

**JANUARY 27, 2010**

**TESTIMONY OF JOHN DENNISTON**

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**BEFORE THE**

**HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY**

### **Introduction**

Good morning, Chairman Gordon and members of the Committee. My name is John Denniston, and I'm a partner at Kleiner Perkins Caufield & Byers, based in California's Silicon Valley. Founded in 1972, Kleiner Perkins is one of America's oldest and most successful venture capital firms.

Our mission at Kleiner Perkins is to recognize emerging technology and market trends. We've funded more than 575 start-up companies over the years, backing entrepreneurs who have introduced innovative advances in such vital growth industries as information technology, medical products and services, and telecommunications. More than 170 of our companies have gone public, including Amazon.com, AOL, Compaq Computer, Electronic Arts, Genentech, Google, IDEC Pharmaceuticals, Intuit, Juniper Networks, Millennium Pharmaceuticals, Netscape, Sun Microsystems, Symantec and VeriSign. Our portfolio companies collectively employ more than 325,000 workers, and generate \$125 billion in annual revenue. My testimony today reflects my own views.

I'm honored to be here today and grateful for the chance to support your vital work in helping America compete in the global race for new energy technologies. The creation of ARPA-E - the Advanced Research Projects Agency-Energy - marks major progress in this increasingly fierce competition. As you know, ARPA-E was modeled after DARPA in the Department of Defense, which has brought us not only cutting-edge military technology, but also life-changing commercial advances through the Internet, global positioning satellites, robotics, and lasers. ARPA-E's great promise is to deliver critically important breakthroughs in clean energy, which will benefit our economy, our standard of living, and our environment.

### **The Second Industrial Revolution**

The world today is in the midst of a major economic transition that in many ways resembles an earlier historic turning point. In the Industrial Revolution, humans traded the power of horses and wood for mass-produced coal and oil, thereby unleashing a cascade of new technologies, from mass-manufacturing methods to railroads, automobiles, electricity, and telephones. These new means of extracting and harnessing fossil fuels enabled virtually all of the other innovations of that era, and thus catalyzed what was arguably civilization's most profound transformation up to that time, from an agrarian society to an industrial one. In that sense, the Industrial Revolution might more accurately be thought of as the world's first Energy Revolution.

Today, history is repeating itself, as the triple threat of climate change, global competition and energy insecurity chases America into a new industrial transformation – in this case, with clean, green technologies replacing the dirty brown ones. It's a time, once again, of creative destruction: an idea popularized by the economist Joseph Schumpeter, which holds that long-term economic growth is achieved through continual innovation by entrepreneurs, who constantly replace incumbent companies and industries with new and better ones.

### **The Innovation Imperative**

Today, as in the Industrial Revolution, our ability to discover new answers for old questions will determine our continued prosperity. In other words, technology innovation continues to be the secret sauce of America's robust economy.

Consider: in recent decades, our high-tech industries have accounted for a relatively modest portion of our overall economy - less than 10 percent of gross domestic product. Yet these same industries have continuously generated fully half of all economic growth and three-fourths of productivity gains. And of course, it is GDP and productivity growth that create dynamic job opportunities and rising standards of living.

Today, throughout the world, we're seeing a burst of inventive and entrepreneurial activity in "greentech" – technologies aimed at helping the environment as well as the economy. Innovators have recently made enormous technical advances across a range of disciplines – electronics, physics, chemistry, biology, and new materials – which have narrowed the price gap with fossil fuels. And this process is only bound to speed up, as the costs of renewable energy continue to decline with further innovation and economies of scale.

A key distinction between renewable and fossil energy is that the renewable fuels themselves - sunlight, wind, ocean waves, and the earth's heat – are free. Unlike coal or oil, these free, clean, sources of power are both abundant and invulnerable to both the disruptive price volatility of the commodity markets and the prospect of increasing environmental compliance costs. All they require of us is that we figure out cost-effective ways to harness them. And we're making swift progress in this regard.

Solar power offers an excellent example of the ability of innovators and the power of economies of scale to drive down cost: As entrepreneurs have sprinted into this sector, solar module prices declined nearly 50 percent last year alone. Experts predict further significant price declines going forward. In contrast, crude oil prices increased 100 percent last year, and are up by roughly 300 percent over the past decade.

### **The Risk of Inaction**

One of our great blessings as Americans is that we're a nation of innovators. This explains why we still lead the world in the information technology and life science industries. What worries me, however, is evidence that we are rapidly falling behind when it comes to clean energy.

In the last Industrial Revolution, America faced very little competition outside of England, and the word “globalization” wasn’t even in our vocabulary. Today, from Ireland to India, dozens of nations have discovered the recipe for our secret sauce, and are racing to innovate their way to new jobs and prosperity. Some are already enjoying extraordinary success – gains, I’m sorry to say, that have come at our expense.

We face a particularly strong economic threat from China, where the central government has determined that renewable energy is mission-critical to its future, and has aggressively rolled out ambitious policies and huge investments to support it. Chinese officials have granted subsidies, free land, and cash for research and development. The nation’s state-owned banks are also bankrolling green exports, a brilliant means of deploying its foreign exchange reserves as a competitive weapon at a time when the rest of the world is short of cash.

The results of these policies have been staggering. Within just a few years, China has become a global leader in the solar, wind, and advanced batteries industries. In the solar industry, it has built an industry basically from scratch to become the world’s largest manufacturer. Three years ago, China held merely 2 percent of the solar panel market; by the fourth quarter of 2009, that share had grown to nearly 50 percent. During the same period, U.S. market share in this sector declined from 43 percent to 16 percent.

We can’t sit back and watch these numbers continue to decline. The large and growing global solar photovoltaic market now exceeds \$40 billion annually, already surpassing the size of the global internet search market.

And let me remind you that solar power is only one sector in what is by far the world’s largest and arguably most essential set of industries: the \$6 trillion energy and transportation markets. These markets are on the cusp of a dramatic transformation, which translates to the kind of economic opportunity seen only every several generations or so. We simply cannot afford to ignore them.

### **The Climate Crisis**

As if globalization weren’t a daunting enough threat, it’s not by any means all we have to worry about. We simply can’t forget, as much as it may be human nature to try, the mounting risks of climate change. Some of the world’s leading scientists have determined that 350 parts per million is the safe upper limit for carbon dioxide in our atmosphere. We passed that benchmark back in 1988, and are rapidly approaching 400, a level that threatens dangerous weather, serious floods, disruptions in food supply, and increased epidemics. Put simply, climate change has become our most urgent innovation imperative: we’re morally obliged to invent a safer world for our children and their children.

### **The Promise of ARPA-E**

ARPA-E is a bold and brilliant effort to support innovation in the greentech industries that hold such promise both for our standard of living and the future of our planet. Once again, I

commend this Committee for its pioneering achievement in creating this new agency. I'll now address the four questions that accompanied my invitation to speak here today.

### **Venture Capitalists, Greentech, and ARPA-E**

You've asked me to describe the role of venture capital in energy technology development and give my thoughts about how ARPA-E might complement that role.

Venture capital's role in the energy markets compares with the one it has played for decades in the information technology and life sciences industries. Typically, venture capital firms seek to invest in companies that have moved beyond their earliest, highest-risk technical phase. The private sector as a whole largely avoids basic research, and venture capitalists are no different in this regard.

In contrast, the federal government has historically and successfully funded very early-stage research, and thus played an instrumental role in the innovation chain in a host of industries, including information technology, the life sciences, and national defense. In fact, through some remarkably successful partnerships with research universities and the private sector, which licenses commercialization rights for products that have demonstrated value, the government has provided the vast majority of basic research funding in this country. These public-private partnerships have saved millions of lives and generated hundreds of billions of dollars in revenue in the life sciences, while creating massive new information technology industries.

The great opportunity with ARPA-E is that this new agency can now play a similar role in U.S. energy technology development by providing that desperately needed, early-stage funding for breakthrough renewable-energy technologies. ARPA-E funding can also help address our competitive and environmental challenges by enabling companies to speed up production of breakthrough technologies and pursue new ones.

ARPA-E can perform this role most effectively, complementing the role of investors and scientists, if it is structured as a long-term initiative, with an expanded budget and clearly defined focus on renewable energy. In these ways it would truly mirror its tremendously successful predecessor, DARPA.

DARPA pioneered what's known as translational research, in which the research sponsors first identify the most crucial market requirements, and only after doing so, provide funding for the most worthy and promising technologies. DARPA achieved its phenomenal success not by seeking to avoid surprises, but by aspiring to create them. It served as a catalyzing force by defining the challenges, working with researchers to develop solution concepts, and building a community of change-agent advocates. DARPA's translational research approach embraces risk, seeking to ignite revolutionary breakthroughs rather than merely incremental improvements in existing products. The risks may be big, but as history has demonstrated, so are the potential rewards.

In the energy industry today, we face many enormous challenges. How can we limit the amount of greenhouse gases escaping from conventional power plants? How can we make intermittent

sources of power, from wind or the sun, more cost-effective and reliable? What are the best technical approaches to achieve high-performance, low-cost batteries for both transportation and grid storage? What policies should the federal government adopt to assure America leads the next industrial revolution? ARPA-E represents an essential first step in addressing these and other urgent questions.

### **The U.S. Greentech Investment Climate**

I last addressed the issue of the climate for greentech investment in my testimony before the House Subcommittee on Energy and the Environment in April 2007, on the eve of the global financial meltdown. The industry faced impediments then, and today, as may come as no surprise, the situation is even more challenging.

The good news is that the venture capital community is keenly interested in this sector, and eager to invest in promising green technologies. In recent years, venture capitalists have invested in many breakthrough green technologies, some of which have already entered the marketplace, and others which will come to market in the near future. I'm confident these companies, taken as a whole, have begun a dramatic transformation of our energy system, green for brown.

Unfortunately, however, U.S. green entrepreneurs and their venture sponsors are encountering obstacles in the form of the financial crisis, a scarcity of renewable energy projects in U.S. research laboratories, and fierce competition from abroad.

The venture industry, like virtually every other industry, has been hit hard by our economic crisis. In 2009, new investor commitments to venture capital firms declined nearly 50 percent over the previous year. The number of venture firms able to raise funds fell to its lowest point last year since 1993. Further, the scarcity of capital across the board – in particular in the credit markets – has imposed a new, major obstacle in the path for renewable energy entrepreneurs.

Total venture capital spending on greentech projects last year amounted to approximately \$5 billion. While that may initially seem like a large figure, it represents a decline relative to 2008 funding, and, more importantly, a tiny fraction – less than three-tenths of one percent - of the \$1.8 trillion U.S. market for energy and transportation. This three-tenths of one-percent, moreover, constitutes the lion's share of U.S. private sector renewable-energy research and development investment, since, as a rule, large energy companies have not been investing significant funds in R&D for renewable energy. And, unfortunately, if you show me an industry investing less than three-tenths of one percent of its revenue on research and development, I'll show you an industry that's not preparing for the future.

I must emphasize here that, to date, this lack of private investment in green energy R&D has not been made up by public sources. While the federal government has provided massive direct and indirect subsidies and benefits for the fossil fuel and nuclear industries over the last several decades, it has afforded only scant support for green energy technology research. In the years leading up to the creation of ARPA-E, the federal government provided little more than \$1 billion annually for all non-nuclear, clean and renewable energy research. In the health care

sector, in contrast, the National Institutes of Health has annually provided approximately \$30 billion in research funding.

The main result of the big greentech R&D deficit is a conspicuous shortage of renewable energy research projects at American universities and national labs. It's not due to any lack of technical talent or interest among researchers to invent breakthrough greentech products. To the contrary, American universities and our national labs are loaded with world-class scientific and engineering talent, many of whom are eager to devote their life's work to greentech research. To date, however, they've been held up by a lack of support for early-stage research. What this means for investors, to use a baseball metaphor, is that we simply aren't getting enough at-bats, even as our global competitors are making the necessary investments to continue hitting home runs.

A final challenge facing the American greentech investment community and entrepreneurs - one that is rapidly becoming a threat to the U.S. economy as a whole - is the fierce competition coming from overseas. Here's an alarming example: Today, the United States is home to only two of the world's ten largest solar companies, merely two of the world's top ten wind turbine producers, and just one of the top ten advanced battery manufacturers. Summing up: only one-sixth of these 30 top renewable energy companies are now based in this country. That's a paltry 17 percent market share.

The momentum in this industry is rapidly moving outside our shores, and the bottom line is that America must either start investing a lot more today to build leadership in these new industries and jobs, or we can continue with business as usual and end up buying windmills from Europe, batteries from Japan and solar panels from China.

### **ARPA-E's Performance**

All I've said up to now may help explain why my colleagues and I are so hopeful about ARPA-E. And all that we've seen to date of this remarkable agency has raised our hopes even more. ARPA-E is no panacea, but it does begin to address America's deficit in high-risk, high-reward renewable energy research projects.

Commendably, you've designed the agency to mirror the successful traits of its worthy predecessor, DARPA. Like DARPA, ARPA-E is small, nimble, and to all appearances unafraid of risk, with a flat, non-hierarchical management structure. It clearly has ample cabinet-level sponsorship and support, with its new chief, Dr. Majumdar, reporting directly to Secretary Chu. Within just a few months of his appointment last September, Dr. Majumdar has already come up with the creative idea of a new Fellows program for recent doctoral graduates.

ARPA-E has made fast, impressive work of selecting its first 37 grantees from an initial pool of 3,600 applications. As I review the list of these high-risk, high-reward projects, I'm heartened to see how many of them are aimed directly at tackling many of today's most urgent energy challenges. These include work on batteries for grid storage, which will assure a stable electrical grid even as we ramp up our supplies of clean but intermittent power sources from the sun and the wind. There's also funding for transportation batteries, which will accelerate the advent of

electric transportation. Several other grantees are working on the urgent task of limiting greenhouse gas emissions from conventional, fossil-fuel power plants. Yet another project focuses on improving building efficiency, saving the vast amounts of energy that today are literally going out the window.

ARPA-E's list of winners also showcases the kinds of partnerships we need to most efficiently ramp up new energy technologies. University researchers are joining entrepreneurs and government managers to transform today's good ideas into tomorrow's mass-produced solutions. These are all terrific models of how to mobilize America's inventive talents.

### **ARPA-E, Job-Creation and Technological Competitiveness**

As I've noted, the United States today remains a world capital of innovation. But we can't take our long-standing technology dominance for granted. Remember, today only one-sixth of the world's top solar, wind and advanced battery companies are based in the United States.

Ask yourself: what if only one of the six top information technology companies were American? What if Microsoft were German, Apple were Japanese, and Google, eBay and Yahoo were Chinese, and only Amazon were based in this country? We'd be sending billions of extra dollars and hundreds of thousands of jobs overseas, to support other nations' economic growth.

Unfortunately, this is just the situation we have shaping up in the renewable energy industries – the ones that will surely drive the second industrial revolution.

Our competitors offer us a daunting challenge. Yet I doubt anyone here in this room is ready to concede this race. In fact, our purpose today is to chart a course to guarantee America's position as the leader in the 21<sup>st</sup> Century's race for energy innovation.

Efforts such as ARPA-E are crucial in our quest to catch up in this contest, which is also our best hope of providing future prosperity. Renewable energy technologies we can scarcely imagine today are destined to lead to a cascade of diverse, breakthrough products and vast numbers of high-quality jobs: for blue-collar builders, factory employees, and maintenance workers; and white-collar engineers, salespeople, and managers.

### **We Can't Lose Momentum**

In a very short time, your determined leadership has brought us exciting progress. ARPA-E is serving an instrumental role in focusing researchers' attention on the right goals. But what happens after this year? It's distressing to imagine ARPA-E's funding may soon expire.

I'd like to remind you that when DARPA was created in 1958, it received a budget appropriation of \$500 million, which is the equivalent of \$3.5 billion in current dollar terms. This amounted to .67 percent of total federal spending that year. Today, our federal spending on all renewable energy represents less than .04 percent of current federal outlays. In other words, DARPA's initial appropriation was more than 16 times the federal budget share devoted to renewable energy research today. Certainly, today's jobs and environmental crises are every bit as

threatening to our country's future as the impetus to DARPA's creation: the October 1957 Russian launch of the world's first earth-orbiting satellite, Sputnik.

I urge you to extend and expand ARPA-E's charter. It should be treated not as a short-term experiment within the DOE, but rather as a pillar of U.S. energy policy. Only then can we show the rest of the world, once again, how to lead an Industrial Revolution.

I appreciate the Committee's invitation to participate in today's hearing, and look forward to learning more about how we can work together to build a more secure and prosperous future.