



**Report of the**  
**EPA–Venture Capital Community Summit:**  
**Exploring Programs to Commercialize**  
**Environmental Technology**  
**November 12, 2008**



*June 2009*



### **Disclaimer**

The information in this report has been reviewed by the EPA and Venture Capital Community participants in the Summit. It also has undergone EPA administrative and general counsel review. It does not necessarily reflect the views of the Agency, however, and no official endorsement should be inferred.

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# Report of the EPA–Venture Capital Community Summit: Exploring Programs to Commercialize Environmental Technology

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# Introduction

## The EPA-Venture Capital Community Summit: Exploring Programs to Commercial-

ize Environmental Technology was convened by EPA as part of the Agency's response to the recommendations in the EPA National Advisory Council for Environmental Policy and Technology (NACEPT) report titled, *EPA and the Venture Capital Community: Building Bridges to Commercialize Technology*. This Venture Capital Report was submitted to EPA's Administrator in April 2008.

NACEPT operates under the Federal Advisory Committee Act (FACA), which permits it to make consensus recommendations to EPA. NACEPT is one of the few EPA FACA groups that provides advice directly to the Administrator. The Summit, in contrast, was an EPA meeting that was not convened under FACA and the group was not asked to reach a consensus or provide recommendations. Ideas put forth by individuals were noted, however, and are described in the Summary in this report.

The Summit was a public meeting designed to address two recommendations in the Venture Capital Report: (1) EPA should forge and sustain communications with the early-stage investment community and (2) EPA should strengthen financial support (e.g., loan guarantees, grants, revolving loan funds) for environmental technology commercialization. The meeting was announced in a *Federal Register* notice (see Appendix E) and

the agenda included Public Comment time. EPA created a Web site ([www.epa.gov/ncer/venturecapital](http://www.epa.gov/ncer/venturecapital)) for the event that includes the Venture Capital Report and two prior NACEPT reports on how to better coordinate EPA's technology programs and to work with partners in the marketplace.

This report contains summaries of the comments made by participants during the EPA-Venture Capital Community Summit. The report also includes three presentations that were made at the Summit to provide background information for the participants. These presentations were: "Venture Capital Overview," by Emily Baker of the National Venture Capital Association; "U.S. EPA: The Context for Promoting New Environmental Technology," by Walter Kovalick of EPA Region 5 (Chicago); and "Department of Energy Technology Commercialization: Energy Efficiency and Renewable Energy," by Drew Bond of the Department of Energy's Office of Energy Efficiency and Renewable Energy.

Importantly, the report also includes a list of potential follow-up items developed by EPA to encourage environmental technology investment and commercialization. This list is provided as an appendix because it was developed after the Summit (see Appendix A).

If you have any questions, comments, or interest in pursuing these ideas with EPA, please contact Paul Shapiro at [shapiro.paul@epa.gov](mailto:shapiro.paul@epa.gov). ●









# Agenda of the EPA-Venture Capital Community Summit

## EPA-Venture Capital Community Summit: Exploring Programs to Commercialize Environmental Technology November 12, 2008

### AGENDA

**Co-Chairs:** Rob Brenner, U.S. Environmental Protection Agency (EPA)  
Hank Habicht, SAIL Venture Partners

**Purpose:** To put forward and discuss a set of potential EPA and venture capital community actions to catalyze the commercialization of environmental technologies.

**Background:** This Summit is a followup to the recommendations in the EPA National Advisory Council for Environmental Policy and Technology (NACEPT) report, *EPA and the Venture Capital Community: Building Bridges to Commercialize Technology* (April 2008), which is available at [www.epa.gov/ncer/ventu-recapital](http://www.epa.gov/ncer/ventu-recapital).

9:30 a.m. – 10:00 a.m.      **Registration**

10:00 a.m. – 10:05 a.m.      **Welcome**

**Rob Brenner**, Director, Office of Policy Analysis and Review, Office of Air and Radiation, EPA, and **Hank Habicht**, Managing Partner, SAIL Venture Partners

10:05 a.m. – 10:25 a.m.      **Introduction to Venture Capital and Growth**

**Emily Baker**, Director, Federal Policy and Political Advocacy, National Venture Capital Association

10:25 a.m. – 10:45 a.m.      **Introduction to How EPA Operates**

**Walt Kovalick**, Assistant Regional Administrator for Resources Management, Region 5, EPA

10:45 a.m. – 12:00 p.m.      **Discussion of the Venture Capital Report Recommendations, Especially Related to Beginning and Sustaining Communication**

- **Desired Outcome:** Develop an initial list of actions that individuals believe would enhance communication over the long term

12:00 p.m. – 12:30 p.m.      **Working Lunch – Overview of the New Department of Energy (DOE) Technology Commercialization Programs**

**Drew Bond**, Director for Commercialization and Deployment, Office of Energy Efficiency and Renewable Energy, DOE



- **Desired Outcome:** Begin discussion of DOE's commercialization programs and how individuals believe similar programs at EPA could advance the Agency's mission

12:30 p.m. – 2:30 p.m.

### **Discussion of Alternative Financing Instruments: Loan Guarantees, Loans, Venture Capital Funds, Grants, etc.**

- **Desired Outcome:** Develop an initial list of actions that individuals believe would be helpful in exploring new EPA financial programs

2:30 p.m. – 2:45 p.m.

### **Break**

2:45 p.m. – 3:00 p.m.

### **Public Comment**

3:00 p.m. – 4:30 p.m.

### **EPA and Venture Capital Roles and Next Steps**

- **Desired Outcome:** Discuss the morning and afternoon lists and ask individuals to put forward potential actions they consider most important for EPA and the venture capital community to pursue to catalyze the commercialization of environmental technologies

4:30 p.m.

### **Adjournment**





# Summary of the EPA-Venture Capital Community Summit

## Welcome

*Rob Brenner, Office of Policy Analysis and Review, Office of Air and Radiation, EPA; Hank Habicht, Managing Partner, SAIL Venture Partners*

Rob Brenner opened the meeting by welcoming everyone to the Summit. He explained that he and Hank Habicht were the co-chairs of the Summit. Mr. Brenner then asked everyone to introduce themselves. He then introduced Paul Shapiro and thanked him for planning and organizing the Summit.

Mr. Brenner described why the Summit was of great importance to the U.S. Environmental Protection Agency (EPA). Traditionally, the availability of commercially available technologies, such as flue gas desulphurization devices for power plants and catalytic converters on cars, has assisted the Agency in the development of standards and regulatory policy. More recently, some states such as California and Massachusetts have enacted progressive energy and environmental legislation and become regional centers for venture capital (VC) investments and emerging environmental technology development. Potentially, EPA could learn from these state models and determine how the Agency could structure programs and regulatory policy to encourage the development of emerging technologies that can enhance environmental protection. Rather than waiting for commercial technologies to become available, EPA may be able to become more proactive and influence environmentally beneficial technology development and adoption.

Mr. Brenner explained that rising energy costs and impending climate change impacts also are driving the Agency to more aggressively investigate new energy technologies that offer beneficial environmental results. The VC community is closely attuned to emerging technology development so it

is very timely for the Agency to initiate communications with this community.

As a former EPA Deputy Administrator, Mr. Habicht expressed his appreciation for the Agency senior managers who were participating in the Summit. He complimented these managers for their abilities to promote environmental protection and their openness to consider new ideas and approaches for raising environmental performance. Mr. Habicht mentioned the book, *The Prophet*, by Kahlil Gibran, which was popular in the 1960s. That book included a statement that went something like “I wasn’t put in this world to make you happy and you were not put in this world to make me happy; each of us has to do our own thing, but if in the end we find each other then it’s beautiful.” Concerning today’s meeting, Mr. Habicht explained that the VC community is not in business to make EPA successful and vice versa but he hoped that at the meeting today each party will have found each other and that at the end of the day each of us will say it is “beautiful.”

Clean technology is not a passing fad or a “flash in the pan.” Mr. Habicht suggested that there is a convergence of issues and challenges that has not existed before. Rising energy prices have affected supply and demand. Global energy use is expected to increase three-fold in the next 30 years; in the past 20 years, energy demand has doubled. Seventy percent of this new demand is coming from the less developed world, with China contributing nearly 30 percent of this new demand. Another factor affecting clean technology growth is the amount of “main stream” financial capital being committed to this sector.



Every private-sector financial institution—from international banks to VC firms—is committing resources to clean technology. The key issue is to put resources behind clean technology “winners” so that both investors and the environment will benefit. Mr. Habicht explained that a reasonable goal for today’s meeting is for EPA and the VC community to gain a better understanding of each other as well as a better appreciation of the driving forces and constraints affecting each other. He hopes that this will form the foundation for establishing a process for ongoing communication.

Mr. Habicht asked Mr. Shapiro to explain the ground rules for the Summit. Mr. Shapiro said that the Summit is not a Federal Advisory Committee Act (FACA) meeting; however, it is a public meeting and there are some rules that apply. The venture capitalists participating in the Summit cannot make recommendations to EPA nor can they reach consensus on group deliberations. The meeting is designed to seek individual rather than group or collective advice. Mr. Shapiro cautioned that the group cannot reach agreements on issues and that participants should strive to direct their comments to EPA and not to each other. In summary, Mr. Brenner explained that the group can offer specific comments to the Agency but cannot offer recommendations to EPA that were derived through consensus voting. He stressed that today’s meeting is an informal session but mentioned that a more formal FACA process may follow. Mr. Brenner suggested that, in the future, EPA may consider forming a VC advisory subcommittee as part of the National Advisory

Council for Environmental Policy and Technology (NACEPT) or some other existing FACA committee.

Based on the Summit agenda, Mr. Shapiro explained that the “Desired Outcome” from each session will be determined by EPA officials who will summarize the discussion from each session and identify items for future consideration. He also mentioned that notice of the meeting was published in the *Federal Register* and that there is time set-aside on the agenda between the afternoon sessions for public comments.

Mr. Habicht suggested that the transition team for the new administration may be interested in the results of today’s deliberations. Although the Summit participants know many of the transition team officials, he emphasized that the focus of the Summit should not be on providing advice to the transition team; rather, the focus should be on what communication mechanisms can be established between government and VC officials to develop a better clean technology policy.

Mr. Habicht explained that the purpose of the first two presentations is to establish a common basis for both EPA and the VC community. The first presentation by Emily Baker of the National Venture Capital Association (NVCA) will describe the VC community, and the second presentation by Walt Kovalick will describe EPA. When introducing Ms. Baker, Mr. Habicht indicated that she is the director of the NVCA Clean Technology Advisory Council. ●

## Introduction to Venture Capital and Growth

*Emily Baker, National Venture Capital Association*  
(Slide presentation is provided in Appendix C)

Ms. Baker explained that the NVCA Clean Technology Advisory Council was established 2 years ago based on the growing interest and investment opportunity in this sector. Over the past 18 months, NVCA has developed a clean technology public policy agenda and is currently lobbying Congress to recognize the significance of this sector. Part of the NVCA efforts has

included establishing a close relationship with the U.S. Department of Energy (DOE) in its energy efficiency and renewable energy activities. Ms. Baker expressed her hope that the Summit would provide an opportunity for the NVCA to establish better communications with EPA about clean technology issues.



Ms. Baker described the history and focus of the NVCA as a trade association. Initially, the NVCA was created to foster communications among VC professionals but the association has evolved into a public policy and advocacy organization for the VC community. The NVCA lobbies all congressional committees including those dealing with tax and trade policies, as well as energy, environment, and small business committees. VC firms are small businesses, so the NVCA is proactive for small business. The NVCA supports basic research because federal laboratory developments—whether from the DOE National Laboratories, EPA, or any other agency—can be a source of new product and technology ideas for venture firms.

Ms. Baker noted that the research data collected by the NVCA on venture investments is provided in the *MoneyTree Report*. These data are shared publicly and are available online. She commented that NVCA's members are responsible for nearly 90 percent of the VC currently under management.

In defining VC, Ms. Baker provided an overview of the VC life cycle. The process starts with VC funds being raised from various institutional investors; once sufficient funds are collected, the VC firms look for portfolio companies in which to make investments. VC firms screen hundreds and potentially thousands of companies annually to identify 8 to 10 companies that will comprise their fund portfolio.

Both financial and management expertise is provided to portfolio companies by venture firms. Ultimately, venture firms want to build a portfolio company to the point where it can be a public entity or be acquired by a larger entity. VC firms do not invest in public markets or security derivatives. They do not leverage or charge fees to portfolio companies; nor do these firms take hedge or short positions in companies. This is the major distinction between VC firms and hedge funds or private equity investments.

Ms. Baker identified some of the characteristics of VC investments. VC investments are long; sometimes as long as 15 years in the life sciences sector.

The investments focus on innovation and usually are high risk and high reward. Forty percent of venture-backed companies fail, forty percent break even or make minimal gains, and only 20 percent make significant gains. In addition, VC builds value in companies and the economy. The investment stays in the company and is used for growth and venture capitalists bring operational and scientific knowledge to bear to catalyze growth by involving themselves in the day-to-day operations.

Although venture investments accounted for just 0.02% of invested capital (about \$230 billion compared to the nearly \$1.5 trillion invested by hedge funds), companies that got their start with VC accounted for 10.4 million jobs and \$2.3 trillion of revenues in the United States in 2006, which was 18% of the Gross Domestic Product. Some companies that were originally funded by VC include Genentech, Microsoft, Apple, Google, FedEx, and Starbucks. Venture-backed companies usually outperform their non-venture counterparts and current venture-backed companies account for more than 400,000 U.S. jobs. Innovations funded by VC include the pacemaker, Herceptin (cancer), and Integrilin (heart disease). Venture capitalists increasingly are focusing on clean technology (solar, wind, carbon capture, and energy efficiency). The *Global Insight Report* prepared by the NVCA offers more details on the economic impact of VC.

Ms. Baker noted that venture capitalists are welcomed by congressional members because they bring jobs and economic growth to their districts and states. For every VC dollar invested in 1970-2001, there was \$7.90 in U.S. revenue during 2006. For every \$28,463 of VC invested in 1970-2001, there was one job in the year 2006. The tangible benefits of venture investments are substantial and long term.

Ms. Baker identified the top 10 states for VC investment in 2007, noting that California, Massachusetts, and Texas are the top three among the states with more than \$19 billion of VC invested. Beyond the top 10 states, there have been a lot of clean technology venture investments in Colorado and New Mexico, probably because of the DOE National Laboratories in these states. California, Texas, Washington, and Massachusetts lead the



top 10 states for VC-backed U.S. revenues in 2006. California, Texas, Pennsylvania, and Massachusetts top the list for VC-backed U.S. jobs in 2006, employing more than 4.8 million workers. Ms. Baker noted that one in ten Americans works for a venture-backed company.

In 2000, venture-backed U.S. revenues were \$1.5 trillion; they grew to \$1.7 trillion in 2003 and then \$2.3 trillion in 2006. The VC-backed growth rate of 11.8% from 2003-2006 outpaced the 6.5% of total U.S. sales growth. In 2000, there were 8.7 million VC-backed U.S. jobs; this number grew to 9.4 million in 2003 and to 10.4 million in 2005. The VC-backed U.S. job growth rate of 3.6% outpaced the 1.7% job growth rate of the private sector from 2003-2006.

Ms. Baker compared Internet-specific investments (dollars invested and number of deals) with clean tech investments from January 2005 to March 2008, indicating that there has been a much greater increase in clean tech investments since 2006. Ms. Baker provided data on the investment activity in the top five industries—biotechnology, software, medical devices and equipment, industrial/energy, and semiconductors—from early 2007 to early 2008. There was an increase in investment activity in medical devices and equipment and semiconductors in early 2008 compared to 2007. The other industries experienced no increase in investment or a decrease in early 2008.

Ms. Baker identified six federal policy initiatives that are needed to drive clean tech: (1) Renewable Portfolio Standard, (2) Renewable Fuel Standard, (3) investment tax credits, (4) strengthened CAFE standards, (5) more robust federal R&D for energy, and (6) the Federal Government as an early adopter and user of clean energy technologies.

In closing, Ms. Baker stated that the NVCA is looking forward to working more closely with EPA to facilitate new partnerships. She provided her e-mail address (ebaker@nvca.org) and encouraged participants to contact her if they wanted more information. Ms. Baker thanked the Summit participants for the opportunity to make her presentation and asked if there were any questions.

Ira Leighton asked Ms. Baker to identify the two most important factors that attract venture investments to certain states. Ms. Baker replied that the high concentration of university research in the top 10 states is one factor and another is the spin-outs of innovations from the DOE National Laboratories, particularly in states such as New Mexico. Historically, another factor that has encouraged venture investments is the close proximity of portfolio companies to the VC firm's offices. Most venture capitalists wanted to avoid getting on a plane to visit their investment companies. Ms. Baker admitted, however, that this factor is becoming less important, particularly with clean tech investments.

Dr. Kovalick asked how cost center-based technology investments, like environmental technologies, might differ from energy efficiency investment technologies, like solar and wind farms that may save industry resources if they are installed. Ms. Baker replied that solar and wind technologies are attracting investments because venture capitalists see a high market potential and high return on their investments in these industry subsectors. Conversely, some venture investments are made in environmental technologies because investors believe they can “do well by doing good.”

Eric McAfee explained his company's venture investments are not based on cost-center or incremental revenue issues, but on the scalability of the business model. Venture capitalists tend to be most interested in a rapidly growing revenue stream from their portfolio investments. Gross profit margins are important to venture investments. Key questions include: What is the potential revenue? What are the growth profit margins? What will it cost to get there and how quickly can it be done? Rosemary Ripley added that EPA needs to think about how to show industry that it can make money on environmental technology investments. She offered that cap and trade technology approaches may be a useful example; industry is interested in reducing carbon dioxide in the atmosphere and if it can be demonstrated that industry could actually make money using these technologies, then the market for them would grow rapidly.



In the early 1990s when the Clean Air Act Amendments (CAAA) were being negotiated, Mr. Brenner explained that EPA asked Smith Barney to conduct a study for the Agency on business opportunities in the proposed CAAA. Following completion of the study, EPA hosted a conference on the clean air marketplace that sought to explain that the CAAA could offer some significant investment opportunities. Although the compliance technology costs associated with some provisions of the CAAA were estimated to be very high, these Amendments did create some of the initial cap and trade programs endorsed by the Agency.

John Preston added that the potential profit center for primary energy generation is much greater

than waste avoidance considerations in most clean technology investments. He noted that, in the early 1990s, there were more than 60 publicly traded, hazardous waste cleanup companies; today, there are only four companies still in business and two of those four are in Chapter 11 bankruptcy proceedings. Nevertheless, primary energy generation does create environmental problems, so the key is to determine how to generate more energy but create fewer environmental problems. A good example of an industry where productivity has increased while discharges have decreased is the chemical industry; during the past 10 years, the productivity of the chemical industry rose but its generation of hazardous materials decreased. ●

## Introduction to How EPA Operates

*Walt Kovalick, Jr., Assistant Regional Administrator, Region 5, EPA*  
(Slide presentation is provided in Appendix C)

Dr. Kovalick explained that his presentation would cover EPA's mission and budget, provide a context for how EPA operates and implements its mission, and conclude with some of his personal observations about the nexus of EPA's work and environmental technology.

EPA is one of more than 20 independent regulatory agencies in the Federal Government. Although EPA is not a Cabinet department, it has Cabinet status. The Agency's mission is to protect public health and the environment. There are more than 20 statutes that provide mandates for the Agency, including: Clean Water Act (CWA); Clean Air Act (CAA); Safe Drinking Water Act (SDWA); Resource Conservation and Recovery Act (RCRA); Comprehensive Environmental Response, Compensation, and Liability Act (Superfund); Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); Toxic Substances Control Act (TSCA); and others. Beyond environmental media like air, water, and land, EPA also has regulatory responsibility for regulating products under FIFRA and TSCA. Under TSCA, for example, EPA regulates existing and new chemicals. Another statute that was not on the slide is the National Environmental

Policy Act (NEPA), which impacts many efforts including some energy development projects.

EPA's Fiscal Year (FY) 2008 budget was \$7,472 million. Since the passage of the 1995 Government Performance and Results Act, EPA like all federal agencies must prepare a 5-year strategic plan. Currently, EPA is operating under the *2006-2011 Strategic Plan* (on the Web at [www.epa.gov/ocfo/plan/2006/entire\\_report.pdf](http://www.epa.gov/ocfo/plan/2006/entire_report.pdf)), which identifies five goals: (1) Goal 1—Clean Air and Global Climate Change, (2) Goal 2—Clean and Safe Water, (3) Goal 3—Land Preservation and Restoration, (4) Goal 4—Healthy Communities and Ecosystems, and (5) Goal 5—Compliance and Environmental Stewardship. Goal 1 accounts for 13.1% of EPA's budget and 2,609 full-time equivalents (FTEs). Goal 2 accounts for the largest portion of the EPA budget, 36.1% and 2,901 FTEs; most of the resources associated with this goal are distributed to states for their local water responsibilities. Goal 3 accounts for 23.6% of the budget and 4,574 FTEs, Goal 4 for 16.7% of the budget and 3,736 FTEs, and Goal 5 for 10.5% of the budget and 3,487 FTEs.



EPA's \$7,472 million budget is divided among state and tribal assistance grants (\$1,222 million), operations from non-Trust Funds (\$3,175 million), operations from Trust Funds (\$1,360 million) and infrastructure/State and Tribal Grant project financing (\$1,715 million).

Dr. Kovalick presented EPA's organization chart, which identified the Agency's headquarters and regional offices. The chart explains how EPA is organized by environmental media and function. Dr. Kovalick noted that each EPA region is organized similar to EPA headquarters with media and functional offices.

Dr. Kovalick explained that the regulated community is any business or organization that is required to comply with EPA statutory or regulatory requirements. This community includes more than 800,000 permitted facilities under CAA, CWA, and RCRA; more than 20 million small businesses; 80,000 units of local government; and millions of regulated facilities under more than 12 major environmental statutes. Dr. Kovalick pointed out that most permitted and regulated businesses are regulated by the states, not EPA. For most statutes, EPA sets national standards and the states implement them on a local basis. State and local governments provide most of the environmental regulation; these agencies issue most of the permits and conduct most of the enforcement cases.

With respect to operations and implementation, Dr. Kovalick explained that EPA exercises discretion in balancing the mandate given in each statute. The different types of traditional regulation used by EPA include technology based (most stringent or cost effective), health based (set for environmental conditions), market based (sets limit for nation/area; facilities get tradable allowances), and use restrictions (exposure restricted by label directions or product restriction). The market-based, cap and trade allowances are available primarily in the Clean Air regulations, and EPA use restrictions are available only through the FIFRA and TSCA regulations.

In the 1990s, EPA began to move beyond "command and control" approaches to environmental protection. In general, large stationary and point

sources are under control in the United States so the focus has turned increasingly toward diverse nonpoint sources of pollution, such as agricultural runoff and salt runoff from highways and other sources. For the past 15 years, EPA headquarters has been working with the regions on compliance assistance, voluntary partnerships, Performance Track (beyond compliance), and partnering for economic gain/development (e.g., Brownfields). EPA currently has more than 50 voluntary partnership programs to help businesses and the public with environmental protection and more than 500 companies involved in Performance Track, which is a voluntary beyond compliance recognition program. EPA also executes more than 100 cooperative research and development agreements (CRADAs) with private sector organizations annually.

Dr. Kovalick presented a map that depicted the 10 EPA regions and the states in each region. He mentioned that these regions are consistent among federal agencies. Almost one-half of EPA's 17,000-member workforce is located in the regional offices because nearly all environmental programs are delegated to the states and tribes. The vast majority of inspection, permitting, and enforcement is at the state/tribal level. The Agency has approximately 2,400 FTEs dedicated to science and technology work and most of these staff members are in the Office of Research and Development (ORD). Dr. Kovalick noted that more than a third of the entire EPA workforce is scientists and engineers. About \$440 million of the Agency's \$760 million science and technology budget is extramural. From a technology perspective, Dr. Kovalick explained that states do not routinely accept the same technologies for control and compliance; therefore, a technology that might satisfy environmental requirements in California might not be acceptable in New York. Reciprocity among states on environmental technologies for permitting and enforcement remains an elusive issue.

Dr. Kovalick identified six EPA roles in the environmental technology marketplace, including: (1) funding agent, (2) technology developer, (3) regulator/enforcer, (4) information broker, (5) partner in deployment, and (6) user of "first



resort.” Dr. Kovalick went on to explain that EPA is best as a regulator/enforcer and as a verification agent (part of the information broker role). The Agency is less experienced as a funding agent, technology developer, or user of “first resort.” As verification agent, EPA has conducted a very aggressive program with more than 400 technologies verified through the Agency’s Environmental Technology Verification (ETV) Program in the past 15 years.

Dr. Kovalick presented a diagram that mapped EPA’s environmental technology programs to the R&D continuum (from research/proof of concept to diffusion/utilization). He explained that the majority of EPA’s efforts are concentrated in diffusion/utilization. (Each of the programs identified in the diagram were fully explained in the hand-out that accompanied Dr. Kovalick’s presentation.) He noted that the EPA technology programs directed at earlier stages along the continuum are small compared with those of other federal agencies; for example, EPA’s Small Business Innovation Research (SBIR) Program is approximately \$6 million annually, whereas DOE’s SBIR Program is about \$500 million annually.

Dr. Kovalick identified a number of intersections between EPA’s work and environmental technologies. For example, EPA’s researchers and program staff have an in depth understanding of technology in certain niche areas, such as drinking water treatment, air pollution control, remediation, and diesel retrofit. He described a recent example wherein Congress directed that EPA determine the best technology available for removing arsenic from drinking water for small communities. Likewise, EPA has expertise in monitoring and measurement technologies because the Agency specifies the methods to be used to track environmental performance for wastewater discharges or air pollution emissions. EPA also has a secondary level of understanding of industrial processes to set Best

Available Control Technology (BACT) and other levels. In addition, EPA has an appreciation of technology aspects of many sectors through partnering programs such as Design for Environment, energy conservation, and others.

Dr. Kovalick stated that, with few exceptions, EPA’s mission is not to be a technology development organization. New environmental problems are viewed first through a statutory/regulatory lens leading to technology inquiry. A recent example of this is the use of the Underground Injection Control (UIC) Program’s proposal to sequester greenhouse gases; the technology did not drive the inquiry, it was driven by the statutory requirement. Although EPA has expertise in some niches, the Agency’s mandates do not call for comprehensive monitoring of technology developments. Dr. Kovalick also mentioned the Environmental Technology Council (ETC), which is a forum established by EPA for joint action across program and regions. More information on the ETC is available on the Internet at [www.epa.gov/etop](http://www.epa.gov/etop).

In closing his presentation, Dr. Kovalick offered some observations about EPA’s role in environmental technology development. Every 6 months, EPA publishes a regulatory agenda that charts the subjects and issues to be addressed over a several year period. This agenda does not provide details about levels of the proposed regulations; this information will become available as regulations are formally proposed in the future. Dr. Kovalick pointed out that, by their nature, technology-driven regulations “fix” best technology and because of limited resources, the Agency is unable to continuously update the best technology identified in regulations. EPA is well vested in technology diffusion activities, especially technology verification. The Agency is experienced in operating SBIR and grant programs but has no mandates for many other financial vehicles. ●



## Discussion of the Venture Capital Report Recommendations, Especially Related to Beginning and Sustaining Communications

Mr. Brenner suggested that questions for both Dr. Kovalick and Ms. Baker can be posed as part of the discussion of the second NACEPT Report recommendation to “forge and sustain communications with the early-stage investment community.” He said that former EPA Administrator Bill Reilly and former EPA Deputy Administrator Hank Habicht will be remembered for encouraging EPA officials to “get out more” and interact with states, environmentalists, and the business community. Several successful new EPA programs such as Performance Track and other partnership programs grew out of these efforts. Mr. Brenner explained that the NACEPT recommendation to forge communications with the venture capital community offers a similar opportunity for the Agency. There were several specific suggestions for the Agency to consider within this recommendation and he encouraged Summit participants to keep these specific suggestions in mind during this discussion.

Mr. Preston complimented Dr. Kovalick and Ms. Baker on their presentations. He offered four observations. First, in clean technology development, private-sector resources greatly exceed federal government resources. The clean technology investments being made by the California Public Employees’ Retirement System (CalPERS) is an example of the vast resources available in the private sector. Three years ago, CalPERS had no resources invested in energy and environmental technologies; today, more than 50 percent of its resources are invested in these technologies.

Second, there is a pending revolution in innovation in energy and environmental technologies. The dramatic escalation of oil prices in the past 2 years is the principal cause for this revolution. An example of this revolution is today’s announcement by C Change Investments (the venture capital firm founded by Mr. Preston and former CalPERS executive Russell Read) to construct the world’s largest, most-efficient synthetic natural gas production facility. Because of its high efficiency, operational availability, and production capacity,

the facility is expected to produce natural gas at less than half the cost of other current gasification technologies. There will be zero carbon dioxide (CO<sub>2</sub>) emissions from the facility because the CO<sub>2</sub> generated will be delivered under pressure to enhance oil recovery in the Gulf area.

Third, the U.S. Federal Government should consider how to reduce its carbon footprint. Mr. Preston explained that C Change Investments is the co-developer of a first-of-a-kind ecologically sustainable Medical Science Green City to be located within Sejong, which is to become the new administrative capital of Korea. The \$200 million project is part of a large effort to build a highly efficient, near-zero carbon emission new capital where Korea’s national government office buildings will be relocated. Globally, office buildings consume nearly 40 percent of energy requirements and simple innovations like high efficiency compact fluorescent light (CFL) bulbs or improved insulation materials can make a significant difference. He suggested that the payback for converting to CFL or higher efficient bulbs in U.S. government office buildings could be 3 years or less. If the Federal Government tried to develop an even more efficient and less expensive CFL bulb than currently available, the potential impact of such a small yet important lighting device would be enormous. He stressed that the Federal Government adoption of such small, but innovative technologies could establish a significant precedence and have a major market impact.

Mr. Preston suggested that the Federal Government consider creating “shoot-offs” to spur innovative technology development. In 1993, the Federal Communications Commission (FCC) sponsored a shoot-off for the design of the high definition television (HDTV). The FCC was unable to decide among the four leading designs; so they contacted the Massachusetts Institute of Technology (MIT) to identify the best design features among each of the four finalist systems and those features were used as the specifications



for HDTV. EPA could emulate this approach to identify the best light bulb or best insulation technology for retrofits in buildings. Mr. Preston commented that the U.S. construction industry is the one of the few sectors that has failed to innovate or improve productivity over the past 50 years. If EPA could push the development of some construction-related technologies and the Federal Government was as an early adopter of these technologies, the results could be significant. This approach would encourage the VC community to invest in these technologies, which would also offer a short economic payback in energy savings for the Federal Government.

Mr. Habicht noted that EPA teamed with utilities and other organizations in the early 1990s to sponsor the development of advanced residential technologies, such as the Super Efficient Refrigerator. These programs were referred to as the “Golden Carrot” programs because they were market-pull partnerships to demonstrate federal leadership in promoting technology advances. With very modest resources, EPA and its partners leveraged a much larger private-sector investment in energy efficiency and pollution prevention.

Mr. McAfee suggested that the Federal Government could make it easy for VCs to fund the technology advances if the government could help the VCs know where to look for such advances. Venture capitalists need insights on markets. He stressed that the venture community spends a lot of time trying to determine the biggest market with the highest margins; anything the Federal Government can do to identify those markets and margins would be of great interest to the VC community.

Mr. McAfee said he is a big fan of setting targets and then letting the market determine how to get there. One of the Cagan McAfee portfolio companies, for example, has developed algae that consumes CO<sub>2</sub> and produces ethanol; the demand for such a technology might be significant if cap and trade programs were established for greenhouse gas emissions. This type of technology also should be of interest to EPA because it addresses two environmental issues—the elimination of CO<sub>2</sub> and the production of biofuel. Mr. McAfee

believes that EPA could signal the establishment of a huge greenhouse gas reduction market if a national cap and trade system for these gases was established. Beyond the VC community, Mr. McAfee noted that large utilities, such as Duke Energy, one of the largest U.S. electric power companies, also would be interested in technology investment opportunities created by a cap and trade system.

Mr. Habicht added that large companies such as Duke Energy make up the primary membership of EPA voluntary programs, such as Performance Track, Climate Leaders, and others. These large companies are the clean technology buyers for many VC portfolio companies. Mr. Preston agreed about the value added provided by large companies and noted that utilities are providing one-half of the capital requirements for the \$3.5 billion coal gasification project he mentioned earlier.

Ms. Ripley agreed that CO<sub>2</sub> emissions reduction will create a big market and she believes the world is waiting for the United States to show leadership on this issue. The new Administration should step up and make some decisions about how the United States can address the problem; then, the VC community can determine the biggest opportunities. She suggested that there may be opportunities to use existing emission control systems to control CO<sub>2</sub> as well. For example, one of the NGEN portfolio companies, Powerspan Corporation, offers one of the least expensive means of capturing CO<sub>2</sub> for sequestration. As a post-combustion technology, its development grew out of another proprietary Powerspan technology that offers cost-effective, multi-pollutant (sulfur dioxide and particular matter) control of coal-fired power plant emissions.

Mr. Brenner noted that Frank Alix, Chairman and Chief Executive Officer of Powerspan, has visited EPA and discussed the company’s pioneering cost-effective technologies for controlling coal combustion emissions. The interaction the Agency has had with Powerspan has been valuable in terms of understanding clean energy technologies. Mr. Brenner said that these types of interactions need to become more common across the Agency.



Ms. Ripley supported the earlier proposal for creating government-sponsored competitions and suggested one for CO<sub>2</sub> reduction technologies. Such competitions would force the Agency into dialogues with companies that are developing advanced technologies.

Larry Starfield asked if the venture capitalists were aware of some of the regional environmental problems being addressed by the Agency, such as environmental issues associated with concentrated animal feed lot operations (CAFOs). He pointed out that CAFOs are a large environmental problem created by dairies, poultry operations, and cattle farms. Some states, like North Carolina and Arkansas, have supported the development of animal waste digesters but all of these systems have to be subsidized because they are not cost effective. Mr. Starfield explained that there is a huge market for technologies that would remove animal waste problems from the watershed and require no government subsidy.

As stated by Dr. Kovalick earlier, there are nearly 800,000 permitted facilities in the United States and each of these facilities must provide monthly reports on permitted operations. The monthly reporting requirement has created a huge market for lawyers when citizens file suits every time the permitted limits are exceeded. Mr. Starfield noted that real-time monitors would prevent the occasions for these suits because permitted facilities could be warned when the limits were exceeded (for various discharge points) and take corrective action immediately. Self-reported violations by companies would prevent citizen suits and reduce EPA enforcement costs tremendously.

Daniel Hullah replied that real-time monitoring technology probably exists but the reason it has not been adapted for use by the permitted facilities is because its other application probably has a larger market. Mr. Hullah also noted that the businesses may be reticent to adopt technologies that would increase their cost by taking more frequent corrective actions. It may be capital intensive to establish the market for such technologies.

Mike Shapiro commented that the “monthly obligation to report” for water discharge permitted facilities is based on the amount of data EPA can receive (and review) as well as the data a permitted facility can generate. If data are generated instantaneously the same violation problems also may apply so citizen suits could continue and may even grow. Further, if real-time monitoring was adopted by permitted facilities then regulations may need to change to react to the type and amount of data reported.

Outside of water discharge monitoring, Mr. Starfield pointed out that remote sensing cameras have been used in the Houston, Texas, area to monitor air emissions from petroleum refineries. There is an economic incentive for refineries to identify and reduce their air emissions because volatilized emissions means they are losing product out of their stacks. Currently, EPA does not use these cameras for emission monitoring and enforcement, but the industry has adopted their use for economic reasons.

Mr. Preston suggested the CAFOs problem may be addressed by looking at the issues associated with the conversion of biomass to energy. The energy density of the animal waste needs to be understood because transportation costs may be significant for moving the waste from the field to the digester. The energy density of petroleum coke and coal is about 14,000 BTU per pound, while the energy density of animal waste may be about 5,000 BTU per pound; thus, the transportation costs for petroleum coke and coal is three times less than that for animal waste. Likewise, corn can produce 200 gallons of biofuel per acre per year, palm oil can produce 500 gallons per acre per year, and algae can produce 20,000 gallons per acre per year. Unfortunately, many investors mistakenly invested in corn because of the government subsidy and neglected to consider the economic capability of the technology. In retrospect, it would have been more beneficial if the government would have offered a subsidy for “green fuel” independent of the conversion technology.



For addressing animal waste, Mr. Preston suggested that small anaerobic digesters may be the solution. He noted that new \$1 billion Bank of America Tower in Manhattan (New York City) will have a small anaerobic digester in the basement to treat all of the waste generated in the building. Initially, Bank of America estimated a 5 to 7 year payback on their investment; but recently revised its estimate to a 3 year payback on water, waste, and energy operations and maintenance. Mr. Shapiro mentioned that the nitrogen and phosphorous associated with animal waste are not normally addressed with methane generation technologies. Both the nutrient and pathogen issues need to be addressed with these technologies.

Mr. McAfee explained that venture capitalists love to hear about problems; the bigger the problem, the more appealing it is to the VC community. If distributed anaerobic digesters are the solution for animal waste but cost is an issue, maybe a loan guarantee program for dairy, poultry, and other farms may be the solution. He would like to have input from EPA and other federal agencies concerning the size of the carbon sequestration problem. He commented that legislating sequestration may not be wise, similar to the corn/biofuel subsidy. If the goal is energy independence or cleaner air, then those issues should be legislated rather than the feedstock.

Ira Leighton stated that, in his experience, environmental requirements are based on ambient not technology standards. A new National Pollutant Discharge Elimination System (NPDES) permit will be water-quality driven and an opportunity exists because existing technology will not be capable of achieving the new standard. This will create a strong driver for emerging technology. Unfortunately, it is very challenging for EPA to issue a performance-based standard. It is difficult to establish the performance criteria because the regulated businesses and developers are not forthcoming about the capability of emerging technologies. How can the VC community assist EPA in writing performance-driven requirements?

Ms. Ripley suggested that EPA may want to consider publishing a Request for Proposals on performance standards for specific pollutants to

initiate a dialogue on the issues. Mr. Preston said that “necessity is the mother of invention” and suggested that rolling reductions with non-performance consequences may be an alternative approach. EPA may want to consider a tax on nitrogen runoff in water or CO<sub>2</sub> emissions that would become effective at some time in the future and businesses and/or manufacturers would be taxed if they did not reach those discharge or emission levels. The cap and trade system for reducing air emissions works; with such as approach, utilities would be charged with reducing CO<sub>2</sub> emissions by “x” amount over so many years. Utilities would make investments to reach these reduction levels and the levels could be changed (lowered) periodically. Mr. Preston suggested that this is the approach the Agency has taken with the diesel engine emission reductions.

For nitrogen runoff, fertilizer manufacturers could be contacted about similar requirements to reduce the runoff into rivers and streams. These manufacturers would make investments to determine how to bind the nitrogen to reduce releases or pay for their inability to do so. These approaches would not only create an investment opportunity for venture capitalists but for the entire private sector because everyone clearly knows that in “x” years it will be worth “\$y” to eliminate this problem.

Mr. Brenner commented that EPA conducted a case study to determine why the Agency’s experience with the diesel rules worked so well. It turned out that this effort was a good example of how effective cooperative processes can be; it included “shuttle diplomacy.” EPA talked with diesel engine manufacturers and pollution control equipment manufacturers to determine what was feasible and how hard the Agency could push without creating impossible regulatory requirements.

Based on EPA’s experience to date with cooperative discussions on more stringent regulatory requirements, Mr. Brenner suggested that EPA could identify “grand challenges” (e.g., CO<sub>2</sub> reductions or animal waste reductions) in the Agency’s *Strategic Plan*. These grand challenges could be supplemented with specific problems such as



lowering fine particulate emission requirements, expanding diesel retrofit applications, expanding wood stove emission reductions, or addressing the pipeline problems associated with ethanol delivery. Publication of these grand challenges and specific problems could be followed by EPA-sponsored conferences with venture capitalists and others about how to deal with these problems. These conferences could build on the type of interactions begun with this Summit and help create an understanding on both sides about the issues associated with these challenges and problems.

Mr. McAfee suggested that scalability is one of the most important issues to consider. How scalable are conferences, Web sites, list serves, and other tools of the trade for use in communicating as much information as possible about these challenges and problems to the VC community and others? There are only a few venture capitalists involved in this Summit but there are 470 NVCA members and thousands of firms involved in private equity. The issue is how can EPA maintain communications with all of these entities and inform them about these challenges and problems. Ms. Baker noted that NVCA would welcome the opportunity to serve as an avenue for communications with the VC community.

Mr. Habicht offered three comments to capture the morning's discussion. First, pre-regulatory

problems such as animal waste control may offer an opportunity for financial assistance programs such as grants or cooperative agreements to find solutions without regulations.

Second, mechanisms need to be created to determine how performance standards can be developed without alienating the regulated industry. Mr. Habicht noted that, in the past, the Hazardous Waste Treatment Council tried to suggest how the hazardous waste treatment standards should be lowered and the regulated industry was offended by this action because it was not part of the dialogue. Venture capitalists do not want to be viewed as encouraging more stringent requirements that may not be acceptable to the regulated industry; these companies would be customers for these emerging technologies and need to be part of the dialogue about challenges and problems.

Third, publicizing grand challenges to be addressed by non-regulatory solutions, such as the Golden Carrot Super Efficient Refrigerator challenge, the lead phase-down, the chlorofluorocarbon (CFC) phase out, and others, is an attractive suggestion. Beyond identifying these challenges and problems, Mr. Habicht suggested that EPA could be the source of needed information on unintended consequences, life-cycle impacts, and other issues that would be useful in determining how to solve some of these challenges and problems. ●

## **Working Lunch – Overview of the New Department of Energy Technology Commercialization Programs**

*Drew Bond, Office of Energy Efficiency and Renewable Energy, DOE*  
(Slide presentation is provided in Appendix C)

Mr. Bond thanked EPA and the VC community for the opportunity to make a presentation about DOE's technology commercialization efforts. In the Federal Government, both legislative authority and political/management support are important in creating new initiatives. He noted that DOE Secretary Sam Bodman and Andy Karsner, former DOE Assistant Secretary for Energy Efficiency and Renewable Energy, were the inspiration and supporters for many of the new DOE technology

commercialization programs. In addition, Mr. Bond explained there are a number of congressional bills that will benefit energy efficiency and renewable energy technologies. He commended EPA for organizing the Summit and hoped that it might lead to more and improved cooperation between EPA and DOE.

National security, environmental, and economic goals form the basis of a robust National Energy



Policy but historical data demonstrate the magnitude and urgency of the challenge. Mr. Bond pointed out that the United States continues to use non-U.S. sources for its energy supply and much of this supply is fossil fuel based. All of these trends are in the wrong direction. Energy security requires that the United States diversify its energy mix and reduce its dependence on petroleum. Environmental stewardship requires an energy policy that reduces greenhouse gas emissions and other negative environmental impacts. Economic competitiveness requires the creation of a more flexible, more reliable, higher capacity U.S. energy infrastructure and improvement of energy productivity.

In describing DOE's organizational structure, Mr. Bond stated that DOE has three principal department organizational units—Office of Energy (energy R&D); Office of Science (basic science research); and National Nuclear Security Administration (nuclear security). The Office of Energy, which includes the Office of Energy Efficiency and Renewable Energy (EERE), focuses on applied research issues, trying to move projects from basic research to the field.

EERE's budget was \$1,344 million in FY 2008. EERE develops a broad range of clean energy technologies, including fuels and vehicles (vehicles, hydrogen, biomass), renewable power (solar, wind and water, geothermal), and energy efficiency (buildings, industrial). EERE also is responsible for the Weatherization Intergovernmental Program (WIP), which works with states on low-income housing retrofit activities and the Federal Energy Management Program (FEMP), which works with counterpart federal agencies on the procurement, use, and management of more efficient energy resources. Nearly one-half (\$622 million) of EERE's budget is devoted to development of vehicles and fuels.

EERE spreads the federal R&D funding across multiple laboratories but works predominantly with the National Renewable Energy Laboratory (NREL). Eleven of the 17 DOE National Laboratories are supported by EERE, but NREL in Golden, Colorado, receives nearly 95 percent of its annual funding from EERE. The DOE National

Laboratories are government owned but contractor operated. For the new NREL contract that was announced in October 2008, a cooperative arrangement was established whereby the two principal contractors—Midwest Research Institute and Battelle Memorial Institute—established partnerships with three universities—Stanford, Ohio State, and MIT—and the financial community to help NREL accelerate the future commercialization and widespread adoption of sustainable energy technologies.

Mr. Bond stated that DOE Program Managers have indicated that the “commercialization valley of death” has prevented DOE program from being as effective as the managers would have liked. The “commercialization valley of death” refers to the quantitative challenge of transitioning between early adopters and mass market penetration. This valley occurs after technology creation in the market-focused business and product development stage. The typical investors at this stage are entrepreneurial and seed/angel investors.

Mr. Bond explained that a technological innovation must overcome four challenging transitions before reaching the market. The first transition is from basic science to applied science. The second is from applied science to technology investors. The third transition is from technology investors to asset investors, and the fourth is from asset investors to markets. The EERE Commercialization Team focuses on building bridges between the applied scientists and technology investors, which is the second of the four transitions. Mr. Bond commented that DOE also is interested in the issues facing developers at transitions 3 and 4 but these deal with tax and regulatory policies. He noted that public benefit is only fully realized when the product is delivered to the market.

EERE's commercialization bridges are designed to overcome four primary gaps: talent, information, capital, and strategy. The “talent bridge” involves DOE attracting and hiring personnel that have both technical and business skills because both skill sets are required to commercialize technologies. The “information bridge” seeks to build effective communications between DOE staff and technology investors. Mr. Bond noted that techni-



cal language fails to resonate with the business community. The “capital bridge” is the recognition that the Federal Government can play a key role in early stage seed funding. The Federal Government may have a higher “risk tolerance” than even angel investors on technology development issues. VCs are more likely to fund business plans and prototypes than research papers and competition for VC funding is stiff. The “strategy bridge” tries to cultivate and promote policies that would impact the development of all EERE technologies. Best practices have been developed to foster a culture of innovative.

Built off of a proven VC model, the Entrepreneur in Residence (EIR) Program forms the primary plank of EERE’s “talent bridge.” This is a well known model that has been used in the VC community to develop knowledgeable investors and company managers. A fundable business needs a technology that works and a market ripe to sell into, but most importantly it needs an entrepreneur who can build the business plan, assemble a management team, and raise capital. VCs favor experienced entrepreneurs with a track record of identifying promising technologies and building markets.

DOE’s EIR Program connects leading scientific and business talent. Through a competitive solicitation process, three DOE National Laboratories—NREL, Sandia, and Oak Ridge—established the pilot EIR Program. The National Laboratories partner with a VC firm to sponsor the EIR. The VC firm identifies, hires, and mentors the EIR who is placed in the National Laboratory. The EIR mines the laboratory intellectual property and drafts business plans for the commercialization of technologies developed by the National Laboratory. Some of the key criteria DOE used to select the VC firms included their size and track record (in the clean technology sector) with commercializing portfolio company technologies, and their experience with EIRs. EERE provided \$100,000 matching-funds and full access to the respective National Laboratory. The program also includes a pre-negotiated standard equity share license agreement.

Kleiner and Perkins was selected for the EIR position at NREL, Foundation Capital for the EIR position at Sandia, and Arch Ventures (formerly spun out from the Argonne National Laboratory) for the EIR position at Oak Ridge. Mr. Bond expects that the EIR Program will cause a cultural change within each of the three participating National Laboratories as well as across the Department toward recognition of the value applied research can offer for technology commercialization.

The Equity Share License Agreement, which is tailored for entrepreneurs and small businesses with tight budgets, forms a primary plank in the “strategy bridge.” Traditionally, the DOE National Laboratories required an up-front large cash payment in licensing fees, making traditional licensing agreements expensive and time consuming to negotiate. Small entrepreneurial companies often are more willing to give up equity rather than offer cash to license emerging technologies. Built off the Stanford University license, the Equity Share License has been pre-negotiated with VC general counsels, National Laboratory general counsels, and DOE general counsel. DOE adopted the Equity Share License Agreement as a replacement for traditional licenses to attract more entrepreneurial interest in National Laboratory-developed technologies.

Designed to introduce investors to technology opportunities, the Technology Commercialization Showcase forms the primary plank of the “information bridge.” Many EERE funded technologies stall in the “commercialization valley of death” simply because the innovation has not been clearly communicated to the business community. DOE challenged the EERE Program Managers to identify 8 to 10 of the most promising technologies in their portfolios. DOE created simple, layman’s descriptions of the innovation opportunities, and then invited prominent investors to a 2-day conference showcasing the technologies. EERE started these Commercialization Showcases in 2007. Twenty-four venture capitalists participated that first year and the number increased to 80 venture capitalists in 2008.



To illustrate how the technologies are described in simple layman's terms, Mr. Bond described the case study of low-cost carbon fiber technology as a lightweight replacement for structural steel. The problem is that carbon fiber currently is too expensive for broad application (\$12-30/lb vs. \$5-8/lb). The Oak Ridge National Laboratory has developed technologies to reduce the cost of carbon fiber production by utilizing low cost feedstocks (low-cost textiles and renewable lignin) and advance processing methods (thermo-chemical stabilization, rapid oxidation, and microwave-assisted plasma carbonization). Low-cost carbon fiber reduces vehicle mass by up to 40 percent, which increases fuel economy up to 25 percent. Three patents have been issued on the technology and five patents and seven invention disclosures have been filed.

Four of the processes have been reduced to practice (microwave-assisted plasma carbonization, textile-based precursors, thermo-chemical stabilization, and plasma oxidation). The time to availability is 3 to 5 years, and the capital needs include a 2-4 MM lb/year carbon fiber plant that is expected to cost \$18-22 million.

The Technology Commercialization Fund, designed to fill the gap between R&D and VC funding, forms the primary plank for the "capital bridge." Because innovations struggle to find financing following completion of the research and prior to VC funding, the Technology Commercialization Fund offers financing for National Laboratory technologies that are not yet proven at the bench scale. The Fund requires 50-50 DOE-industry matched funds. The funds are restricted to prototype development, demonstration, and deployment, and they cannot be used for further scientific research. The Fund is designed to complement angel investment or early stage corporate product development.

Eight of the 13 National Laboratories received financing from the Technology Commercialization Fund in 2008. The funding decisions are based on the potential for market opportunity, the likelihood of commercial success, the management team, DOE priorities, and private-sector partners. The Fund is a "carrot" to attract private-sector partners to examine the National Laboratories'

intellectual property portfolios. Resources for these funds was established through Section 1001 of the 2005 Energy Policy Act, wherein DOE was tasked with setting aside 0.9 percent of its annual budget for applied research to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes.

The EERE Commercialization Team pursues an aggressive schedule to accelerate the deployment of advanced energy technologies. Mr. Bonds presented a timeline that identified the many activities undertaken by EERE to support each of the four bridges described earlier. For the "talent bridge" the activities included EIRs working in the laboratories, Senior Executive Service (SES) Advisors on board, Summer Associates at DOE, and Commercialization Fellows at NREL. Mr. Bond explained that the SES advisors are 3-year SES appointments that were created to bring into DOE business and finance executives to help EERE with its technology commercialization efforts. Mr. Bond stated that he holds one of the three current appointments in these positions. The Summer Associates at DOE are second-year Stanford University students seeking a Master of Business Administration (MBA) degree who work at DOE as interns on various energy-related projects. EERE expects to reach out to Ohio State University and MIT MBA Programs in the future for interns, given their partnership with NREL. The Commercialization Fellows at NREL are business-minded individuals (up to three business persons annually) selected to help NREL push intellectual property development at the laboratory.

In addition to its efforts to facilitate the second transition from applied science and technology investors, the EERE Commercialization Team advises many of DOE's public-private initiatives that address the subsequent transitions. Mr. Bond described a few examples. In January 2008, EERE signed an agreement with the Governor of Hawaii creating the Hawaii Clean Energy Partnership. This bipartisan agreement was created to help Hawaii implement its Renewable Portfolio Standard (RPS). The Hawaii RPS is to reach 20 percent use of eligible energy efficient and renew-



able energy technologies by 2020. Hawaii has one of the highest electricity rates in the United States—27 cents a kilowatt hour in Oahu and 49 cents a kilowatt hour in Kauai. Ninety-five percent of Hawaii's energy is from oil and 99 percent comes from non-U.S. sources. The goal for the Partnership Program is for Hawaii to achieve 70 percent of its energy from renewable sources by 2030.

The DOE Loan Guarantee Program was created as a result of the Energy Policy Act of 2005. DOE received appropriations (up to \$4 billion) to offer loan guarantees in 2006. More than 140 companies responded to the initial DOE loan guarantee solicitation, and in 2007, 16 companies were selected from the solicitation and asked to submit full proposals. In 2008, DOE received up to \$38.5 billion in additional loan guarantee appropriations. These additional appropriations were provided for nuclear energy, fossil energy, and energy efficiency and renewable energy technology development; \$10 billion was slated for energy efficiency and renewable energy technologies. The current solicitation for energy efficiency and renewable energy technologies has been extended from December 31, 2008 to February 26, 2009. This solicitation focuses on three issues: (1) building a better "widget" (e.g., an advanced technology); (2) building the widget domestically (e.g., manufacturing capabilities in the United States); and (3) putting together the widgets in a way that they have not been put together before. Regarding this third issue, Mr. Bond explained that DOE is interested in proposals that offer the integrated deployment of energy efficiency and renewable energy technologies. The issue of concern is how to deploy technologies that are scalable? How can wind energy, for example, be matched with energy storage (e.g., battery operated vehicles)?

Mr. Bond cautioned that DOE and other federal agencies cannot operate at the speed of business. This is clearly seen in implementation of the DOE Loan Guarantee Program, which is 3 years old and DOE has not yet issued the first loan guarantee. DOE is thinking about ways to make the Loan Guarantee Program more "small business friendly." Most energy efficiency and renewable energy technology development companies that have

expressed an interest in loan guarantees are large (e.g., \$100 million revenues); DOE is interested in attracting smaller companies (e.g., \$25 million revenues or less) for loan guarantees as well.

DOE will be establishing a Finance and Investment federal advisory committee to assist the Department with its Loan Guarantee Program and other technology commercialization and deployment efforts. According to Mr. Bond, the establishment of this federal advisory committee was mandated either by the Energy Policy Act of 2005 or the America COMPETES Act.

In closing his presentation, Mr. Bond provided e-mail addresses for the SES Advisors of the EERE Commercialization Team, which in addition to himself includes Carol Battershell and Wendolyn Holland. Mr. Bond thanked everyone for their attention and asked if there were any questions.

Mr. Preston complimented Mr. Bond on his presentation but expressed his concern that DOE had yet to issue a single loan guarantee. He cautioned that failure to move quickly is the "kiss of death" for developers and investors. Mr. Preston said he helped developed the "fast track" option for the Department of Defense's (DOD) SBIR Program and he would be glad to offer suggestions from this experience to DOE. Mr. Bond responded that David Frantz, Director of the DOE Loan Guarantee Program, is seeking advice and would be interested in hearing any suggestions to improve his program.

Ms. Ripley asked if the Loan Guarantee Program would make loans to small companies that are pre-revenue or if the Program was directed only to post-revenue companies. Mr. Bond replied that the Loan Guarantee Program favors companies that are post-revenue. The Program has to be self-sustaining and there has to be a high probability of repayment of the loans. In addition, there are four substantial fees associated with the Program that make it more favorable for post-revenue companies. The application fee alone ranges from \$75,000 to \$125,000, depending on the size of the project. The credit subsidy fee also is substantial. This fee is the government's estimate of the risk level associated with each project. The



amount of this fee has not been publicly release yet; the Office of Management and Budget (OMB) and DOE are still working on this issue. Even with these fees, the unpredictability of when a loan guarantee will be offered continues to hamper the Program.

Mr. Leighton asked about capital versus operating costs for energy efficiency and renewable energy projects. In New England, he explained, a lot of effort is expended to maintain communications with state energy regulators regarding local energy policy. There is more than \$400 million in “system benefit charges” in New England. He asked if DOE is connected with state energy regulators to determine how the use of energy efficiency and renewable energy technologies will affect state rate payers and other local energy generation policies.

Mr. Bond replied that, in general, his office does have responsibility for these issues. He explained that if consumers can overcome the higher capital costs for renewable energy sources, then the operating costs work to their advantage because they often are negligible. Mr. Bond noted that to achieve its 70 percent RPS goal by 2030,

Hawaiian officials will have to work with their state energy regulators and state utilities. This also will require Hawaii to look at energy policy mechanisms in other states and potentially other countries to determine what it can adopt. About a month ago, a voluntary agreement was signed with the state utility to determine how it can become a partner in Hawaii’s RPS program. Issues that are being investigated include feed-in tariffs, smart metering, and other utility programs. Mr. Bond also noted that the DOE FEMP responsibilities include understanding state energy regulatory issues.

Mr. Preston noted that, for investors, the up-front capital costs are the biggest barrier to most energy efficiency and renewable energy technology deals in the clean technology sector.

Mr. Habicht commented that, in the past in New England, air regulators have met with utility regulators. At the federal level, both EPA and DOE should establish communications with the Federal Energy Regulatory Commission (FERC) because utilities are very sensitive to energy regulatory policies. ●

### **Discussion of Alternative Financing Instruments: Loan Guarantees, Loans, Venture Capital Funds, Grants, etc.**

Mr. Habicht stated that the DOE presentation offered some useful insights into how current federal programs work and this can provide the basis for the discussion of alternative financing instruments.

Mr. McAfee noted that DOE has developed a useful roadmap for financial instruments for large companies that have good credit ratings from Moody’s or Standard and Poor’s. Unfortunately, venture capitalists do not work with companies of this size and revenue status. Mr. McAfee suggested that DOE and other federal programs have to extend their financial assistance programs beyond Fortune 50 companies. His opinion is that the DOE Loan Guarantee Program needs to be amended. If EPA is considering a loan guarantee program, the Agency should examine the programs

of the U.S. Department of Agriculture (USDA). Mr. McAfee explained that one of the Cagan McAfee portfolio companies is at USDA today securing a loan guarantee approval. The application was submitted just 30 days ago, and it is being approved today. The funding will be available in 30 days. The USDA has a good template for effectively executing loan guarantees and other federal agencies should learn from that experience.

Mr. McAfee stressed that the DOE Loan Guarantee Program can be an important accelerator for the clean technology sector but the Department’s inability to process a loan is hurting the Program and the industry. Given the status of the current credit markets, Mr. McAfee suggested that DOE is now the “perfect partner” to assist the clean technology sector. He encouraged EPA to offer



DOE its respected scientific expertise to help the Department more effectively execute its financial assistance programs for clean technology.

Mr. Preston noted that DOE is a much needed industry partner for scale up of energy projects. DOE is filling a gap in energy project financing and has to concentrate on eliminating the time delay in processing loan guarantees. Mr. McAfee stressed that DOE needs scientific help in executing its financial assistance programs, adding that the only internal scientific resource the Department has is NREL. He pointed out that clean technology investments are capital intensive, longer term investments unlike Internet investments that were less expensive and had short-term exit strategies. DOE has a good team, but Mr. McAfee emphasized that the Department needs external assistance to help speed up the execution of its Loan Guarantee Program.

Mr. Brenner mentioned that NREL has sought to establish better working relationships with EPA, but acknowledged that the Agency has to be more proactive in collaborating with NREL. He asked if specific mechanisms and/or scientific issues could be identified that should be pursued between the organizations.

Mr. McAfee noted that there is a leadership transition underway at DOE because the Assistant Secretary for Energy Efficiency and Renewable Energy will not be nominated for several months. He suggested that EPA should use this time to discuss internally the issues that should be taken up with DOE so when the new Assistant Secretary is confirmed, EPA is prepared to meet to discuss potential collaborations. In the interim, Mr. McAfee encouraged EPA officials to meet with DOE's current senior management to offer the Agency's assistance.

Mr. McAfee encouraged DOE to have a rolling solicitation process for its Loan Guarantee Program. Rather than having an annual or biannual solicitation process, DOE should seek proposals monthly or quarterly. He suggested that DOE treat its Loan Guarantee Program as a bank that can offer loans routinely to technology developers.

Mr. McAfee asked if the DOE Loan Guarantee Program had an equity component. Mr. Bond replied that technology developers need to provide 20 percent equity in their proposed energy projects. Of the remaining 80 percent project cost, 100 percent is guaranteed.

Mr. McAfee noted that the source of the 20 percent equity is key for the investment returns to venture capitalists. In the State of Oregon, for example, up to \$18 million in grants are available from the state for ethanol plants. Therefore, to receive a \$180 million DOE loan guarantee for an Oregon ethanol plant, venture capitalists only have to provide \$18 million in equity. Mr. McAfee pointed out that if DOE requires the 20 percent equity to be solely provided by investors, the potential returns are greatly reduced and investors are less likely to participate in such projects. Mr. McAfee noted that DOE should expand its commitment to energy independence and treat the issue like a "war for energy independence."

With regard to financing technology projects, Mr. Habicht explained that some of the critical elements are: the probability of success of the project, a proven track record of the project sponsors, and the overall financial plan for the project. He noted that loan guarantees require sufficient coverage for cash flows and debt to protect against defaults. Although many loan guarantees and even some grant programs favor large companies, most federal grant programs are oriented toward small companies where the probability of success may be the same but the stage and level of investment are smaller. A better set of metrics for success may need to be developed for small business grant programs to illustrate how useful these programs are in technology development. With its technical expertise, EPA can be a resource for investors through its technology validation and verification programs. These programs can help address effectiveness and cost issues for investors and technology customers as well.

Because of the large size of the projects (e.g., \$100 million plus) being considered under the DOE Loan Guarantee Program, some studies have been conducted on the credit-to-risk ratios



anticipated for these projects. The conclusion is that the size of these ratios is much higher than current USDA loan guarantees and it is unknown how significant these ratios will be in determining who will receive a DOE loan guarantee.

Mr. Leighton cited the EPA New England (Region 1) experiment with the EPA SBIR Program as a possible model for other regions to emulate to spur environmental technology development. The region worked with ORD to develop the first targeted EPA SBIR solicitation focused on a regional environmental problem. One of the regional needs was for a device to assess the level of lead in soil. X-Ray Fluorescence (XRF) portable detectors were identified as appropriate devices for this application. Because most environmental regulations are methods-driven, EPA New England had to work with the Office of Pollution, Pesticides, and Toxic Substances (OPPTS) to verify the reliability of these detectors for lead soil analysis. It took Region 1 18 months to convince OPPTS about the efficacy of this technology because it required a change in the lead detection methods to allow its use.

Mr. Starfield offered another example of method-driven requirements. He explained that the current method for detecting leaks from petroleum refineries is a sniffer leak detector. EPA Region 6 wanted to use infrared cameras for leak detection rather than sniffers but was stymied because of the Method 21 requirements for volatile organic compound emissions, which were based on sniffer technology exclusively. Petroleum refiners are using infrared cameras but get no credit for doing so because Method 21 has not yet been modified. When Method 21 ultimately is changed to allow the use of both technologies, it is expected companies will have the choice to select either technology for their compliance assurance.

At the EPA Science Forum in May 2008, Mr. McAfee noted that there was some discussion about how the Agency can communicate its findings about technologies. He explained that EPA is in a unique position to offer its opinion about what adds value to a technology. These opinions should not be recommendations but objective findings that can be widely communicated.

Another suggestion offered by Mr. McAfee was the X PRIZE. He explained that, in 2004, the X PRIZE Foundation awarded its largest prize in history for a spacecraft capable of carrying three people into space, twice within 2 weeks. Even though EPA may not be able to offer a \$10 million prize, the Agency could announce a competition for the best form of carbon sequestration or some other environmental challenge and select the best proposal for possible technology application by industry, venture investors, and others.

Ms. Baker commented that one issue that needs to be addressed is the ineligibility of venture-backed companies for participation in the SBIR Program. This has become an issue with the National Institutes of Health SBIR Program and more recently with the DOE SBIR Program. Ms. Baker noted that the NVCA is lobbying Congress to clarify the Small Business Administration's (SBA) affiliation rules and ownership definitions for venture-backed businesses. Currently, if more than 51 percent of a company is owned by a venture capitalist then that company is ineligible for SBIR consideration.

April Richards, one of the EPA SBIR Program Managers, noted that EPA has not experienced this problem with its SBIR applicants; probably because the program is small in comparison to those of other federal agencies. Mr. Leighton noted, however, that there are reciprocity issues between federal agencies with respect to SBIR Programs. He noted that the recipient of an EPA Phase I SBIR award for development of the XRF detection technology could not seek Phase II funding through the DOD SBIR Program because of differences between the two programs.

Mr. Preston commented that MIT was contacted by DOD more than 10 years ago to help rethink the Department's SBIR Program. MIT helped DOD create a "Fast Track" component for its SBIR Program wherein the award time between Phase I and Phase II could be reduced and other considerations given to the company if the Phase I recipient could attract outside (private sector) investors who will match the SBIR Phase II funding. DOD SBIR projects that obtain such outside investments and qualify for the Fast Track can receive interim funding of \$30,000 to \$50,000



between Phases I and II and be evaluated for Phase II award under a separate, expedited process. Ms. Richards pointed out that DOD has a \$1 billion SBIR Program, while EPA has a \$4 million SBIR Program. She noted, however, that EPA does offer an incentive for Phase I recipients to seek third-party investments but the size of the incentive is small compared to those offered by DOD and some other federal agencies.

Jeff Heimerman noted that Ms. Richards and other EPA SBIR Program staff members are working with other federal agency SBIR Programs to identify opportunities for technology developers in the clean technology sector. Mr. Heimerman said EPA is working to make these other sources of capital more transparent to everyone.

Dr. Kovalick asked if the list of SBIR companies from EPA and other federal SBIR Programs would be useful to venture capitalists. Mr. Preston replied that receipt of SBIR funding is not as important to venture capitalists as the company's management team. If a company receives multiple SBIR awards, it often is viewed by venture capitalists as a "professional SBIR recipient." Venture capitalists care more about the substance than the hype. Mr. Preston added that the EPA New England XRF technology example was a huge success story; the company recently was purchased by a large organization that will market the technology nationally.

Mr. Habicht agreed that small businesses that market their ability to receive multiple SBIR grants is a "turn-off" for venture capitalists because such companies think the government is their client rather than the marketplace. Dr. Kovalick suggested that EPA could provide information about its SBIR recipients at future meetings with the venture capital community to allow investors an opportunity to determine their interests, if any.

It was pointed out that some technologies may only be suitable for design applications and scaling up a technology beyond its design capacity may not be possible. An energy technology designed for 50 megawatt capacity applications, for example, may not work when it is scaled up

to 200 megawatt requirements. Sometimes small businesses are seeking information, rather than funding, from the government about permitting issues or quality assurance metrics to verify that their technology can be replicated. In some cases, venture investing is viewed negatively by small companies because too much equity and leverage has to be sacrificed to get venture funding. EPA needs to examine the value proposition offered by clean technologies because problems could be shifted from one environmental media to another.

Historically, EPA has not been a technology financing agency and Mr. Habicht asked, based on the discussions so far, if there are financial assistance instruments that the Agency should consider in the future. Ms. Ripley replied that EPA should consider small grant programs for pre-revenue companies. She suggested that Canada offers a good model for highly successful applied research programs. One of the biggest programs is the \$3 billion Scientific Research and Experimental Development (SR&ED) Program. Basically, this is a tax credit program for which Canadian companies receive a federal tax credit of up to 35 percent for investments up to \$2 million and a 20 percent tax credit for investments larger than \$2 million. The Program has been tremendously successful in encouraging technology development across Canada.

Mr. Leighton suggested that perhaps EPA should hold technology development forums around the practice areas known best to the Agency. Recently, EPA New England sponsored a technology development forum on waste sites, specifically Brownfields sites and old landfills. EPA asked developers and investors involved in cleaning up these sites to offer their perspectives on what was done right and wrong, and how EPA could help others clean up sites in the future. Perhaps, a similar forum could be planned among EPA, DOE, and USDA and developers and investors could offer their perspectives on how the three agencies might cooperate to solve mutual problems.

Mr. Preston agreed that this could be a very useful approach for addressing cross-Agency problems and identifying Agency-specific needs.



This approach also could circumvent some of the limitations EPA and others may face in technology commercialization such as the lack of new resources to support technology development and the inability to pick technology winners. The sponsorship of such forums by EPA and other federal agencies could help identify technology trends, Agency challenges, and federal energy requirements for light bulbs, insulation, and other building-related issues.

For the past several years, EPA has made a heavy investment in technology verification. Mr. Brenner asked if this should continue to be a strong investment for the Agency. Mr. Preston confirmed that technology verification should continue to be provided by the Agency. Mr. Hullah agreed, noting that the technology verification provided by NREL has helped investors evaluate the efficacy of those technologies.

James Rea, SiteStories, suggested that the President's Green Chemistry Challenge Award has provided some important recognition for sustainable technologies. Although there are no resources associated with these awards, they have provided national credit for innovative technologies. Another program is EPA's People, Prosperity and the Planet (P3) Student Design Competition for Sustainability. Although the P3 competition does not offer much funding, it has resulted in the creation of several small innovative technology companies.

Mr. Habicht noted that, to date, EPA has developed two types of technology programs:

- ✧ Statutory programs such as Best Available Control Technology (BACT) required on major new or modified sources of air pollution and Lowest Achievable Emission Rate (LAER) required on major new or modified sources of air pollution in non-attainment areas, and
- ✧ The ETV Program that does not have strict statutory requirements but offers an objective analysis of several different media-specific technologies. He noted that ETV is not the EPA "seal of approval" for a technology.

Mr. Habicht suggested that it might be useful to discuss how ETV could be better structured and communicated to satisfy investor needs.

Mr. McAfee cautioned that any technology verification program needs to offer intellectual property protection. He explained that some of his portfolio companies have not used the NREL verification program because it does not offer such protection. Mr. Habicht noted that EPA's pesticides and toxics programs have good Confidential Business Information (CBI) procedures and requirements that work. Mr. McAfee replied that if a company's intellectual property is protected and the Agency can verify the technology, then this information could be highly useful to DOE in implementing its financial assistance programs. Mr. Preston warned that EPA may not be able to go too far in verifying a technology.

Sarah Bauer, EPA ORD, described the Agency's Federal Technology Transfer Act (FTTA) Program that includes protection of intellectual property rights. EPA is in the process of developing an Agency-wide position on intellectual property rights. EPA also has a large number of patents that are available for review by investors and has partnered with several businesses through CRA-DAs. Sally Gutierrez, Director of EPA's National Risk Management Research Laboratory (NRMRL) in Cincinnati, Ohio, explained that NRMRL routinely validates technology performance and works to understand other technical and economic issues associated with technology development. This experience has allowed NRMRL to provide detailed advice and data to EPA regional offices, headquarters offices, and states. NRMRL also has been contacted by venture capitalists about specific issues concerning technologies and the laboratory is prepared to continue this service in the future. Mr. Leighton added that the Agency's ability to write performance-based objectives rests on an experienced workforce and the ability to offer programs like ETV.

Ms. Ripley asked if EPA is writing methods-based or performance-based rules. Mr. Leighton replied that EPA historically has written methods-based rules, which work well for monitoring require-



ments; however, the Agency needs to write performance-based rules in the future.

Mr. Shapiro explained that EPA generally tries to develop numerical, performance-based standards in Agency regulations. In certain cases, however, such as storm water management, it has been difficult to develop meaningful numerical standards, so the Agency has used Best Management Practices (BMPs) instead. Mr. Starfield added that EPA also faces environmental problems for which multiple standards apply. In Region 6, for example, hurricanes have created large physical challenges in the region. EPA has been asked to determine the best way to demolish 30,000 houses. There are multiple and sometimes conflicting regulations to consider, such as the 1973 National Emission Standards for Hazard Air Pollutants (NESHAP) Standard for asbestos removal as well as water runoff and land remediation issues and standards. Beyond regulatory requirements, there are numerable unintended consequences that have to be considered. Once the houses are demolished, there are debris issues. Should these materials go to a landfill or be incinerated? Three to four years after Hurricane Katrina, EPA is still trying to figure out how to address a number of these issues. There are many technical, political, and environmental factors associated with these problems.

Mr. Habicht returned to the ETV Program. He suggested that EPA think about what kind of verification statement can be made once a technology is evaluated. Does the technology do what the company says it does? Beyond describing the verification results, well developed metrics need

to be established so the evaluated technology can be compared to the state-of-the art so that investors and potential users can assess if it is a better investment. Mr. Habicht agreed that unintended consequences need to be examined for all types of technology from nano-scale applications to energy storage. Investors always are interested in scaling up technology, but he cautioned investors to be sensitive to unintended consequences like those realized with CFC substitutes. Investors do not want to solve one problem now but create a bigger problem later.

Mr. Preston said he thought it was useful for VCs to hear about the national and regional environmental problems raised in the discussions so far and he offered some perspectives on how to address them. If industry were in charge of the hurricane cleanup, for example, requests would be made to create disaster recovery landfills with relaxed regulatory requirements to allow more expeditious disposal of the waste material. Restrictions likewise could be waived for materials separation to allow more rapid recovery and disposal of waste material. EPA could take a leadership role in disaster recovery because the Agency knows the environmental requirements and how they may be temporally modified to address pressing environmental problems.

Mr. Starfield replied that states normally implement most environmental standards so to take the role suggested by Mr. Preston, EPA would have to preempt state laws. Following Katrina, it was decided that the states and not the Federal Government would lead the clean-up efforts in response to the disaster. ●

## Public Comments

Mr. Brenner asked if anyone present would like to make a public comment. Walter Howes, Verdigris Capital, suggested that EPA collaborate with DOE on setting up the Department's Loan Guarantee Program in a way that it can be operated by a third party like the Export-Import (Ex-Im) Bank or Overseas Private Investment Corporation (OPIC). By joining forces, EPA could complement

DOE with various skill sets and assist the Department in establishing the loan guarantee process so an Ex-Im Bank or OPIC entity could operate it.

Mr. Brenner asked if DOE had any reaction to Mr. Howes' suggestion. Mr. Bond replied that several U.S. Senators and the Center for American Progress have made similar recommendations.



He thought it would be helpful if the DOE Loan Guarantee Program were operated under a structure like the Ex-Im Bank. Currently, DOE has a need to quickly review applications from a technology evaluation standpoint and provide an objective response. DOE would welcome EPA participation in the review process. Beyond proposal reviews, DOE also is very interested in technology verification programs. The NREL program to evaluate technologies is not sophisticated and needs strengthening. Mr. Bond suggested that DOE probably could learn a great deal from EPA's ETV Program.

Dr. Richard Sustich of the University of Illinois Center of Advanced Materials for the Purification of Water with Systems (the WaterCAMPWS) explained WaterCAMPWS is a National Science Foundation Science and Technology Center. Dr. Sustich offered comments about the "valley of death" at the proof of concept stage of technology development. Although this is a higher risk stage of development, it also is an opportunity for venture investment. Regarding large environmental challenges, he suggested that it may be useful to ask researchers to review these challenges and prepare a survey of the proof of concepts that may be used to address these challenges. This could be useful for Agency managers in identifying where things might lead in technology development. An example of this approach is captured in a new book entitled "Nanotechnology Applications for Clean Water," which was published by William Andrew Publishing.

Mr. Heimerman introduced Norm Birchfield, who serves as EPA's Senior Environmental Technology Official (SETO), adding that Norm can direct investors wishing to discuss technology development issues to the appropriate individual within the Agency.

Ron McIlwain, Filtersure, described his company's unsuccessful efforts to secure an EPA SBIR grant. Although the company could not secure EPA support, the firm was able to build a plant in Canada that is effectively treating hog waste.

Raymond Ricci, NanoRemediation Technologies, said he operates a small nanotechnology company that deals with water cleanup and other remediation issues. Although a lot of resources have been offered to large companies, most technology development research is conducted by university scientists and engineers who do not have access to these resources. He stressed that small business ideas often do not receive much attention at the DOE National Laboratories or other large government organizations. He asked that government policy makers keep the small business operator and university researchers in mind as new funding programs are developed. He noted that one of the biggest challenges facing small business operators is getting through the regulatory requirements that limit new technology applications.

Mr. Brenner thanked everyone for their comments. ●

## EPA and Venture Capital Roles and Next Steps

Mr. Shapiro identified four items that were suggested during the morning session:

- ✧ Use the EPA *Strategic Plan* to identify grand challenges and develop lists of specific priority problems at the national and regional levels within those challenges. EPA could sponsor conferences with investors and others to discuss technology solutions to these challenges and problems (Rob Brenner).
- ✧ Maintain scalability in communications about these challenges and problems; communication mechanisms should include conferences, Web sites, list serves, and other tools of the trade to share and exchange information about these issues (Eric McAfee).
- ✧ Use the NVCA as a conduit for communicating with the VC community (Emily Baker).



- ✧ Use grants and cooperative agreements to address pre-regulatory problems such as CAFOs and create mechanisms for developing performance standards without alienating the regulated industry (Hank Habicht).

Mr. Preston added that the grand challenges should go beyond well-known problems such as methane emissions from landfills or sulfur and nitrogen emissions from power plants and focus on problems “one level down” that are not being addressed. Missing from the above list is the notion that EPA can play a significant role in advising the Federal Government in saving energy in the built environment. If EPA took on such a role, developers and investors could identify options for new building lighting systems with a 3-year or less payback period. Beyond lighting, options also could be suggested for heating, ventilating, and air conditioning (HVAC) controls; insulation; and other building construction and maintenance issues.

Another idea proposed by Mr. Preston concerned the establishment of performance-based standards. Venture capitalists may be able to offer some suggestions to EPA about how “rolling reductions” could be established within regulatory requirements.

Barry Breen agreed that identifying grand challenges would be useful for the Agency and the VC community. He suggested that these challenges focus on issues for which new technology is in the critical path toward finding a solution. The audience for these challenges also should be broader than the capital markets and should include the Agency and others in the Federal Government. Mr. Brenner agreed with these suggestions and explained that the challenges should be useful to the public, EPA personnel, and anyone else interested in environmental protection.

Kevin Teichman suggested that the grand challenges include international as well as domestic issues. In drinking water, for example, NRMRL worked with the Grainger Challenge Prize to find point-of-use water treatment for arsenic-contaminated drinking water in Bangladesh. EPA also worked on cook stove designs to promote health, the environment, and economic prosperity in many developing countries. Mr. Habicht added that EPA

may need more resources to support international environmental problems.

Mr. Starfield noted that the General Services Administration (GSA) is the Federal Government landlord and it would be in the interest of both EPA and DOE to work with GSA on improving energy issues within federal buildings. EPA and DOE could assist GSA and DOD in improving the energy efficiency of every federal facility.

Mr. Preston suggested that EPA may be able to embarrass or shame other federal agencies into doing the right thing with respect to improving energy efficiency in federal buildings. EPA could sponsor a “shoot-off” for the best lighting, the best HVAC, and the best building insulation materials. Although recognition would be the only award from such competitions, EPA could use the results to retrofit its own buildings. EPA would quantify the energy savings from these retrofits and these data could be used to convince other federal agencies about the value of these retrofit technologies. Investors may be willing to fund these retrofits if they could receive the savings gained because the paybacks are generally less than 3 years and have a 20 percent or greater internal rate of return.

Mr. Brenner acknowledged that EPA may have an opportunity in federal building retrofits because the Agency has a federal leadership responsibility in the National Green Building Program. Mr. Preston noted that competitions and prizes develop a lot of self-sustaining interest. He pointed out the MIT \$100K Entrepreneurship Competition is the biggest event on campus. It has attracted enormous media attention and now is bigger than homecoming and graduation. If EPA sponsored American innovation competitions, it would attract enormous attention. This is all positive because the focus is to reduce energy consumption and make the environment cleaner. EPA could be on the “side of the angels” with such competitions.

Mr. Bond added that DOE would be interested in co-sponsoring prize competitions with EPA on energy-related issues. Although DOE has several competitions underway already, the Department would like to take a more strategic approach with respect to prize competitions and DOE would welcome EPA input on this issue.



Dr. Kovalick stressed that EPA is not a monolith and each EPA region probably has a different set of priority environmental problems. In Region 5 (Chicago), for example, EPA is very concerned about Great Lakes issues, while EPA Region 8 (Denver) probably is more concerned about the issues associated with biofuels. The top 20 environmental issues thus may differ dramatically depending on the region in which they are identified.

Mr. Heimerman suggested that one universal grand challenge may be the aging national and regional water infrastructure. Mr. Shapiro agreed, stating that in the next 30 years the United States probably will be replacing most water and wastewater pipes throughout most cities and counties. The Agency should be considering ideas such as whether “smart pipes” could be installed to address the aging infrastructure problem. Could such smart pipes help address impending environmental problems more quickly? Could smart pipes extend the life of water infrastructure? A huge investment opportunity exists with respect to replacing deteriorating structural problems and detecting impending problems more quickly.

Mr. Habicht noted that millions of dollars are spent annually to treat drinking water in the United States, but less than 1 percent of the nationally treated drinking water is actually consumed; likewise, there is a substantial difference between “peak” and “off-peak” electricity generation needs and capacity across the country. There are business opportunities within these areas and investors as well as the government may be well served in thinking cooperatively about them. Beyond counterpart federal agencies, EPA also can be a resource for states. Each state offers significant economic incentives to locate manufacturing facilities and plants within their jurisdictions and EPA could assist states on technology issues regarding their economic development plans.

Ms. Baker agreed that states are encouraging a lot of economic development. She offered to alert the NVCA regional chapters about EPA-sponsored regional meetings. NVCA regional chapters have established good relationships with local economic development agencies and they stand ready to work with EPA and others in addressing local environmental issues. The NVCA has a successful

track record of working with universities and DOE National Laboratories on technology development issues. The NVCA also has sponsored clean technology “road trips” to National Laboratories. In July 2008, for example, more than 35 venture capitalists visited government laboratories in Colorado. She asked if EPA would be interested in such road trips.

Mr. Brenner replied that the EPA National Vehicle and Fuel Emissions Laboratory in Ann Arbor, Michigan, might be interested in hosting a visit by venture capitalists. EPA’s clean automotive technology research is focused on hydraulic hybrid drive train vehicles and clean engines. Ms. Gutierrez added that NRMRL also has been trying to attract the interest of companies, not just venture capitalists, in water technology development issues. She explained that in September 2007, NRMRL sponsored a Clean Water Partnership Summit that was highly successful and attracted numerous small companies and some venture capitalists. In May 2008, EPA sponsored the Science Forum that included a technology showcase of advances in air, water, and soil monitoring technologies and other new emerging technologies.

Ms. Ripley asked how EPA prioritizes its research projects. Ms. Gutierrez replied that the prioritize process starts with the goals of the *EPA Strategic Plan*, which are translated into specific research program plans and objectives. In water infrastructure, for example, NRMRL is conducting a gap analysis to identify potential state-of-the-art technology solutions to this problem. NRMRL also is investigating the environmental implications of the wide-spread production and use of biofuels. Ms. Ripley asked if NRMRL looks at the size of the end market in determining its priorities. Ms. Gutierrez replied that the laboratory does not look at the market size. Dr. Teichman pointed out that EPA’s mission is to protect human health and provide environmental protection and this responsibility, rather than market size, drives the Agency’s research priorities. He explained that EPA also conducts a lot of risk assessment research on technology issues. Regarding the communication of successful technologies and trends, EPA conducts an annual National Sustainability Design Expo on the National Mall. This Design Expo is based on the P3 Program, mentioned earlier, and showcases innovative designs across a range



of issues including alternative energy technologies, water purification, and new technologies for green buildings. The three “Ps” represent the three “legs” of sustainability—People, Prosperity, and the Planet. Dr. Teichman noted that P3 not only has resulted in several very innovative designs for new technologies but also is training the next generation of environmental scientists and engineers.

If the U.S. economy is moving toward a recession or depression, Mr. Preston predicted that higher unemployment will occur and suggested that EPA may be in a unique position to offer suggestions for job creation opportunities in rebuilding the national water infrastructure. If large national environmental problems can be identified then the VC community may be able to offer suggestions for technology solutions. Recently, for example, a fiber-reinforced composite technology was announced that is capable of building bridges in 2 days rather than the conventional approach that takes weeks or months. It was demonstrated that the military could drive tanks over these new bridges in 1 week. Such a technology may have application in repairing the U.S. water infrastructure system. Sometimes, the VC community sees technologies that may have with diverse applications that may not be known to the Federal Government.

Mr. Bond asked if there are any opportunities to fast track siting and permitting for these new commercial scale energy technologies. Section 932 of the Energy Policy Act of 2005 requires DOE to demonstrate the commercial application of cellulosic feedstock biorefineries. There will be significant NEPA implications regarding the siting of these biorefineries. Are there ways to fast track the Environmental Impact Statement (EIS) requirements for these facilities?

Dr. Kovalick noted that EPA’s behavior regarding permitting has been a perennial flower. In 1995, environmental permitting was raised as a significant issue in the White House Conference on Environmental Technologies and it has bloomed regularly since then. NEPA is a federal not a state responsibility so EPA can deal with it, but the problem may be a matter of prioritizing this function. Normally, there are a limited number of EPA personnel designated for the NEPA review

process. State permitting, however, is a significant problem because of reciprocity. Sister states normally do not recognize each other’s permits.

Although cross-state permitting is difficult, Mr. Brenner acknowledged that EPA has helped states in the past permit “first time” technology demonstration projects. As more states seek to host new energy efficiency and renewable energy technology sites, the potential for EPA to assist an individual state in the permitting process may become more apparent.

Ms. Gutierrez noted that some states already have added the requirement to use only “verified” technologies (by EPA or others) in their project development plans. So the value of the ETV verifications has been recognized. In the past, the involvement of EPA researchers in technology demonstration projects also raised the “comfort level” of some state officials and garnered their acceptance to host a project within their jurisdiction.

Mr. Habicht commented that there are some major new thrusts in technology as a result of environmental regulation. Some of these thrusts include CO<sub>2</sub> sequestration, nanomaterials, advanced biofuels, vehicle-to-grid technologies, large solar arrays, large wind arrays, and others. EPA needs to position itself to be involved in the design and evolution of these technologies. EPA involvement is important to assess unintended consequences as well as to be an integral part of the infrastructures that are built up around these technologies. Biofuels is an example of a new energy technology that may have some unintended consequences. EPA and NREL collaboration on the impacts of these technologies is a model that should be expanded in the future. Disruptive technologies will have infrastructure impacts and the earlier EPA and DOE can collaborate on their assessments the better.

Mr. Habicht reiterated that EPA needs to communicate its biggest environmental challenges. Once these challenges are identified, there needs to be a “give and take” about them with the business community and others. Through this process, the challenges can be sharpened into a potential technology and investment opportunity.



Mr. Leighton explained that some “building blocks” already are in place for communication on these issues. From 1995 to 2000, when John DeVillars was EPA Administrator in Region 1 (Boston), VC forums were being conducted in New England. These forums focused on the identification of innovative technologies that may offer solutions to priority regional problems. Maggie Theroux, who is now with EPA’s ETV Program, was a key player in conducting these technology forums. From these forums, Region 1 learned about the need to frame problems with as much specificity as possible to facilitate the development of effective solutions. This effort helped establish the current dialogue between EPA regions and the EPA’s ORD on defining priority problems. Last year, a science symposium, attended by the EPA Deputy Regional Administrators and the senior ORD program managers, was conducted to exchange ideas on problems and potential solutions. A common format was used to define regional problems that included a lot of specificity. Based on this symposium, data are now available to allow problems to be defined on a regional, media, or national basis.

Dr. Teichman added that, for the symposium, each EPA region was asked to identify its three high priority problems and 40 problems were identified. Obviously, more problems were identified than expected and not all of these problems involve technology in their critical path. Nonetheless, this exercise may be one source for identifying problems with potential technology solutions. What would you do with the research results if you received them was a frequent question raised during the symposium.

Mr. Preston suggested that it might be useful to translate these problems into a cost value; if this problem were solved how much would that be worth. The VC community could really focus on a problem if there is some estimate about its value proposition.

Dr. Teichman cautioned that value propositions may be easier to estimate in the health area than in ecosystems. ORD currently is working on how to value ecosystem services but agreed upon metrics have not yet been established. Mr. Preston acknowledged that a value cannot be put on human life and made a business proposition, but a

value can be placed on the loss of tourism because of polluted waters.

Mr. Starfield agreed that it would be useful for EPA and VCs to discuss regional environmental problems because of the unique differences among regions that were mentioned earlier. Water has a tremendous value in the South and Southwestern United States but is not as critical an issue in other parts of the country. He suggested that “smart meters” to gauge electricity usage within individual homes is a great idea but it is not being widely used in EPA Region 6 (Dallas). Likewise, water meters to gauge water usage would be equally valuable.

Mr. Brenner agreed that there are regional as well as national issues facing the Agency. He suggested that future meetings could focus on regional issues, national issues, or potentially only two or three issues; there are a variety of ways to address these problem sets. Are there preferences for any single approach?

Ms. Ripley replied that meetings are helpful but more use should be made of Web communications. The NVCA also may be a good way to communicate with the VC community. She admitted that today’s meeting has given her a renewed appreciation for the challenges EPA faces; nonetheless, she would like the Agency be more of a catalyst for adoption of innovative technologies. EPA is uniquely positioned to do so. Does the identification of grand challenges depend on the new EPA Administrator? What does it take for EPA to be a catalyst for adoption of innovative technologies?

Mr. Brenner responded that more federal agency collaboration (e.g., EPA collaborating with DOE, USDA, and others) is inevitable. The degree to which this collaboration occurs may hinge on the new Administrator’s priorities but the value in more collaboration is recognized. Mr. Brenner expects EPA to be much more involved in a technology-driven environmental process than it has been in the recent past.

Mr. Habicht agreed that personalities always make a big difference. He mentioned that the President’s Council on Environmental Quality also will be important.



Dan Watts said that he would be presenting the results of today's Summit at the NACEPT meeting tomorrow because today's meeting was conducted as a follow-up to the NACEPT Report on venture capital. He asked if there are there some actions from the Summit that can be reported to NACEPT. Is there more work for NACEPT to do on this topic?

Mr. Brenner thanked NACEPT for its work to date. He thought the general response to the NACEPT Report was that it was well done and will be valuable to the Agency. He admitted that there are many in the Agency who will want to review the Report further before specific next steps can be determined. Given the range of the Report's findings and recommendations, EPA may want to create another NACEPT Subcommittee to further advise the Agency, but it would be premature to make such a decision at this time.

Dr. Kovalick proposed that, in the interim, the Agency could move forward by scheduling regional meetings with the VC community and others to discuss challenges and problems of concern to the regions. Mr. Brenner agreed and suggested this may be good point at which to conclude the meeting. He thanked everyone for their participation in what he thought was a very valuable meeting to EPA. He expects to see the results of today's Summit reflected in the Agency's efforts over the next several years and looks forward to working with the VC community on these issues in the future.

Mr. Habicht explained that perhaps the best way to summarize today's meeting is that "we have found each other and it is beautiful." This Summit has assembled some of the most talented and hard working people around and very useful discussions have resulted. Based on his experience at EPA, he understands that the Agency staff often feels isolated because of institutional constraints.

He hoped that today's meeting will be the initial step toward offering officials a channel to communicate about issues of common interest with other problem solvers.

Mr. Preston suggested that there is an opportunity at EPA for bold leadership in the Federal Government on technology issues. He believes there is a lot of interest within the Agency for bold leadership and such leadership makes it unlikely that such an initiative will fail.

Mr. Brenner agreed that there are numerous examples of where EPA has taken a leadership role in the past on technology issues. He offered the Diesel Retrofit Program as a recent example where EPA worked to find and develop a technology solution early on and the result is that nearly \$1 billion worth of diesel retrofits are being made annually. This is just one example; there are many others in the water and solid waste media where similar advances have been made through technology-driven approaches. EPA gets it. Now, there is an opportunity for the Agency to push hard on these approaches and EPA plans to take advantage of it.

Mr. Leighton explained that even in the "Big Dig" in Boston, the Agency was able to drive diesel retrofit use in the excavation and construction process. This opportunity was created because government officials used the "bully pulpit" to push for it and the "court of public opinion" asked "why not?" He expressed hope that NEPA can be a very important driver for public policy and opinion for regional and national energy and environmental problems.

Mr. Habicht agreed, explaining there are and will be unique opportunities for collaboration between EPA and DOE on energy and environmental issues. Hearing no more comments, Mr. Habicht and Mr. Brenner adjourned the meeting. ●



# ***Appendices***

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## **A. EPA-Venture Capital Community Summit: Potential EPA Follow-Up Activities**

## **B. List of Summit Attendees**

## **C. Summit Presentations**

1. Venture Capital Overview
2. U.S. EPA: The Context for Promoting New Environmental Technology
3. Department of Energy Technology Commercialization: Energy Efficiency and Renewable Energy

## **D. Stages of Investment**

## **E. *Federal Register* Notice for EPA-Venture Capital Community Summit**







## Appendix A: EPA-Venture Capital Community Summit: Potential EPA Follow-Up Activities

The following is a list of potential follow-up activities developed by EPA subsequent to the Summit to help further environmental technology investment and commercialization. Some of the activities have been initiated.

### I. Collaborating With Other Agencies

- A. Develop partnerships with DOE, USDA, and other agencies to learn from their technology commercialization efforts
- B. Seek to use Stimulus and venture capital funds to support environmental technology development and deployment
- C. Explore cooperating with other federal agencies to encourage wide-scale government purchasing of innovative environmental technologies (e.g., energy efficient and greenhouse gas reduction technologies)
- D. Develop a strategy for collaborating with state, tribal, and city economic development organizations to create green jobs

### II. Fostering Interaction With the Venture Capital Community

- A. Communicate EPA's "Grand Challenges" for which technology might provide solutions
- B. Organize regional follow-up meetings with the venture capital community
- C. Develop with venture capital associations mechanisms to facilitate communication and cooperation
- D. Create a framework to inform EPA on how to work with the venture capital community

### III. Considering New Programs and Activities

- A. Create prize programs for technological solutions to major challenges confronting the Agency
- B. Assess the need for grant and loan guarantee programs that would encourage investment in environmental technology commercialization
- C. Assess whether the Agency's Green Building Strategy should be revised to add technology commercialization
- D. Discuss the need for a FACA group focusing on venture capital investment in environmental technology and/or related themes (e.g., other finance and investment actions catalyzing environmental technology development and deployment)



## Appendix B: List of Summit Attendees

### Participants

#### EPA Senior Career Managers:

Barry Breen  
Deputy Assistant Administrator  
Office of Solid Waste and Emergency Response

Rob Brenner, **Co-Chair**  
Director  
Office of Policy Analysis and Review  
Office of Air and Radiation

Walter Kovalick, Jr.  
Assistant Regional Administrator for Resources  
Management  
Region 5 (Chicago)

Ira Leighton  
Deputy Regional Administrator  
Region 1 (Boston)

Mike Shapiro  
Deputy Assistant Administrator  
Office of Water

Larry Starfield  
Deputy Regional Administrator  
Region 6 (Dallas)

Kevin Teichman  
Deputy Assistant Administrator for Science  
Office of Research and Development

Pai-Yei Whung  
Chief Scientist  
Office of the Science Advisor

#### Senior Venture Capitalists:

Hank Habicht, **Co-Chair**  
Managing Partner  
SAIL Venture Partners

Daniel Hullah  
Principal  
RockPort Capital Partners

Eric McAfee  
Managing Director  
Cagan McAfee Capital Partners

John Preston  
Managing Director  
C Change Investments

Rosemary Ripley  
Managing Director  
NGEN Partners

Dan Watts  
Executive Director  
Otto H. York Center for Environmental  
Engineering and Science  
New Jersey Institute of Technology

#### Presenters:

Emily Baker  
Director  
Federal Policy and Political Advocacy  
National Venture Capital Association

Walter Kovalick, Jr.  
Assistant Regional Administrator for Resources  
Management  
Region 5 (Chicago)

Drew Bond  
Director for Commercialization and Deployment  
Office of Energy Efficiency and Renewable Energy  
U.S. Department of Energy

### Audience

#### EPA Attendees:

Amanda Aldridge  
Office of Air Quality Planning and Standards  
Office of Air and Radiation

Sonia Altieri  
Office of Cooperative Environmental Management



## Appendix B: List of Summit Attendees *(continued)*

Diana Bauer  
National Center for Environmental Research  
Office of Research and Development

Sarah Bauer  
Office of Science Policy  
Office of Research and Development

Michael Bender  
Office of Resources Management  
and Administration  
Office of Research and Development

Norman Birchfield  
Office of the Science Advisor

Michael Brody  
Office of the Chief Financial Officer

Rafael DeLeon  
Office of Cooperative Environmental Management

Jordan Dorfman  
Office of Water

Peter Fargo  
Office of Research and Development

Sally Gutierrez  
National Risk Management Research Laboratory  
Office of Research and Development

Jeff Heimerman  
Office of Solid Waste and Emergency Response

Mark Joyce  
Office of Cooperative Environmental Management

Michael Kane  
Office of Policy, Economics and Innovation

Mitch Lasat  
National Center for Environmental Research  
Office of Research and Development

Cynthia Nolt-Helms  
National Center for Environmental Research  
Office of Research and Development

April Richards  
National Center for Environmental Research  
Office of Research and Development

Neil Stiber  
Office of Science Policy  
Office of Research and Development

Larry Weinstock  
Office Air and Radiation

David Widawsky  
National Center for Environmental Innovation  
Office of Policy, Economics and Innovation

Mary Wigginton  
National Center for Environmental Research  
Office of Research and Development

### Other Attendees:

Richard Canino  
New Energy and Industrial Technology  
Development Organization

Sarah Carter  
American Association for the Advancement of  
Science Fellow

Ray Cheung  
World Resources Institute, Inc.

Edie Findeis  
EMS, Inc.

Prasad Guple  
National Institute of Standards and Technology  
U.S. Department of Commerce

Walter Howes  
Verdigris Capital

Glen Kedzie  
American Trucking Association

Valarie Latraverse  
Canadian Embassy



## **Appendix B: List of Summit Attendees *(continued)***

Mary Mai  
Center for Environmental Innovation

Ron McIlwain  
Filtersure, Inc.

Jim McVaney  
Rentech, Inc.

David Nguyen  
American Trucking Association

Andrew Paterson  
Econergy

Raymond Ricci  
NanoRemediation Technologies

Brian Routhier  
American Trucking Association

Edward Saltzberg  
USA Energy Advisors

Paul Schaudies  
GenArraytion, Inc.

Sumita Singh  
National Venture Capital Association

David South  
T&M Solutions

Richard Sustich  
Center of Advanced Materials for Purification of  
Water with Systems (WaterCAMPWS)  
University of Illinois at Urbana-Champaign

### **EPA Project Officer and Contact:**

Paul Shapiro  
National Center for Environmental Research  
Office of Research and Development  
E-mail: [shapiro.paul@epa.gov](mailto:shapiro.paul@epa.gov)

### **Contractor Support:**

Beverly Campbell  
Angela Hays  
Greg Ondich  
The Scientific Consulting Group, Inc.

James Rea  
SiteStories



# Appendix C: Summit Presentations

## 1. Venture Capital Overview

### EPA-Venture Capital Community Summit: Exploring Programs to Commercialize Environmental Technology

November 12, 2008

Venture Capital Overview

Emily Baker, NVCA

### About NVCA

- Formed 35 years ago to foster better communications among venture capital professionals
- Today focuses on advancing public policies conducive to entrepreneurship, innovation and capital formation
- Also has research, education, networking charter
- Based in Washington DC
- 470 member firms

2

### What is Venture Capital?

- Venture capital is invested alongside management in private start-up companies operating in innovative industries.
  - Information Technology
  - Life Sciences
  - Clean Technology
- Venture capital funds are capitalized by institutional investors and the VCs themselves.
  - Pension funds
  - Endowments
  - Foundations
- The goal of a venture investment is to build a company to the point that it can stand on its own as a public entity or be acquired as part of a larger organization.

3

### Venture Capital Characteristics

- Venture capital is long term investment.
  - Venture investments typically last 5-10 years, often longer, rarely less.
- Venture capital is focused on innovation.
  - VCs invest in companies that look to transform the status quo in high technology spaces.
- Venture capital is high risk *and* high reward.
  - Forty percent of venture backed companies fail; forty percent break even/make minimal gains; only 20 percent make significant gains.
- Venture capital builds value in companies and the economy.
  - Venture capital investment *stays* in the company and is used for growth.
  - Venture capitalists bring operational and scientific knowledge to bear to catalyze growth, involving themselves in day-to-day operations.

4

### Venture Capital = Economic Growth

- Venture investments accounted for just .02% of invested capital.
- Despite the small venture industry size, companies that got their start with venture capital accounted for 10.4 million jobs and \$2.3 trillion of revenues in the US in 2006 or 18 % of GDP.
- Companies that were originally funded by venture capital include Genentech, Microsoft, Apple, Google, FedEx and Starbucks.
- Venture-backed companies outperform non-venture counterparts.
- Current venture backed companies account for over 400,000 US jobs across the country.
- Innovations funded by venture capital include the pacemaker, Herceptin (cancer), Integritin (heart disease). VCs are also increasingly focused on clean technology – solar, wind, carbon capture, energy efficiency.

5

### Venture Capital Investment is Productive ...

- For VC every dollar invested in 1970-2001, there was \$7.90 in US revenue during 2006
- For every \$28,463 of venture capital invested in 1970-2001, there was one job in the year 2006
- Note these ratios are based on investment through 2001 (\$296B) because investment after that time has likely had little effect on 2006 jobs and revenues. If investment through 2006 (\$421B) is used, the ratios would be \$5.55 and \$40,364 respectively

Source: Venture Impact 2006 by Global Insight

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## Appendix C: Summit Presentations (continued)

### 1. Venture Capital Overview (continued)

#### Top 10 States for Venture Capital Investment 2007

State	Billions Invested
California	\$14.19
Massachusetts	3.59
Texas	1.42
Washington	1.34
New York	1.17
Pennsylvania	.85
Maryland	.63
New Jersey	.60
North Carolina	.59
Florida	.58

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#### Top States for VC-Backed US Revenues 2006

Rank	State	National Employment at VC-Backed Companies	2003-2006 Growth
1	California	566,600	12.6%
2	Texas	293,700	10.2%
3	Washington	144,200	12.8%
4	Massachusetts	131,300	12.8%
5	Pennsylvania	121,600	9.6%
6	Georgia	120,000	11.0%
7	Virginia	104,900	14.7%
8	New York	98,000	10.6%
9	Tennessee	92,100	15.7%
10	Minnesota	82,600	16.2%

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#### Top States for VC-Backed US Jobs 2006

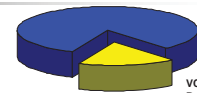
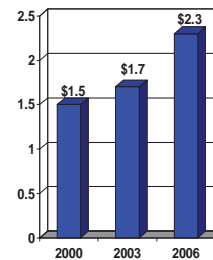
Rank	State	National Employment at VC-Backed Companies	2003-2006 Growth
1	California	2,362,400	2.8%
2	Texas	1,118,600	5.6%
3	Pennsylvania	697,400	2.2%
4	Massachusetts	674,300	3.0%
5	Georgia	604,500	4.8%
6	Tennessee	564,500	2.6%
7	Washington	463,800	7.1%
8	New York	427,700	2.4%
9	Virginia	385,300	3.7%
10	Minnesota	352,700	9.5%

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#### Venture-Backed Revenues

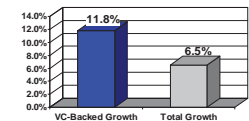
VC-Backed US Revenues (trillions)

As a % of total US GDP in 2006



VC-Backed Revenue = 18%

Outpaces 2003 - 2006 Total US Sales Growth



NVCA

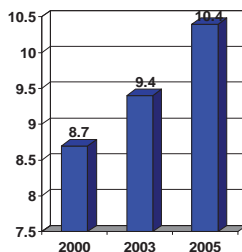
Source: Venture Impact 2006 by Global Insight

GLOBAL INSIGHT

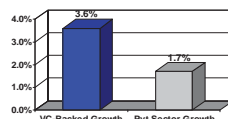
#### Venture-Backed Employment

VC-Backed US Jobs (millions)

As a % of total US Pvt Jobs in 2006



Outpaces 2003 - 2006 Total US Job Growth



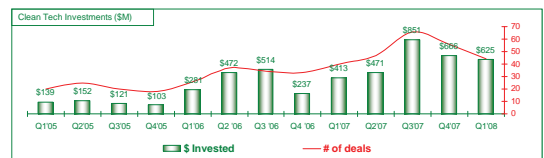
NVCA

Source: Venture Impact 2006 by Global Insight

GLOBAL INSIGHT

#### Internet-Specific & Clean Tech Investments

2005 - Q1 2008

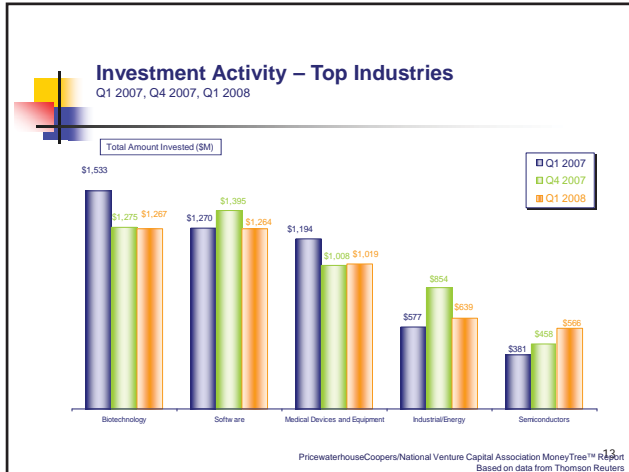


PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report  
Based on data from Thomson Reuters



## Appendix C: Summit Presentations (continued)

### 1. Venture Capital Overview (continued)



### Federal Policy Initiatives Needed to Drive Clean Tech

- Renewable Portfolio Standard
- Renewable Fuel Standard
- Investment Tax Credits
- Strengthened CAFE standards
- More robust federal R&D for energy
- Federal government as early adopter and user of clean energy technologies

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### New Partnerships

NVCA is looking forward to working more closely with EPA

Emily Baker, [ebaker@nvca.org](mailto:ebaker@nvca.org)

Sumita Singh, [ssingh@nvca.org](mailto:ssingh@nvca.org)

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## Appendix C: Summit Presentations (continued)

### 2. U.S. EPA: The Context for Promoting New Environmental Technology

#### U.S. EPA: The Context for Promoting New Environmental Technology

Presented at the  
EPA-Venture Capital Community Summit:  
Exploring Programs to Commercialize  
Environmental Technology

November 12, 2008



Walter W. Kovalick, Jr. Ph.D.  
Assistant Regional Administrator  
U.S. EPA—Region 5  
Kovalick.walter@epa.gov

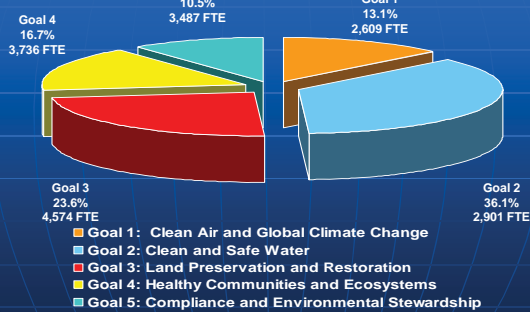
#### Outline

- Mission and budget
- Operations and implementation
- Technology nexus

#### Mission and Mandates

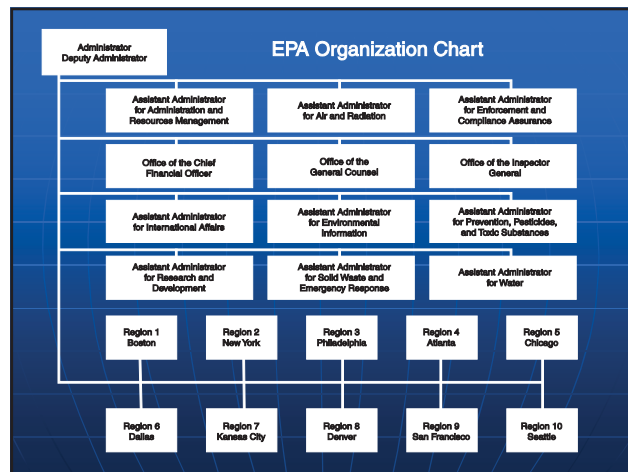
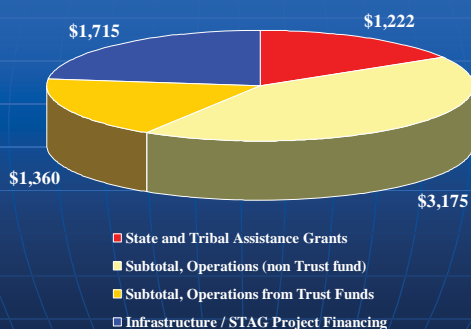
- One of 20+ independent regulatory agencies
  - Not a Cabinet department, but Cabinet status
- Protect public health and the environment
- Multiple statutes provide mandates
  - Clean Air Act
  - Clean Water Act
  - Safe Drinking Water Act
  - Resource Conservation and Recovery Act (as amended)
  - Comprehensive Environmental Response Compensation and Liability Act (Superfund)
  - **Federal Insecticide Fungicide and Rodenticide Act (FIFRA)**
  - **Toxic Substances Control Act (TSCA)**
  - Others

#### FY 2008 Budget by Goal Total Agency: \$7,472 Million



Strategic plan—[www.epa.gov/ocfo/plan/2008/entire\\_report.pdf](http://www.epa.gov/ocfo/plan/2008/entire_report.pdf)

#### EPA 2008 Budget Allocation (Millions)





## Appendix C: Summit Presentations (continued)

### 2. U.S. EPA: The Context for Promoting New Environmental Technology (continued)

#### What is the Regulated Community?

- Any business/organization that is required to comply with EPA statutory or regulatory requirements.
- Includes:
  - More than 800,000 permitted facilities under CAA, CWA and RCRA
  - Over 20 million small businesses
  - 80,000 units of local government
  - Millions of regulated facilities under more than 12 major environmental statutes

#### Operations and Implementation

- Agency exercises *discretion* in balancing mandate given in each statute—mainly in HQ
- Traditional role—different types of regulation
  - Technology based—most stringent or cost effective; can “freeze” technology, once set
  - Health based—set for environ. conditions; room for source control technologies to meet limits
  - Market based—sets limit for nation/area; facilities get tradable allowances
  - Use restrictions (for chemicals/pests)—exposure restricted by label directions or product restriction

#### Ops and Implementation (cont.)

- New Strategies (beyond “command and control”)
  - Begun in 1990’s—HQ together with Regions
    - Compliance assistance
    - Voluntary partnerships
    - Performance track—beyond compliance
    - Partnering for economic gain/development e.g. Brownfields, CRADAs
- Plus
  - International developments/imperatives (ISO 14000/EMS plus EU/China requirements)

N.B. As always, enforcement keeps a level playing field



#### Ops and Implementation (cont.)

- Almost half of 17,000 FTE in Regional Offices
  - Most EPA regulatory programs delegated to states and tribes
  - Vast majority of inspection, permitting, enforcement at state/tribal level
- ~2400 FTE for science and technology work—mostly ORD
  - Of \$760M budget, ~\$440M extramural

N.B. Large % of entire EPA workforce are scientists/engineers

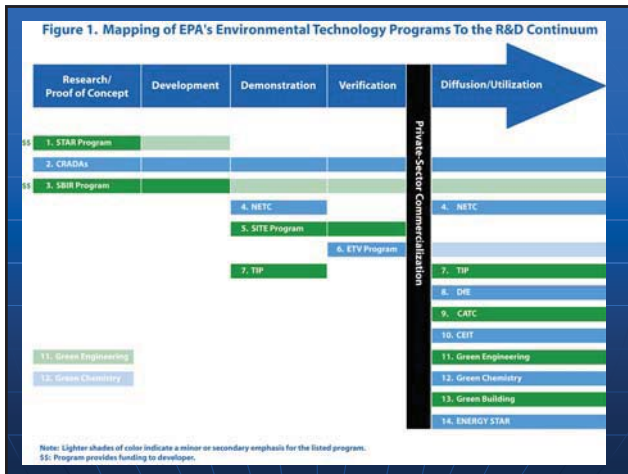
#### EPA Roles in Environmental Technology Marketplace

- Funding agent 💡
- Technology developer 💡
- Regulator/enforcer 💡💡💡
- Information broker
  - Neutral 💡💡
  - Verification agent 💡💡💡
- Partner in deployment 💡💡💡
- User of “first resort” 💡



## Appendix C: Summit Presentations *(continued)*

### 2. U.S. EPA: The Context for Promoting New Environmental Technology *(continued)*



#### Intersections: EPA's Work and Environmental Technologies

- For niche areas, in depth understanding by researchers/programs,
  - E.g. drinking water treatment, air pollution control, remediation, diesel retrofit
  - Monitoring and measurement technologies
- Secondary level of understanding of industrial processes to set BACT, etc. levels
- Appreciation of technology aspects of many sectors through partnering programs, i.e. Design for Environment, energy conservation, etc.

#### Observations: How Technology Intersects with EPA Work

- With few exceptions, EPA mission is not to be a "technology development" organization
- New environmental problems are viewed first through statutory/regulatory lens (e.g. GHG sequestration = UIC program) leading to technology inquiry
- While expert in some niches, EPA's mandates don't call for comprehensive monitoring of technology developments
- The Environmental Technology Council is a forum for joint action across programs/regions—see [www.epa.gov/etop](http://www.epa.gov/etop)

#### Observations (cont.)


- EPA's regulatory agenda charts the subjects and issues to be addressed over a several year period
- By its nature, technology driven regulations "fix" *best* technology; resources normally limit EPA's ability to continuously update "best"
- EPA is well vested in technology diffusion activities, esp. verification
- EPA is experienced in operating SBIR and grant programs; no mandates for many other financial vehicles



## Appendix C: Summit Presentations (continued)

### 3. DOE Commercialization: Energy Efficiency and Renewable Energy

**Technology Commercialization**  
Energy Efficiency and Renewable Energy

  
**U.S. Department of Energy**  
November 2008

Drew Bond  
Director of Commercialization and Deployment

National security, environmental and economic goals form the basis for a robust National Energy Policy but historical data demonstrates the magnitude and urgency of the challenge.

**Energy Security**

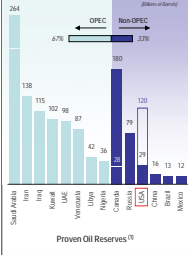
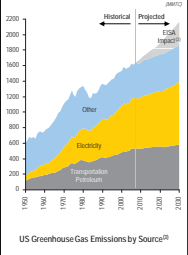
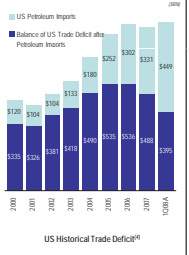
- Diversify our energy mix and reduce dependence on petroleum

**Environmental Stewardship**

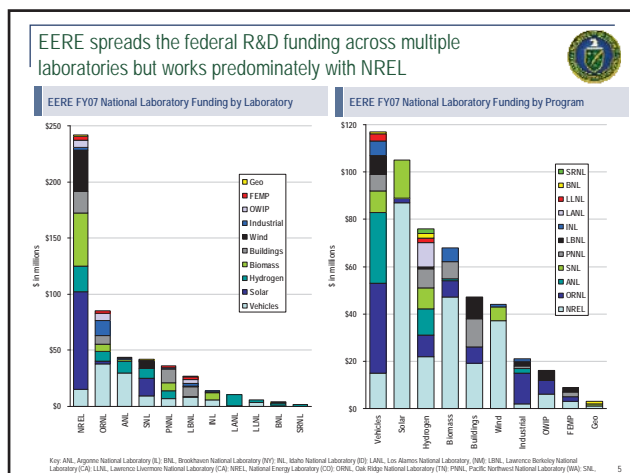
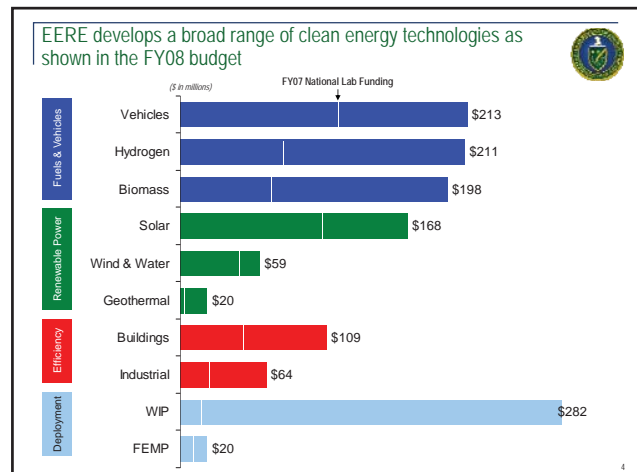
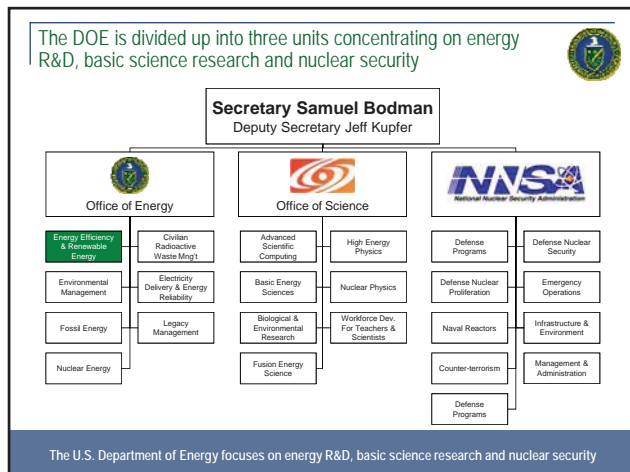
- Reduce greenhouse gas emissions and other negative environmental impacts

**Economic Competitiveness**

- Create a more flexible, more reliable and higher capacity U.S. energy infrastructure
- Improve the energy productivity of the U.S. economy

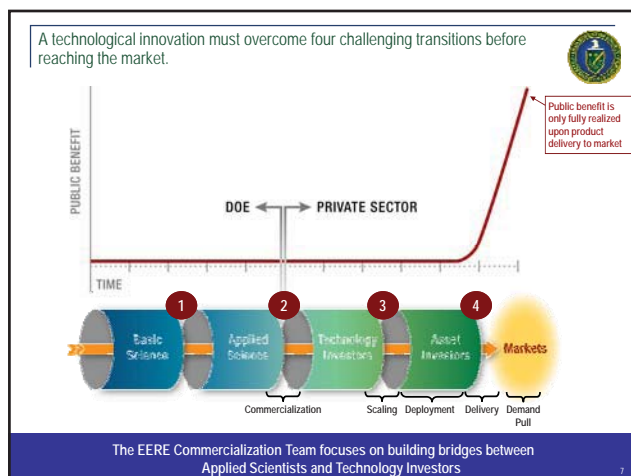
Source: BP Statistical Review of World Energy 2008; US Greenhouse Gas Emissions by Source 2008; US Historical Trade Deficit 2008





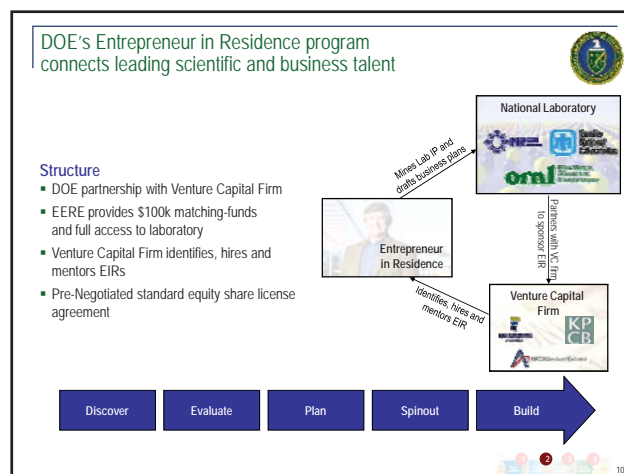
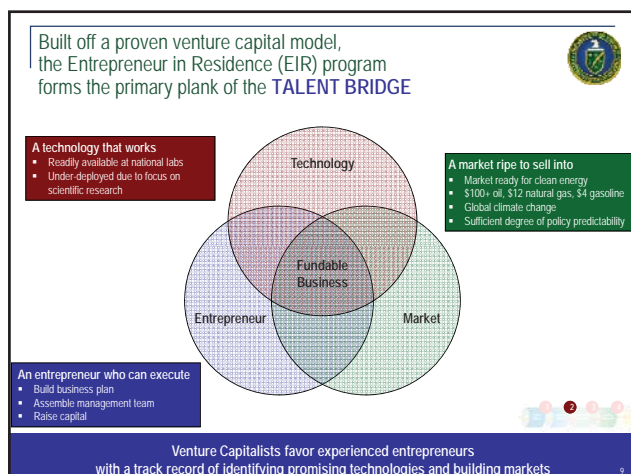
## Appendix C: Summit Presentations (continued)

### 3. DOE Commercialization: Energy Efficiency and Renewable Energy (continued)



EERE Commercialization Bridges are designed to overcome four primary gaps

Talent	<ul style="list-style-type: none"> <li>DOE traditionally hires scientists – not businessmen</li> <li>Commercializing technologies requires both technical &amp; business skill sets</li> </ul>
Information	<ul style="list-style-type: none"> <li>Communication is a fundamental prerequisite of commercialization</li> <li>Technical language fails to resonate with the business community</li> </ul>
Capital	<ul style="list-style-type: none"> <li>Competition is stiff for venture capital funding</li> <li>VCs more likely to fund business plans and prototypes than research papers</li> </ul>
Strategy	<ul style="list-style-type: none"> <li>The Commercialization Valley of Death is not unique to national laboratories</li> <li>Best practices have been developed to foster a culture of innovation</li> </ul>



Tailored for entrepreneurs and small businesses, the Equity Share License agreement forms a primary plank of the **STRATEGY BRIDGE**

	Traditional License	Equity Share License
Laboratory Benefit	<ul style="list-style-type: none"> <li>Up-front license fee</li> <li>Royalties</li> </ul>	<ul style="list-style-type: none"> <li>Equity share of company, royalties or combination</li> </ul>
Points of Negotiation	<ul style="list-style-type: none"> <li>All terms</li> </ul>	<ul style="list-style-type: none"> <li>Percent equity share</li> </ul>
Length of Contract	<ul style="list-style-type: none"> <li>30 pages</li> </ul>	<ul style="list-style-type: none"> <li>17 pages</li> </ul>
Private Sector Preference	<ul style="list-style-type: none"> <li>Large companies with cash on hand</li> </ul>	<ul style="list-style-type: none"> <li>Small businesses on tight budgets</li> <li>Entrepreneurial ventures</li> </ul>

Built off the Stanford license, the Equity Share License has been pre-negotiated with venture capital general counsels, national laboratory general counsels and DOE general counsel

Designed to introduce investors to technology opportunities, the Technology Commercialization Showcase forms the primary plank of the **INFORMATION BRIDGE**

**Need**

- Many EERE funded technologies stall in the "commercialization valley of death" simply because the innovation has not been clearly communicated to the business community

**Structure**

- Challenged EERE Program Managers to identify 8-10 most promising technologies in their portfolio
- Created simple, layman's descriptions of the innovation opportunity
- Invited prominent investors to a two day conference showcasing technologies

**Investors Represented**



## Appendix C: Summit Presentations (continued)

### 3. DOE Commercialization: Energy Efficiency and Renewable Energy (continued)

**DOE Technology Commercialization Showcase Case Study:**  
Low-cost carbon fiber: increases fuel economy 25%

**Simple, layman's description of technology**

- Problem:** Carbon fiber, a lightweight replacement for structural steel, is currently too expensive for broad application (\$12-\$30/lb vs. \$5-\$8/lb)
- Description:** ORNL has developed technologies to reduce the cost of carbon fiber production by utilizing:
  - Low costs feedstocks (low-cost textiles and renewable lignin) and
  - Advanced processing methods** (thermo-chemical stabilization, rapid oxidation, and microwave-assisted plasma carbonization)
- Impact:**
  - Automobiles:** Reduces vehicle mass by up to 40% which increase fuel economy up to 25%
  - Wind:** Increases blade efficiency through superior properties
- IP Position:** 3 patents issued, 5 patents filed, 7 invention disclosures
- Technology Status:**
  - 4 processes reduced to practice:
    - Microwave-assisted plasma carbonization
    - Textile-based precursors
    - Thermo-chemical stabilization
    - Plasma oxidation
  - Time to availability: 3-5 years
  - Capital Needs: A 2-4MM lb/year carbon fiber plant is expected to cost \$18M-\$22M

**Direct contact to inventor**

Dave Warren | ORNL | Phone: 865-574-9693 | WarrenCD@ORNL.GOV

**Filling the gap between R&D and venture capital funding, the Technology Commercialization Fund forms the primary plank of the CAPITAL BRIDGE**

**Need**

- Innovations struggle to find financing post-research and pre-venture capital funding as described by the "Commercialization Valley of Death"

**Structure**

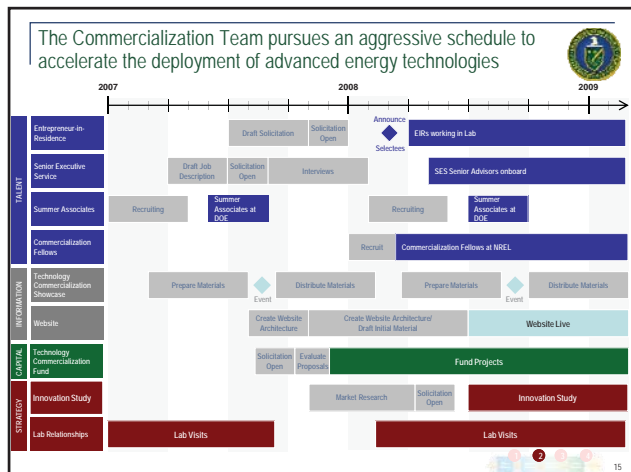
- 50-50 industry matched funds required
- Funds restricted to prototype development, demonstration and deployment – not further scientific research Designed to complement angel investment or early stage corporate product development

**Decision criteria**

- Potential market opportunity
- Likelihood of commercial success
- Management team
- DOE priorities
- Private sector partners

Laboratory	Funds (\$MM)
National Renewable Energy Laboratory (CO)	\$4.0
Oak Ridge National Laboratory (TN)	\$4.0
Lawrence Berkeley National Laboratory (CA)	\$1.5
Pacific Northwest National Laboratory (WA)	\$1.5
Sandia National Laboratories (NM)	\$1.4
Los Alamos National Laboratory (NM)	\$0.7
Argonne National Laboratory (IL)	\$0.7
Lawrence Livermore National Laboratory (CA)	\$0.5

The Technology Commercialization Fund is a carrot to attract private sector partners to examine the national laboratories' intellectual property portfolio



**The EERE Commercialization Team advises many of the Department's public-private initiatives**

**Deployment Programs**

- Commercial-scale integration and demonstration
  - Hawaii Clean Energy Partnership
  - Greensburg, KS
  - New Orleans, LA
- Federal Energy Management Showcases
  - National Parks Service
  - National Marine Sanctuaries

**Policy Proposals**

- Quasi-Governmental Agency for Clean Energy Financing
- Advanced Research Projects Agency – Energy (America Competes 07 § 5012)
- Tax Policy

**Advisory Roles**

- Loan Guarantee Program (EPAct 05 Title XVII)
- DOE Technology Transfer Policy Board (EPAct 05 § 1001)
- Commercial-Scale Cellulosic Biorefineries (EPAct 05 § 932)
- Freedom Prize (EPAct 05 § 1008)

For further information please contact the Commercialization Team

- Carol Battershell, carol.battershell@ee.doe.gov
- Drew Bond, drew.bond@ee.doe.gov
- Wendolyn Holland, wendolyn.holland@ee.doe.gov

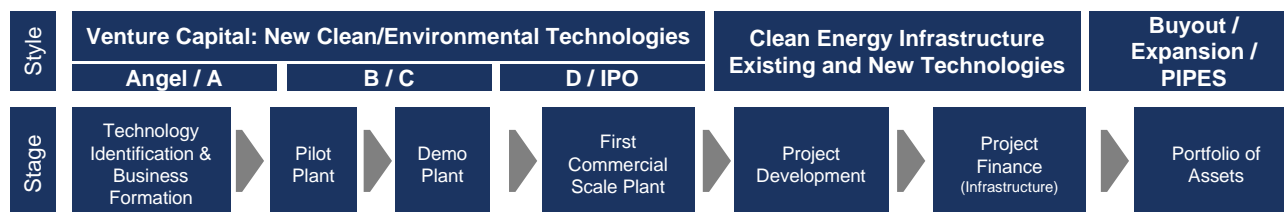


## Appendix D: Stages of Investment

Sustainable  
Development  
Investments

### Analysis of Investment Styles

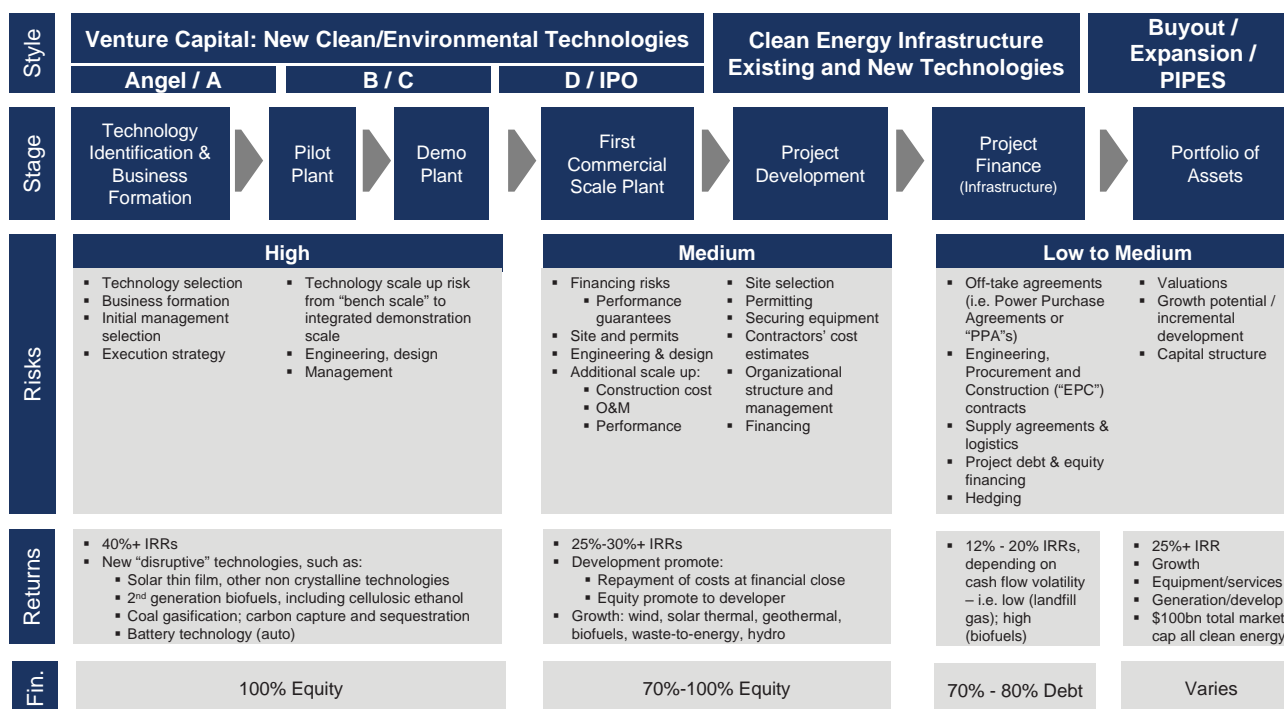
- The sustainable development investment opportunity is broad and, as such, comprises a wide range of investment styles across various stages of a company's development:



- Clean technology venture capital will require a significant amount of additional private equity to take new (and existing) technologies that are proven in pilot and demonstration plants to commercial scale
- While project development permitting risk is typically considered arbitrary and difficult to judge, macro trends supporting the clean energy infrastructure build out (i.e. renewable portfolio standards and cap & trade regimes) can help to mitigate this permitting risk
- The later stage private equity clean energy opportunity is more limited, but will grow over time as more clean energy infrastructure is built. Consolidation and buyouts are already beginning to occur, particularly in more mature markets in Europe

Sustainable  
Development  
Investments

### Analysis of Investment Styles – Risk and Return Profiles, Financing





# Appendix E: Federal Register Notice for the EPA-Venture Capital Community Summit

Federal Register / Vol. 73, No. 214 / Tuesday, November 4, 2008 / Notices

65603

Subsegment	Waterbody name	Pollutant
090106	Holmes Bayou—From the Pearl River to the West Pearl River (scenic)	Mercury and Turbidity.
090107	Pearl River—From Pearl River Navigation Canal to Holmes Bayou	Mercury.
090201	West Pearl River—From Headwaters to confluence with Holmes Bayou (scenic)	Mercury and Turbidity.
090202	West Pearl River	Turbidity.
090202–5126	Morgan River—From Porters River to its confluence with Pearl River (scenic)	Mercury.
090203	Lower Bogue Chitto—From River Navigation Canal to Wilsons Slough	Mercury.
090204	Pearl River Navigation Canal—Below Lock No. 3	Mercury and Dissolved oxygen.
090205	Wilson Slough—Bogue Chitto to West Pearl River	Mercury.
090206	Bradley Slough—Bogue Chitto to West Pearl River	Mercury.
090207	Middle Pearl River and West Middle Pearl River—From West Pearl River to Little Lake.	Mercury and Dissolved oxygen.
090207–5112	Morgan Bayou—Headwaters near I–10 to confluence with Middle River	Mercury.
090301	Pushpatapa Creek	Fecal coliform.
090401	Bogue Lusa Creek	Fecal coliform.
090501	Bogue Chitto River—From MS State Line to Pearl River Navigation Canal (scenic)	Mercury and Turbidity.
090502	Big Silver Creek	Fecal coliform.
090505	Bonner Creek	Fecal coliform.
090506	Thigpen Creek	Fecal coliform.

EPA requested the public to provide EPA with any significant data or information that might impact the 29 TMDLs in the **Federal Register** Notices: Volume 72, number 137, page 39420 (July 18, 2007) and volume 73, number 22, pages 6178 and 6179 (February 1, 2008). The comments which were received, the EPA's response to comments, and the TMDLs may be found at <http://www.epa.gov/region6/water/npdes/tmdl/index.htm>.

Dated: October 28, 2008.

**Larry D. Wright,**

*Acting Director, Water Quality Protection Division, EPA Region 6.*

[FR Doc. E8–26262 Filed 11–3–08; 8:45 am]

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## ENVIRONMENTAL PROTECTION AGENCY

[FRL–8737–6]

### EPA-Venture Capital Community Summit: Exploring Programs to Commercialize Environmental Technology

**AGENCY:** Environmental Protection Agency.

**ACTION:** Notice of meeting.

**SUMMARY:** The Environmental Protection Agency (EPA) will hold an EPA-Venture Capital Community Summit: Exploring Programs to Commercialize Environmental Technology to follow up the National Advisory Council for Environmental Policy and Technology (NACEPT) report on “EPA and the Venture Capital Community: Building Bridges to Commercialize Technology” (April 2008). The report recommends that EPA create programs, similar to those of the U.S. Department of Energy, to provide financial support (e.g., loan

guarantees, grants, revolving loan funds) to encourage venture capital investment in environmental technology commercialization. The Summit will bring together senior career EPA managers (Deputy Assistant Administrators and Deputy Regional Administrators) with senior venture capitalists who were part of the NACEPT Venture Capital Study. A report will be produced from the Summit that will be a companion to the NACEPT Venture Capital Report; both will be given to the next Administration, the venture capital community, technology developers, state and local governments, Congressional members and staff, academia, and members of the public. The Summit will be open to the public.

**DATES:** The Summit will be held on November 12, 2008, beginning at 10 a.m. and adjourning at 4:30 p.m. Registration is at 9:30 a.m. Times noted are Eastern Time.

**ADDRESSES:** The meeting will be held at the Ronald Reagan Building and International Trade Center, 1300 Pennsylvania Avenue, NW., Washington, DC, in the International Gateway Room on the Mezzanine.

**SUPPLEMENTARY INFORMATION:** The Venture Capital Report is available electronically through <http://www.epa.gov/etop>. A hard copy of the report can be ordered from the National Service Center for Environmental Publications by requesting document number EPA/600/R–08/043 through the Web site ordering system at <http://www.epa.gov/nscep> or by calling 1–800–490–9198. The agenda for the Summit can be found electronically through the EPA Web site at <http://www.epa.gov/ncer/venturecapital>.

The Summit is open to the public. Registration before the Summit is requested. Any member of the public wishing to make a presentation at the Summit should request to do so beforehand. Presentations should be limited to 3 minutes or less. Time allotted will be shortened if several people request to speak.

The results of the Summit will be discussed the following day (November 13) in a NACEPT forum on future directions for EPA to be chaired by the EPA Administrator. This forum will be part of the NACEPT Council 20-Year Meeting on November 13 and 14, for which there will be a separate **Federal Register** notice.

**Special Accommodations:** EPA welcomes the attendance of the public at this Summit and will make every effort to accommodate persons with disabilities. If you require special accommodations due to a disability, please contact Linda Parham at [parham.linda@epa.gov](mailto:parham.linda@epa.gov) at least seven days before the meeting.

**FOR FURTHER INFORMATION CONTACT:** To register for the Summit, request time to make an oral public comment at the Summit, and for details on how to provide written public comments, please see the National Center for Environmental Research's Web site at <http://www.epa.gov/ncer/venturecapital>. Questions about the Summit and written comments should be submitted to Paul Shapiro at [shapiro.paul@epa.gov](mailto:shapiro.paul@epa.gov).

Dated: October 28, 2008.

**William H. Sanders III,**  
*Director, National Center for Environmental Research.*

[FR Doc. E8–26263 Filed 11–3–08; 8:45 am]

BILLING CODE 6560–50–P



















