17%-20% growth over 2009 results. The company also expects to generate annual sales of \$117-\$118 billion.

**IBM:** Eked out a less than 1% gain, after Dell flattered the company by mimicking its technology services strategy with an acquisition of Perot Systems.

**SMMX:** Slipped more than 4% on the month. The company continued to sharpen its focus on scientific software tools, opening a new R&D center in Bangalore, India, where developers will work on the company's enterprise electronic lab notebook (ELN), data acquisition software, decision-support software and scientific information databases.

**SDTH:** ShengdaTech dropped almost 3% despite a making number of new production announcements. The company kicked off production in its new 60,000 metric ton (MT) nano-precipitated calcium carbonate (NPCC) production facility, in the Shandong Province. With the additional capacity from the new plant, ShengdaTech's annual production capacity increased 31.6% to 250,000 MT. ShengdaTech also acquired Anhui Chaodong Nanomaterials Science and Technology Co.,

Ltd., with 10,000 MT of annual NPCC production capacity.

**LIFE:** Shares of Life Technologies were flat after hitting a new 52-week high of \$48.85 during the month. Barclays upgraded the life science enabling tools sector to "Positive" from "Neutral," expecting increased demand from industrial customers while government and academic customers will have more to spend as stimulus funds are disbursed. Danaher also announced it would pay \$1.1 billion for two businesses, including Applied Biosystems/MDS Scienc, a mass spectrometry business, partially owned by LIFE.

**NSPH:** Nanosphere climbed 7.5% as investors warmed to the medical diagnostics sector. The company is now up 174% from its March 2009 low.

**NVEC:** NVE Corp. dropped more than 5% on no news.

**FSLR:** First Solar has become a battleground stock. Investors believe the company is the best-executing, lowest-cost producer of low-carbon solar energy, while bears believe FSLR's margins in an over-capacity, commodity market will fall off a cliff. The bulls declared victory in September—with shares advancing more than 25% on a new Chinese PV agreement and a \$300 million credit line.

**AONE:** A123 Systems was welcomed to the public markets with open arms, surging almost 50% on its first day of trading. The company raised \$378 million from the Nasdaq debut, increasing the number of shares sold at an offering price of \$13.50, above its already-increased range of \$10-\$11.50 per share. A123 was founded in 2001, based on proprietary MIT Nanophosphate technology for lithium ion batteries. The company reported a loss of \$40.7 million on revenue of \$42.9

million in the six months ended June 30, 2009. The company develops and manufactures advanced lithium-ion batteries and battery systems for electric vehicles, electric grid services and consumer markets like power drills.

**VECO:** Veeco's white-hot stock rocketed nearly 51% over the past month on traction for its LED and data storage equipment. D.A. Davidson subsequently downgraded Veeco from Buy to Neutral, citing fears of an eventual supply glut for LED backlighting and the recent moon shot for its stock price. The bank raised its price target to \$25 from \$22. VECO has more than tripled in 2009.

**FEIC:** FEI shares rose 7.2%. The company announced the first Asian installation of its Titan Krios multi-million dollar TEM microscope at Tsinghua University in Beijing.

**ACCL:** Accelrys lost almost 7% on a lack of news.

**TINY:** Harris & Harris reached nearly 5% higher on the month. The venture capital firm now trades for 1.52x its stated NAV of \$4.27.

**PXN:** PowerShares Lux Nanotech Portfolio rose 3.3%, and has significantly outperformed both the S&P 500 and Nasdaq over the past 6-month climb.

**PBW:** PowerShares WilderHill Clean Energy portfolio was marginally higher on the month. The ETF can become a big beneficiary if A123's IPO catalyzes investor perceptions of the clean tech sector.

**Stock prices as of September 25, 2009**

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