

CREATING THE CALIFORNIA CLEANTECH CLUSTER

*How Innovation and Investment Can
Promote Job Growth and a Healthy
Environment*

Principal Author
Patrick R. Burtis

Contributing Authors
Bob Epstein, E2
Roland J. Hwang, NRDC



Natural Resources Defense Council



Environmental Entrepreneurs

September 2004

ABOUT NRDC

The Natural Resources Defense Council is a national nonprofit environmental organization with more than 550,000 members. Since 1970, our lawyers, scientists, and other environmental specialists have been working to protect the world's natural resources and improve the quality of the human environment. NRDC has offices in New York City, Washington, D.C., Santa Monica, and San Francisco. Visit us on the World Wide Web at www.nrdc.org.

ABOUT E2

Environmental Entrepreneurs (E2) is a national community of more than 500 businesspeople who believe in protecting the environment while building economic prosperity. Working with NRDC, E2 serves as a champion on the economic side of good environmental policy by taking a reasoned, economically sound approach to environmental issues. E2 works to influence state and national environmental policy through its bipartisan efforts. Collectively, E2's members have created more than 800 companies and 400,000 jobs, and manage \$20 billion of venture capital. Visit us on the World Wide Web at www.e2.org.

ACKNOWLEDGMENTS

The authors would like to acknowledge the following people for the information, assistance, and guidance they provided in the development of this report:

Ralph Cavanagh, Mary Jean Burer, Craig Noble, and Christine Koronides (NRDC); Keith Raab (Cleantech Venture Network); Chuck McDermott (Rockport Capital Partners); Sanjay Wagle (Expansion Capital Partners); Sam Kingsland (Granite Ventures); Jeanne Trombly (); Ivor Frishknecht (H2onsite); Rob Pratt, Stephen Fleming, Joshua Green, and Karina Funk (Massachusetts Renewable Energy Trust); Bryan Garcia (Connecticut Clean Energy Fund); Jim Boettcher (McCathel LP); Professor Daniel Kammen (UC Berkeley, Energy & Resources Group); Ron Pernick (Clean Edge, Inc.); Adam Werbach (Common Assets, Apollo Project); Kari Smith; Greg Rosen (PowerLight Corporation); Hyung Kim; Carol Tiernan (Clean Air Power); Bill Anderson; Tim Truex (Catalytic Solutions); and the 25 venture capitalists and investors who provided their input to this report. The firms they represent are listed below in alphabetical order (two firms remain anonymous):

Advanced Capital Markets
Altira Group LLC
Angeleno Group
Blue Hill Partners
Braemar Energy Ventures, LP

Broadmark Capital
Chrysalix Energy Management
Draper Fisher Jurvetson
Enertech Capital
Expansion Capital Partners

Creating the California Cleantech Cluster

Garage Technology Ventures	Rockport Capital Partners
Global Environment Fund	Rustic Canyon Partners
Hydro-Quebec CapiTech	WHEB Ventures Limited
McCathel LP	W.R. Hambrecht & Company
NGEN Partners, LLC	Zero Stage Capital
Nth Power	
Nucleus Partners	

NRDC President

John Adams

E2 Co-Founders

Bob Epstein and Nicole Lederer

NRDC Executive Director

Frances Beinecke

This report can be downloaded directly from www.nrdc.org or www.e2.org.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	6
Chapter 1: The Cleantech Industry: An Engine for High Quality Job Growth	11
1.1 Definition of the Cleantech Industry	11
1.2 Cleantech: Already a Substantial Industry	12
1.3 Cleantech Venture Capital Investment Is on the Rise	13
1.4 California's Cleantech Vision: 52,000 to 114,000 Quality Jobs Seeded by 2010	14
Chapter 2: California: The Future Center of the Cleantech Industry?	17
2.1 California Is a Leading Candidate to Host a Cleantech Cluster	17
2.2 Cleantech Is Underrepresented in California Venture Capital Investing	18
2.3 A Coordinated Effort: Public Policy and Venture Capital Investment	20
Chapter 3: Policy + Cleantech + Finance = Jobs	23
3.1 Venture Capital: A Powerful Catalyst for Economic Growth	23
3.2 Job Creation in California from Cleantech Venture Capital: A Scenario Analysis	24
3.3 The Value of 10 percent	26
3.4 Increasing California's Cleantech VC Market Share to 40 percent	26
3.5 Putting the Job Creation Scenarios in Context	27
Chapter 4: Public Policy: A Critical Driver for the Cleantech Industry	29
4.1 Public Policy Is a Real Factor in Private Equity Investment Decisions	29
4.2 Key Existing Regulations and Initiatives	29
4.3 California Cleantech Public Policy Options	32
Chapter 5: Cleantech-Related Initiatives in Other States	39
5.1 Massachusetts – Innovative Energy Funding	40
5.2 Connecticut – Future Fuel Cell Capital of the World?	41
5.3 Texas – “The Texas Wind Rush”	42
5.4 New Mexico – Alternative Fuels and Fuel Cells	43
Chapter 6: Recommendations: A Cleantech Prescription for California	45
Appendix 1	49
Endnotes	57

EXECUTIVE SUMMARY

Cleantech is a relatively new industry encompassing economically compelling and environmentally friendly technologies, products, and services. The cleantech industry can be a major driver for new investments and job growth in California. But while the state is ideally positioned to be a cleantech leader, focused public policy efforts are needed to create new markets and to attract additional private investment to the state.

Venture capital, or funding provided to startups in return for company equity, is most often described as a fuel for economic growth. This important financial catalyst also serves as a useful proxy for the promise and progress of a new industry. In researching “Creating the California Cleantech Cluster,” the Natural Resources Defense Council (NRDC) and Environmental Entrepreneurs (E2) conducted a detailed survey of 25 private equity investors (mostly venture capitalists) who are active in the cleantech field. Together, these respondents control more than \$7 billion of capital, of which they plan to invest \$1.2 billion in the cleantech sector over the next three years. NRDC and E2 also examined industry data on venture capital investment, interviewed cleantech entrepreneurs and executives, and reviewed existing studies related to private equity investing and the many industries that make up the cleantech sector.

Background

Cleantech as a distinct industry is still in its formative years. The industry encompasses a broad range of products and services, from alternative energy generation to wastewater treatment to environmentally friendly consumer products. Although some of these industries are very different, all share a common thread: They use new, innovative technology to create products and services that compete favorably on price and performance, while reducing mankind’s impact on the environment.

Tremendous Global Growth Potential for Cleantech

Venture capital interest in cleantech has surged in the last several years, largely because of a fundamental change in the economics of the environmental industry. Advances in technology, research methods, manufacturing, and communications have lowered the costs of environmentally sensitive technologies, bringing many into the economic mainstream. At the same time, worldwide efforts to address environmental problems such as global warming, air pollution, water pollution, and increased energy use are on the rise. This confluence of forces—the simultaneous maturity of both environmental technology and impetus—makes cleantech a promising sector for future growth.

FINDINGS

Finding 1: California is well positioned to be a cleantech leader.

California is well positioned to take advantage of the growing cleantech market. In fact, the state is already spawning cleantech businesses at a rapid rate. As one venture capitalist put it, California is the “primordial soup” for cleantech entrepreneurialism.

California has many of the ingredients necessary for the creation of a cleantech cluster:

- a thriving technology base;
- abundant entrepreneurial and management talent;
- access to capital;
- proactive environmental public policy.

Not surprisingly, California is viewed as an attractive place for venture capital investment in new cleantech technologies, and the state received more cleantech venture capital investment than any other U.S. state or region in 2003 (\$339 million, or 29 percent of the North American total). The venture capitalists (VCs) surveyed also gave California almost twice as many mentions as the next state, region, or country worldwide that is “the most attractive for cleantech/clean energy investment.”

Finding 2: A cleantech cluster can create thousands of new jobs and attract billions of investment dollars to the state.

Venture capital investment in cleantech start-ups can seed the creation of 52,000 to 114,000 high-quality jobs and \$11 to \$25 billion in annual revenue in California by 2010. Most of these jobs would be high-paying, skilled positions. (This analysis reflects only jobs and revenue created by venture-backed companies. Non-venture-backed cleantech companies would contribute additional jobs and revenue to the state.)

At the current rate of cleantech investment growth, increasing California’s market share of North American cleantech venture capital investment from 29 percent to 40 percent could lead to 15,000 more jobs and \$3.3 billion more in annual revenue seeded by 2010.

Finding 3: Public policies are a critical driver of cleantech growth.

Public policies are an important driver for new jobs and investment:

- 91 percent of VCs surveyed say that a pro-environmental public policy stance can be a driver in bringing new business and investment to the state.
- 79 percent of VCs surveyed say that current California public policy (regulations, programs, and incentives) is a prominent factor in their investment decisions.
- “Regulatory Climate/Public Policy” received the second highest number of mentions for why VCs prefer to invest in California.

Finding 4: California needs focused, well-coordinated public policies to develop a leading cleantech cluster.

While California has had some success in attracting cleantech businesses and investment, to date there has not been a concerted, coordinated effort to encourage the development of a cleantech cluster. As a result, the state has not yet realized the full benefit of the cleantech opportunity. For instance, from a venture capital perspective, the cleantech industry is under-represented relative to the state's other technology industries. In 2003, California companies received 63 percent of all venture capital invested in the U.S. semiconductor industry, more than 50 percent of U.S. venture capital invested in computers and peripherals, networking and equipment, and medical devices and equipment, and 43 percent of *all* VC investment in the country. Yet the state received only 31 percent of U.S. cleantech investment (29 percent of North American investment).

Additionally, other states and countries are aggressively pursuing cleantech investors and entrepreneurs through a variety of programs that California could emulate. Connecticut, Massachusetts, Texas, New Mexico, New York, New Jersey, Florida, and Pennsylvania were all mentioned by cleantech VCs as having proactive cleantech public policies. Europe and Japan are also successfully building cleantech clusters. For instance, Germany and Japan have usurped California's once-leading position in solar and wind energy through targeted policies and initiatives.

Most states' and countries' cleantech efforts are focused on renewable energy, to the exclusion of other cleantech sectors. This presents an opportunity for California to establish itself in other fields where it has natural advantages, such as information technology, materials science, and transportation.

RECOMMENDATIONS

Recommendation 1: Establish visible state leadership to help create the California cleantech cluster.

To demonstrate that California is serious about leading the nation in the cleantech industry, the state should undertake the following:

- **Catalog** the myriad public, private, and quasi-public agencies, initiatives, and programs that affect the cleantech sector.
- **Improve coordination** across these organizations and create linkages to help them organize around common objectives.
- **Define and promote the state's cleantech core competencies**, and assist in focusing investors on a handful of key industries for targeted cluster development. Areas in which the state has a significant head start include advanced materials and nanotechnology, renewable energy generation, air pollution control, advanced transportation technology (including hydrogen), and IT-related cleantech.

Recommendation 2: Help create new markets for cleantech products.

- **Make the state government a bigger, better cleantech customer.** California has the world's sixth largest economy. Every year, it spends billions of dollars on construction and goods. The state should make it a policy to purchase the cleanest, most efficient and cost-effective products. Many of these products, such as fuel-efficient cars, efficient replacement tires, and other energy-efficient technologies, pay for themselves and will help the state save money.
- **Continue to develop, adopt, and implement environmental regulations that create new markets for cleantech.** State and regional environmental regulations can be powerful drivers of economic growth. California's air pollution control industry, for instance, has grown from a roughly \$450 million industry employing 3,000 Californians in 1970 to a \$6.2 billion industry that now employs 32,000 Californians, primarily due to state and regional (rather than federal) laws and programs.

Through its cleantech efforts, California now has an opportunity to create large new markets for clean car technologies, renewable energy generation, and energy-efficient appliances. For example, the **Renewable Portfolio Standard**, the **Hydrogen Highway Network** initiative, and **AB 1493** (Pavley 2002), the state law that mandates new global warming pollution standards for passenger vehicles, could open multibillion-dollar markets for clean and efficient technologies. To provide certainty for investors, entrepreneurs, and customers, it is important that California not weaken these existing initiatives, and that it makes multiyear commitments to existing and new ones.
- **Help promote cleantech export markets.** Progressive environmental policies give California's cleantech industry an advantage in exporting products overseas. As developing countries struggle with rising electricity demand and auto ownership, energy supply problems, and other environmental issues, their demand for cleantech products is likely to soar. For example, China's new car market is predicted to be as large as the United States' by 2015, and its need for emissions reduction technology, advanced vehicle components, fuel cells, and hydrogen generation equipment is likely to increase dramatically. By fostering a strong domestic cleantech cluster, California can ensure that its businesses are well positioned to satisfy this growing export market.

Recommendation 3: Help enhance funding for cleantech companies.

- **Boost publicly funded cleantech research and development.** Technology research and development is at the heart of California's efforts to establish a cleantech cluster. Yet private early-stage funding often is hard to come by for cleantech companies. The state can play a valuable role in helping them bring their technologies and products to market by increasing public spending for cleantech research and development activities. A key step will be to encourage the University of California system to focus more of its research on cleantech. The state should also consider expanding funding for existing programs and creating new programs to support underfunded sectors in the cleantech industry.

- **Focus more existing state funds on California cleantech companies.** The state has a number of funds and programs designed to help cleantech companies, including the Public Interest Energy Research program, the CalPERS and CalSTRS private equity funds (which are a result of the Green Wave initiative), and the California Clean Energy Fund. Together, these initiatives control hundreds of millions of dollars in investment money. The state should give the funds' recipients incentives to do business in California. Additionally, it can help investors better understand the market and policy climate that fosters new clean technologies, and highlight the strengths of California companies for project managers.

CHAPTER 1

THE CLEANTECH INDUSTRY: AN ENGINE FOR HIGH- QUALITY JOB GROWTH

1.1 DEFINITION OF THE CLEANTECH INDUSTRY

Cleantech (clean technology) products and services use technology to compete favorably on price and performance while reducing pollution, waste, and use of natural resources. As the term is used today, cleantech encompasses a broad range of industries, from renewable energy generation to wastewater treatment to environmentally sensitive consumer products. Some cleantech sectors, such as wind power, solar power, and air pollution control equipment, have long pedigrees, boasting billions of dollars of research expended and hundreds of successful companies. Other technologies and industries are more nascent: Environmentally focused nanotechnology and solid oxide fuel cells, for instance, are promising fields but have yet to achieve widespread commercial acceptance. For the purposes of this report, we have chosen to use the term “cleantech” the way private equity investors do. Table 1.1 shows 11 cleantech industry categories. Many of these industries have applications that extend far beyond the environmental field. In this study, we are concerned only with those applications that reduce the environmental impact of human activities.

Table 1.1
Cleantech Industry Categories

Industry	Examples
Advanced Materials and Nanotechnology	- Non-platinum catalysts for catalytic converters - Nano-materials for more efficient and fungible solar photovoltaic panels
Agriculture and Nutrition	- Innovative plant technologies and modified crops designed to reduce reliance on pesticides or fungicides
Air Quality	- Stationary and mobile emission scrubbers - Testing and compliance services
Consumer Products	- Biodegradable plasticware - Nontoxic household cleaners
Enabling Technologies and Services	- Advanced materials research services - High throughput screening research equipment
Energy Generation, Storage, and Infrastructure	- Solar photovoltaic technology - Wind power - Hydrogen generation - Batteries and power management technology

Environmental Information Technology	- Regulatory and policy compliance software - Geographic Information Services (GIS)
Manufacturing/Industrial Technologies	- Hardware and software to increase manufacturing productivity and efficiency
Materials Recovering and Recycling	- Chemicals recovery and reprocessing in industrial manufacturing - Remanufacturing
Transportation and Logistics	- Fuel cells for cars - Diesel retrofit equipment - Hybrid electric systems for cars, buses, and trucks
Waste and Water Purification and Management	- Biological and chemical processes for water and waste purification - Fluid flow metering technology

1.2 CLEANTECH: ALREADY A SUBSTANTIAL INDUSTRY

Because cleantech encompasses such a disparate group of industries, and because there is substantial overlap with non environmental applications, it is difficult to accurately estimate the size of the cleantech industry today. But an examination of even a partial listing of industries reveals that cleantech is already a substantial driver of economic activity in the United States and California.

In California, the environmental industry supports an estimated 180,000 jobs.¹ At the national level, environmental job numbers rival those of other established industries. The main renewable energy industries, including solar, wind, geothermal, and biomass, currently employ approximately 115,000 people in the United States (Table 1.2). The entire U.S. coal industry, by comparison, employs 83,000 people.²

Table 1.2
U.S. Jobs in Renewable Energy Industries

Energy Source	Direct U.S. Jobs
Biomass	66,000 ³
Solar Photo-voltaic	20,000 ⁴
Wind	17,000 ⁵
Geothermal	12,300 ⁶
Total	115,300

The air pollution control industry (excluding renewable energy jobs) employs an estimated 160,000 people in the United States, with 18,000 of those in California.⁷ The remanufacturing industry (the practice of recovering, disassembling, and reusing or recycling a product's parts) employs 480,000 people in the United States and generates \$53 billion in annual revenue.⁸ The U.S. water and liquid waste treatment industry employed 99,000 people in 2002.⁹

This subset of environmentally related industries alone accounts for more than 850,000 U.S. jobs. To put these numbers in perspective, the entire mining and electricity generation industries in the United States employ 1.4 million people.¹⁰

In short, cleantech is already a significant business in the United States. But opportunities for further growth in the sector abound. A “perfect storm” may be brewing for the industry, one that could result in significant job growth and economic activity for the United States and California. Three main factors are driving this growth:

- Materials science innovations, coupled with improvements in research and manufacturing processes, are leading to breakthroughs in environmental products. The resulting reductions in cost together with advances in functionality have spurred business and consumer demand for many of these “green” products. Indeed, many purchasers choose cleantech products purely on their economic merits, bolstering the growing body of evidence that environmental protection and economic growth can go hand in hand.
- Consumers, policy makers, and corporations are increasingly realizing that they must act quickly to repair past environmental damage and lessen future environmental impact.
- Some of the most prescient, influential, and aggressive financial decision makers in our economy—entrepreneurs and private equity investors—are beginning to make substantial investments in cleantech.

1.3 CLEANTECH VENTURE CAPITAL INVESTMENT IS ON THE RISE

In 2003, venture capitalists invested \$1.2 billion in North American cleantech companies, up 7.7 percent over 2002.¹¹ Cleantech investment accounted for 5.9 percent of total U.S. venture capital investments in 2003. (While cleantech investment grew, 2003 overall U.S. venture capital investments declined almost 14 percent from 2002 levels, to \$18.4 billion.¹²) Some of the venture capital firms investing in cleantech companies are specialists in the cleantech field, including Altira Group, Nth Power, Vantage Point, Enertech, Chrysalix, Perseus Capital, and Rockport Capital. But notably, many of the largest and most established Silicon Valley firms, such as Draper Fisher Jurvetson, Kleiner Perkins Caufield & Byers, and U.S. Venture Partners are making investments in cleantech companies, or are adding domain expertise in cleantech fields. While it is too early to say if venture capital firms will embrace cleantech the way they did the software industry, for instance, it is a sign of cleantech’s strong economic promise that venture capitalists are starting to place bets on the industry.

For California, there’s a lot at stake. If cleantech venture capital investment grows only at its current rate for the rest of the decade, more than \$11 billion of venture capital will be invested in North American cleantech companies between now and 2010. From a state’s perspective, this capital—and the economic benefits that go with it—is up for grabs. The seeds are being sown now to determine which states’ companies will get the lion’s share of investment and which states will call the future leaders of the cleantech industry their own. The state or region that can best woo entrepreneurs and investors now will have a chance to create a self-perpetuating cleantech cluster—a hub for cleantech companies and technology—that can lead to dynamic economic growth while also improving the environment.

Clearly, it is in California's interest not only to participate in what could be a significant boom, but also to take concrete steps to make California a hub for the cleantech industry. The benefits, both economic and environmental, could be substantial.

1.4 CALIFORNIA'S CLEANTECH VISION: 52,000 TO 114,000 QUALITY JOBS SEEDED BY 2010

Using statistics from past venture capital investments and the economic impact generated by that capital, we constructed several scenarios of what a California cleantech cluster could mean for the state's economy. These calculations show that cleantech venture capital investments in California could seed the creation of 52,000 to 114,000 California jobs, and \$11.2 billion to \$25.3 billion in annual revenue by 2010. (These scenarios are discussed in Chapter 3.) Perhaps most important for California's public policy makers, any successes in attracting additional venture capital would likely be extremely leveraged: Each additional 10 percent of North American cleantech venture capital market share that California companies receive could result in an incremental 18,000 to 29,000 jobs seeded by 2010. Most of these jobs would likely be high-paying, skilled positions.

An additional economic benefit to the development of a cleantech cluster in California is specific to renewable energy. A recent study by Daniel Kammen, Kamal Kapadia, and Matthias Fripp of the University of California at Berkeley found that "the renewable energy sector generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment than the fossil-fuel-based energy sector."¹³ Kammen et al. found that a wind power installation employs up to 2.8 times as many people over its life span as a coal or gas-fired power plant for the same energy output when counting all phases of the value chain. A solar photovoltaic installation employs 7 to 11 times the people for the same energy output. The net result: Transitioning 20 percent of U.S. electricity generation to renewable sources by 2020 would result in 101,000 to 157,000 more American jobs than relying solely on coal and natural gas-fired electricity.

In addition to the economic benefits, California's environment would also gain from a healthy cleantech sector. Growth in the renewable energy sector, by replacing existing fossil fuel-based power plants or obviating the need for new ones, would reduce emissions of local and global pollutants (such as mercury, nitrogen oxides (NO_x), and greenhouse gases like carbon dioxide) and reduce the environmental impact of resource extraction throughout the state. In non energy sectors, a thriving California cleantech sector would directly reduce energy demands and lessen pollution, encourage local businesses and consumers to purchase more environmentally friendly technology, and provide a more cost-effective option than buying products imported from other states or countries.

This report intends to provide concrete ideas for making California a leading center for the cleantech industry. In approaching this issue, we address three key questions:

1. How can California better **attract and nurture cleantech start-ups** in the state?

2. How can California better **encourage cleantech private equity investors** to invest in those companies?
3. How can California **grow market demand** for cleantech products and services?

Attracting cleantech start-ups and investment won't be easy; it will require the careful coordination of many variables, committed leadership, and a little luck. Other states and countries are competing for the same companies and investment dollars. The good news is that California has a head start.

CHAPTER 2

CALIFORNIA: THE FUTURE CENTER OF THE CLEANTECH INDUSTRY?

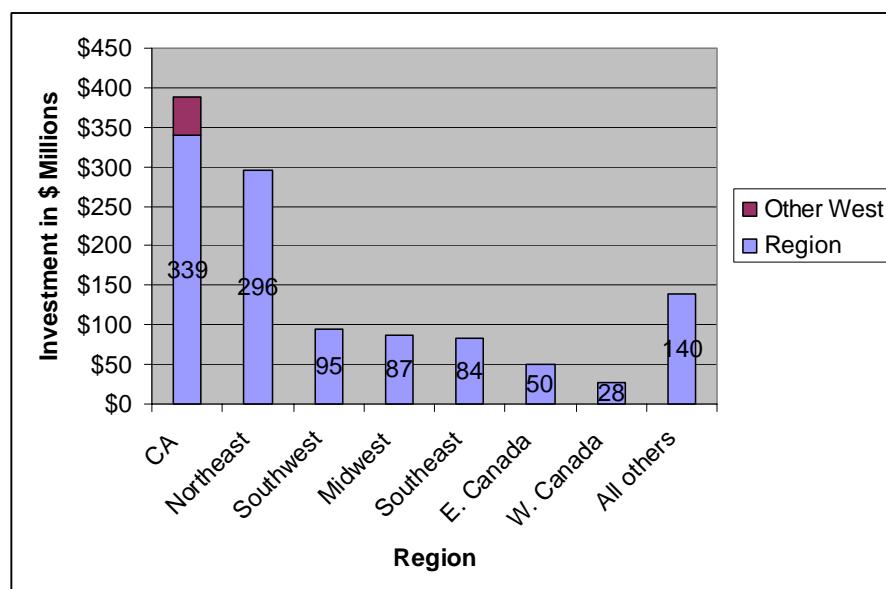
2.1 CALIFORNIA IS A LEADING CANDIDATE TO HOST A CLEANTECH CLUSTER

We surveyed 25 venture capitalists from around the country and the world who are active cleantech investors. We wanted to understand, among other things, how they view California as a place to invest in cleantech companies. This sample of investors controls more than \$7 billion in committed capital and plans to invest more than \$4 billion over the next three years, with \$1.2 billion of that in cleantech companies. (Please see *Appendix A: Survey Methodology* for an explanation of the survey process and respondent demographics.) These investors' responses indicate that California is already one of the top candidates—if not *the* top candidate—for the establishment of a U.S. cleantech cluster:

- **California companies lead the nation in attracting cleantech venture capital investment, with \$339 million flowing to the state in 2003, 29 percent of the North American total.¹⁴**
- **When asked to rank California versus other U.S. states based on its attractiveness for cleantech investing, California received a score of 4.2 out of 5.0.** (“5” indicated that California was “much more attractive than other states”, “4” indicated California was “more attractive than other states”, “3” indicated that California was “neither more nor less attractive”.)
- **When asked to identify “the most attractive state or region worldwide for cleantech/clean energy investing,” California received almost twice as many mentions as any other region.** (Respondents could mention more than one state or region.)
 - California 13 mentions
 - Individual New England states 7 mentions
 - Europe 6 mentions
 - Southwestern states 4 mentions
 - Canada and Mid-Atlantic states 3 mentions each
- **Although California is a leader in the cleantech space, it does not hold a dominant position.** In 2003, the Northeast received 25 percent of total North American cleantech

venture funding versus California's 29 percent.¹⁵ Most respondents feel there is not yet a dominant cluster for cleantech investing.

Figure 2.1
2003 North American Cleantech VC Investment by Region

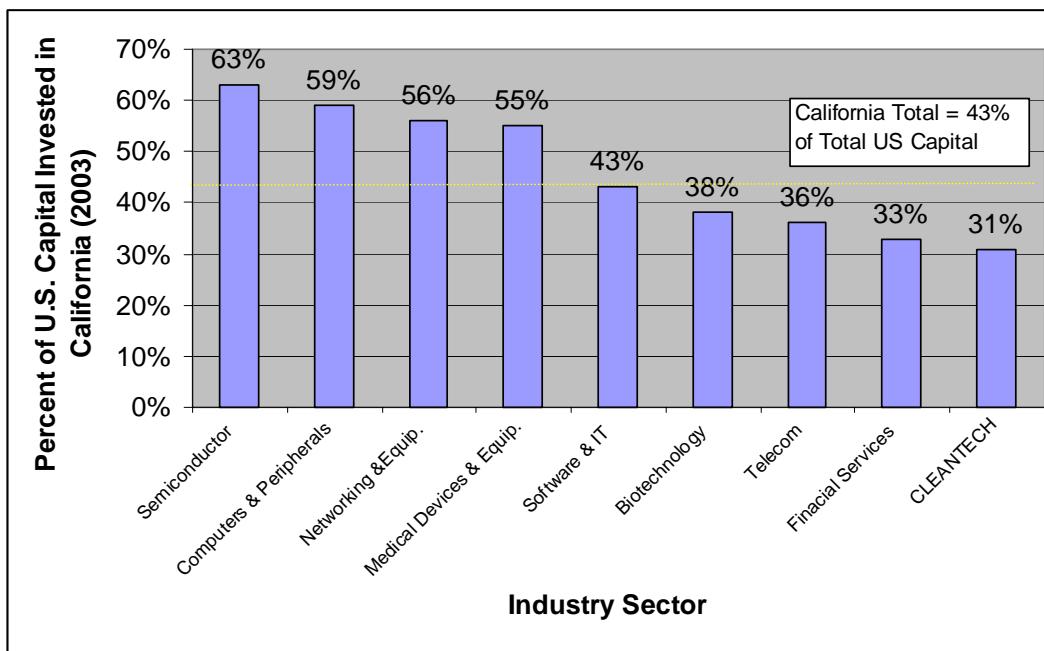


Source: Cleantech Venture Network

2.2 CLEANTECH IS UNDERREPRESENTED IN CALIFORNIA VC INVESTING

Despite early successes, California's cleantech industry is still not achieving its potential. In 2003, California companies received 43 percent of all venture capital invested in the United States. In some industries, California companies received well over 50 percent of U.S. venture capital investment. California's cleantech industry, by comparison, attracted 31 percent of the nation's cleantech venture capital in 2003 (29 percent of the North American total), trailing other technology industries and the state's average.

Figure 2.2
California's Share of U.S. VC Investment by Sector (2003)



Source: Pricewaterhouse Coopers/Thomson Venture Economics/NVCA MoneyTree Survey; Cleantech Venture Network

One explanation for California's relatively low share of venture capital investment in cleantech is that the growth of the cleantech sector in California has been organic and unplanned. As a result, while California has attracted some cleantech capital, the state has not become the focal point for cleantech investment that it has for other industries, like semiconductors, computers, networking, medical devices, software, and biotechnology. These industries have flourished because public and private interests have combined to develop powerful industry clusters in the state. If California's cleantech industry is to achieve its full potential, it should emulate the success of these sectors through an organized, focused approach to development. In short, the state should set as a goal the establishment of a cleantech industry cluster and adopt targeted initiatives that can help the sector develop.

Our recommendation is that California aim to achieve a 40 percent market share of North American cleantech venture capital investment (equivalent to 43 percent of U.S. cleantech venture capital investment) over the next several years. This does not mean taking cleantech venture capital that other states would receive—none of the recommendations outlined in this report will impede the ability of companies to locate in other states, or for those companies to attract venture capital. Instead, by fostering a cleantech cluster, California can both grow the overall cleantech pie and carve out a bigger slice for itself.

2.3 A COORDINATED EFFORT: PUBLIC POLICY AND VENTURE CAPITAL INVESTMENT

For public policy makers trying to create new economic growth, a common strategy is to create conditions for the development of an industry cluster. Harvard Business School professor Michael Porter defines a cluster as “a concentration of companies and industries in a geographic region that are interconnected by the markets they serve and the products they produce.”¹⁶

California already has three world-class clusters: Silicon Valley, Hollywood, and the California wine cluster. Other well-known clusters include the mutual fund industry in Boston, the textile cluster in the Carolinas, and the fashion shoe cluster in northern Italy. As Porter points out, new clusters often grow out of established ones. For instance, the same resources that enabled Silicon Valley’s high-tech cluster to develop—a great educational system, entrepreneurial talent, expertise in advanced technologies, and access to capital—will be critical building blocks for a cleantech cluster. Existing companies play a crucial role as well: Technology and management spinouts from established high-tech companies are already spawning new cleantech businesses in California.

THE BENEFITS OF CLUSTERS

Companies in a cluster compete against one another, but they also share key resources. By gathering together in one region, companies foster communication and trust, leading to eventual advantages in efficiency, effectiveness, flexibility, and the rate of innovation. They share access to employees and suppliers, they leverage the same specialized business services (lawyers, accountants, banks, marketing, and other support services), and they trade information and technologies. This shared access, and the fierce competition it engenders, provides cluster companies a leg up on companies not in the cluster. Clusters spur new successful companies, which perpetuate and upgrade the cluster, and so on.

Clusters tend to form around academic institutions that produce much of their technological raw material. For instance, information technology (IT) start-ups Sybase, Ingres, Illustra, and Inktomi were all founded on technology developed at the University of California at Berkeley. Sun Microsystems and Google both originated at Stanford. All these companies were founded in California and remain here today, employing thousands of people as part of the state’s huge IT cluster.

Clusters create another important benefit for their companies—a cluster puts a face on an industry, unifying often disparate corporations into a coherent entity to which industry outsiders can relate. (Rattle off a list of high-tech companies and many people won’t know half of them. Say “Silicon Valley” and people know immediately what you’re talking about.) This “face” is important—it helps brand an industry, raising its profile and helping investors, entrepreneurs, and consumers better understand the industry’s significance.

The presence of a cluster may also reassure investors. As a cluster of successful businesses in one industry emerges, investors tend to gain confidence in placing money with new start-ups in that sector. Where others have succeeded, and with available talent and resources in close proximity, there is more reason to believe that the risk inherent in any one company is manageable.

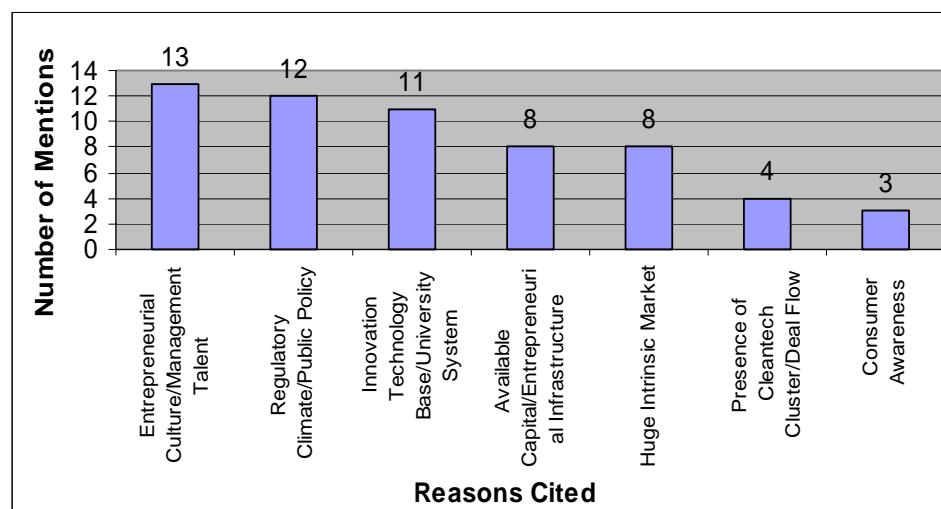
Creating a cluster is no simple task, and public policy is but one ingredient in a complex recipe. We have identified seven key factors for the development of a cleantech cluster in California:

- Technology innovation and expertise (from public and private research);
- Entrepreneurial culture;
- Management talent;
- Access to capital and other financing;
- Large local market for products and services;
- Proactive and conducive public policy;
- Consumer/customer acceptance.

Fortunately for California, most of these factors already exist in abundance. The venture capitalists we surveyed repeatedly mentioned the intrinsic advantages that make California a natural place from which to spawn environmentally oriented industries: a huge internal market, a world-class university system, a vibrant and experienced entrepreneurial community, a long list of successful high-tech companies (with subsequent spin outs and management talent), a host of environmental pressures, proactive environmental public policies, relatively high consumer awareness of environmental issues, and a significant amount of capital.

Figure 2.3 shows the main reasons venture capitalists find California an attractive place to invest in cleantech, ranked by the number of mentions in the survey. (Each respondent could name up to three reasons.)

Figure 2.3 Reasons for California Attractiveness as a Cleantech Investment Site (Mentions)



Source: E2 Venture Capital Survey (n=25 respondents)

Importantly, “Regulatory Climate/Public Policy” received the second highest number of mentions among reasons VCs prefer to invest in California. At the same time, nearly every VC we interviewed said they won’t invest in a company that is *dependent on one*

regulation for its success. This apparent contradiction makes sense when viewed from a holistic perspective: A consistent and forward-thinking approach to environmental regulation and public policy, across a broad spectrum, is more important to the investing climate than any individual regulation.

Several respondents pointedly mentioned their bad experiences with California's efforts to promote Zero Emission Vehicles (ZEVs). Others recalled being burned by the state's experiment with energy deregulation. On the whole, however, California is viewed as having a proactive, dynamic, and precedent-setting set of environmental public policies, one that encourages entrepreneurial activity. Maintaining that leadership position requires continually moving forward and being consistent in the way the state implements its policies. As one venture capitalist remarked, "*How* they do this is as important as *what* they do."

Some respondents did mention negative points of doing business in California, namely the high cost of living, high taxes, and worker's compensation issues. But none of these are specific to the cleantech industry, and most investors feel that California's other advantages trump those drawbacks.

Of the seven key ingredients required for a successful cluster, it is worth noting that most take decades to develop. California has a natural lead on some of the more difficult characteristics required to create a cleantech cluster. For instance, a world-class university system cannot be built in a few years; world-class companies and management talent do not spring up overnight; and no state can match California's economy for sheer size and breadth.

CHAPTER 3

POLICY + CLEANTECH + FINANCE = JOBS

3.1 VENTURE CAPITAL: A POWERFUL CATALYST FOR ECONOMIC GROWTH

In the last 30 years, venture capital has been a catalytic force for some of the biggest growth industries in U.S. history. The personal computer, biotechnology, software, Internet, and retail beverage industries are just some of those that trace their meteoric growth back to venture capital funding. Notable companies that were backed by venture capital investors include Microsoft, Intel, FedEx, Apple, Palm Computer, Amazon, Yahoo, eBay, Sun Microsystems, Jet Blue, Amgen, Genentech, The Home Depot, and Starbucks.

The overall impact of venture capital on the American economy has been huge: According to a 2004 study by Global Insight and the National Venture Capital Association (NVCA), in 2003 companies backed by venture capital directly accounted for 10.1 million jobs and contributed \$1.8 trillion annually to the U.S. GDP.¹⁷ Global Insight's study also found that venture-backed companies grew sales at almost twice the rate of non-venture-backed companies and invested twice as much proportionately in research and development (R&D). An earlier Global Insight/NVCA report found that venture-backed companies generate almost twice the exports and pay almost three times as many taxes as non-venture-backed companies per every \$1,000 in assets.¹⁸ And European studies have shown that venture-backed companies have higher rates of innovation and generate more productivity from their R&D expenditures.¹⁹ Perhaps most important, venture-backed companies create jobs at a faster rate than non-venture-backed companies.^{20,21}

Venture capital is more than just a fuel for growth. It is a leading indicator of economic and technological innovation. Venture capitalists (VCs) are always on the lookout for cutting edge technology that can reshape an industry; they must keep their proverbial ears to the ground in order for their investment model to work. As a result, when the venture capital community gets excited about a technology, idea, or industry, there's a good chance it's about to take off. In the last several years, many VCs have identified cleantech as one of the most promising new investment sectors—an encouraging sign for environmentalists and entrepreneurs.

How VENTURE CAPITAL WORKS

Venture capital is both a fuel for entrepreneurial activity and a measure of it. Venture capitalists, or VCs, make money by investing very early in the development of promising companies, often before those companies have revenues. VCs try to pick start-ups that have the potential to be “game-changing”—in other words, those that can revolutionize an industry or create an entirely new one. As a result, VCs are like an early warning system for new industries—other investors and corporate decision makers often watch venture capitalists to identify hot new technologies and companies.

By investing at an early stage, VCs buy into their “portfolio companies” at low valuations. They then work with them to help them grow and prosper. Most VCs aim to exit (sell their stake) in three to eight years, hopefully at a much higher valuation when the company goes public or is acquired. VCs typically invest a few million dollars in a company and hope to earn returns that are 5, 10 or 20 times higher than what they invested. Of course, not every start-up succeeds; the majority of venture-backed companies go out of business or only break even. But when a company does hit it big, investors stand to make returns far above those available in other capital markets.

By investing in companies that are too risky for most banks to lend to, and too small to attract other institutional investors, VCs help foster the growth of new industries and companies that might not otherwise receive funding. And by bringing industry-specific expertise and management to their portfolio companies, they can help guide start-ups to enormous growth.

3.2 JOB CREATION IN CALIFORNIA FROM CLEANTECH VENTURE CAPITAL: A SCENARIO ANALYSIS

In an effort to understand the potential job and revenue impacts of the cleantech sector on California’s economy, we modeled three scenarios of cleantech investment over the remainder of the decade. For inputs, we relied on current industry data and previously published reports. The primary report used to calculate the job and revenue creation numbers was Global Insight’s 2004 study.²² It found that \$338.5 billion of venture capital invested in U.S. companies from 1970 to 2003 led to the creation of 10.1 million jobs by 2003, or one job created for every \$33,500 of VC money.

California companies, for a variety of reasons, created one job by 2003 for every \$56,700 of venture capital invested. Each dollar of venture capital invested also yielded an average of \$3.12 in 2003 revenue for California companies.²³ By using these numbers, and making assumptions about the amount of venture capital that could be invested in California companies between now and 2010, we modeled a range of job and revenue creation scenarios for the California cleantech industry.^{24,25}

Base Case Scenario

North American (N.A.) cleantech venture capital investing (\$1.2 billion in 2003) continues to grow at its current rate of 7.7 percent annually through 2010, and California

companies receive only their current share of it (29 percent). Under this scenario, a cumulative investment of \$3.2 billion in California cleantech would seed 51,517 jobs and \$11.2 billion in annual revenue by 2010 (see Table 3.2a).

Table 3.2a: Current Growth Conditions

Cleantech VC funding annual growth rate	7.7 percent
California share of N.A. cleantech VC funding	29 percent
N.A. cleantech VC investment in 2010	\$2.0 billion
California cleantech VC investment in 2010	\$570 million
California cleantech cumulative VC investment 2004--2010	\$3.2 billion
Total California jobs seeded by 2010	51,517
California annual revenue seeded by 2010	\$11.2 billion

Middle Case Scenario

North American cleantech VC investing grows at 15 percent annually through 2010 (about double the current rate), and California companies receive 35 percent of that investment (6 percentage points higher than its current share). Under these conditions, cumulative California cleantech investment would reach \$5.2 billion by 2010, seeding 82,578 jobs and \$18.1 billion in annual revenue (see Table 3.2b).

Table 3.2b: Moderate Growth Conditions

Cleantech VC funding annual growth rate	15 percent
California share of N.A. cleantech VC funding	35 percent
N.A. cleantech VC investment in 2010	\$3.1 billion
California cleantech VC investment in 2010	\$1.1 billion
California cleantech cumulative VC investment 2004-2010	\$5.2 billion
Total California jobs seeded by 2010	82,578
California annual revenue seeded by 2010	\$18.1 billion

Aggressive Case Scenario

North American cleantech VC investing grows at 20 percent per year through 2010, and California companies receive 40 percent of that investment. Under these conditions, California would receive \$7.2 billion in VC cleantech investment, which would seed 114,476 jobs and \$25.3 billion in annual revenue (see Table 3.2c).

Table 3.2c: Aggressive Growth Conditions

Cleantech VC funding annual growth rate	20 percent
California share of N.A. cleantech VC funding	40 percent
N.A. Cleantech VC investment in 2010	\$4.2 billion
California cleantech VC investment in 2010	\$1.7 billion
California cleantech cumulative VC investment 2004-2010	\$7.2 billion
Total California jobs seeded by 2010	114,476
California annual revenue seeded by 2010	\$25.3 billion

3.3 THE VALUE OF 10 PERCENT

Because these scenarios involve moving two variables at the same time—the growth rate of cleantech VC funding and California companies’ share of that funding—it may be easier to think about the job and revenue impacts in the following way: At today’s rate of growth for cleantech VC funding, every additional 10 percent of North American cleantech venture capital that California attracts could seed 18,000 more jobs and \$3.9 billion more in annual revenue by 2010. If funding to the industry grows by 15 percent per year (roughly double its current rate), every additional 10 percent of market share could seed an additional 24,000 jobs and \$5.2 billion in annual revenue by 2010. The faster cleantech funding grows, the more jobs and revenue each percentage point of VC funding is worth.

The following table outlines the incremental employment and revenue impact of a 10 percent gain in California’s share of cleantech VC funding.

Table 3.3
Value of a 10 Percent Gain in California Share of Cleantech VC Funding

N.A. VC cleantech funding annual growth rate	Incremental jobs seeded by 2010	Incremental annual revenue seeded by 2010
7.7 percent	17,765	\$3,853,376
10 percent	19,430	\$4,231,815
15 percent	23,593	\$5,182,571
20 percent	28,619	\$6,336,171
25 percent	34,663	\$7,730,534

3.4 INCREASING CALIFORNIA’S CLEANTECH VC MARKET SHARE TO 40 PERCENT

As noted in section 2.2, California received 29 percent of North America’s cleantech venture capital in 2003. This equates to 31 percent of U.S. cleantech funding, well below California’s average share across all industries of 43 percent, and well behind its share of the country’s relevant VC investment in industries such as semiconductors (63 percent), computers and peripherals (59 percent), and networking and equipment (56 percent).

At 31 percent, California’s share of U.S. cleantech funding is more on par with its share of financial services venture capital (33 percent), a sector in which the state does not host an appreciable cluster.²⁶ In other words, the amount of VC funding California receives in cleantech reflects the position of the industry itself: strong and growing, but not yet a dominant cluster.

Based on these comparables, we feel California should aim for a 40 percent share of North American cleantech VC funding—or 43 percent of U.S. cleantech funding—in three years. This would equal California’s average share across all VC sectors and put cleantech on par with software & IT services (43 percent) and slightly ahead of

biotechnology (38 percent) and telecommunications (36 percent), where the state has substantial, if not dominant, clusters.

At the industry's current VC funding growth rate of 7.7 percent, raising California's share of North American cleantech VC funding to 40 percent by 2007 and maintaining it for the rest of the decade would result in 14,800 additional jobs and \$3.3 billion in additional revenue seeded by 2010. In reality, the economic impact would likely be much higher. If venture capital is viewed as a measure of a cluster's success, reaching a 40 percent North American share would indicate a thriving, perhaps dominant cleantech cluster in California, one that could spawn many more companies, jobs, and revenue than those calculated here.

Of course, increasing market share cannot be accomplished by fiat. A state's share of invested capital is a derivative measure that reflects the inherent strength and growth potential of the industry in question. Nonetheless, there are things the state government can do to make California a more attractive place for cleantech investors and entrepreneurs (outlined in Chapter 6).

3.5 PUTTING THE JOB CREATION SCENARIOS IN CONTEXT

In considering the job creation scenarios described above, four points bear highlighting:

First, these numbers reflect only a partial accounting of the economic impact of cleantech. A successful cleantech cluster would benefit many companies, not just those that are venture-backed. Technology clusters also sustain a broad range of support services, including legal, marketing, real estate, and accounting, which tend to develop in close proximity to the cluster, and which are not considered here.

Second, the broad range of results produced in the three scenarios above—anywhere from 52,000 to 114,000 jobs and from \$11 to \$25 billion in revenue—underscores the leverage that decision makers have in shaping how the cleantech industry develops. It is *not* accurate to say that public policy makers alone can make the aggressive scenario a reality. However, the California government can take actions to better attract cleantech start-ups, help them prosper, and encourage private equity investment. As Table 3.3 shows, each small gain counts: An increase of 10 percentage points in California's share of North American cleantech VC funding could increase the job rolls by tens of thousands.

Third, it's useful to view these investment scenarios in the context of historical venture capital activity. Although \$1.7 billion invested in California cleantech companies in 2010 (the aggressive scenario) may sound large, it is not big relative to past venture capital spending. At the market peak in 2000, venture capitalists invested more than \$100 billion in the United States, most of it in information technology companies.²⁷ California received \$41 billion of that investment.²⁸ Similarly, few venture capitalists would argue that the base-case and middle-case scenarios presented here (\$570 million and \$1.1 billion invested in California companies in 2010, respectively) are unreasonable, particularly given that California received almost \$340 million in cleantech VC money in 2003.

Finally, venture capital is perhaps the most mercurial of all capital. When VCs decide a sector is hot, investments can skyrocket in just a few years. (Indeed, North American cleantech VC investments were up 45 percent in the first quarter of 2004 over the prior quarter.²⁹) It is therefore unlikely that VC funding will grow at the linear rates we have assumed in our scenarios. Any surge in cleantech venture investing could occur very rapidly, and cleantech spending could greatly exceed that modeled in our aggressive scenario.

California must be prepared to capitalize quickly on this opportunity. This means not only implementing long-term initiatives such as investing more in the state's higher education system, but also implementing programs that can have immediate impact on the complex decisions with which entrepreneurs and investors wrestle daily.

CHAPTER 4

PUBLIC POLICY: A CRITICAL DRIVER FOR THE CLEANTECH INDUSTRY

4.1 PUBLIC POLICY IS A REAL FACTOR IN PRIVATE EQUITY INVESTMENT DECISIONS

Our survey of 25 leading cleantech venture capitalists (VCs) shows that California public policy *does* influence where VCs invest. The link is an indirect one—VCs invest in companies, not in states. But the vast majority of investors we surveyed think the California government can have a significant impact on the growth of the state's cleantech industry by 1) attracting and fostering cleantech start-ups through its policies and programs, and 2) encouraging cleantech VCs to invest in California companies.

- 79 percent of VCs surveyed (representing more than \$7 billion in private capital) say that current California public policy (regulations, programs, and incentives) is a factor in their cleantech investment decisions;
- 91 percent of VCs surveyed say that a pro-environmental public policy stance can be a driver in bringing new business and investment to the state;
- As discussed in Chapter 2, regulatory climate/public policy ranked second in the list of reasons why VCs like investing in California cleantech companies (behind the presence of entrepreneurial culture/management talent).

4.2 KEY EXISTING REGULATIONS AND INITIATIVES

The VCs we surveyed highlighted several California initiatives that they feel already encourage both cleantech start-ups and private equity investment in the state. The list presented below is not comprehensive, but reflects only those programs that were repeatedly mentioned by VCs as being drivers of entrepreneurial and investment activity in the state.

The Green Wave Initiative

Through Green Wave, the CalPERS and CalSTRS pension funds pledged to distribute \$450 million to private equity firms for investment in cleantech companies. Green Wave

is an important initiative for several reasons. First, the sheer magnitude of capital should provide a significant boost to the cleantech sector. Second, as a historical leader in environmental regulation and policy, California is setting a strong example for other states. Ideally, Green Wave will cause a ripple effect and encourage other states to follow suit. Third, the state is sending a strong signal to entrepreneurs, investors, and other constituencies that it plans to continue its role as a leader in environmental policy and innovation.

The net effect of Green Wave on cleantech venture capital investment is difficult to quantify. But there is consensus among VCs that Green Wave will encourage additional cleantech investment, particularly in California. As one VC put it, Green Wave could be “a key lubricant” for the California cleantech industry.

Public Interest Energy Research (PIER) Program

The California Public Interest Energy Research (PIER) Program supports research and development in energy technologies through direct research grants totaling up to \$62 million annually. Companies receiving PIER awards must address a California energy problem and provide a potential benefit to California electric ratepayers. Many investors and entrepreneurs cite PIER as a critical link in the development process of energy technology companies, since many have technology gestation periods that make them initially unsuitable for venture capital investment. PIER funding, by filling a critical gap in the financing infrastructure, helps these companies get to a point where they might attract venture capital.

A good example of a PIER success is PowerLight Corporation, a designer, manufacturer, and installer of solar photo-voltaic systems (PV) based in Berkeley. Now a \$55 million company with more than 100 employees, PowerLight initially used PIER funding to develop its flagship product, Powerguard®, a patented polystyrene solar roof tile. (PowerLight is profiled at the end of this section.)

California’s Renewable Portfolio Standard (RPS)

Passed into law in 2002, California’s Renewable Portfolio Standard (RPS) requires the state’s investor-owned utilities to buy or produce 20 percent of their power from renewable sources by 2017. As of 2002, 12 percent of the electricity consumed in the state came from renewable sources. The law would require utilities to increase the renewable portion of their portfolios by 1 percent annually until each utility meets the 20 percent standard. Governor Arnold Schwarzenegger has proposed accelerating the deadline to 2010, something that two of the state’s three largest utilities, PG&E and Edison, should be able to achieve. (PG&E and Edison currently derive 12 and 14 percent of their power from renewable sources, respectively. Sempra derives 1 percent of its power from renewable sources.³⁰)

Although California’s RPS provides no explicit funding for renewable energy companies, by mandating a rapid increase in renewable energy demand, it spurs new business ideas and encourages cleantech investment.

Solar Photo-voltaic and Wind Incentive Programs

California offers several incentive programs for generators of solar photo-voltaic (PV) and wind power.

Solar PV: Both the California Energy Commission (CEC) and California Public Utilities Commission (PUC) offer “buy-down” programs that reimburse purchasers of solar systems for up to 50 percent of their project costs. California also offers a phased Solar Income Tax Credit (15 percent for the first two years, 7.5 percent for the remaining two years) for residential and commercial customers purchasing on-site PV systems up to 200 kilowatts in size. Finally, net-metering credits reimburse solar system owners for energy they produce but do not use. Individual municipalities and utilities also offer substantial rebates to customers installing PV equipment.

Wind Power: As part of its electricity industry restructuring plan, California created several incentive programs for producers of wind energy. The Existing Renewable Program distributes \$70 million over four years to wind energy suppliers through a cents per kilowatt-hour (kWh) payment. (Similar payments are also made for producers of biomass, waste tire, solar thermal, geothermal, small hydro, digester gas, landfill gas, and municipal solid waste energy.) The New Renewables Program allocated more than \$240 million to support prospective new renewable electricity generation projects built in California after September 26, 1996. By the end of 2003, almost 1,000 megawatts of new installed wind capacity had been funded through this program.

The CEC also provides a buy-down program (similar to that for solar PV systems) for grid-connected, small wind systems of 10 kW or less through the Emerging Renewables Buy-Down Program.

By offsetting the capital and installation costs of PV and wind power systems, California has helped nurture one of the largest state-based renewable energy industries in the country, with hundreds of solar and wind equipment manufacturers, installers, and servicers now employing thousands of Californians.

Diesel Emissions Reduction Plan

In September 2000, the California Air Resources Board (ARB) adopted a plan to achieve 75 percent reductions by 2010 in particulate matter and NOx emissions from on- and off-road diesel engines, and 85 percent reductions by 2020. As of the year 2000, diesel engines released more than 25,000 tons of particulate matter into California’s air each year, of which roughly two-thirds came from off-road equipment. The Diesel Risk Reduction Plan and its subsequent regulations seek to lower emissions through a combination of stricter regulations, incentive programs, and compliance assurance activities. Targeted diesel vehicles and engines include waste collection trucks, school buses, transit buses, stationary and portable diesel engines, and transport refrigeration units for trucks, trailers, shipping containers, and rail cars.

Two of the Diesel Risk Reduction Plan’s more prominent programs provide incentives for owners of diesel engines to replace their existing equipment with cleaner options. The

Carl Moyer Program, established in 1999, pays vehicle owners to offset the extra cost of reducing NOx emissions; to date the program has paid more than \$200 million to subsidize replacement of diesel engines with alternative-fuel and cleaner engines. The Lower-Emission School Bus Program has so far allocated more than \$70 million to help purchase 400 new, lower-emission schoolbuses, and plans to help install filters on more than 3,000 additional buses.

By creating a mandated market and providing incentives for customers, California's diesel emission programs have opened numerous entrepreneurial opportunities for California-based companies. (As an example, we include at the end of this section a profile of Catalytic Solutions, Inc., which makes advanced catalysts for catalytic converters.)

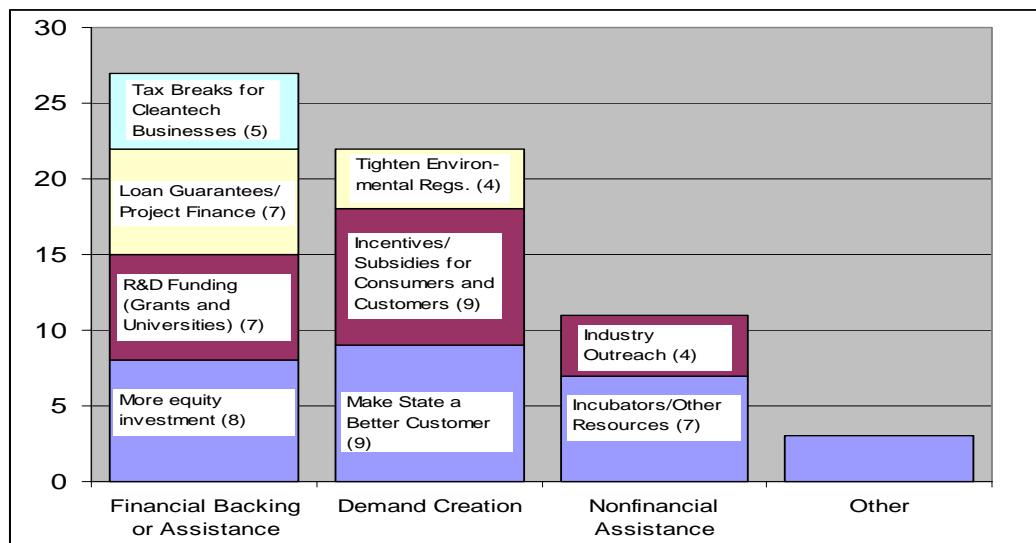
4.3 CALIFORNIA CLEANTECH PUBLIC POLICY OPTIONS

The VCs we interviewed had many suggestions for how California could better attract and foster cleantech start-ups and cleantech investments. Some of these suggestions must be taken with a grain of salt, as they tend to directly benefit the respondents. Most of the suggestions, however, are predicated on sound economics and would encourage the growth of the cleantech sector.

Respondents' suggestions are loosely grouped into three major categories:

1. Additional financial backing (direct or indirect) to cleantech start-ups.
2. Demand creation (direct or indirect) for cleantech products and services;
3. Non financial assistance to cleantech start-ups.

Figure 4.3
Ways to Attract and Foster Cleantech Start-ups and Investment (Mentions)



Source: E2 Venture Capital Survey (n=25 respondents)

Following are specific responses from the survey, grouped by primary category. (The numbers in parentheses represent the frequency of mentions in the survey.)

A. Additional Financial Backing (Direct or Indirect) to Start-ups (27)

1. Solve the “Early-Stage Funding Gap” Through Additional State Investment, (Research & Development) Grants, and University Funding (15). Many respondents cited a paucity of early-stage funding (commonly known as “seed investment”) for companies with technology that is “leaving the lab” but is still years from being commercialized. This period, known colloquially in the venture capital industry as the “Valley of Death,” is the graveyard of many start-ups (for some, it must be said, fittingly).

This problem is not unique to cleantech—many businesses falter for lack of funding in the period between the discovery of new technology and its commercial debut. The reason for this is fundamental to the venture capital industry—most VCs like to exit their investments in three to five years, yet many technologies take far longer to develop and commercialize. (This is why industries like software, which require only the proverbial “two guys in a garage with computers” to get started and can produce working prototypes in months, are so popular among VCs.) Yet, the early-stage funding gap is exacerbated in the cleantech industry for several reasons, including long technology gestation periods, unproven markets, and high capital requirements (particularly in energy and wastewater projects).

A number of state and regional initiatives, most notably California’s PIER program, aid start-ups with early-stage (R&D) funding. However, many VCs felt that neither PIER nor the other programs are sufficiently funded to support the increasing number of start-ups that will need assistance as the cleantech industry grows. Furthermore, several VCs pointed out that there is little state R&D funding available for *non energy* cleantech companies; PIER has no significant counterpart in materials research, wastewater treatment, consumer products, information technology, or other industries.

Numerous respondents wished for an increase in PIER funding, and for the creation of programs comparable to PIER that are targeted at non energy cleantech sectors. Several respondents suggested implementing a state version of the federal Small Business Innovation Research (SBIR) Program.

Many respondents also voiced concern over recent budget cuts in the California higher education system. As a crucial spawning ground for new technology, many felt that the cuts in higher education risk undermining the state’s long-term technological leadership.

Finally, several respondents noted that even large investment initiatives like Green Wave do not appear to address the early-stage funding gap. As Green Wave capital is channeled into existing VC funds (few of which invest significantly in very early-stage companies), it does not affect the venture capitalist industry’s current emphasis on expansion and late stage technology investment. Several respondents suggested that California direct a portion of the CalPERS and CalSTRS private equity funds (resulting from the Green Wave Initiative) specifically toward early-stage investments, and/or

emulate the innovative approach that Massachusetts has adopted to cope with this problem: the Massachusetts Renewable Energy Trust, or RET (detailed in Chapter 5).

2. Loan and Lease Guarantees and Project Finance (7). Because many cleantech projects such as wastewater treatment and renewable energy installations are capital intensive, and because many banks are hesitant to lend to companies in these still unproven industries, there was a call for the state to assist in facilitating financial transactions that are common in other industries. By guaranteeing loans and leases to cleantech start-ups and providing project finance support, the state could ensure that cleantech start-ups and their customers obtain financing with the same ease and at the same cost as in other industries.

3. Tax Breaks for Cleantech Companies (5). For most early-stage start-ups, tax breaks would not be a critical aid, since most start-ups lose money during their first several years. Yet for companies that are further along, targeted tax breaks can make a crucial difference. In Canada, for instance, early-stage companies may write off 30 to 40 percent of the salary of R&D employees.

Demand creation (Direct or Indirect) for Cleantech Products and Services (22)

1. Make the State a Bigger, Better Customer (9). California state and local governments purchase an enormous volume of products and services each year. Steering more of this funding toward cleantech products would help create crucial demand for struggling start-ups, improve California's environment, and "mainstream" many of these products in the public eye. Increasing production volumes of these products would also improve their cost positions and make them more competitive in national and global markets. While the state already has a number of innovative programs in place, many respondents felt California could do more. For instance, state mandates for public fleets to purchase a mix of alternative, dual-fuel, or fuel cell vehicles would give the state's advanced transportation sector a boost. And while many county-and municipal-owned buildings have installed solar power systems, California has been relatively slow in adopting clean energy technology in state-owned buildings.

2. Expand Incentives for Cleantech Consumers and Customers (9). By providing incentives to consumers and businesses to purchase environmentally sensitive products, the state can help spur demand for its cleantech companies. For example, a "green mortgage" program, by which the state would subsidize mortgages on homes that install solar panels or other environmental features, would allow solar providers greater access to the state's enormous housing market and reduce grid-based energy demand.

3. Tighten Environmental Regulations (4). Environmental regulation is perhaps the most powerful lever the state has to spur the cleantech industry. By mandating stricter standards along a variety of fronts, the state could give a dramatic boost to cleantech

markets and companies. For instance, environmental regulation (primarily *state* regulation) is directly responsible for the 32,000 California jobs now supported by the Air Pollution Control (APC) industry. (See the case study at the end of this section for a synopsis of the APC industry.)

A more current example is AB 1493 (Pavley 2002), which requires a significant reduction in greenhouse gas emissions from California's passenger vehicle fleet. By implementing strict standards, the state would spur demand for transportation-related cleantech companies in the state in addition to improving the environment.

C. Non-financial Assistance to Start-ups (11)

1. Cleantech Incubators and Expanded Resources (7). Incubators are centers of shared resources and facilities for start-ups. In incubators, companies work side by side in office space or labs, lowering costs and fostering collaboration. Incubator companies also receive assistance with basic business tasks, such as writing business plans and filing taxes and patents. Cleantech incubators would assist many start-ups in their development and slow the rate at which they burn precious capital.

2. Industry Outreach (4). Several respondents noted the important role that state leaders can play in promoting California as a cleantech center. By sponsoring public/private seminars, conventions, workshops, and organizations (such as the Hydrogen Highway Blueprint summits and California Fuel Cell Partnership), the state can foster business collaboration and innovation at minimal cost.

Perhaps more important, California's leaders can leverage their enormous influence and visibility to promote California as a breeding ground for the cleantech industry. Both Governor Schwarzenegger and State Treasurer Phil Angelides earned kudos for their leadership on Hydrogen Highways and Green Wave, respectively. But many VCs felt that public officials could do more. As one venture capitalist put it, "Someone needs to plant the flag and say that California is the nation's cleantech center."

Other states are actively recruiting cleantech businesses (see Chapter 5), and other countries are also having success in creating cleantech clusters. A recent e-mail circulating in the cleantech community outlined a proposal by the United Kingdom to attract California cleantech businesses to Europe. And Germany and Japan have fostered leading wind and solar industries through initiatives that make long-term renewable energy projects more economically viable. To stay competitive, California needs to publicly present a compelling vision of the state's plan to be a global cleantech center.

CALIFORNIA CLEANTECH SUCCESS STORIES

California is home to many promising cleantech start-ups. We highlight two that have substantial revenues and the potential to become significant contributors to California's economy and environment. Both have received venture capital funding in the past.

Catalytic Solutions, Inc.—Oxnard, CA

Fields: Advanced Materials and Nanotechnology; Transportation; Air Quality

Catalytic Solutions, Inc. (CSI) designs and manufactures advanced catalysts that lower the cost and extend the life of catalytic converters for vehicles and stationary motors. Founded in 1996, CSI today employs nearly 140 people at its California research and manufacturing facilities.

The basis of CSI's success is in-house materials research. The company has developed patented nanostructures that are extremely thermally stable and resistant to sintering (or loss of surface area, which degrades catalyst performance). By utilizing CSI's catalyst technology, manufacturers can use smaller quantities of expensive metals like platinum, rhodium, and palladium (which today account for \$130 to \$150 of cost in a typical catalytic converter). This improves performance and dramatically lowers component costs. CSI's research methods also allow it to identify new catalysts that better control emissions from sources such as diesel engines.

To date, the market for catalytic converters has been driven by state and federal emissions regulations, particularly California's Low Emission Vehicle (LEV II) standards, and the federal TIER II standards, which require catalytic converters on all new passenger vehicles. Says CSI CEO Bill Anderson, "The prime driver for our market has been environmental regulation." Historically, the bulk of CSI's business has been in the catalytic converter aftermarket, which it serves through a partnership with California-based Car Sound Exhaust System, Inc. But CSI also sells directly to automotive original equipment manufacturers such as Honda, Ford, and General Motors, and is continually eyeing new markets.

Those markets are fast approaching. Recent federal and state legislation should create new opportunities for emission-control companies like CSI. California's AB 1493 (also known as the Greenhouse Gas Bill) could spur the light-duty market for CSI's products. The state's Heavy Duty Diesel Retrofit Program requires existing diesel trucks, buses, and stationary engines to install after-treatment equipment that reduces diesel particulate emissions. And new federal legislation aims to drastically cut emissions of new heavy-duty diesel trucks by model year 2010. The diesel regulations not only open a new class of vehicles to CSI's products, they drive new product development. (Diesel engines emit different pollutants than gasoline-powered cars and require different catalysts.) With more than 12 million heavy-duty diesel engines on the road, the new standards could result in hundreds of millions of dollars in revenue for companies that can develop effective, low-cost diesel technologies.

Although much of the world's automotive component manufacturers are in Detroit, Japan, or Europe, being in California has its advantages, says Tim Truex, CSI's vice president of new business development. "California leads the nation in emission regulations, and new regulation accelerates technology development. Here in California, we're right in the middle of it all."

As California and the nation continue to pursue sensible, strict emissions regulations, the future is bright for CSI and its peers. Says Anderson, "We're on track to double year-to-year revenues in 2004, and we expect to double them again in 2005. In five to seven years we plan to have 500 to 750 employees."

POWERLIGHT CORPORATION—BERKELEY, CA

Field: Renewable Energy Generation

PowerLight, a private company founded in 1991, is the nation's leading independent designer, manufacturer, and installer of grid-connected solar photo-voltaic (PV) electric systems and energy efficiency services. With more than 100 employees and \$55 million in 2003 revenue, PowerLight has made *Inc Magazine*'s list of the 500 fastest growing privately held companies for four years running. And recently, the Cleantech Venture Network (an association of cleantech venture capitalists) gave PowerLight its 2003 Emerging Enterprise of the Year Award.

PowerLight's rapid growth is a product of leading-edge science, entrepreneurial initiative, and the rapidly decreasing costs of solar PV cells. The company has also made good use of California programs. For instance, grants from California's PIER program helped PowerLight develop its flagship product, Powerguard®, a patented polystyrene solar roof tile that forms the substrate for PV cells.

PowerLight and its customers also utilize several California programs that lower the cost of a solar system for the end-user. The Self Generation Incentive Program (SGIP) administered by the California Public Utilities Commission (PUC) reimburses commercial customers for up to half of the cost of their solar facilities at the time of installation. (A similar program exists for residential customers.) Net-metering programs give credits to solar power generators who don't use all the power they produce. And a one-time tax credit passed in 2001 allows some customers to write off an additional 7.5 to 15 percent of their investment each year.

These programs have been crucial to the development of the California solar market. With their support, customers can achieve a five-to eight-year payback on their solar investment, making solar an economically viable proposition, not just an environmental good deed. Says Kari Smith, PowerLight's senior manager of regulatory affairs, "California public policy essentially makes this market possible today. The current programs help our customers get over a critical economic hurdle."

Still, PowerLight executives point out that the state could do more. Shifting regulations, incentives, and subsidies makes it hard for solar customers and entrepreneurs to plan for the long term. For instance, as of July 1, 2004, SGIP had no funding remaining for 2004 Level 1 projects. The 2001 tax credit is due to expire at the end of 2004. And it remains uncertain whether or not a cap will remain in place for the state's net-metering program, which limits the amount of unused power for which customers are reimbursed.

In response, the California Solar Energy Industry Association (SEIA), of which PowerLight is a member, is pushing for what they call "a decade of certainty" for solar initiatives. Says Greg Rosen, PowerLight's senior manager of business development, "The first question potential customers and investors—including venture capitalists—ask is: 'How do we know the program will be there in three or five years?' We need to be able to look them in the eye and say, because it's legislated for 10 years."

Rosen would also like to see more state assistance with the often complex transactions involved in selling solar systems. State-backed or subsidized loans and leases would ease financing on capital-intensive projects that banks are often unwilling to back. As models, Rosen points to Germany and Japan, which have implemented risk-sharing loan programs and 20-year guarantees on their state-sponsored solar initiatives.

How the state addresses these challenges will directly impact the prospects of PowerLight and the other 400 California companies selling solar products. By continuing to invest in solar, and adopting long-term legislation, the state can foster the development of more companies like PowerLight, bringing new investment and thousands of high-paying, environmentally friendly jobs to California.

CASE STUDY: THE CALIFORNIA AIR POLLUTION CONTROL (APC) INDUSTRY

In addition to protecting the environment, environmental legislation can help create new business markets at the state and federal levels. A good example is California's Air Pollution Control (APC) industry. From humble beginnings, with only about \$450 million in revenue and 3,000 California jobs in 1970, California's APC industry has grown into a \$6.2 billion industry that now employs 32,000 Californians.

Most of these jobs and related revenues would not exist in California today were it not for state and federal air quality regulations. By setting and enforcing measurable standards, these laws drove demand for environmental products and services, setting the stage for the rapid growth of the APC industry.

While federal regulation has had a significant impact on the APC industry, a recent report by Environmental Business International, Inc. (EBI) found that *it is state and regional laws and programs*, rather than federal regulation, that are the primary drivers of APC economic activity. EBI's survey of 130 APC equipment manufacturers found that the most important factors driving sales of their equipment were: 1) enforcement of air quality regulations, 2) local and regional standards in California air districts, and 3) California state air quality standards (tied with economic conditions in their customers' industries). These local and regional factors ranked well above federal legislation in their importance as APC economic drivers. "It is clear," states the EBI report, "that [California] Air Resources Board programs are responsible for a considerable portion of the revenues derived by APC companies in the state."

Two examples of state laws and programs that drove APC sales stand out. California's Smog Check 2 standards (1994) were responsible for an estimated \$2.4 billion in additional California APC revenue from 1995 to 2002 (more than \$300 million per year). And the Air Resources Board's 1998 Low Emission Vehicle standards (LEV II), which established emissions standards for most minivans, pickup trucks, and sport utility vehicles, resulted in an estimated \$550 million in additional APC revenues from 1999 to 2002 (nearly \$140 million per year). Other individual laws and programs also had measurable effect.

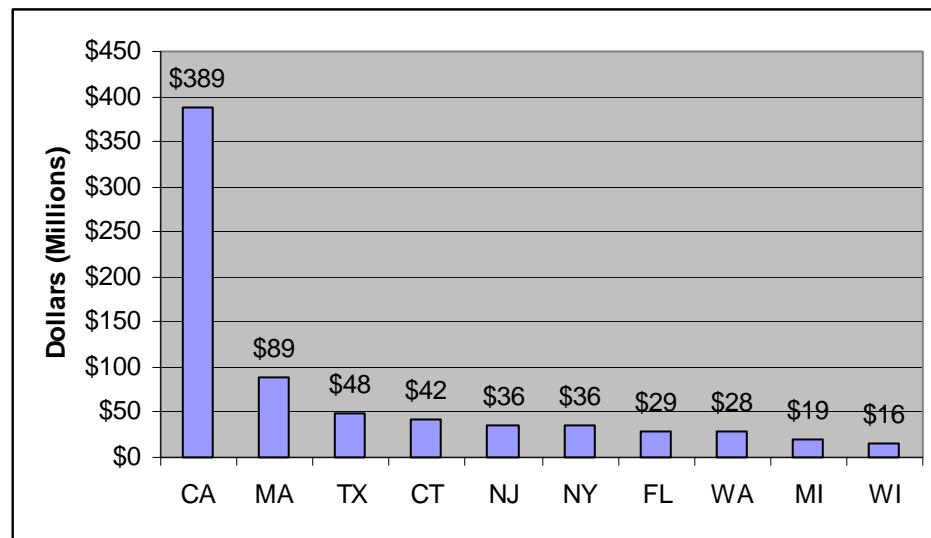
By adopting sensible air quality legislation over the last three decades, California's legislature and related agencies have accomplished two laudable goals: They have dramatically improved the quality of air for California citizens, and they have laid the foundation for more than 30,000 California jobs.

CHAPTER 5

CLEANTECH-RELATED INITIATIVES IN OTHER STATES: MASSACHUSETTS, CONNECTICUT, NEW MEXICO, TEXAS

In 2003, California received far more cleantech venture capital than any other state (see Figure 5.1). But other states are aggressively recruiting and nurturing cleantech startups. Furthermore, given California's relative size, it is perhaps more appropriate to look at venture capital investment in other parts of the country on a regional level (see Figure 2.1): The Northeast received 25 percent of 2003 North American cleantech VC investment, close behind California's 29 percent.

Figure 5.1
Cleantech Venture Capitalist Investment by State (\$ Millions)



Source: Cleantech Venture Network

Below are profiles of the cleantech industry and related public policy initiatives in four states. These states were chosen based on their mentions by cleantech VC investors as being strong proponents of the cleantech industry, the volume of cleantech investment they received in 2003, and/or the presence of new initiatives designed to attract cleantech businesses and investment. This is not an exhaustive list of state initiatives, but reflects only those most pertinent to the growth of the cleantech industry.

Table 5.1
Areas of Particular Emphasis (State-Sponsored Initiatives)

California	Hydrogen Highways; Renewable Energy Generation; Fuel Cells; Air Quality (mobile and stationary emissions); Alternative Fuels; Cleantech Capital Funding
Massachusetts	Renewable Energy Generation; Renewable Energy Funding
Connecticut	Fuel Cells; Renewable Energy Funding
Texas	Wind Power; Other Renewable Energy Generation
New Mexico	Alternative Fuels; Fuel Cells; Hydrogen; Renewable Energy Generation

5.1 MASSACHUSETTS—INNOVATIVE ENERGY FUNDING

2003 Cleantech Venture Capital Received: \$89 Million

Renewable Energy Trust (RET): Through the Massachusetts Technology Collaborative, or MTC, the state's development agency for the innovation economy, the state is enacting a number of policy initiatives to improve the Massachusetts environment and create new jobs by fostering a strong cleantech cluster. The chief cleantech instrument of the MTC is the Renewable Energy Trust, or RET, established in 1998 and funded at approximately \$27 million annually through a surcharge on ratepayers' utility bills. Organizations receiving RET funding to date include Evergreen Solar and Konarka Technologies (leading solar photo-voltaic manufacturers), Nuvera Fuel Cells and Accumentrics (both fuel cell companies), New Energy Capital (an investor in renewable energy and distributed generation technologies), and the Massachusetts Energy Consumers Alliance, a nonprofit advocacy group.

Massachusetts Green Energy Fund (MGEF): For the purposes of this study, perhaps the most relevant of the RET's initiatives are the Massachusetts Green Energy Fund (MGEF) and the Sustainable Energy Economic Development (SEED) Initiative. The MGEF is a privately managed venture capital fund chartered to invest in Massachusetts-based renewable energy companies, with the goal of fostering clean energy companies in Massachusetts while maximizing investment return. The RET is contributing \$15 million as the lead limited partner in the MGEF. The MGEF also solicits funds from financial and strategic investors. The MGEF, which had its initial closing in early 2004, will make investments in companies developing the next generation of solar Polyvinyl, fuel cell, wind, biomass, tidal power, hydroelectric power, and energy storage technologies.

Sustainable Energy Economic Development Initiative (SEED): The SEED initiative provides \$50,000 to \$500,000 convertible loans for companies undertaking new product

development at the critical stage between R&D and commercialization. The loans may be converted to company equity, and no interest is due until the company generates revenues. If the loans are not converted to equity, the state may take payment in the form of a 3 to 5 percent royalty on the company's revenues until the loan is repaid, and a 1 percent royalty after that for the remainder of the seven-year term.

Companies receiving SEED funding are required to obtain matching funds from a third party. The first round of SEED awards was announced at the end of July 2004.

Renewable Portfolio Standard (RPS) and Renewable Energy Certificate (RECs)

Option Agreements: Massachusetts' Renewable Portfolio Standard (RPS) requires that its power providers utilize renewable energy sources for 4 percent of their total output by 2009, after which the requirement will increase 1 percent per year. Electricity providers may use certificates from a previous year to satisfy up to 30 percent of the following year's compliance requirements.³¹ A new class of renewable energy providers in Massachusetts owes its existence largely to this recent legislation. As Renewable Energy Trust director Rob Pratt said, "It's quite safe to say that without the RPS, none of these projects would be coming on line."³²

The Massachusetts Technology Collaborative, through the RET, has taken an active role in the RPS initiative by agreeing to long-term option agreements for Renewable Energy Certificates (RECs) generated in renewable energy projects. In November 2003, the MTC announced awards topping \$32 million in long-term funding commitments for RECs from five wind, hydro, biomass, and landfill gas projects. The RET funds provide guaranteed revenue to these businesses at a critical stage in their development, and help defray some of the capital costs associated with their projects.

5.2 CONNECTICUT—FUTURE FUEL CELL CAPITAL OF THE WORLD?

2003 Cleantech Venture Capital Received: \$42 Million

Connecticut Clean Energy Fund (CCEF): Connecticut's Clean Energy Fund, operational since 2000, is much like Massachusetts' in that it makes equity investments in commercial enterprises whose products and services will accelerate the development of clean energy technologies, including fuel cells, solar, wind, biomass, wave/ocean technologies, and potentially, green buildings. The CCEF also supports research, education, and outreach initiatives designed to stimulate ratepayers' desire for clean energy. The CCEF's funds come from a surcharge on Connecticut ratepayers' utility bills and are expected to total more than \$100 million over five years.

One of the CCEF's stated goals is to make Connecticut "the fuel cell capital of the world." The CCEF plans to invest more than \$37 million in fuel cell research, demonstration, and deployment efforts by 2005. The CCEF recently made a significant investment establishing the Connecticut Global Fuel Cell Center for fuel cell technology research at the University of Connecticut. The CCEF also aims, more broadly, to encourage the expansion of the state's renewable energy industry, which it considers to be "a major driver of the state's economy" in the future.³³

Renewable Energy Initiatives

Renewable Portfolio Standard (RPS): Connecticut's recently revised RPS requires electricity providers in Connecticut to purchase and retire a quantity of certificates from Class I renewable energy providers equal to 1% of their supply portfolios in 2004, ramping up to 7% in 2010. The heavy reliance on Renewable Energy Certificates (RECs) distinguishes Connecticut's RPS from other states in that electricity generators may purchase RECs from generators outside the state to meet the entirety of the RPS requirement. Connecticut now has purchase agreements with the New England Power Pool (NEPOOL), New York (NYISO), and the Pennsylvania, New Jersey, and Maryland power pool (PJM).³⁴

100 Megawatt Requirement: 2003 legislation requires that electricity distribution companies in Connecticut purchase at least 100 megawatts (MW) of power in the form of long-term purchase agreements from companies funded by the CCEF. This innovative statute not only creates additional demand for renewable energy projects, it provides guaranteed revenue for some CCEF portfolio companies, bolstering the state's interests on two fronts. Purchases of renewable energy made by electricity distributors under the 100MW Requirement count toward the RPS requirement. The price paid for energy in these agreements is not to exceed the price of wholesale power plus 5.5 cents per kilowatt-hour.³⁵

Clean Energy Retail Options: As part of the same legislation, the Connecticut Department of Public Utility Control (DPUC) must develop a plan whereby electricity distribution companies in the state offer nearly all ratepayers a clean energy option. This should increase consumer awareness of and demand for renewable energy at the retail level.³⁶

Clean Cars Legislation: Connecticut recently passed legislation requiring it to adopt California's current passenger vehicle emissions standards (the LEV II program). This includes a zero-emission vehicle requirement, and in the future will include the greenhouse gas emissions covered by California AB 1493 (Pavley 2002). This program could spur additional activity in Connecticut's fuel cell and advanced transportation industries.

5.3 TEXAS—"THE TEXAS WIND RUSH"

2003 Cleantech Venture Capital Received: \$48 Million

The majority of cleantech related regulation and policy in Texas concerns energy. Prime among these is Texas' Renewable Portfolio Standard. Passed in 1999, it requires 2.15 percent of the state's energy to be derived from renewables in 2005, rising to 3 percent, or 2,880 megawatts (MW) of renewable energy, by 2009. The legislation succeeded in

setting off a “Texas Wind Rush,” including 10 new wind projects totaling 930 MW of power in 2001 alone. Twelve new landfill gas projects with 44 MW capacity and 50 MW of hydropower renovations were also announced or came on line in 2001.³⁷ Texas is now considered by many to be a national leader in the wind power industry, and innovative energy companies are springing up at a rapid pace. Much of the activity centers around the technological and entrepreneurial hub of Austin.

5.4 NEW MEXICO—ALTERNATIVE FUELS AND FUEL CELLS

2003 Cleantech Venture Capital Received: \$9 Million

Guided by New Mexico Governor Bill Richardson, who was the U.S. Energy secretary under President Bill Clinton, New Mexico is making strides toward developing a cleantech cluster. The state’s policies appear to be focused on three sectors: clean energy generation, vehicle energy efficiency, and hydrogen and fuel cell technology.³⁸ Some initiatives include:

RPS and Energy Generation:

- A statewide Renewable Portfolio Standard (RPS) of 10 percent by 2011 (5 percent by 2006) was signed into law in March 2004. This legislation includes provisions requiring that utilities offer “green power” programs to their customers.
- The Clean Energy Grants Program awards up to \$100,000 for projects that utilize clean energy technologies or provide clean energy education, technical assistance, and training programs.

Alternative Fuels and Hybrid Electric Vehicles:

- New Mexico’s Alternative Fuel Acquisition Act of 1992 requires that 75 percent of state government and educational institution fleet vehicles acquired in fiscal year 2003 and thereafter (except authorized exemptions) be bi-fuel or dedicated alternative fuel vehicles (AFVs), or gas-electric hybrid vehicles. The act authorized a \$5 million revolving loan fund for AFV acquisitions by state agencies, political subdivisions, and educational institutions.
- A recent law authorized a one-time vehicle excise tax exemption for people who buy hybrid electric vehicles.

Hydrogen and Fuel Cells:

- New Mexico’s Hydrogen and Fuel Cell Technologies Development Program aims to foster the development of hydrogen and fuel-cell–related commercialization and economic development in the state through several initiatives:
 - Public-private partnerships between the state, national laboratories, nonprofit organizations, and the hydrogen and fuel cell industry sectors;
 - Adoption of uniform hydrogen safety codes and standards;
 - Hydrogen demonstration projects using federal and other funds to augment state resources;

- Coordinating and supporting research and education in hydrogen and fuel cells between state universities and federally funded research and development organizations.
- A recent law allocates \$200,000 for marketing and promotional efforts aimed at attracting businesses conducting hydrogen research. The amount of money is trivial, but in a state with a long history of oil, gas, and mineral extraction, and an industrial community that has historically been dead set against environmental regulations, it represents another step in Governor Richardson's efforts to make New Mexico a hub for clean energy companies.

CHAPTER 6

RECOMMENDATIONS: A CLEANTECH PRESCRIPTION FOR CALIFORNIA

Creating a California cleantech cluster is in the state's best economic and environmental interests. The state can achieve a leadership position by adopting new environmental policies that create new cleantech markets, and by better coordinating the many existing programs that benefit nascent cleantech companies.

In order to establish leadership, California must attract a higher percentage of cleantech venture capital funding. At 31 percent of U.S. cleantech investment, California's cleantech industry is well below the state's overall average of 43 percent of total venture capitalist investment, and far behind other California technology industries.

Obviously, increasing the state's share of cleantech funding cannot be accomplished by decree. The best way to attract more venture capital is by creating a climate in which cleantech companies thrive. The state can do this by instituting a combination of thoughtful regulations, initiatives, and programs that foster cleantech innovation and help the resulting start-ups mature and grow. While venture capital investment is not a perfect measure of the state's success in building a cleantech cluster, it *can* serve as a useful proxy. In other words, if California cleantech start-ups begin to find success, the capital will follow.

Recommendation 1: Establish visible state leadership to help create the California cleantech cluster.

The state of California can demonstrate its commitment to building a cleantech cluster by improving coordination within the cleantech industry, helping focus the state's development efforts, and identifying (and where appropriate, emulating) successful cleantech regulations and programs from other states and countries. Specifically, the state should do the following:

- **Catalog** the myriad public, private, and quasi-public agencies, initiatives, and programs that impact the cleantech sector.
- **Improve coordination** across these organizations and create linkages to help organize them around common objectives.

- **Define and promote the state's cleantech "core competencies,"** and allow investors to focus on a handful of key industries for targeted cluster development. Given the disparate nature of the 11 cleantech industries, it is unlikely that California will be a leader in all of them. Areas in which the state has a significant head start include advanced materials and nanotechnology, renewable energy generation, air pollution control, advanced transportation technology (including hydrogen), and any IT-related cleantech. However, further study is required to identify those areas in which California has the best chance to foster thriving clusters.

Recommendation 2: Help create new markets for cleantech products.

- **Make the state government a bigger, better cleantech customer.** California has the world's sixth largest economy. Every year, the state spends billions of dollars on construction and goods. The state should make it a policy to purchase the cleanest, most efficient, cost-effective products. Many of these products, such as fuel-efficient cars, replacement tires, and energy efficiency technologies, pay for themselves and will help the state save money.
- **Continue to develop, adopt, and implement environmental regulations that create new markets for cleantech.** California's leadership on protecting the environment has brought tremendous benefits to the state. Simply put, these environmental protections are a key reason California is such a desirable place to live. Environmental standards have also created huge markets for products in California, the United States, and around the world. The global market for renewable energy, for instance, an industry long driven by environmental regulation, is estimated to reach \$625 billion by 2010 and \$1.9 trillion by 2020.³⁹

Through its cleantech efforts, California now has an opportunity to create large new markets for clean car technologies, renewable energy generation, and energy-efficient appliances. For example, the **Renewable Portfolio Standard**, the **Hydrogen Highway Network** initiative, and **AB 1493** (Pavley 2002), the state's new global warming pollution standards for passenger vehicles, could open up multibillion-dollar markets for clean and efficient technologies. To provide certainty for investors, entrepreneurs, and customers, it is important that California not weaken these initiatives, and that it make multiyear commitments to any new ones.

- **Help promote cleantech export markets.** Progressive environmental policies give California's cleantech industry an advantage in exporting products overseas. As developing countries struggle with rising electricity demand and auto ownership, energy supply problems, and other environmental issues, their demand for cleantech products is likely to swell. For example, China's electric power consumption in 2004 is expected to grow 11 percent over last year, with some regions' consumption growing by nearly 25 percent. And the Chinese vehicle market is growing at upwards of 80 percent annually and is expected to be as large as the United States' by 2015. (Current China sales are roughly 2 million passenger vehicles per year.⁴⁰) China is now

considering major policies to promote energy efficiency in buildings, industry, and vehicles, which could create multibillion dollar markets for cleantech products and services.^{41, 42} By fostering a strong domestic cleantech cluster now, California can ensure that its businesses are well positioned to satisfy this growing export market in the future.

Recommendation 3: Help enhance funding for cleantech companies.

- **Boost publicly funded cleantech research and development.** Technology research and development is at the heart of California's efforts to establish a cleantech cluster. Yet private early-stage funding is often hard to come by for cleantech companies. The state can play a valuable role in helping companies bring their technologies and products to market by increasing public spending for cleantech research and development (R&D) activities. A key step will be to encourage the University of California system to focus more of its research on cleantech. The state also should consider expanding funding for existing programs and creating new programs to support underfunded sectors in the cleantech industry.
- **Focus more existing state funds on California cleantech companies.** The state has a number of funds and programs designed to help cleantech companies, including the Public Interest Energy Research (PIER) Program, the Green Wave Initiative (discussed in Chapter 4), and the California Clean Energy Fund (CCEF), which arises from the PG&E bankruptcy settlement negotiated by the California Public Utilities Commission. Together, these initiatives control hundreds of millions of dollars in investment money. The state should give the funds' recipients incentives to do business in California. Additionally, the state can help investors better understand the market and policy climate that fosters new clean technologies, and highlight for project managers the strengths of California companies.

APPENDIX 1

VENTURE CAPITAL SURVEY METHODOLOGY

We interviewed 25 investors active in the cleantech space, with the goal of understanding their views on the cleantech space in general, and in particular on how they view investing in California cleantech companies. The survey was conducted under the auspices of Environmental Entrepreneurs (E2) and Natural Resources Defense Council (NRDC). The interviews took place over the course of three weeks in May 2004. Twenty-one of the interviews were conducted via telephone, two were conducted in person, one was conducted via e-mail, and another via fax.

Sample Generation

The sample of potential respondents was generated based on a list of participants at the Cleantech Venture Network Conference held in San Francisco in April 2004, the author's own connections within the VC industry, connections provided by E2, and personal references from other survey respondents. Forty-one potential respondents were contacted, resulting in 25 completed interviews.

Participants

Representatives from the following firms participated in the study (two firms remain anonymous):

Venture Capital Firms

Advanced Capital Markets (Washington, DC)
Altira Group LLC (CO)
Angelino Group (CA)
Blue Hill Partners (PA)
Braemar Energy Ventures, LP (NY)
Chrysalix Energy Management (Vancouver, BC, Canada)
Draper Fisher Jurvetson (CA)
Enertech Capital (PA)
Expansion Capital Partners (CA)
Garage Technology Ventures (CA)
Global Environment Fund (Washington, DC)
Hydro-Quebec CapiTech (Quebec, Canada)

NGEN Partners, LLC (CA)
Nth Power (CA)
Nucleus. Partners (CA)
Rockport Capital Partners (MA)
Rustic Canyon Partners (CA)
WHEB Ventures Limited (London, England)
Zero Stage Capital (MA)

Investment Banks

Broadmark Capital
W.R. Hambrecht & Company

Angel Investor

Jim Boettcher (McCathel LP; Focus Ventures)

Sample Characteristics

Geography: Twenty-one of the respondents were based in the United States. (One U.S. respondent represented a foreign firm.) Two respondents were based in Canada, one in Germany, and one in London. All respondents are active in the United States cleantech market.

Of the 21 U.S. respondents, the breakdown by state was as follows:

CA	11
Washington, DC	3
MA	2
PA	2
NY	1
WA	1
CO	1

Capital Managed: Most respondents were forthcoming about the size of their funds. A few provided a range of funds managed, rather than an exact number. No funds were attributed to the survey sample for the two investment bankers and the one angel investor.

The 22 venture capitalist (VC) respondents collectively manage \$7.4 billion in capital, of which \$4.2 billion is uncommitted, or not yet invested. These respondents indicated they were raising or planning to raise an additional \$1.4 billion of capital in the near future for new or existing funds.

Many of these VCs invest in multiple industries. Although it is difficult for a venture capitalist to forecast exactly what portion of their funds they will invest in which industries, most provided their best estimate. They also estimated the time period over which they plan to invest those funds. The aggregate results are as follows:

- Cleantech-targeted funds raised: \$2.5 billion
- Cleantech-targeted funds invested: \$1.3 billion
- Uncommitted cleantech-targeted funds: \$1.2 billion

- Cleantech-targeted funds being raised: \$1.1 billion
- Average time frame over which respondents planned to invest their uncommitted funds: 2.5 years

Survey Responses

The survey questions comprised a variety of multiple choice, yes/no, and unprompted (“open”) questions. The survey is reproduced on the following pages. For certain questions requesting an unprompted response (10b, 11a, 13, 15, 16, 17, 19, and 23), the author coded the responses and aggregated them for simplicity and presentation.

Survey Questions

Please find a copy of the survey used on the following pages.

Natural Resources Defense Council/ Environmental Entrepreneurs

Impact of California Public Policy on Clean Technology/Clean Energy Private Equity Investing in California

Please fax or email completed questionnaire to Patrick Burtis, c/o NRDC:

Fax: (415) 876-0486 (USA)

Email: pat@patburtis.com

Mobile: (415) 699-4834 (USA)

Target length: 10-15 minutes

Questionnaire Objective: California has often lead the U.S. in environmental policy and technological and environmental innovation. Several major public policy initiatives are currently in the early stages of implementation in California (i.e. Green Wave, Hydrogen Highways, AB 1493). Each could have ramifications on the clean-tech industry in the state. *The purpose of this survey is to understand how (if at all) California's public policy stance on environmental matters affects your approach to clean-tech investing in the state.* Ten to fifteen minutes of your time will provide the U.S. an invaluable tool with which to continue advocating for the environment and the economy in California. Thank you!

All individual responses are confidential. Results will be used in disguised or aggregate form only, unless permission is granted by interviewee. Aggregate results will be shared with interviewees upon request once study is complete.

- I. Demographics
 - II. Public Policy Impact on Clean Tech/Clean Energy Investing
 - III. Public Policy Impact on Transportation-related Clean Tech Investing
-

I. Demographics

1. Interviewee name:
2. Firm:
3. Contact info for follow-up or clarification of responses: (*information will not be shared with anyone*)
 - a. Phone #:
 - b. Email address:
4. Fund size: \$ _____ MM raised.
Spent so far \$ _____ MM
Raising fund size: \$ _____ MM raising
5. Investment horizon (years to invest the fund): _____ years

6. Fund Status:
 - a. Raising money
 - b. Raised and Investing
7. In which spaces do you plan to focus the fund? (i.e. solar, fuel cells, wind, hydrogen, transportation, other sectors, etc.)
 - a. Space: _____ - Estimated % of fund allocation: ____ %
 - b. Space: _____ - Estimated % of fund allocation: ____ %
 - c. Space: _____ - Estimated % of fund allocation: ____ %
 - d. Space: _____ - Estimated % of fund allocation: ____ %
8. In which financing rounds do you primarily focus your investments? (check all that apply)
 - a. Seed round _____.
 - b. First round _____.
 - c. Second round _____.
 - d. Third round _____.
 - e. Fourth and later rounds _____ .
9. Expected regional focus of fund expenditures:
 - a. % CA
 - b. % Other U.S.
 - c. % Europe
 - d. % Asia
 - e. % ROW

II. Public Policy Impact on Clean Tech/Clean Energy Investing

(For all written answers, please take as much space as you need.)

10. Relative to other states or regions in the U.S., how attractive do you find California as a place to invest in clean energy/clean technology startups?
(from 1 to 5; 5 = much more attractive than others, 3 = indifferent, 1= much less attractive than others)
 - a. (1 to 5)
 - b. Why? Please give specific examples where possible (take more space as necessary):

11. What one state or region worldwide do you find to be the most attractive for clean tech/clean energy investment? _____
a. Why?
12. Does the California government's current public policy regarding clean technology/clean energy in any way affect your likelihood to invest in California companies? ("public policy" being defined as regulation, tax incentives, funding, or other initiatives)
a. yes
b. no
13. If yes, how?
14. Do you think a proactive environmental public policy stance can be a driver in bringing new business to the state in the clean tech/clean energy field?
a. yes
b. no
c. not sure
15. If yes, why or how:
16. What could California do to better encourage clean energy/clean technology startups to locate or prosper in California?
17. What could California do to better encourage clean energy/clean technology private equity investors to invest in California startups?

III. Public Policy Impact on Transportation-related Clean Tech Investing

18. Within the clean energy/clean tech space, how do you view transportation-related investments (i.e. fuel cells for cars, vehicle battery technology, automotive innovation, etc.) relative to other investment sectors, such as solar, wind, or water/waste treatment?

- a. (5) Much more attractive
- b. (4) More attractive
- c. (3) The same
- d. (2) Less attractive
- e. (1) Much less attractive

19. Why?

20. Are you familiar with AB 1493, a.k.a. the Greenhouse Gas Bill or Pavley Bill?

- a. yes
- b. vaguely
- c. no

21. On a scale of 1 to 5 how important a factor is the successful implementation of AB 1493 in your decision to invest in California clean energy/clean technology startups?

- a. (1 = not a factor at all / 3 = somewhat important/ 5 = very important)

22. If AB 1493 were killed or watered down, do you think you would ultimately invest less of your fund in California?

- a. yes
- b. no
- c. don't know

23. If yes, why?

ENDNOTES

- 1 Mariko Killion and Grant Ferrier, *The Impact of the Air Pollution Control Industry on the California Economy* (San Diego, CA: Environmental Business International, Inc. (EBI), May 2004). Prepared for the California Air Resources Board and California Environmental Protection Industry.
- 2 Michael Renner, *Worldwatch Paper 152: Working for the Environment: A Growing Source of Jobs* (Worldwatch Institute, 2000).
- 3 National Renewable Energy Laboratory (NREL), *Dollars from Sense: the Economic Benefits of Renewable Energy* (Washington, DC: Produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, 1997).
- 4 European Wind Energy Association (EWEA) and Greenpeace, *Windforce 12* (Hamburg, Germany: European Wind Energy Association and Greenpeace, May 2004); author's analysis.
- 5 National Renewable Energy Laboratory (NREL), *Dollars from Sense: the Economic Benefits of Renewable Energy* (Produced for the U.S. Department of Energy, by National Renewable Energy Laboratory, 1997).
- 6 Ibid.
- 7 Mariko Killion and Grant Ferrier, *The Impact of the Air Pollution Control Industry on the California Economy* (San Diego, CA. Environmental Business International, Inc. (EBI), May 2004), pp.99; author's analysis.
- 8 Michael Renner, *Worldwatch Paper 152: Working for the Environment: A Growing Source of Jobs*, (Worldwatch Institute, 2000), pp. 53.
- 9 U.S. Department of Labor, Bureau of Labor Statistics (BLS), <http://www.bls.gov/oes/home.htm>.
- 10 Michael Renner, *Worldwatch Paper 152: Working for the Environment: A Growing Source of Jobs*, (Worldwatch Institute, 2000), pp. 53.
- 11 Cleantech Venture Network, <http://www.cleantechventure.com>.
- 12 National Venture Capital Association, <http://www.nvca.org/>.
- 13 Daniel Kammen, Kamal Kapadia, and Matthias Fripp, *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* (Energy and Resources Group/Goldman School of Public Policy at University of California, Berkeley, April 13, 2004).
- 14 Cleantech Venture Network.
- 15 Cleantech Venture Network.
- 16 Michael E. Porter, "Clusters and the New Economics of Competition", *Harvard Business Review*, November-December 1998.
- 17 National Venture Capital Association (NVCA) and Global Insight, *Venture Impact 2004: Venture Capital Benefits to the U.S. Economy* (Arlington, VA: National Venture Capital Association, 2004).
- 18 National Venture Capital Association (NVCA)and DRI-WEFA, a Global Insight Company, *The Economic Impact of the Venture Capital Industry on the U.S. Economy* (Arlington, VA: National Venture Capital Association, 2002).
- 19 Astrid Roman and Bruno van Pottelsberghe de la Potterie, *The Economic Impact of Venture Capital*, (Frankfurt, Germany: Deutsche Bundesbank, September 2003).
- 20 British Venture Capital Association (BVCA), *The Economic Impact of Private Equity in the UK 2003* (London, England: British Venture Capital Association, 2003).
- 21 National Venture Capital Association (NVCA) and DRI-WEFA, a Global Insight Company, *The Economic Impact of the Venture Capital Industry on the U.S. Economy* (2002).
- 22 Ibid.
- 23 The bulk of the \$338 billion in venture capital recorded by Global Insight was invested after 1994. Nonetheless, it is important to note that the Global Insight study counted jobs in companies that received venture funding as far back as 1970.

- 24 This analysis does not assume that the jobs and revenue quoted below would be realized by 2010. Rather, based on the historical economic impact of venture capital investments, those jobs and revenue would be expected to materialize over the life of the companies receiving investment. Accordingly, some job and revenue creation from capital invested between 2004 and -2010 would likely occur after 2010.
- 25 This analysis is not intended to be a forecast of venture capital investment, job creation, or revenue creation for the cleantech sector.
- 26 Financial services VC investment has recently been dominated by the Midwest, which received 55 percent of relevant VC investment in the first quarter of 2004. Illinois alone received nearly as much financial services venture capital in 2003 (\$143 million) as did California (\$147 million).
- 27 PricewaterhouseCoopers, Thomson Venture Economics, and National Venture Capital Association, (NVCA) *MoneyTree Survey* (PricewaterhouseCoopers, <http://www.pwcmoneytree.com/moneytree/index.jsp>).
- 28 DRI-WEFA and Venture Economics, www.ventureconomics.com.
- 29 Cleantech Venture Network.
- 30 Mark Glyde, "California Passes RPS," *Northwest Energy Coalition Report*, September 2002.
- 31 Evolution Markets LLC, www.evomarkets.com, (7 June 2004).
- 32 Jesse Broehl, "\$32 Million Targets Renewable Energy Developers," *Solar Access*, November 14, 2003.
- 33 Connecticut Clean Energy Fund Strategic Framework and 2003 Annual Report, www.ctcleanenergy.com/.
- 34 Evolution Markets LLC, www.evomarkets.com (accessed 6/7/04); Connecticut Clean Energy Fund staff.
- 35 Connecticut Clean Energy Fund staff.
- 36 Connecticut Clean Energy Fund staff.
- 37 Ryan Wiser and Ole Langniss, *The Renewables Portfolio Standard in Texas: An Early Assessment* (Berkeley, CA: Ernest Orlando Lawrence Berkeley National Laboratory, November 2001).
- 38 U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), www.eere.energy.gov/cleancities/vbg.
- 39 Carbon Disclosure Project, *Carbon Finance and the Global Equity Markets* (New York, NY: Prepared by Innovest Strategic Value Advisors for the Carbon Disclosure Project, 2003).
- 40 Feng An, "GHG Emissions and Oil Consumption from Transportation Sectors in the U.S. and China" (presentation at the Sustainable Multi-Modal Transportation for Chinese Cities International Seminar, October 20–21, 2003, Shanghai, China).
- 41 NRDC's China Clean Energy Program has worked since 1996 to promote clean, efficient, and affordable energy and environmental policies, strategies, and technologies in China. In 2004, Environmental Entrepreneurs members collaborated with NRDC's staff to launch the China-U.S. Energy Efficiency Alliance to help support NRDC's work with the Chinese government and build a network of businesses interested in energy efficiency in China. For more information, see www.chinacleanenergy.org.
- 42 Joseph B. White, "Where the Industry's Future Looks a Lot Like Los Angeles," *The Wall Street Journal*, July 14, 2004.