Building San Francisco's Cleantech Economy:

Analysis and Strategy Options

SPUR

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Prepared for
San Francisco Planning + Urban Research Association
312 Sutter Street, Suite 500
San Francisco, CA 94108

Prepared by:
ICF International
394 Pacific Avenue, 2nd Floor
San Francisco, CA 94111

Business Cluster Development
160 N. Castanya
Portola Valley, CA 94028

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1. Introduction

As climate change and rising energy costs become priority concerns across the economy and community, cities and regions that develop a high concentration of clean technology enterprises will benefit in two ways. First, they will create new jobs as their cleantech businesses grow to serve expanding national and global demand. Second, they will capture an important portion of the cost of adapting local industries to climate change and energy efficiency needs within their own economy. The first outcome will create new jobs and prosperity for the city and region. The second outcome will reduce "leakage" of jobs and revenues out of the metropolitan economy and community and generate new jobs within the value chains of other city and regional industries. Considering how to accomplish these two objectives is perhaps one of the most exciting and challenging opportunities of this early stage of the 21st century. This report examines the emerging structure, opportunities and requirements associated with building clean technology enterprises in San Francisco. The goal is to set the stage for collaborative initiatives to accelerate cleantech industry development.

Every city and surrounding regional economy around the world is made up of a portfolio of industries and institutions that generate employment and opportunity for residents. Given the realities of climate change and rising energy prices, each of these industries and institutions such as schools, transit districts, or government offices face rapidly rising pressure to adapt—to reduce greenhouse gas emissions and reduce energy use**.** This means that many industries, as well as public and nonprofit institutions, are going to be reviewing their entire value chain—from how they design or produce goods, to how they distribute products to the marketplace and recover materials. They will all be seeking ways to increase the efficiency of their resource use and reduce their environmental impact. This wave of change, still in its infancy, will generate growing demand for products and services that use new principles and practices for carbon minimization and energy efficiency.

A critical part of the solution for greening of the economy is the range of technologies collectively referred to as cleantech. Cleantech is that part of the greening of the economy that focuses primarily on technologically-driven innovations in design, engineering, production, maintenance, distribution and services that reduce carbon emissions and improve energy efficiency—as well other environmental performance objectives. The building blocks of cleantech—what differentiates it from conventional processes—are the use of innovations in materials and processes that reflect new green principles. As was true of earlier revolutions in the economy, such as microelectronics and biotechnology, the greening of the economy is new today but may be taken for granted in the future. Our economy is not there yet. We are just at the earliest stage of a sea change in how we do business.

What distinguishes the San Francisco Bay Area from many other regions of the globe is the fact that our historically high concentration of information technology, materials science, life science and financial services knowledge and industry are powering the growth of these cleantech enterprises. Our region is often an early leader in emerging areas of technology and is also home to many of the financial investors who help capitalize their growth as markets expand. This dynamism has enabled the Bay Area to grow a diverse array of cleantech enterprises and could enable San Francisco to specialize in specific areas that create high quality employment opportunities.

With the support of targeted public policies and leveraging private investment, emerging clean technology enterprises can be enabled to grow to meet the exploding global demand for

greener products and services. In so doing, these local efforts will not only grow opportunities to serve markets worldwide, but can also help transform our own economy, keeping more value in our region while creating new wealth and new jobs and improving sustainability.

The time is right for this next step in the evolution of new enterprises and enhancement of existing industries and institutions. As the evolution of the industry drivers and institutional inputs of the economy move towards a more energy and carbon focused perspective, there will be growth of a new generation of firms that will specialize in one or more portions of the emerging clean technology marketplace. Cleantech will be a dynamic, fast changing agglomeration of companies serving the value chain of needs in and across the national, state and regional economies. Over time, San Francisco may specialize in those cleantech segments that gain greatest market acceptance and are more widely adopted by buyers while still emphasizing the natural strengths of San Francisco's economy.

The rising demand for cleantech solutions is already focusing attention on the enormous growth potential of these emerging industries. Venture capital investments in cleantech companies reached a record $2 billion in the second quarter of 2008, led by investments in solar technologies and second-generation biofuels, according to a recent report from Cleantech Group LLC. Investments jumped 58 percent from the second quarter last year and 48 percent from the first quarter of this year. California firms have received a very significant proportion of this venture investment, with California companies accounting for 40% of worldwide cleantech investment in the second quarter of 2008.[1]

The economic value of the greening of the economy is becoming a popular theme and this will reinforce interest in cleantech enterprises. A number of studies have already shown the significant job creation and economic development benefits that this emerging industry can provide, not only those jobs directly in cleantech firms but also a broader range of positions relating to support for the adoption of these technologies across the entire economy. A U.C. Berkeley report reviewed 13 studies examining the impact of renewable energy on job creation, and concluded 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."[2] Another study that looked at the impact of the California Global Warming Solutions Act (AB 32) found that by 2020 the State would see a $74 billion increase in GDP and generate 89,000 new jobs.[3] These early findings anticipate that there will be broad economic impacts from this trend. While many of the jobs that will be created from the growth of renewable energy, energy efficiency, and other cleantech segments will be in engineering-related occupations, the majority of job growth is expected to be in areas such as manufacturing, construction, accounting, and management.[4]

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1 Cleantech Group LLC, Press Release 7/8/08, http://cleantechnetwork.com/index.cfm?pageSRC=PressReleases

2 D. Kammen, K. Kapadia, M. Fripp, "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?", Renewable and Appropriate Energy Laboratory, UC Berkeley, 2006.

3 D. Roland-Holst, "Economic Growth and Greenhouse Gas Emissions in California", UC Berkeley, 2006.

4 R. Bezdek, "Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century", American Solar Energy Society, 2007.

Introduction

As cities increasingly commit to adapting to the realities of climate change and begin to build their own green economies, they will need to concurrently develop strategies to achieve the important double bottom-line potential— achieving greater sustainability while capturing economic value. To do this, cities will need to grow the emerging cleantech and green portion of their economies to serve broader market demand while creating a new array of related local jobs. The good news is that cities can simultaneously work to improve the energy and environmental performance of their existing industries and institutions which will reinforce their cleantech and green enterprises and reduce outflow of revenue while helping retain and strengthen existing (but increasingly green) industries and institutions.

As suggested above, every city or metropolitan area has the possibility of growing and attracting one or more segments of the emerging cleantech industry at this early stage of its history. There will be considerable fluidity and change in their growth over time, but eventually those cities with the strongest input advantages for cleantech (innovation, skills, capital) and the most active end-users (private and public buyers) will capture not only economic value in cleantech but also will enhance the sustainable prosperity of their entire set of economic engines. Setting up a business environment that fosters strong supply and demand for cleantech will help differentiate one city or region from another in the growing green economy.

Fortunately, as noted, the Bay Area is recognized as one of the leading centers of cleantech innovation in the world. We enjoy this distinctive position because of the presence of factors such as our strong research universities, the culture of entrepreneurship, our leading environmental policies, and the concentration of technology companies and venture capital in the region.

At this time when many cities are trying to lay the groundwork for supporting the development of their local cleantech industries, the challenge for San Francisco is to determine which segments of the industry are best able to form, expand or relocate here and to develop strategies to support their growth. To that end, this paper describes the segments of cleantech that are currently present in San Francisco, assesses the relevant characteristics of the local economy that support cleantech now, considers the role that the city can play within cleantech in the Bay Area, and proposes strategies that can help San Francisco capture an increasing share of the economic value of the cleantech products and services it helps produce. The balance of this paper is organized as follows:

- **Framework**: A framework is offered through with which to consider the opportunity and challenges of growing cleantech in San Francisco.
- **Structure and Trends**: The composition of the Bay Area's cleantech segments is examined, highlighting key segments and sub-regional concentrations, and showing where San Francisco stands out relative to the Bay Area.
- **Challenges**: An appraisal of strengths and weaknesses of San Francisco's capacity to sustain and grow the current and future segments of cleantech.
- **Strategic Directions**: Presentation of candidate options for enhancing and accelerating growth of cleantech.

2. Cleantech Overview

The term cleantech (an abbreviation of "clean technologies") is a term used to define a broad category of innovative products, processes and services that improve efficiency of resource use and reduce environmental impact. Cleantech is probably best described as a group of technology-driven sectors whose common thread is their ability to improve operational performance, productivity or efficiency while reducing inputs, energy consumption, waste or pollution.[5] Cleantech encompasses a broad range of products and services, from renewable energy generation to wastewater treatment to more resource-efficient industrial processes. Although some of these industries are very different, all share a common attribute: they use new, innovative technology to create products and services that compete favorably on price or performance while reducing humankind's impact on the environment.

Some technologies, such as renewable energy generation, are intrinsically clean, because their essential function is to provide a cleaner alternative to existing products. However, other technologies are not inherently clean and rely on their application for definition. For example, many nanotechnology firms are increasingly considered part of cleantech because their products can be used in a range of cleantech applications including green building materials (energy efficient architectural glass and roofing applications), lighter and stronger materials for building airplanes and vehicles (making them more fuel efficient), and materials for producing thin film solar cells.

The definition of cleantech adopted for this study includes those segments and sub-segments listed in Exhibit 1. More detailed descriptions of these categories can be found in Appendix A. In addition to firms focused on new technology development, this analysis examined a range of related business activities that are critical to the growth of cleantech and support the widespread adoption of these technologies. This includes specialized services firms such as environmental consulting, solar installation companies, and cleantech finance/investment firms. However, as with any emerging industry, these definitions are not permanent and will evolve over time.

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[5] J. Logerfo, "Cleantech Venture Investing: Patterns and Performance", Cleantech Venture Network, 2005.

Exhibit 1. Cleantech Segments and Sub-Segments

- **Renewable Energy Generation**
  - Solar
  - Wind
  - Geothermal
  - Hydro/Marine/Tidal
- **Energy Efficiency**
  - Building Energy Efficiency
  - Appliance and Equipment Energy Efficiency
- **Energy Storage**
  - Advanced Batteries
  - Fuel Cells
- **Green Building**
  - Green Architecture and Design
  - Green Builders
  - Green Building Materials
- **Clean Transportation**
  - Electric and Hybrid Vehicles
  - Alternative Fuels
  - Transportation Logistics
- **Cleantech Finance/Investment**
  - Venture Capital
  - Angel Funders
  - Project Finance
  - Private Equity
- **Carbon Offsets and Trading**
  - Emissions Reduction Project Development
  - Emissions Offset Brokering/Trading/Selling
  - GHG Inventory, Footprinting, and Verification
- **Energy and Environmental Consulting**
  - Energy Efficiency Consulting
  - Environmental and Sustainability Consulting
- **Advanced Materials**
  - Nano-materials
  - Bio-materials
  - Foils, Coatings, Polymers
  - Green Chemistry
- **Air, Water, and Environment**
  - Emissions Controls
  - Carbon Sequestration
  - Environmental Remediation
  - Water Conservation & Treatment
- **Recycling and Waste**
  - Recycling & Product Reuse
  - Waste Treatment

A key question facing public and private leaders as they consider how best to help grow cleantech in San Francisco is whether cleantech should be treated as a single industry or should be viewed as a series of distinct segments which are increasingly a natural part of the value chain of other existing industries. This question is important for one particular reason: if cleantech is treated as a single industry—though broad and evolving—success will be measured by the growth of firms, employment, and investment in cleantech in the aggregate. By contrast, if each segment of cleantech is treated as a distinct industry, policy interventions can be varied and targeted for each segment.

Nevertheless, the label cleantech is still useful today as a concept that unites varied emerging technologies around their shared focus on improved energy efficiency and environmental performance. It is very likely that the diverse segments that are presently considered to make up cleantech will grow and change over time. For this reason, maintaining a common focus at this early stage can have a significant impact on building a critical mass of initiatives to enhance broader enterprise formation, expansion and attraction. What is valuable about having an integrated cleantech perspective is that it provides an integrated approach to diverse segments with shared needs.

Capsule History of Cleantech

How did demand for this emerging range of industries grow into the form we now see? Some cleantech segments, particularly those related to air quality, water quality, and waste, can trace their origins to earlier environmental industries. Beginning in the mid-1960s, federal laws introduced top-down regulations to limit environmental air, water and hazardous waste emissions by industrial facilities (point sources) and vehicles (mobile sources). Federal laws fostered development of expertise within companies as well as demand for design, engineering and environmental systems, as well as assessment and remediation services. Concurrently, federal research focusing on energy innovation has been a major supply-side stimulus to California's cleantech growth. California has led the nation in share of federal funding in energy research as well as in generation of intellectual property in new energy related applications.

States, particularly California, have introduced policies over the years that have exceeded federal standards and provided leadership on many fronts—often to the frustration of existing industries who bore the costs of these policies. These externally imposed requirements, however, had two economic impacts—they motivated or required industries to rethink their design, engineering, resource use, production, waste management and distribution to consider air, water and waste emissions—prevention, capture and treatment—*and* they gave rise to further demand for diverse set of service and product providers focusing on these needs. For these reasons, cleantech can hardly be considered as entirely new. Certain segments of cleantech, notably Air, Water, Environment and Recycling and Waste, have their roots squarely in this earlier wave of environmental regulation.

More recently, as energy prices and climate change became major concerns for California, the State has experimented with its regulatory options and resolved to reduce its dependency on fossil fuels. Through a variety of policies, notably the Renewable Portfolio Standard (RPS), AB32, incentives for solar power, initiatives in geothermal and experiments in alternative energy (wind, hydrogen and fuel cells), as well as ongoing expenditures through the California Energy Commission's Public Interest Energy Research (PIER) program focused on renewable energy and energy efficiency technology development, the state has fostered significant innovation in cleantech as well as some degree of demand for cleantech products and services.

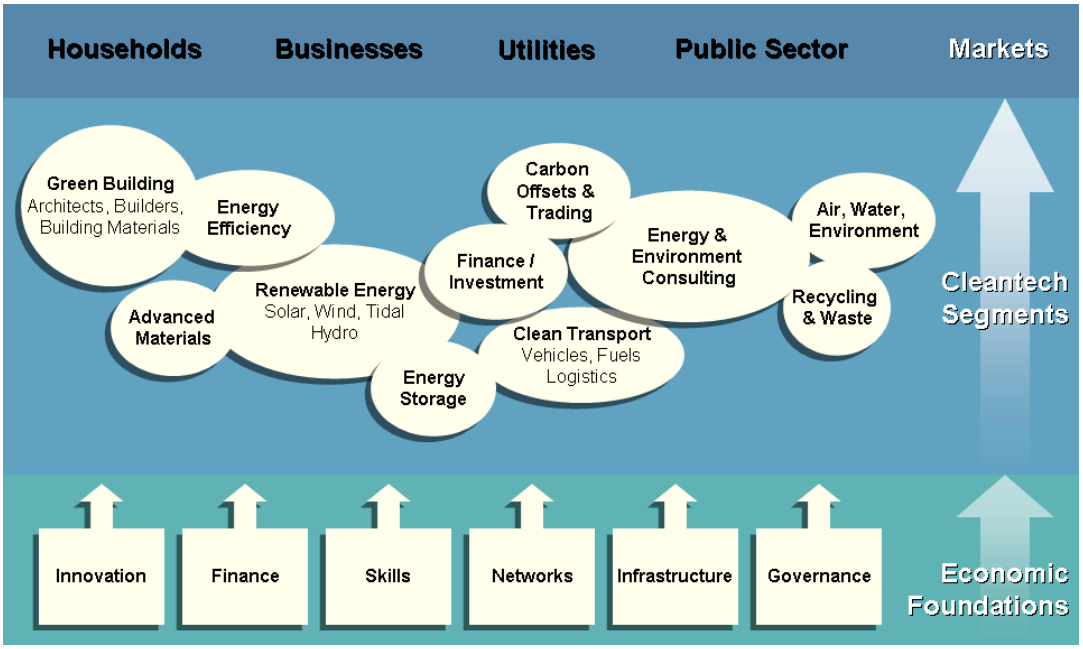
However, the growth of cleantech is arising from new factors shaping demand. One of the characteristics of cleantech highlighted by several definitions to distinguish it from earlier terms like “environmental technology” or “green tech” that were popularized in the 1970’s and 80’s is that demand for those earlier technologies was largely driven by environmental regulation and the need to comply with “end-of-pipe” standards. By comparison, in the current context of rising energy prices and significant public concerns around environmental and climate issues, demand for cleantech is now also being driven by significant market opportunities, and thus these nascent industries appear to have a far greater financial upside and long term sustainability.

The Cleantech Value Chain

The Bay Area’s cleantech firms serve markets ranging from individual households to specific industries—such as transport, manufacturing and construction—to major utilities and public agencies. Cleantech firms provide specialized products and services along the length of each of these value chains—from R&D to production and distribution to financing, distribution, installation and service. As these industries mature and the demand for clean technologies and products increases and diversifies, each segment begins to develop along its own value chain, eventually requiring its own set of suppliers, distributors and service providers.

In order for these cleantech industries to develop and mature, they must be able to draw on key economic “foundations” or building blocks—innovation, skills, finance, infrastructure and governance—provided by the region in which they are based. The City and private actors must work jointly to continually improve and strengthen these foundations to provide local firms with the input advantages they need to innovate and grow.

Exhibit 2. Diagram of Cleantech



Source: ICF International

Cleantech's Role in the Emerging Green Economy

As various sectors of the economy seek to reduce their energy consumption and improve their environmental performance, they are exerting pressure on partners throughout their value chains to reduce their environmental impact. New technologies, combined with this increased demand, are leading to the evolution of a range of new business activities across the entire economy to develop in more energy efficient, environmentally clean, and sustainable ways.

Cleantech firms are key suppliers of products and services critical to the greening of the entire economy. Over time, many portions of cleantech will become gradually integrated into the business practice of many existing industries as they each incorporate energy efficiency, clean energy, and sustainable practices into every step of their value chains. This may lead some segments to disappear as distinct industries as they are absorbed into broader traditional industry sectors.

In fact, the term "cleantech" may ultimately go the way of the term "high-tech" and lose the meaning that today may serve well to organize action. The term "high-tech" started being used in the 1960's to describe products that were at the cutting edge of technology at that point in time. Since there is no specific class of technology that is meant by high-tech, the definition necessarily shifts over time. This definition has led marketers to use the term so broadly that the term has sometimes lost its utility. Clearly, while the term "cleantech" may be useful for now—as the ideas relating to cleantech remain new—some industries currently described as cleantech may remain distinctly recognizable as such by the marketplace over time, while other segments will evolve into natural elements of the value chains of other industries.

The evolution of cleantech is a very significant economic opportunity for San Francisco and the Bay Area as a whole. As companies and regions throughout the world seek to reduce their environmental—and often carbon—impact, they will look to the firms that offer the most innovative and advanced solutions. As has happened for most prior technology-based booms, these firms will likely be clustered in several regions. San Francisco has a chance to play a leading role in the development of cleantech within Bay Area, which is already one of the global centers of cleantech.

There are three reasons why pursuing development of cleantech is of economic importance for San Francisco:

1. **Exporting cleantech:** First, by developing its cleantech establishments, San Francisco can generate new sources of "exports" from here to the increasingly energy- and climate-focused global marketplace (although this still will be highly competitive).
2. **Capturing local spending on greening:** Second, just as firms throughout the world will seek to manage their energy use and reduce their carbon output, so too will local firms who will also be looking to buy the best technologies or services in the marketplace. The challenge will be to make sure that our local cleantech firms are globally competitive enough to be able to sell their goods and services to the rest of the local economy. This will avoid what is called "economic leakage," or the loss to outside markets of money that otherwise would be spent locally. The presence of this local cluster thereby helps retain the economic benefits of existing companies while fostering cleantech firm formation and employment growth.
3. **Broadening the benefits of cleantech**: Third, beyond creating high-end, technology and engineering jobs, the presence of a local cleantech firms has multiplier effects on the whole regional economy, creating jobs in a range of supporting industries including both professional services (law, architecture firms, marketing, and investment firms) that service firms in cleantech, and green-collar jobs relating to the distribution, installation, and maintenance of renewable energy and energy efficiency products.

3. Economic Geography of Cleantech in the Bay Area

Understanding the geographic distribution of the emerging cleantech in the San Francisco Bay Area is important to determining the differences in opportunities for the City of San Francisco. This section of the report describes the geographic distribution of cleantech across the Bay Area, analyzes the distribution of firms across key cleantech segments, and highlights San Francisco's competitive position within the region. Typically, industry analysis is conducted by examining a sample of firms defined by a specified set of industry codes from the North American Industry Classification System (NAICS). However, this classification system is not adequate for analyzing emerging areas of the economy such as cleantech and related green businesses, as they do not correspond to existing industries codes. Establishing a clear statistical picture of the rapidly growing and changing set of industries is further complicated by the fact that many companies engage in some activities that are deemed to be cleantech and others that are not, thus making it difficult to determine exactly which firms should be included in such an analysis.

The analysis offered here is based on a database of 428 firms across the Bay Area region that was compiled specifically for this study. The database was generated through a combination of compiling existing listings and databases of Bay Area cleantech firms and organizations, business search through green business associations and government listings, data mining of Dun & Bradstreet data, and identifying cleantech firms through interviews with local experts.

Rather than focusing on the broader green economy and including traditional firms that are greening their operations, this analysis focused in on a narrower subset of firms that are providers of innovative cleantech products and services, as well as selected segments that serve as important enabling vehicles to create economic growth in other green segments (e.g., green venture capital financing may lead to more activity in the solar industry). There are many other types of firms that might have been included because a portion of their activities are related to cleantech, but the intention was to study this narrower set of companies.

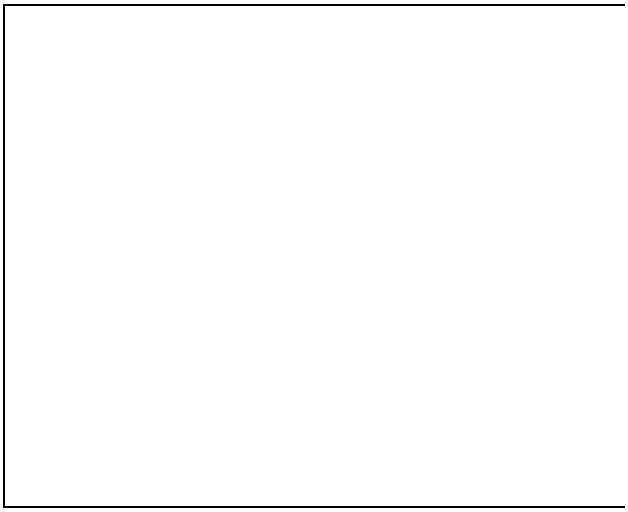
While the results here are clearly not inclusive of all firms working in cleantech or related industries, this analysis advances the understanding of the scope these activities in the Bay Area economy. Further work will certainly need to be undertaken to expand the completeness and accuracy of the database that has been generated here, refine the categorization of firms, and update and deepen the analysis of firm level data.

Overall Composition by Cleantech Segment

The majority of cleantech firms in the Bay Area fall into the following six segments:

- **Renewable Energy Generation:** Accounts for 20 percent of all establishments, with 75 percent of these firms specifically focusing on solar energy.
- **Finance/Investment:** Makes up 17 percent of cleantech business, with most of these being cleantech-focused venture capital firms.
- **Energy and Environmental Consulting:** Represents 14 percent of firms, with roughly half of these specializing in energy consulting and the remainder providing general environmental consulting services.
- **Green Building and Design:** Makes up 13 percent of establishments, with green architecture constituting 61 percent of the segment and green building materials constituting 23 percent.
- **Clean Transportation:** Accounts for 9 percent of firms, with half of these involved in research and production related to alternative fuels, and the other half involved in design, production, and maintenance of electric, hybrid, and other low-emissions vehicles.
- **Energy Efficiency:** Accounts for 7 percent of cleantech businesses, with nearly half of these firms focused on the design, manufacturing and sales of low-wattage lighting products. [6]

Exhibit 3. Bay Area Establishments by Segment



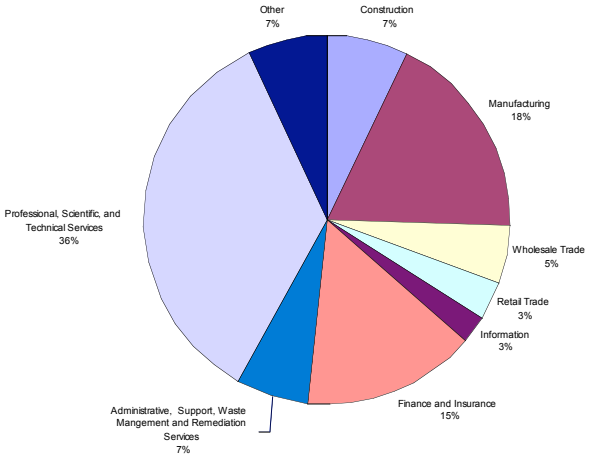
[6] In this analysis, only firms focused on technology product development in the EE segment were included, while EE consulting firms were merged into the broader "Energy and Environmental Consulting" segment. Counting only this former group, energy efficiency product companies comprise only 7 percent of Bay Area cleantech businesses. When EE consulting firms are included in this group, energy efficiency becomes the third largest segment in the Bay Area, representing 14 percent of all cleantech establishments.

Composition by Industry Sector (NAICS)

The Bay Area's cleantech segments were analyzed in terms of how they fall into the North American Industry Classification System (NAICS). As would be expected from the broad range of activities in cleantech, these firms ranged in category from construction and manufacturing to professional and scientific services.

- Professional, Scientific and Technical Services have the largest share of establishments at 36 percent; and
- The second highest number of firms are in Manufacturing sector at 19 percent.

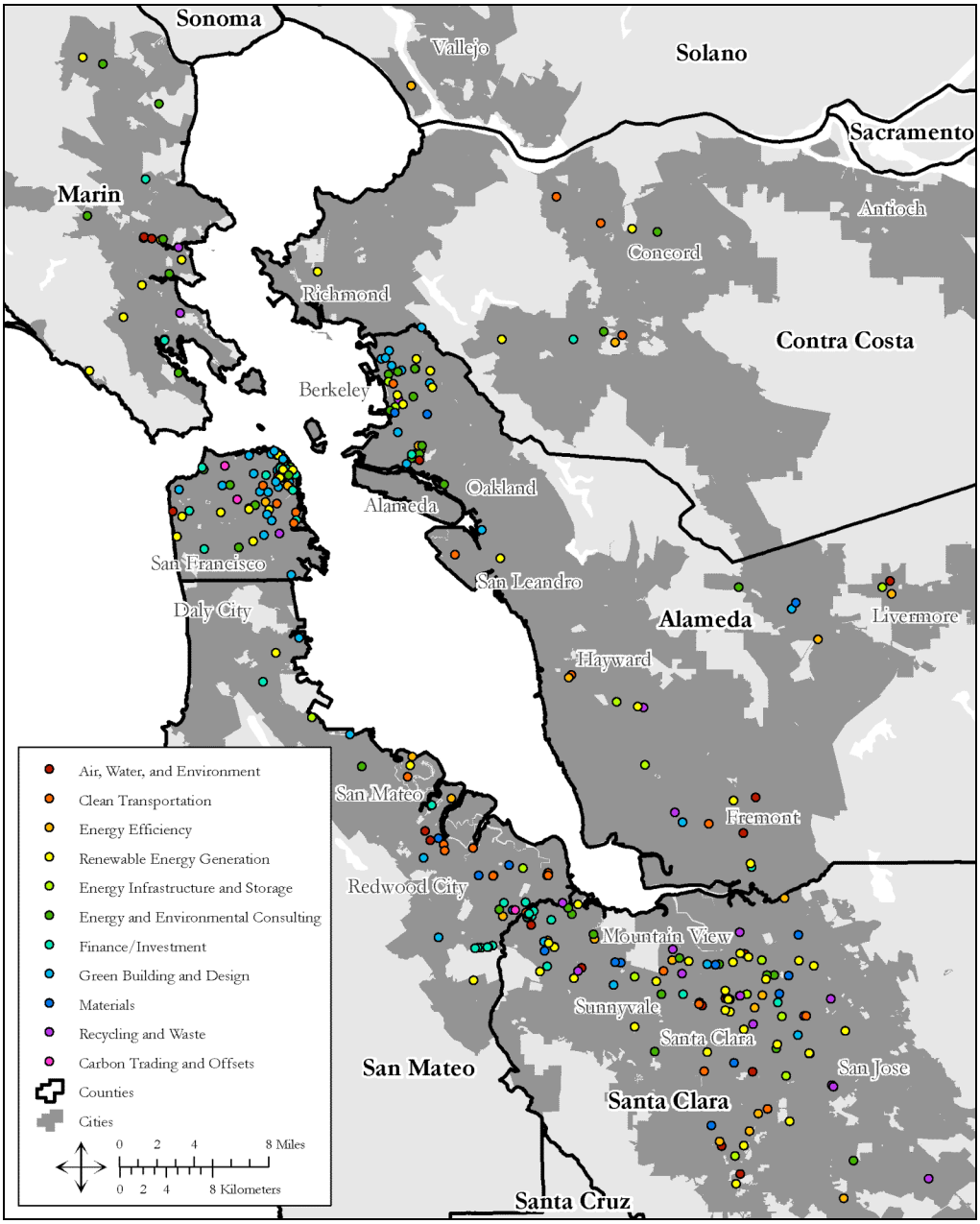
Exhibit 4. Establishments by Industry Sector



Geographic Distribution of cleantech in the Bay Area

The database of cleantech firms was analyzed to understand the geographic distribution of these industries by subdividing them into four sub-regions: San Francisco County, the North Bay (Marin, Sonoma, and Napa Counties), East Bay (Solano, Contra Costa, and Alameda Counties), and South Bay (Santa Clara and San Mateo Counties). Firm analysis by geography showed that cleantech in the Bay Area is truly regional in nature—there are firms from all segments distributed across the entire region, with distinct geographic clustering in San Francisco, the East Bay, and along the South Bay corridor. Exhibit 5 maps the location of cleantech establishments across the Bay Area.

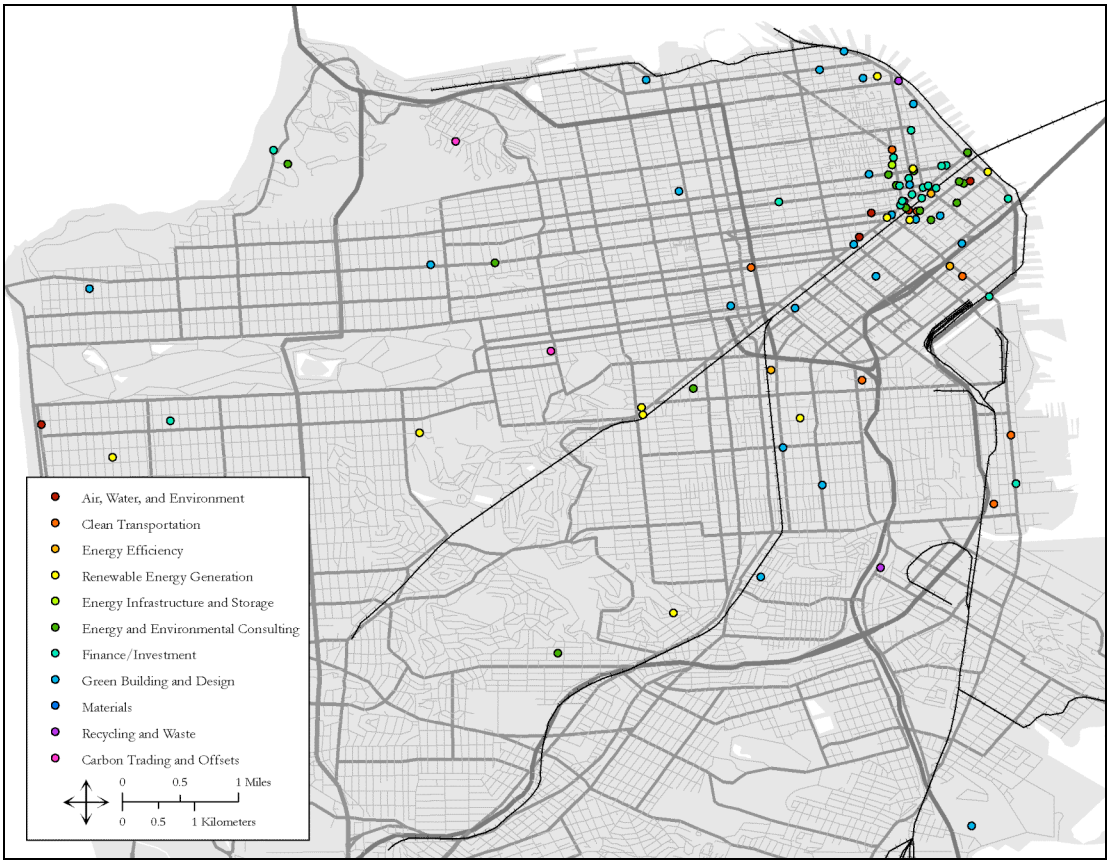
Exhibit 5. Location of Bay Area Cleantech Establishments



Source: ICF International

Looking more narrowly at the location of cleantech establishments within San Francisco, Exhibit 6 shows an agglomeration of firms in the downtown business district, particularly finance, green building and environmental consulting firms, but also a significant number of establishments scattered across the city.

Exhibit 6. Location of San Francisco Cleantech Establishments

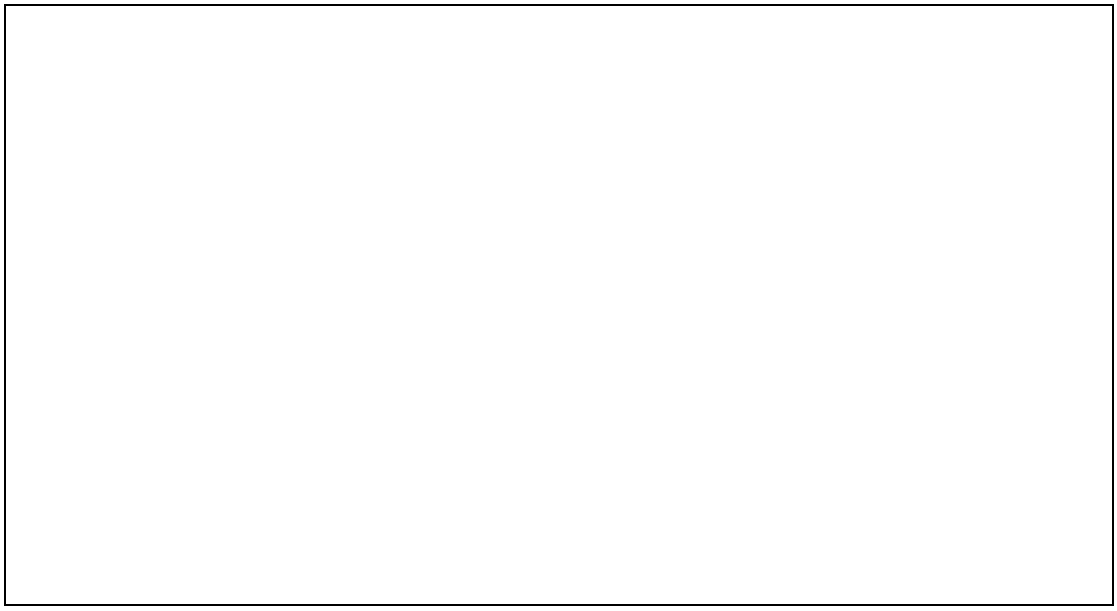


Source: ICF International

Distribution of Industry Segments across the Bay Area

Exhibit 7 shows the distribution of each of the cleantech segments by sub-region. The South Bay leads the region in nearly every segment, with San Francisco generally having the second largest number of enterprises. San Francisco has a significant share of several key segments, including Green Building, Finance, Energy and Environmental Consulting, and Carbon Offsets and Trading.

Exhibit 7. Relative Distribution of Cleantech Segments across Sub-Regions



The analysis further found that all of the regions are evenly divided between long-established firms and newer firms, with an average of 65 percent of firms being established prior to 2002, and 35 percent of firms being established since 2002. The only sub-region with a significant divergence from this pattern is the North Bay, where a higher proportion (83 percent) of cleantech firms were established prior to 2002.

Sub-Regional Specialization

Finally, the segment composition of each sub-region was analyzed to understand where they had the greatest internal concentration of firms. In general, each of the Bay Area's sub-regions has a similar distribution across industries. The analysis found that the following pattern:

- **South Bay:** Cleantech establishments are most concentrated in Renewable Energy Generation (20 percent), Finance/Investment (17 percent), and Clean Transportation (11 percent).
- **East Bay:** Cleantech establishments are most concentrated in Renewable Energy Generation (21 percent), Green Building (19 percent), Energy and Environmental Consulting (17 percent), and Clean Transportation (11 percent).
- **North Bay:** Cleantech establishments are most concentrated in Renewable Energy Generation (33 percent) and Energy and Environmental Consulting (22 percent).
- **San Francisco:** Cleantech establishments are most concentrated in Finance/Investment (26 percent), Green Building (23 percent), Energy and Environmental Consulting (15 percent) and Renewable Energy Generation (14 percent).

A discussion of those segments that offer significant economic opportunities for San Francisco follows next.

4. Cleantech Opportunities in San Francisco

Successful business and economic development is often about playing to one's strengths and working with those resources one already has. With that in mind, San Francisco's economic development activities related to cleantech should most appropriately focus on those segments where the city has an existing specialization and for which it has advantages over its competitors in terms of key economic inputs. Broadly speaking, San Francisco should seek to build on its leading position in green building, cleantech finance, and professional services to develop specializations in parts of the cleantech value network that are best aligned with the city's strengths.

To this end, this section provides a deeper analysis of those cleantech segments that offer important opportunities for further development in San Francisco, either because (i) a significant share of the Bay Area's firms in that segment are already located in San Francisco; (ii) that segment constitutes a significant proportion of the total number of San Francisco cleantech firms; or (iii) it presents a particularly promising economic potential for the city. These key segments are listed in Exhibit 8 below.

Exhibit 8. Key Cleantech Segments in San Francisco

Cleantech Segment	San Francisco Share of Bay Area Firms	Proportion of All SF Cleantech Firms
Green Building and Design	48%	23%
Renewable Energy Generation	20%	14%
Energy Efficiency[7]	10%	3%
Energy and Environmental Consulting	31%	15%
Carbon Offsets and Trading	75%	5%
Cleantech Finance/Investment	44%	26%

Green Building and Design

This segment includes architectural, design, and construction firms that focus on the development of energy efficient and environmentally sustainable buildings, as well as firms involved in the production of reduced-waste and high-performance building materials. This segment makes up 13 percent of the overall Bay Area cleantech establishments, with green architecture and design constituting 61 percent of establishments in the segment and green building materials constituting 23 percent.

This industry is particularly concentrated in San Francisco, with 47 percent of Bay Area green building firms being located in the city, and the East Bay and South Bay accounting for 27 percent and 20 percent of the region's establishments, respectively.

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[7] These numbers only include firms focused on EE technology product development. When EE consulting firms are also included in calculations for this segment, San Francisco has 17% of all EE firms in the Bay Area, and the EE segment makes up 8% of all cleantech firms in San Francisco.

Promoting green building in San Francisco is important for meeting both the city's environmental and economic objectives. Since approximately half of all emissions in San Francisco come from buildings and other stationary sources, improving the efficiency of buildings can go a long way toward meeting the city's climate objectives. And the green building industry is an important economic development opportunity, due to the high number of quality jobs in design, engineering, construction, and building maintenance that it can create.

San Francisco should continue to leverage its strong architecture, design and construction industries to become a leading center for green building. One particular opportunity is for the city to explore ways to combine its strengths in green building, energy efficiency consulting, and finance to develop innovative approaches to scaling up the process of building retrofits in specific types of structures. Many cities are seeking new ways to aggregate demand for residential energy efficiency upgrades and develop creative tools for financing block by block retrofits. Competition for this market segment will be substantial, but the scale of expenditure over time on retrofitting buildings will be very large. Consider, for example, that New York City has almost 1 million buildings, many of which will require retrofitting over time. The City's strong green building policies and commitment to develop new areas of the city, such as Treasure Island and Hunters Point, using green building approaches are important tools for further strengthening this important industry.

Renewable Energy Generation

The Renewable Energy Generation segment includes firms involved in R&D, manufacturing, design, installation, maintenance, and management of systems for generating energy from solar, wind, and other renewable sources. While this segment accounts for 20 percent of all cleantech establishments across the Bay Area, renewable energy firms are less concentrated in San Francisco, accounting for only 14 percent of establishments. In this section, we focus on the three most relevant renewable energy sub-segments for San Francisco: solar, wind, and tidal energy.

Solar Power

Solar power is by far the largest renewable energy sub-segment in the Bay Area. The cleantech study found that 75 percent of firms and 60 percent of employment in the renewable energy generation segment are primarily involved in solar power. The majority of solar technology development in the region occurs in Silicon Valley, due largely to its proximity to silicon chip production and semiconductor engineers. As many as 25 solar industry companies call San Jose home, with another 60 or so distributed across the greater Silicon Valley region. Most of these firms are involved in R&D and production, with the remaining focused on installations.

San Francisco leads the region in the total number of solar installations, even while it lags other jurisdictions in per capita solar installations. On average, there are 14 solar projects being installed in San Francisco each month, according to the City's environment department. However, due to the concentration of solar R&D and production in Silicon Valley, and given the shortage of industrial space for manufacturing in the city, the opportunities for San Francisco to develop new enterprises at the lower levels of the value chain—e.g., silicon purification, materials, and solar cell manufacturing—are not promising activities for San Francisco. San Francisco should concentrate its economic development efforts at the other end of the value chain: system design, installation, and servicing are the most viable solar opportunities for San Francisco, as they involve on-site management and client interaction and need to be locally based.

WIND POWER

There are a limited number of wind power firms in the Bay Area. This analysis found that 11% of renewable energy generation firms in the region are focused on wind. Wind power is dominated by firms located outside of California. General Electric is the largest turbine producer in the world and many of most influential wind energy companies are headquartered overseas. So, although U.S. wind power capacity grew by 45 percent over the last year, opportunities for San Francisco to develop utility scale wind power companies as a major exporting segment are not likely.

Distributed wind system technology—creating less than 100kW—holds more promise for development in the Bay Area. San Francisco is starting to focus on this niche segment, and Mayor Gavin Newsom recently issued an executive order to City departments to fast-track permitting for small-wind projects. Newsom and county Supervisor Tom Ammiano also have gathered a 20-member task force and 12 technical advisers to figure out how best to encourage the development of more urban wind-power projects. The task force is working to change zoning to encourage wind projects, and is considering the development of an incentive program.

TIDAL POWER

San Francisco has intriguing potential for the development of tidal power at the mouth of the Golden Gate—experimentally if not commercially. In 2006, a report by the Electric Power Research Institute (EPRI) claimed the mouth of San Francisco Bay was one of the best locations on the West Coast for tidal power. Officials hoped the project would generate as much as 38 megawatts of electricity. But a more recent study commissioned by the San Francisco Public Utilities Commission (PUC) found tidal energy in the Bay would cost tens of millions of dollars and yield a meager megawatt or two of power.

While there are extremely few local firms focused on tidal power, this renewable energy segment could present an opportunity for the city to differentiate itself in the cleantech space in the future. The Mayor has recently expressed his continued support for the concept of tidal energy and further feasibility studies are anticipated. Since tidal power technology is at very early stage of development, with most turbine technologies still in the prototype or pilot stages, the City should continue to move forward by focusing on applied research and technology demonstrations aimed at lowering both production and installation costs.

Energy Efficiency

The Energy Efficiency (EE) segment includes firms whose products and services are intended to reduce energy use in lighting, appliances, building operations, and manufacturing and industrial processes. Examples include energy efficient refrigerators, air-conditioners, and other appliances, tools for reporting real-time energy use, advanced light sources and controls, and high-efficiency motors, pumps, burners and boilers and industrial process systems.

Energy efficiency is one of the areas of greatest promise in cleantech, in terms of its climate change impacts, energy savings, relatively low-cost entrepreneurial opportunities and potential economic development benefits. Energy efficiency technology can significantly reduce wasted energy and diminish the need to increase power generation capacity. Many energy efficiency solutions also create construction, manufacturing and service jobs that often have higher employment impact than if money had been spent to purchase energy, as well as creating home and building improvements that deliver long-term economic value. In 2008, energy efficiency

matured as a cleantech investment sector, with both dedicated energy investors and generalist VCs focused on consumer and industrial energy efficiency.

In California, energy efficiency makes up about 30 percent of the cleantech sector, with roughly one-half of that total related to energy efficiency consulting and the remainder reflecting technology products. The energy efficiency industry is less concentrated in the Bay Area. As stated earlier, only firms focused on EE technology product development were included in the analysis of this segment, as EE consulting firms were merged into the broader "Energy and Environmental Consulting" segment. Counting only this former group, energy efficiency product companies comprise only 7 percent of Bay Area cleantech businesses. Of these firms, nearly half are focused on the design, manufacturing and sales of low-wattage lighting products. When EE consulting firms are included in this group, energy efficiency becomes the third largest segment in the Bay Area, representing 14 percent of cleantech establishments. With increased emphasis on energy efficiency at the state research and regulatory level and increasing interest among investors, no region of California has yet emerged as the leader in EE. For this reason opportunities for San Francisco to compete within this sector continue to exist.

Energy and Environmental Consulting

The Energy and Environmental Consulting category includes firms that assist other establishments in improving their energy use or environmental performance. Examples include firms that conduct energy audits, advise on energy efficiency improvements, analyze greenhouse gas and environmental footprints, and provide sustainability strategy advice. In this study, energy and environmental consulting firms comprised 14 percent of all Bay Area cleantech establishments, and the largest sub-regional concentrations of these firms were in San Francisco and the South Bay, with each having roughly one-third of the region's firms in this industry. San Francisco should consider opportunities to encourage energy and environmental consulting firms to locate and grow within the city. The existence of many corporate headquarters, including Pacific Gas and Electric, adds to the appeal of San Francisco for such firms.

Carbon Offsets and Emissions Trading

In recent years, there has been a growth in firms that specialize in Carbon Offsets and Emissions Trading, and this segment appears poised for significant growth. CleanEdge LLC is now predicting that carbon trading will be one of cleantech's biggest global markets in the near future. Outside of the U.S., carbon markets are well-established in Europe, and the value of global carbon credits has doubled in recent years to over $40 billion. At a time when California is moving toward mandatory carbon caps and national climate legislation is expected, many large U.S. corporations, including PG&E, are now supporting cap-and-trade legislation.

The Bay Area has a number of young firms that specialize in selling renewable energy credits and emissions offsets and in advising firms on offset strategy and purchases. San Francisco has the majority of firms in this small but growing segment. These firms are engaged in a broad range of functions, including identifying offset projects domestically and internationally, developing carbon financing mechanisms, advising on trading emissions, developing software to track offset-related investments, and verifying offset quality. Further, while they are not included in the study's statistical analysis, a number of large banks, financial institutions, and nonprofit organizations in the Bay Area are establishing new practices focused on offsets and emissions trading. San Francisco should continue to cultivate its leading position in this specialized industry, leveraging its strengths in finance, environmental policy and consulting.

Cleantech Financing & Investment

The Cleantech Financing & Investment segment includes businesses providing project financing for renewable energy and energy efficiency projects as well as venture capital, private equity and other investment firms that provide targeted capital for the development of cleantech ventures. This segment is critical to overall growth of these industries, as early stage financing is essential to the development of new technology and creation of new firms and innovative project financing tools are increasingly important to ensure that end consumers are able to purchase and make use of the new technologies. The Finance & Investment segment is the second largest segment among cleantech in the Bay Area, representing 17 percent of all cleantech establishments in the Bay Area, with most of these being cleantech-focused venture capital firms. This segment is even more important to San Francisco than to the broader region, as it accounts for more than one-quarter of San Francisco cleantech businesses.

Cleantech finance is a segment in which San Francisco, and the broader Bay Area, has a major competitive advantage. The region has been a center of high tech financing since the 1980s and has leveraged this existing strength to become a leader in this new wave of investing. One of the world's first dedicated clean energy VC firms, Nth Power is based in San Francisco, and many Silicon Valley VCs such as Kleiner Perkins Caufield & Byers and Draper Fisher Jurvetson have launched cleantech or greentech funds. The City should continue to explore creative ways to bring together the region's financial expertise and resources to accelerate the growth of its cleantech industries.

Balance of San Francisco Cleantech Portfolio

The array of cleantech segments that account for less than 5% of establishments in San Francisco include clean transportation; air, water, and environment; recycling and waste; energy storage; and advanced materials:

- **Clean Transport:** This segment consists of firms that provide products, services, or technologies for cleaner transportation or improved transportation energy efficiency, including alternative fuels, electric vehicles, and transport logistics.
- **Air, Water and Environment:** This segment includes firms developing technologies, services and equipment related to emissions control, reduction, or treatment, and to the detection and treatment of pollutants and toxins.
- **Recycling and Waste:** This segment includes firms that recycle or treat waste, as well as companies that reclaim, refurbish or redistribute products and materials that would otherwise be thrown away.
- **Energy Storage:** This segment includes firms that design, manufacture, and distribute advanced batteries and fuel cells, and components for these technologies.
- **Advanced Materials:** This segment includes firms that develop or produce chemical, nano-, or bio-materials used in applications that reduce environmental impacts, produce renewable energy, or provide superior energy efficiency compared to traditional materials.

Emerging Potential: Business and Professional Services

Finally, the strong growth of cleantech in the Bay Area presents a significant economic opportunity for San Francisco's business and professional services firms. While not analyzed as a distinct cleantech segment in this study, professional services are important due to an ongoing

trend in which existing professional services firms in the city—particularly law, consulting and public relations firms—are retooling themselves to target and serve emerging cleantech markets as a distinct market segment. Many firms are establishing cleantech-focused departments or practices, and others are reinventing themselves to focus exclusively on cleantech. These firms play in an important role in both supporting the development of cleantech and in speeding the adoption of these technologies by consumers and businesses.

Because only a portion of these firms' activities and revenues relate to cleantech, they were not included in the statistical analysis of the Bay Area industry. But this is another important area of competitive advantage for San Francisco, given its strengths in public relations, legal services, and other professional services. As these firms in the city develop specialized knowledge and a track record of success working on cleantech issues, these services can increasingly become an important export for the city's companies.

5. San Francisco's Building Blocks for Cleantech

Successful industries form and mature in geographic environments where there are advantages in supply of economic inputs, strong market demand or, ideally, both. Developing strong advantages in economic inputs and fostering market demand are building blocks of a cleantech strategy.

The Bay Area and its broad portfolio of value-added industry clusters have grown spectacularly over the past half century because of the continuing availability of advantages in economic building blocks--from microelectronics and software to biotechnology, telecommunications, the internet and digital media. Not only have each of these industries grown because of distinctive advantages in the region, their history of development has often fed from one into the other, reinforcing the Bay Area's regional advantage. Cleantech can and does, in turn, draw from this same heritage and leverage its value to grow its future. The Bay Area's distinctive concentration and leadership in a core array of economic inputs—innovation, skills, finance, infrastructure, and governance (business environment)—continues to foster growth and enable adaptation, including the genesis of clean technology.

The set of inputs or building blocks that create a platform for industry growth are often called "economic foundations."[8] Countries and regions have long admired and emulated the characteristics of the Bay Area—and Silicon Valley in particular—for its distinctive economic dynamism: a high rate of enterprise formation in leading fields of innovation, a continued stream of maturation into industry and capture of the highest portions of the value chain over time. This historic advantage is not even in all fields or industries. Yet, for those that are most successful, there is clearly a "vital cycle" at work in which the inputs that are available—whether innovation from universities or other firms; capital from high net worth investors or venture funds; skilled workforce that is mobile; infrastructure that enables logistical efficiency; and appropriate government regulation—strongly support enterprise formation, growth and attraction which, in turn, draws in ever more innovation, workforce skills, industry investment and supporting supply-chain.

This vital cycle or positive feed-back loop has characterized those industries that have taken shape and grown in the Bay Area. In the case of cleantech, the high concentration of firms in the region is evidence that there is a basic vital cycle in place that serves this cluster of industries. The question then is: Does this vital cycle work for cleantech in San Francisco? And, given that San Francisco didn't benefit as much as some other regions in previous tech booms, such as semiconductors, how can the city position itself to capture more of the value chain in key segments?

This section provides an overview of the key economic foundations or building blocks that San Francisco must cultivate and enhance in order to attract, retain, and grow cleantech firms and jobs, and an assessment of the city's distinctive strengths and weaknesses in these areas with respect to cleantech development. This assessment draws from data gathered through a combination of literature review, a survey of Bay Area cleantech firms and organizations carried out by ICF, and interviews conducted with local cleantech experts. The findings also draw from previous analyses of the city's economic foundations conducted by ICF in preparing the San

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[8] J. Gollub, "Clusters 2.0: Local Context of Globalization", EDA America, 2004;

[8] S. Waldhorn, E. Egan, and J. Gollub, "American Regions in the Global Economy: A New Framework for Metropolitan Economic Strategy", Office of Policy Development & Research, US Department of Housing & Urban Development, 1999;

[8] J. Gollub, "Cluster-based Economic Development: A Key to Regional Competitiveness", US Economic Development Administration, 1997.

Francisco Economic Strategy. Finally, this report provides recommended strategic directions for the City to consider in addressing challenges identified to strengthen cleantech innovation and enterprise development in San Francisco.

Innovation

Every region has an innovation pipeline. This pipeline is a continuum of public and private resources that generate knowledge discovery, transforms this into technology and product development and deploys this to the marketplace. The Discovery system of the San Francisco innovation pipeline consists of major universities, institutes and national laboratories that are centers of research and generate scientific publications and intellectual property as well as graduates and (on occasion) pre-competitive initiatives that are feedstock for the Development system. The Development system is made up of existing companies that harvest discoveries from multiple sources (internally and externally) from which they develop technology and products in their own laboratories, as well as startups by entrepreneurs. The Deployment system consists of existing companies and their marketing, sales and distribution partners, as well as publicly-funded technology transfer or technical assistance programs to accelerate adoption of best practices and new solutions.

As a knowledge-intensive set up industries, innovation is a key input for the growth of many cleantech firms. 79 percent of firms surveyed indicated that proximity to innovation centers was either somewhat important or extremely important to their location decisions.

The Bay Area innovation pipeline is extremely strong, and the long historic relationship between local industries and the UC system, Stanford, the national laboratories, industry-serving R&D laboratories (such as SRI and EPRI) and CSU campuses has been a major economic input advantage for virtually every technologically driven industry in the region—including cleantech. The agglomeration of technology enterprises around UC and Stanford reflects the importance of these institutions as important feeders of the innovation pipeline. Historically, much of the Bay Area's research has focused on information technology, semi-conductors and bioscience. However, Stanford and U.C. Berkeley have both recently established cleantech and energy efficiency research institutes with budgets over $100 million per year, and grant-funded research in the clean energy and energy efficiency fields exceeding $300 million per year at both institutions.

The most prominent research universities and labs related to cleantech are not located in San Francisco and the core of technology innovation in the Bay Area is not located within the city. However, the history of technology industries in the Bay Area has shown that it is not necessary for universities to be located within the boundaries of a particular city for it to play an important role in that industry. Rather, it is general proximity to these institutions that is key—within commuter distance.

In fact, the geographic location of other innovation-driven clusters such as semiconductors, computers, and biotechnology have tended to be even more influenced by the availability of workforce, affordable land and commercial facilities than by direct proximity to a research institution. For example, the biotechnology cluster initially formed in South San Francisco, rather than Berkeley or Palo Alto, and it is now spreading to Mission Bay as commercial real estate suitable for biotechnology becomes more available in there than it is in South San Francisco. Another such example is that of the semiconductor cluster which was initially most concentrated in Santa Clara and Sunnyvale. The industry spread to San Jose, as land became scarce in these other cities and the San Jose Redevelopment Agency created new commercial opportunities. In each case, the innovation core of the cluster (i.e., Stanford or U.C. Berkeley) was located close enough to the eventual commercial centers that developed to be convenient for both the spin-out

of technology from the universities and travel between the commercial enterprises and the universities and labs, which is necessary to take advantage of the innovation resources.

Reinforcing this point is the fact that 80 percent of respondents to the cleantech survey felt that San Francisco rated either favorably or very favorably with respect to its proximity to innovation centers. Firm-specific interviews further supported the view that San Francisco was well positioned to take advantage of research and new discoveries taking place in the region, but several respondents felt that more could be done to strengthen its ties with these institutions and leverage their capabilities through activities such as establishing commercialization programs to help launch San Francisco-based spinouts, recruiting staff and interns in San Francisco cleantech companies, and sponsoring seminars and technology conferences.

One of the major constraints for San Francisco in taking advantage of nearby innovation centers to establish cleantech businesses is the cost of commercial space and limited availability of space for manufacturing. To address this limitation, San Francisco should consider developing a location for cleantech industrial growth both to change the market perception about opportunities for location in San Francisco, and to provide a visible hub for cleantech activity, much as the City has done for life sciences through the development of Mission Bay.

Finance

Just as there is an innovation pipeline that provides a flow of ideas that moves to the marketplace there is a finance pipeline. And just as the innovation pipeline may not flow smoothly or have gaps, so to the finance pipeline may easily have short comings. Financing typically moves through stages—from financing sources for initiation of ideas, which comprises pre-seed funding (grants, self-funding and angel/early-stage risk capital), to development (formal venture financing in multiple rounds) and growth (commercial credit, industrial loans as well as IPOs, mergers and acquisitions). Ensuring access to capital at all stages of growth is essential to the success of all new business formation, and is especially critical to the formation of new innovation-based industries.

The Bay Area is known for its deep and broad capital market that focuses on developing technology-based enterprise, and the region's investors have thoroughly embraced cleantech. Cleantech is now a mainstream financial investment market in the Bay Area, and around much of the world. Venture capitalists in the U.S. invested $2.7 billion in the cleantech sector in 2007, and venture investment in cleantech increased by more than 70 percent (the fourth year in a row with increases over 40 percent). The key industry segments—solar, wind, biofuels and fuel cells showed a 40 percent increase in revenues in 2007. With these four sectors projected to grow to $254 billion within a decade, the future is bright.[9]

Global investments in energy technologies—including venture capital, project financing, public markets and R&D—expanded 60 percent from $92B to $148B in 2007, according to New Energy Finance. While this investment is significant, the International Energy Agency estimates that $600B per year needs to be invested through 2030 in order to meet the projected demand for energy. Given current climate issues, we can expect to see increasing percentages of such investment focused on renewable energy. With over 40 percent of venture investment in clean energy occurring in the Bay Area, venture financing does not seem to be the limiting factor. The key gap in the financial pipeline in the Bay Area, and particularly in San Francisco, is early-stage

[9] Clean Energy Trends, Clean Edge, Inc., 2008. http://www.cleanedge.com/reports/accessReport.php?rp=/reports/reports-trends2008.php&report=Trends2008.

seed financing. Notably, as venture funds have grown in size due to the influx of institutional investment over the years, the funds' interest in early-stage investment placements has declined. Today, a very small portion of total venture fund placement is in early-stage enterprises. More of the capital is now invested in firms that are more mature. This creates an abiding challenge for growth of innovation driven firms at the earlier stages—including cleantech.

San Francisco is perceived to have highly developed sources of later stage financial capital. The city is home to several of the leading venture investors in cleantech, including Nth Power, Expansion Capital Partners, Aqua International Partners, Investors Circle, and Renewable Ventures, LLC, although the core of cleantech venture investment is in Silicon Valley. San Francisco also has many leveraged buy-out firms, M&A firms, banks, and other financial institutions. The list of international financial firms with multiple investment vehicles available for cleantech is long and includes JP Morgan, Credit Suisse, WR Hambrecht, Draper Richards, Golden Gate Capital, and many others. The ICF survey found that 89 percent of respondents felt that proximity to sources of financing was one of San Francisco's strengths.

However, San Francisco is not perceived to have "early" money, or seed stage funding, readily available to those creating new businesses in the city. During the interviews, Silicon Valley was widely perceived to be the source of early stage financing for cleantech and that Silicon Valley venture capitalists often exerted pressure on small emerging startups to locate nearer to their headquarters (typically Menlo Park). San Jose has experienced the same pressure by VC's to move companies "up the Valley".

San Francisco should try to increase the availability of deal preparation (to ensure good quality, ready, candidates) as well as local seed stage financing of various types to thereby ensure that there is a flow of capital available from the earliest stages of proof of concept and prototype development through to commercial scale-up readiness. This strategy can enable the city's finance segment to bracket the Silicon Valley venture stage and help attract, grow and retain cleantech enterprises in San Francisco.

Workforce Skills

Every economy is enabled by workforce capabilities. Every region has educational institutions that prepare, advance and renew skills—some better than others. Regions need a concentration of high performing educational institutions at each of these levels—increasingly so in today's knowledge economy. Having a flow of workers that matches the skills expectations and needs of industries is more essential than ever to ensuring competitiveness. In the survey of cleantech firm location decisions, access to a skilled workforce was cited as the most important factor: 92 percent of firms indicated that access to skilled labor was somewhat important or extremely important, with more than 60 percent saying that it was extremely important.

If San Francisco is to capture the full economic value of its cleantech and green sectors, the city will need a range of workforce skills along the length of the value chain corresponding with the occupational needs of the industry's growing segments. This will require not only workers with high-end skills related to engineering, finance, and entrepreneurship—areas where the city is already a leader—but also a growing workforce in the skilled trades, such as manufacturing, construction, operation, and maintenance.

In terms of high-skill workforce, the Bay Area has a much higher concentration of knowledge-based professionals and executives than the rest of the nation, and 35 percent of adult residents hold a bachelor's degree or higher. San Francisco has an even higher average, with

nearly 50 percent of workers holding a bachelors degree.[10] San Francisco has a dynamic business community with a strong presence of the type of business leaders—CEO's, CFO's and mid-managers—needed to grow cleantech companies. Even stronger is the diverse group of professional firms—lawyers, marketing and public relations firms, bankers, CPA's, and architects—that provide key services to these firms as they are being established and mature.

The cleantech survey and interviews found that San Francisco's skilled workforce is perceived to be an advantage by 80 percent of the sample. However, many of those interviewed also felt that attraction and retention of this workforce is sometimes challenged by the cost of living, the cost of housing and the quality of K-12 education in San Francisco.

With its combination of a strong existing professional services industry a distinct reputation as a green and environmentally enlightened city, San Francisco is developing one of the leading workforces in professional service relating to cleantech and green practices. As discussed earlier, the city is seen as a hub of expertise in green building, environmental consulting, and cleantech finance. The presence of the California Public Utilities Commission (CPUC) and the state's largest regulated utility (PG&E) headquarters in San Francisco are seen to further enhance the city's reputation as a leading destination for professionals seeking careers in energy efficiency, renewable energy, and other areas of cleantech.

One area of workforce skills where San Francisco is comparatively weaker is engineering. No engineers that were spoken with saw San Francisco as a compelling location for cleantech work. The sentiment was that cleantech engineering was the forte of Silicon Valley. Changing this perception will be important to attracting and retaining the technical workforce needed to support the development of cleantech in San Francisco. As workforce ages and skill needs change, retraining and transferring older or displaced workforce from declining industries to new cleantech opportunities will make increasing sense.

San Francisco also faces the challenge of creating cleantech job opportunities for its less educated citizens and building a workforce development system that enables more of the city's residents to reap the economic benefits associated with the growth of these industries. The Apollo Alliance has estimated that the clean energy sector alone can create 438,000 jobs in California over the next ten years, with most of these being in the skilled trades. San Francisco should create a green jobs program to help prepare residents to enter into this growing green workforce. While the city has a number of important programs in place, such as CityBuild, there needs to be improved alignment between these initiatives, and a scaling up of their activities. The planned cleantech development at Hunters Point, which will employ green building techniques throughout much of the planned construction, provides an excellent opportunity for expansion efforts to get more residents into green collar jobs.

Physical Infrastructure

As with any industry, cleantech needs access to appropriate land, commercial facilities, and infrastructure as an input to its growth. One of the constraints to the development of some segments of cleantech in San Francisco is the shortage of industrial space for light manufacturing and the overall cost of commercial space.

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[10] Bureau of Labor Statistics.

The availability and cost of these industrial and commercial sites and associated infrastructure around the Bay Area has in large part affected the geographic distribution of the cleantech industries across the region, perhaps to a greater degree than other inputs such as than innovation, workforce or finance. Not surprisingly, San Francisco's cleantech firms are most heavily concentrated in segments that are suited to being located in commercial offices, as opposed those that require more industrial facilities.

The majority of negative comments about San Francisco in the cleantech survey related to the cost of commercial space and transportation infrastructure. 92 percent of respondents felt that the cost of commercial space was either extremely or somewhat important to their location decisions and 75 percent felt that San Francisco rated unfavorably on this factor. This is a significant constraint to the development of cleantech in the city and reinforces the importance of developing new commercial and industrial sites that are suitable for the growth of these industries.

Access to parking was slightly less of a concern than expected among survey respondents. Less than half felt that availability of parking was an important factor in their location decisions. By contrast, proximity to public transport was either extremely important or somewhat important to 72 percent of survey respondents, and 74 percent felt that San Francisco's access to transit rated favorably. These results are important as they highlight how the attitudes of cleantech companies toward parking and transit may differ from other technology based startups such as biotech.

In terms of commercial space needs, cleantech firms were asked to state the types of facilities they would seek if they were to move or open new operations. While 44 percent said they would seek a downtown office, 46 percent said that they would need flexible, lower-cost office space located outside of downtown San Francisco, and 29 percent would seek manufacturing or industrial space.

As San Francisco evolves its strategy to develop cleantech, planners and economic development officials should be aware of the particular space and infrastructure needs of companies in particular technology segments and at different life cycle stages. Many startups need flexible space with short term and flexible lease structures. The City should continue to pursue its plans for the developing the Hunters Point Shipyard and nearby India Basin as a site for the agglomeration of cleantech related businesses. At this location there is adequate space for growing companies at competitive commercial rents. As it does so, the City should attempt to ensure that there is sufficient transit infrastructure in place to service this location, and that zoning is flexible enough to enable cleantech firms to remain in the city as they advance from their startup phase into production and beyond that into sales and potentially broader corporate management functions.

Governance

A city's public policies and administrative procedures can stimulate or inhibit the growth of an industry. Policies that are viewed as constraining or inhibiting the formation, expansion and attraction of enterprises include: inefficient permit processes, unclear or inappropriate taxes, and inconsistent or burdensome regulations. San Francisco has already taken a step to reduce its payroll tax for cleantech firms. However, given the challenges of appropriately defining cleantech (a designation that that could be claimed by increasingly large parts of the economy), the participating in the tax incentives is minimal and not yet an important tool for significant business attraction.

At the same time, cities can enact policies that play a critical role in helping in fostering enterprise growth by creating demand for cleantech products and services, thereby supporting the growth of local firms and good quality green jobs. In the broadest terms, local government can stimulate this demand in two ways: through direct public sector investments or through

public policy that establishes incentives, standards, and mandates. Investments include actions such as retrofits or new construction on public buildings to make them more energy efficient or to implement demand response programs and commitments to purchase cleantech products such as alternative vehicle cars. Standards, incentives and mandates include the green buildings mandates, local clean energy incentives, or zoning that supports the hybrid nature of cleantech businesses, particularly in industrial districts.

In the cleantech survey, the development of consistent city policies to stimulate demand was given the highest ranking of all proposed interventions, with 82 percent of firms stating that consistent city policies were either critically important or very important to development of their industry. More than half of all respondents rated this factor as critically important.

The mayor and Board of Supervisors have played an active role in developing environmental policy initiatives, including efforts to promote a green fleet of city vehicles and public transport, promoting the construction of energy efficient buildings and diversifying the city's energy sources. Recently, the City passed the nation's highest solar subsidy, providing up to $6,000 in rebates to households and up to $10,000 to businesses that install photovoltaic systems. This solar program is expected to lead to more solar firms relocating to the city and the creation of hundreds of green-collar jobs at living wages. For instance, one of the largest solar installers in the country, SolarCity, has pledged to open its national solar job training academy in San Francisco's Bayview neighborhood as a result of this program being in place.

Despite the current enthusiasm for solar installation, there is a risk that this segment of the solar industry may become oversaturated. Competitive market forces will ultimately determine the number of solar installation companies that can survive in San Francisco. However, the City should think realistically about how many solar installation companies it really needs to be located here, and the risks of reduced installations if the federal investment tax credit is not renewed at the end of the year. These concerns should also be taken into account when designing green jobs programs, as there is a risk of over-saturating the market for solar installers.

The City also has a long history of establishing green building policies**,** dating back to 1999, when the San Francisco adopted the Resource Efficient Building Ordinance. More recently, the City has required that all City building projects (new construction and major renovations over 5,000 square feet) achieve LEED Silver certification. The City provides fast-track permitting for LEED Gold projects, and is now considering introducing some of the most ambitious green building codes in the country, that would require all new residential high-rises over 75 feet and new commercial buildings over 5,000 square feet to comply with LEED standards. Finally, the City has announced plans to develop both Treasure Island and Hunters Point using green building approaches.

Together, these and other policies have been instrumental in setting new standards in the marketplace as well as bringing attention to the city as a green leader. Yet many of these policies are disconnected from economic development goals and have minimal impact on growing cleantech firms. By comparison, the City of San Jose has a green vision that combines ambitious environmental goals such as reducing per capita energy use by 50 percent and retrofitting 50 million square feet of buildings with a goal of creating 25,000 cleantech jobs with. Moving forward, the City should consider articulating an integrated long-term vision for cleantech development and seek to develop green policies that more systematically integrate environmental objectives with economic development goals.

6. Strengthening Cleantech Innovation and Enterprise Development

San Francisco has a competitive position in a range of cleantech segments. The city has both distinctive assets as well as weaknesses among the building blocks needed to enable continued cleantech development. Given the growth underway and the challenges facing existing and emerging cleantech segments, San Francisco should develop a strategy for strengthening cleantech innovation and enterprise growth building on these three principles:

1. **Focus on Key Cleantech Segments as Economic Engines:** The principle here is leverage—building on existing cleantech segments in San Francisco that are already strong to continue their growth. These are the economic engines among San Francisco's cleantech firms. The goal here should be to increase current concentrations and to assist these segments to deepen and broaden their value-chains, with the anticipated outcome of creating more jobs and expanded economic value. This is the heart of what industry clustering is about.
2. **Create Input Advantages:** The principle here is to identify and provide distinctive inputs needed by cleantech firms to enable their growth. This means that in order to form new enterprises, expand existing ones, and to attract new firms, San Francisco must work to continually improve the responsiveness of its economic input foundations to cleantech—in workforce, innovation, finance, infrastructure, and governance. Improving these economic inputs is not the exclusive responsibility of the City and County. Strengthening skills, finance, and innovation is strongly based on private action as well as public effort.
3. **Collaborate to Create Advantages:** Successful markets are essentially about collaboration—recognizing value and making transactions. In order to implement a vision for cleantech development, San Francisco needs to foster collaboration among cleantech firms and between the public and private sector users or buyers, to more effectively share information, align public inputs to needs of local businesses, and develop partnerships on key opportunities. Leadership in cleantech will require both public sector vision and private sector action.

Strategies to enable and sustain the development of emerging markets can use a continuum of public and private "tools" to achieve their objectives. Not every intervention needs to be a public program—actions are best when they are market driven. Each of the actions proposed below fall into one or more of the following types of public or private action. These tools are mentioned because, while solutions are often viewed as depending on public intervention, in many cases there is a range of ways to get things done:

- **Inform—Use information to foster market development**
  - **Demand**: Provide market information to identify demand and aggregate market opportunities to create scale economies that grow cleantech.
  - **Supply**: Exchange best practices and link partners in value-chain to strengthen cleantech concentration.
- **Enable—Use policy and practice to open markets**
  - **Demand**: Use standards to define new cleantech markets, to accelerate demand and shape public and private sector behavior pertaining to use of cleantech.

  - **Supply**: Reduce regulatory barriers and streamline administrative processes to permit new cleantech business activities.

- **Induce—Apply incentives to reduce marginal cost of market change**
  - **Demand**: Provide buyer-side grants, tax incentives or lower cost borrowing facilities (such as bonds secured by real estate) and public or private procurement policy to increase uptake of cleantech products.
  - **Supply**: Minimize marginal costs for new green and clean business activities via one-time grants, seed investments, R&D or equipment tax incentives to stimulate cleantech growth.
- **Sustain—Make investments or use redistribution to meet shared need**
  - **Demand**: Equitably distribute financial burden for use of cleantech through user subsidies (built into various fees and taxes).
  - **Supply**: Public investment in clean and green infrastructure, such as transit-oriented development, renewable energy and energy efficiency.

Building on these principles, the findings from the preceding analyses, and the range of tools available, the following discussion proposes seven strategic directions for enhancing and accelerating the development of cleantech in San Francisco:

1. Promote cleantech segments that leverage existing San Francisco strengths.
2. Establish a cleantech innovation center combining R&D, incubation and supporting services as a focal point for cleantech development in San Francisco.
3. Develop an eco-industrial park at a location such as Hunters Point or Pier 70 where cleantech companies can work together to demonstrate new clean technology solutions on-site.
4. Partner with key educational/research institutions in the Bay Area to strengthen the innovation pipeline to San Francisco's cleantech enterprises.
5. Create a seed fund to provide early stage capital to San Francisco cleantech companies.
6. Establish a green jobs program to deliver needed skills to cleantech firms and capture the economic benefits of cleantech growth in San Francisco.
7. Create a vision, strategy and implementation partnership for cleantech in San Francisco

Recommendation 1: Promote "Cleantech" to leverage the city's key strengths and assets, such as green building and cleantech finance.

Challenge: Cities across North America and globally are now recognizing cleantech as a priority focus for adapting to climate change and energy issues while growing jobs and are promoting themselves as centers for this form of industry growth. Despite progressive policies, San Francisco does not as yet have a clear or distinctive image as a cleantech center. Having a near-term initiative that promotes existing strengths is essential to capturing development in order to position the city for longer-term growth.

Objective: The City should develop a "cleantech market strategy" that focuses on reinforcement and promotion of those segments where it already has existing firms and competitive advantages related to key inputs and markets. This will help San Francisco quickly differentiate itself in this fast growing market. While most clean technologies will be important to meet San Francisco's environmental goals, not all of them should be focused on equally as economic development targets.

Just as Silicon Valley is becoming known as the center of excellence for solar technology development, and the Berkeley area is becoming known for biofuels research and development, San Francisco needs to establish and communicate a focus for its cleantech efforts. Several candidate industry themes on which near-term promotion and associated development can focus are outlined below:

1.1. **Promote SF as Cleantech Finance Center:** The City should take advantage of its strength as a financial center by creating a clear promotional focus on cleantech financing. San Francisco is already a leader in this segment and is home to a number of cleantech venture firms and investment banks. The full range of financial services in San Francisco available to cleantech companies needs to be identified and communicated more effectively to end-user markets to establish and reinforce this industry segment position and thereby also attract related cleantech businesses to San Francisco.

Status Today: As previously noted, cleantech venture capital investment is growing rapidly and Bay Area venture capitalists are leading the way. In addition, organizations like the Cleantech Network have offices in San Francisco, even as their focus is national in scope. Other statewide programs have their base in San Francisco, such as the California Clean Energy Fund (CalCEF). Leveraging this concentration is important to enhancing San Francisco's visibility and attraction to both other financial institutions involved in cleantech, but also cleantech companies who may want to be located close to prospective investors.

Approach: San Francisco can leverage its strong cleantech finance industry base by promoting itself nationally and internationally as a center for cleantech finance. Beyond promoting San Francisco—which is timely—the City needs to also reinforce this industry by advancing the development of the overall cleantech finance value-chain. This means fostering the visibility and cohesion of the continuum of financial services available to cleantech in San Francisco—from seed capital through venture finance and carbon trading.

One way to accomplish this objective is to more effectively network San Francisco based angel investors, venture capitalists, later stage equity firms and banks, project financing groups, merger and acquisition firms, and corporate venture programs with an interest in cleantech investments. Creating a center point for a critical mass of investment entities will help put San Francisco on the map the way that Sandhill Road in the Silicon Valley is viewed as the center for technology industry investment. While these firms in this network will not limit themselves to investment in San Francisco cleantech companies, their

geographic concentration will assist surrounding enterprise. Further, a program or service could be developed to prepare, screen and introduce San Francisco cleantech firms to such financial partners as part of the networking activities. Banks, law firms, accounting firms and others within San Francisco can help with such networking goals. In general, San Francisco has a more sophisticated financial network than other Bay Area cities, and this network should be encouraged to focus more explicitly on the supporting the local cleantech sector. The City could also consider adopting a policy for green investment within its own pension fund to match private partner placements.

A key branding feature of cleantech finance in San Francisco should be the presence of funding along the continuum of finance needs from seed through M&A. While seed stage equity investment is specifically addressed in a subsequent recommendation, access to capital for later stages of commercial develop is important as well. Late state investors are needed for project financing, debt and for specialty financing vehicles. Hedge funds are even becoming active in the carbon trading markets. Finally, acquisitions by large multi-national corporations have already become a primary method of growing cleantech. San Francisco is unique in the number of firms it has across this spectrum, and now it needs to effectively leverage these financial strengths by making certain that such corporations are aware of local acquisition opportunities.

Key Tools: Leveraging existing advantages in cleantech finance can be achieved as implied by informing markets and networking providers and those seeking cleantech finance. Achieving this objective can be accomplished by pooling public and private funds to position San Francisco in major forums on cleantech and by industry teaming with other partners to build a network that identifies, screens, and introduces cleantech deals.

1.2. Promote Green Building and Design: Another strong cleantech segment in San Francisco that can already be broadly promoted is Green Building and Design.

Status Today: The city has a strong concentration of architectural and design talent, a significant pool of accredited green building professionals, and pace-setting local policies on green buildings. The city is well positioned to establish itself as the regional hub of green building and ultimately to become one of the country's leading centers of green design.

Approach: San Francisco can strengthen and grow this segment of cleantech by documenting and linking together the city's capabilities in green building, cleantech finance, and environmental consulting to establish a distinctive specialization in the design and financing of green building retrofits. Many cities across the country are grappling with the problem of how to finance energy efficiency retrofits for existing buildings. If, San Francisco's public and private sector can work together to develop innovative solutions to this problem, this could become an important export market for the city's firms.

Key Tools: Enhancing the positioning and growth of San Francisco green building segments can be achieved through informing markets about the distinctive knowledge of firms based in San Francisco and by communicating distinctive capabilities. The growth of this segment of cleantech can be further enhanced over time by the City's expanded adoption and use of green standards for public facilities which will stimulate demand for local services as well as increase visibility of city-based providers. By providing leadership in standards demand for innovation will be fostered and lead to visible projects, further increasing demand for San Francisco firms elsewhere.

1.3. Tidal Power: A third way in which cities can differentiate themselves and create visibility for themselves as they develop their cleantech industries is to focus on renewable energy development that is linked to their local natural resource endowments. In that regard, tidal power presents an intriguing opportunity for San Francisco.

Status Today: There is no tidal energy generation in the San Francisco Bay Area today. As discussed earlier, there is still debate as to the actual potential for tidal power at the mouth of the Bay, given current costs for the relevant technology.

Approach: San Francisco should work with appropriate partners (as New York did with its East River project) to explore ways that it might leverage its proximity to the Bay and the ocean to capture a portion of the tidal power value chain. As the City does so, it will be important to remember that there is a major difference between being positioned to use such a resource for power generation and being positioned to exploit that resource to help grow a new segment of the economy—San Francisco may not necessarily become the center for tidal generator technology. Subject to further studies on the viability of tidal power, the City may wish to consider focusing economic development efforts on obtaining public and private funding for applied research and technology demonstrations focused on tidal power and projects aimed at lowering turbine production and installation costs for this area of renewable energy.

Key Tools: Clearly, bringing about a highly differentiating initiative on a theme, such as tidal power is not easily achieved. The City may inform or catalyze market action among investors by supporting studies of the feasibility and value of tidal power generation. The City could also enable future demonstration projects by, where appropriate, using its regulatory powers to facilitate on and offshore land-use development and transmission line access. Beyond these initial efforts the City may also need to consider if there are ways to accelerate action by using inducements, such as tax incentives to reduce the marginal cost of demonstration or full-projects. Finally, if there was a clear public good derived from subsidizing higher priced tidal energy, the City could agree to either provide low cost financing for capital required or underwrite some portion of the renewable energy costs purchased from a future tidal power generator. At this stage, the key focus should be on informing markets and showing City leadership on exploring then continuum of renewable energy options.

Recommendation 2: Establish a Cleantech Innovation Center as a focal point for cleantech development in the city.

Challenge: Regions that have a high rate of enterprise formation and high concentration of technology-based companies often have one or more hubs of activity around which development takes place. Unlike the East Bay or Silicon Valley, San Francisco does not have universities and associated research programs that have a leadership role in cleantech. The challenge to expanding cleantech development therefore is to capture new growth through creating a center of cleantech innovation.

Objective: San Francisco should establish a Cleantech Innovation Center, to provide a physical hub for aggregating cleantech innovation and enterprise development and to symbolize the City's commitment to growing a critical mass of target segments of cleantech

Approach: A Cleantech Innovation Center would likely have these features:

- **Overall Center Features**: This Center could house a number of related functions designed to foster enterprise formation and support growth. These functions would ideally include having a world class R&D institution focused on cleantech innovation, but at a minimum include an incubator to help support cleantech startups as well as flexible space for more established cleantech companies and graduates of the incubator. This facility would also include meeting space for cleantech events and related networking, and possibly adjacent facilities for proof of concept, pilot testing and technology demonstrations of clean technologies (see Eco-Industrial Park discussion).
- **Incubator**: The Cleantech Innovation Center should house an incubator for cleantech startups and should also be used to attract more established anchor companies focused on cleantech, much as programs in Chicago and Portland have done. Interview results consistently showed that establishing a cleantech incubator/technology center was the most popular suggestion, and it was clear that entrepreneurs would value such an addition to the city. The San Francisco Cleantech Center might also be established as an Enterprise Zone and offer tax incentives or tax credits to cleantech companies

  The Cleantech Innovation Center incubator should concentrate on a selection emerging cleantech segments and should offer business start-up services to assist in the growth of new businesses in these targeted sectors. Although the specific target segments should be finalized as part of the incubator business plan development process, examples playing to the strengths of San Francisco cleantech might include a focus on green building engineering, energy efficiency, green fleet transportation, or tidal/wave power technology. Some interview participants suggested that this hypothetical Center could become a one-stop-shop on green building retrofits where developers could go to a single place to get information and advice on energy auditing, green design/landscaping, energy efficiency strategy, and innovative financing of retrofits.
- **Technology Commercialization Services**: This proposed cleantech incubator could also assist in technology commercialization and new business development. This function would be important in establishing the Cleantech Center as a world class location for clean technology companies. The cleantech incubator could foster, promote and support private businesses engaged in the development and production of cutting-edge clean and renewable energy-related products and services. The incubator would assist with prototype and product development, market assessment, strategic planning, intellectual property protection, product testing, market access, introductions to potential customers and access to capital. In addition, an entrepreneurial community could be created with 12 to 18 startups operating in one location and networking with another. The Center could also promote and demonstrate the technologies developed and produced by the businesses located there. Providing technology demonstration opportunities offers a significant opportunity to attract emerging cleantech companies.
- **Linkage to Adjacent Space**: Over time, the businesses launched at the incubator will graduate and possibly expand into other cleantech space located nearby. The Cleantech Innovation Center should be designed to provide such additional space in the same or adjacent buildings in order to establish a critical mass of cleantech businesses in the area, much as the life sciences are focused at Mission Bay.

Key Tools: Achieving development of a Cleantech Innovation Center will require applying a continuum of public and private policy tools overtime. Initially, to make the case for this initiative and to engage a range of partners advocates will need to inform the surrounding marketplace of the need for and value of this Center—market feasibility and business planning. This process ideally would not only make the economic case for the Center, but also recruit partners who would co-sponsor and possibly co-locate R&D, incubation, technology commercialization and related testing services at the Center. Having informed the market (e.g., gotten key stakeholder ready), the City will be in a position to ensure that it has enabled development to take place. The City would do this by working with the designated sponsors and partners to obtain and approve land for development (possibly within an Enterprise Zone). To induce partners to invest or commit to operate at the site the City and its collaborators may then need to provide existing or new tax incentives for facilities, below market lending facilities, as well as seed capital grants for early stage development and the initial range of services. However, the source of grants may come from many sources—future federal block grants, state energy programs as well as private sector investment.

Recommendation 3: Develop an eco-industrial park at a location such as Hunters Point or Pier 70 where cleantech companies can work together with the City to demonstrate new clean technology solutions on-site.

Challenge: Many emerging stage cleantech companies need facilities for proof of concept, proto-type and pilot testing of innovations as well as sites for scale-up of demonstrations of individual or integrated cleantech systems. Sites offering these capabilities are not easily accessible in the San Francisco Bay area, although there are some sites that attempt to serve these needs in the East Bay.

Objective: Establish a distinctive site to support cleantech development and testing within San Francisco to accelerate enterprise development from start to scale-up of production.

Approach: The recommended eco-industrial park for cleantech would have these elements:

- **Test Facility**: To meet the critical need on the part of emerging cleantech companies for commercial demonstration sites, programs and facilities for product testing and demonstration should be established at a location such as Hunters Point. The Shipyard provides a unique opportunity to serve as a test bed for new products and services that will be developed by cleantech companies. This program can further help to attract startups to participate in the incubator or to locate elsewhere at Hunters Point or nearby.
- **Agglomerate Cleantech Activities**: Creating a physical site for cleantech agglomeration will help reduce costs for companies and also serve as a demonstration of the City's commitment to cleantech. The site should provide flexible space to accommodate firms as they evolve (i.e., increasing the proportion of office space within their building as they evolve from prototype to sales and outsource the large-scale manufacturing elsewhere.
- **Provide Technical Services for Innovation Demonstrations**: While cleantech engineering talent is available in the Bay Area, many interviewees and survey respondents indicated that they need assistance with finding opportunities to do technology demonstrations. Such a program focused on technology demonstration opportunities could attract this type of talent to San Francisco and provide the City with a leadership role. While a solar demonstration facility is under discussion in Silicon Valley and an eco-industrial park with an eco-technology demonstration program is contemplated near Seattle, neither program is yet implemented.

Key Tools: Establishing an eco-industrial park-demonstration and test site in San Francisco, like any other initiative, will require that leadership move this idea through successive stages of development. To inform stakeholders—whether the City or development partners—the proposed eco-industrial park/cleantech test bed concept needs a concept development and feasibility study. This step will make the economic and business case for the eco-industrial park idea and enable the effort to take the next step forward. Given the unusual focus of this concept—an eco-industrial park (typically a brown field site) with a concentration of cleantech companies—the City will need to consider enabling policies, such as appropriate land use designations, land assembly and service issues. Having accomplished these, to recruit or confirm development partners the City may need to offer inducements, such as tax incentives and/or bond financing to build the requisite site infrastructure. Further, by using "energy district" and "smart community"[11] concepts that foster development around key energy efficiency, shared renewable energy, transportation and related service principles, the project may be able to become a distinctive center of leadership in the fast-moving cleantech world.

Recommendation 4: Strengthen partnerships with Bay Area education and research institutions.

Challenge: San Francisco is not currently known as a center of university or national laboratory leadership in cleantech R&D or related science and engineering graduates. For this reason current and future enterprises will need to draw from broader Bay Area sources to supply innovation and workforce inputs.

Objective: Enhance the flow of innovation from university and laboratories to San Francisco cleantech enterprise through building new bridges between producers of innovation and its users.

Approach: Developing new partnerships for San Francisco cleantech firms with Bay Area education and research institutions could be developed through these steps:

- **Identify Cleantech Needs**: The first step is to better understand cleantech needs and Bay Area resources. Applied research and technology development is key to the growth of cleantech in the Bay Area. Many cleantech companies are based upon technology originally developed in universities or research labs. As pointed out earlier, it is not always necessary for these institutions to be located within a city's limits in order to reap economic benefits. The key is to develop ties and networks with the cleantech and environmental programs within the universities and labs.
- **Profile Bay Area Resources**: Knowing the specializations and structure of Bay Area institutions is a key to guiding any new organizational structure. The Bay Area has a wealth of world class cleantech-related research institutions, including Stanford's Precourt Institute for Energy Efficiency, its Global Climate and Energy Project, and it's Woods Institute for the Environment. At UC Berkeley there is the California Institute for Energy and Environment, the UC Energy Institute, UC Berkeley's College of Environmental Design, and the Berkeley Institute of the Environment. In addition, the Bay Area is a major center of federal laboratories and research institutions that have world class cleantech research and development capabilities (see below).
- **Build a Cleantech Bridge**: Building on this information, the City and its partners should develop a new organizational channel to harness the region's innovation capabilities for San

[11] ICF International White Paper: "Economic Analysis and Structure of Smart Communities: Cases and Lessons Learned", 2008.

Francisco-based cleantech enterprise. This should include developing programs to link university faculty and student interns with San Francisco cleantech companies, helping university researchers spin-out technology, and attracting recent engineering graduates and others to work in San Francisco's cleantech sector. Sponsoring seminars, technology conferences and business networks focused on cleantech will also help familiarize and attract key workers to San Francisco.

- **Broker Laboratory Partnerships**: Links to the federal, state and private research labs are also key to cleantech development. Locally-based federal and private laboratories such as the Lawrence Berkeley Lab, NASA Ames, Lawrence Livermore Lab, Sandia Lab, the Electric Power Research Institute and SRI International are all active in renewable energy and clean technology research. Each of these labs has a technology transfer office focused upon commercializing their research and finding partners. The San Francisco Cleantech Center should develop partnerships with all of them and become familiar with their tech transfer opportunities and workshops.
- **Ensure Accessibility—Co-locate at Cleantech Innovation Center**: A Cleantech Innovation Center and incubator could provide a useful location and organizational vehicle for building these linkages. The San Jose Environmental Business Cluster, the Sacramento Clean Start Incubator, and the Marina Technology Cluster all currently use university interns to bolster their clean technology incubation programs, as does the Mineta Transportation Institute and the UC Davis Transportation Institute.
- **Establish a Collaboratory**: Although San Francisco does not have its own major cleantech R&D institution, a facility for collaborative research between companies and research institutions could be established at the Cleantech Innovation Center. The objective would be to reserve space at which specific research projects on clean technology issues could be carried out between companies and research partners from universities and federal laboratories. While having the space available is important, equally if not more important is the objective of defining one or more pre-competitive R&D issues for which this Cleantech Innovation Center would help apply and raise public and private funds, anchoring R&D activities at the center with a multidisciplinary array of partners. The collaborative pre-competitive issues would have to do with specific carbon reduction or energy efficiency challenges that might best be best studied and developed at physical site with specific spatial and technical features—ideally focusing on a strategic cleantech issue facing the city or region. Over time this collaboratory could evolve into a full time R&D organization, with or without affiliation with the participating institutions and corporate sponsors.
- **Coordinate Resources**: Business plan competitions are another method to link with university resources. The City of San Francisco and the City of San Jose already partner with the California Cleantech Open, the premier Bay Area business plan competition. But, more narrowly focused business plan competitions might be held in San Francisco in the future. MIT sponsors an annual clean energy business plan competition, and UC Davis sponsors the Big Bang renewable energy business plan competition. Each of the California business plan competitions receives financial support from the California Energy Commission.

Key Tools: Creating a new bridge to Bay Area university and national laboratories to support cleantech development and operations in San Francisco can be achieved through an incremental process. To begin with, if the economic and scientific value of working with San Francisco-based cleantech companies can be effectively made to Bay Area institutions by San Francisco stakeholders along with market aggregation of cleantech needs and opportunities—existing relationships will be reinforced and new connections will naturally emerge. Universities

and laboratories are always seeking opportunities and partnerships for work that matches their research mission and needs of faculty and graduate students. These market links can be further enabled if there is some formal R&D intermediary is established. This could be the organizational "bridge" described above that creates a network to match interests. Further inducement of activity can be accomplished if seed funding for a program or new cleantech R&D institution can be obtained or a branch or special project of a national or federal laboratory can be recruited. Cities and their partners often provide sites and matching funds to attract important anchors to development sites. A cleantech "anchor" institution could be formed or attracted to San Francisco through collaborative effort.

Recommendation 5: Create a "seed fund" to provide early stage capital to local cleantech companies.

Challenge: Perhaps the most significant challenge facing cleantech enterprise growth in San Francisco is obtaining capital at the riskiest point of their development. Cities that have experienced early stage risk takers will have a higher number of start-ups and enterprises that survive into maturity. San Francisco does not have this risk-oriented capital base serving cleantech—nor does much of the Bay Area.

Objective: To ensure that San Francisco's cleantech enterprises can form and grow to the point at which they can bring innovations to the marketplace, these early stage firms need improved access to carefully managed and placed seed capital. This capital is not currently as available as it was earlier in the history of the Silicon Valley.

Approach: Addressing the challenge of creating seed capital for early stage cleantech enterprises in San Francisco would need to consider these realities:

- **Overcoming A Crucial Weakness**: San Francisco has strong sources of later stage capital for cleantech companies, but is also perceived as lacking in early stage capital. 71 percent of survey respondents felt that attracting more seed and venture funding was critical or very important to helping to grow San Francisco cleantech businesses.
- **Need to Pass Through "Valley of Death"**: Seed stage funding is nearly always the most difficult type of funding for startup companies to secure, not only those in the cleantech sectors. This early stage funding gap has also been well documented and has become known as the "Valley of Death" in the investment community. There is a value for some form of leveraged public seed stage funding of early stage cleantech startups.
- **Respond to Substantial Demand**: The need is so great that overcoming the seed capital challenges is probably the single most significant step that San Francisco could take to ensure that a Cleantech Innovation Center would attract high quality startups with a strong likelihood for success. There is even less seed funding available for non-renewable energy startups, and this may offer an opportunity for San Francisco to target a fund. For example, the Connecticut Clean Energy Fund's goal is to make Connecticut the fuel cell capital of the world.

Key Tools: Building seed capital funds can be achieved in a variety of ways. Without raising any new sources of capital a seed fund can often be created by helping markets to work more effectively—reducing risks for investors. This requires an investment of time and professional effort to identify, screen and introduce early-stage cleantech candidates to a well organized and staffed angel network of high net-worth individuals. This is how early stage technology investment often works in the Silicon Valley. If managing risk by working on both the demand and supply side of the market does not work, then the next step is to organize form risk capital in an early stage

fund. San Francisco could work to establish a cleantech seed fund, drawing on both public and private funds, to provide early stage financing to new cleantech startups here or choosing to locate in San Francisco. Such a fund can help attract early stage cleantech companies and accelerate their growth and eventual success. The seed stage funded companies can then be linked to the full range of capital markets in San Francisco to help ensure more effective financing at each stage of cleantech growth than is available elsewhere in the Bay Area.

- **Option 1—Leveraged Seed Fund**: There are many models for seed funds. One potential model for such a fund would be to be to establish a $10 to $20 million range seed fund, leveraging public and private capital with rigorous selection and screening provisions. This early stage equity fund would make placements of $100,000 to $1,000,000, depending upon the size of the fund, for new businesses focused on areas of special interest to San Francisco, such as green building or energy efficiency technology, green fleet development, or renewable energy. CalCEF's Angel Fund, which was started in April 2008, will be making $300,000-500,000 seed stage investments in cleantech startups, and perhaps a partnership with a San Francisco seed fund could be explored.
- **Option 2—Start-Up Grants**: Alternatively, a San Francisco seed fund could be developed that provides small early stage grants to companies that enter the San Francisco cleantech incubator on a competitive basis. Such grants can be effective in helping in attracting new companies to a city at the time of their formation and their need for initial office space. The grants are typically given to help purchase equipment needed by startup companies and are somewhat smaller in size than the equity investments. Grants of $50,000-$100,000 are typical in incubation programs of this type. Such a fund could also potentially be supplemented by funding from such entities as PG&E and other local established corporations and banks and by one time contributions by the City and state resources.

Recommendation 6: Establish a green jobs program to broaden the economic benefits of cleantech development.

Challenge: If San Francisco is to capture the economic opportunity arising from the cleantech "revolution", it will need a workforce skilled at all levels of the value chain. Many of the jobs that are rapidly being created in the fields of renewable energy, energy efficiency, green building, are for occupations among the skilled trades: manufacturing, construction, installation, operation and maintenance. Meeting this skill needs is a growing need that San Francisco should anticipate and act upon based on solid occupational demand forecasts.

Objective: Train San Francisco workforce for the emerging array of occupational skills required by cleantech firms and by the greening of each industry and institution. San Francisco should establish a green-collar jobs training program to help prepare more of its residents to participate in this growing green workforce and to enable them reap the economic benefits of these growing industries.

Approach: A San Francisco green jobs program should keep in mind the following principles[12] and options:

1. Workforce programs should train people for jobs that actually exist.

[12] Adapted from "Green-Collar Jobs in America's Cities: Building Pathways out of Poverty and Careers in the Clean Energy Economy," Apollo Alliance and Green for All, 2008.

2. They should target low-income residents who have been excluded from past workforce and economic development initiatives.
3. Green-collar initiatives should be developed in concert with other workforce and economic development strategies, rather than as standalone efforts. They should be linked to broader policies, programs and investments aimed at growing the green economy and combating climate change.
4. Training programs should provide entry points and support services for a broad range of workers, including: those who have been laid off; underemployed workers; unemployed men and women; and disconnected young people seeking an entry point into the mainstream economy.

- **Program Options:** The Apollo Alliance and Green for All are leaders in the emerging green-collar jobs movement. They have articulated two main types of programs that are both needed to develop a green workforce. The first is green-collar job training partnerships that match industry demand with workforce training. The second is Green Jobs Corps programs, such as that pioneered in Oakland, whose focus is on providing pathways out of poverty for low-income job seekers.
- **Coordinate City Initiatives:** San Francisco has a number of good ongoing initiatives, but there needs to be better planning, coordination and integration of these activities. The City should link its progressive policies more explicitly to job creation goals, this should begin with identification of projected job and occupational growth trends and demand for skilled labor, and it should actively build green-collar job training partnerships with industry, unions, community-based organizations, and local educational and workforce training institutions.
- **Cleantech Center for Training:** The proposed Cleantech Innovation Center could also serve as a useful facility for green-collar job training. The Center could be designed to incorporate space for technical training related to cleantech manufacturing, assembly, installation and maintenance; as well as an employment center for recently trained clean technology workers and for intern placement. This could be carried out in conjunction with San Francisco's workforce councils and community colleges.

Key Tools: Matching workforce skills to emerging needs does not necessarily require major new investments. What is required is to obtain accurate estimates of changing or growing demands for key occupations and their job paths. This can often be accomplished by linking prospective employers in cleantech segments or mainstream employers who are greening their value-chain with community colleges and vocational training providers. Both sides need to be assisted to identify changing demands and training pipeline realities (what number of graduates by category by when). When the supply-side training organizations are not able to respond, this is the signal for either a change in rules that structure how training is delivered—perhaps providing special preparation for disadvantaged workers, adopting new coop and apprenticeship policies or permitting industry professionals to participate in designing training—or, in some cases, finding matching grants funds that can be used to design and deliver curriculum through new channels both for preparation as well as retraining. The key point here is that by bringing employers and the workforce providers together the training marketplace can be helped to adapt more rapidly and cost effectively to training needs.

Recommendation 7: Develop a collaborative cleantech vision, strategy and implementation mechanism—a San Francisco Cleantech Partnership.

Challenge: San Francisco's cleantech segments have no formal vision or strategy for industry development nor does it have an organizational vehicle to assist in convening stakeholders or to support the implementation of actions arising from a collaborative strategy process. Without a vision, strategy and implementation mechanism cleantech development will remain ad hoc and while opportunistic, key windows for achieving a critical mass of growth may be missed, while competing cities move ahead.

Objective: San Francisco needs a structured vision, strategy and implementation mechanism to carry out cleantech initiatives. There are natural building blocks in the strategy development process. But maintaining continuity of action from start through implementation is essential. Regardless of everything stated in the preceding recommendations, strategies, policies and programs by themselves won't lead to accelerated formation of cleantech and its adoption in San Francisco—a structured strategy process and a formal intermediary to take actions forward with private and public sector partners is very likely essential—a Cleantech Partnership.

Approach: San Francisco has all the necessary elements needed to develop the dynamic segments within cleantech. The City has progressive climate and green policies, access to a skilled workforce, a community of venture capitalists and investment bankers well versed with cleantech firms, a number of near-by world-class research universities and government research labs, and a strong tradition of technology innovation and entrepreneurship.

However, there is still a need for an integrated vision and strategy to bring together supply and demand forces to grow cleantech. To help effectively weave these elements together, the City and its cleantech stakeholders should undertake a collaborative effort to craft a vision, strategy and implement actions that will accelerate cleantech development as well as the adoption of cleantech across all sectors of the San Francisco economy and public institutions. The clock is ticking. Jurisdictions across the San Francisco Bay Area have already established their own coordinated cleantech plans, including the Silicon Valley Leadership Group's "Clean and Green Energy Action Plan" and the City of San Jose's "Green Vision" and its statement of fifteen-year goals which include cleantech enterprise development—not simply climate or energy objectives.

San Francisco needs to shape its own cleantech strategy and establish its own implementation mechanism. To do this, San Francisco should base its vision and strategy on a bottom-up, stakeholder-driven, collaborative cleantech process—not a top down, high-level set of aspirations that do not have buy-in or commitment from those most affected or more influential.

A collaborative vision and strategy can specify the shared cleantech challenges facing major industries as well as institutions in San Francisco and based on those shared needs can establish agreements on how to achieve the double bottom-line goals of maintaining user economic vitality while enhancing carbon reduction and energy efficiency—both pulling along and supporting cleantech as a core driver or enabler of change.

An important feature of this approach is that the City of San Francisco should be an active participant as an important "user" whose policies dramatically shape demand. 82 percent of participants in this cleantech study stated that stimulating demand through local purchasing programs was either critical or very important to growth of cleantech in San Francisco. And there is no doubt that cleantech will be substantially shaped by evolving City standards and

procurement policies. As a partner in the cleantech strategy process or simply informed by its results the City can be important to the future of cleantech in these ways:

- **City as Customer**: The City can serve as important early customer for cleantech companies. Cities can use purchasing and performance policies to favor cleantech products and solutions. Such measures allow the City to simultaneously pursue environmental and economic development objectives.
- **City Standards**: The City can also spur demand for cleantech products directly through its own standards and procurement process as well as by continuing to adopt policies and goals that encourage corporations and consumers to purchase cleantech products. California's renewable portfolio standard requiring utilities to use 20 percent renewable energy for power by 2010 is an example that is clearly driving utility purchases. The City's Climate Action Plan identifies areas where standards and procurement may be used to foster carbon reduction and energy efficiency that will stimulate cleantech development.
- **Align City Goals**: City policies focusing on climate action and related areas, such as green building, currently do not specifically address the objective of fostering the development of cleantech in San Francisco and how to foster or capture this economic value. The City may wish to consider this issue as an addendum to its long-term goals or targets for climate action and related energy efficiency objectives. Further, confirming commitment to implementing the set of City cleantech objectives would provide important signals to the cleantech business community and affiliated institutions.

San Francisco needs both a strategy process and partnership that can undertake the following collaborative steps to define and implement actions to grow cleantech:

- **Define priority cleantech segment needs and actions:** San Francisco leaders can convene a range of cleantech segments and their supplier to identify their development challenges and opportunities for growth. This process would assess their needs for improved advantages in inputs from innovation to finance to workforce, infrastructure and governance. These cleantech stakeholders and their providers would be helped to jointly negotiate agreements on how to create better advantages in their economic inputs to enable better formation, retention and expansion, and attraction of cleantech enterprise. The output of this process would be mutual agreements between firms, suppliers and institutions on who does what with commitments to implement specific initiatives—including possibly the recommendations that already emerged from this cleantech initiative.
- **Accelerate cleantech adoption by San Francisco industry and government users:** To aid in the uptake of cleantech solutions by the San Francisco economy collaborative work sessions should also be convened for each San Francisco industry, as well as for each set of public and non-governmental institutions (schools, transportation, water, waste, administration). The purpose would be to define these users' cleantech challenges and what they require to adopt cleantech products and services. This approach could, for example, be viewed as a natural next step for assisting implementation of the City Climate Action Plan, and, help set the stage for community choice aggregation opportunities for clean energy enabled under AB 117.

  This collaborative process would have the spectrum of cleantech providers listening to and working with representatives of large firms from each key sector of the economy, such as financial services, hospitality (hotels and restaurants), medical facilities, retailers, and utilities, as well as public institutions, such as schools, universities, transportation, the port, waste, hospitals, and government administration. These groups would be presented with their carbon and energy footprints and then identify the carbon and energy challenges on which they were

willing to work with others. Building on this, each group would then define approaches for facilitating the adoption cleantech solutions and accelerating the adaptation of the economy to energy prices and carbon management realities. In this manner, a specific industry, such as hospitality-tourism, might define a set of cleantech initiatives on which they would work together with multiple-providers. Similar, institutions, such as school districts, might define cleantech priorities on which they would work together with cleantech providers. This user "silo" approach is missing from most climate change and energy efficiency strategy process and could assist markets in better communicating cleantech demand and supply opportunities.

- **Define crosscutting cleantech initiatives:** Building from the commonalities across each industry and/or each institution's needs and their readiness to adopt cleantech, a set of city-wide cleantech adoption initiatives can then be crafted. These might involve any of the cleantech theme areas and could involve creation of broad programs for scaling-up purchase and use of cleantech—from large scale introduction of renewable energy to wholesale adoption of energy efficiency innovations (as proposed in the Climate Action Plan, for example). These might be carried out with new cross-cutting initiatives added over time.
- **Shape a San Francisco cleantech vision and strategy:** The set of cleantech user initiatives (supply side), industry and institution initiatives (demand side) and cross-cutting initiatives would provide a clear set of strategic opportunities, directions and implementation requirements. These building blocks would constitute the elements of a public-private vision and strategy for Cleantech in San Francisco.
- **Build Commitment to a Cleantech Partnership:** Once a cleantech vision and strategy for San Francisco is articulated—with its key components—it can be endorsed, published broadly and used consistently to guide implementation. Equally important, public and private participants can then agree on, form and work together through, a new "Cleantech Partnership" to represent the City's cleantech vision and carry out its implementation in a unified manner and track progress.

  While there is no current group anchoring these types of activities, perhaps the Cleantech Advisory Council can be reconvened to help guide the crafting of an overall City cleantech strategy. The mayor could continue to use political visibility and dedication to environmentalism to communicate a vision for the city. This new partnership could be overseen by a cleantech "stewardship group" comprising leaders from across the city, including an array of private sector organizations concerned with cleantech, such as PG&E, the Chamber of Commerce, as well as the CPUC, and associated public policy organizations.

  At the core the strategy and guiding the partnership activities would be a set of compacts focusing on accelerated development and adoption of cleantech innovations in San Francisco. This convergence of market supply and demand would enable San Francisco to foster cleantech growth that will generate new exporting industries, growing jobs and improving San Francisco's energy and environmental performance.

In sum, San Francisco stands to gain significantly from developing a strong local presence of cleantech firms. These firms can simultaneously aid the city in addressing its energy and environmental challenges, help other local industries to green their operations and increase their competitiveness, and create new economic dynamism and good quality jobs for its citizens. Enabling San Francisco's economy to capture the benefits of cleantech growth an its environment to maximize the benefits of cleantech adoption will require addressing near-term cleantech needs and building a longer-term term cleantech strategy.

Appendix A. Description of Cleantech Segments

Air, Water, and Environment: Firms that focus on resource conservation, pollution and emissions control, and environmental remediation. Additionally, firms providing products or services for water conservation, water treatment, and wastewater treatment in residential, commercial, or industrial operations. Examples include services, instruments, and equipment related to emission control, treatment, or reduction technologies, including carbon sequestration, and methods for the detection and treatment of pollutants and toxins.

Energy and Environmental Consulting Services: Firms that assist other companies and institutions in improving their energy use or environmental performance. Examples include services such as the determination of a firm's carbon footprint, monitoring and improvement of a firm's energy use, and sustainability strategy consulting.

Energy Efficiency: Firms whose products and services are intended to reduce energy use in lighting, appliances, building operations, and manufacturing and industrial processes. Examples include advanced performance refrigerators, air-conditioners, and other appliances, in addition to tools for reporting real-time energy use, advanced light sources and controls, and high-efficiency motors, pumps, burners and boilers and industrial process systems.

Renewable Energy Generation: Firms that produce materials and components used in the generation of renewable energy, in addition to firms that are actually generating energy from solar, wind, hydro, tidal, geothermal, and other renewable sources.

Energy Infrastructure and Storage: Firms involved in the management and improvement of the power grid and other forms of power transmission as well as firms that produce advanced batteries, fuel cells, hybrid systems, and components for these technologies. Also included are firms developing other technologies related to the storage of energy.

Cleantech Finance/Investment: Venture capital firms, private equity funds, angel investors, and other firms that provide targeted capital for the development of cleantech businesses.

Green Building and Design: Architecture and design firms that focus on the construction of sustainable and energy efficient buildings, plus firms involved in the production of reduced-waste and high-performance building materials.

Materials: Firms that develop or produce chemical, nano-, or bio-materials used in cleantech. Firms that develop or produce advanced materials that provide efficiency improvements over traditional materials are also included.

Recycling and Waste: Firms that recycle or treat waste. Examples include traditional recycling operations as well as firms that reclaim, refurbish or redistribute products and materials that would otherwise be thrown away.

Carbon Offsets and Emissions Trading: Companies that sell renewable energy credits and carbon emissions offsets, along with firms that assist other firms in the purchase of these products.

Clean Transportation: Firms that provide products, services, or technologies for cleaner transportation or improved transportation energy efficiency. This includes firms involved with vehicles, logistics, and fuels, as well as other activities related to transportation.

Appendix B. Methodology Notes

Compiling the Cleantech Database

The cleantech analysis is based on a database of 428 firms across the Bay Area region that was compiled for this study. The database was generated through a combination of methods, including compiling existing public and private listings and databases of cleantech firms and organizations, business search through green business associations and government listings, data mining of Dun & Bradstreet data, and identifying important cleantech firms through interviews with local cleantech experts.

While an early version of the database included more than 800 firms broadly related to cleantech, the database was revised to eliminate those firms that only had a small proportion of their business activities in the cleantech sphere. The resulting database of 428 firms is thus not inclusive of all firms working in cleantech or related industries (as that would encompass too broad a portion of the economy) but, rather, those firms in the Bay Area whose primary focus or exclusive focus relates to one of the main cleantech segments.

Survey Demographics

The cleantech survey was sent to the entire database of Bay Area cleantech-related organizations. This included clean technology companies, large firms with a significant concentration of activity in cleantech, national labs, relevant University departments/centers, key local government agencies, and relevant non-profit organizations and trade associations. There were 154 respondents.

Note that the 154 survey respondents are not necessarily from the same firms as the 428 firms which were analyzed above. Some of the survey respondents work for firms that are not 100 percent focused on cleantech activities while several were thought leaders in the field.

A breakdown of respondent characteristics is below.

What type of organization do you represent?	Response Percent
For-profit company	74.0%
Non-profit organization	16.2%
Local, State or Federal Government	7.1%
University or Educational Institution	1.3%
National Laboratory	1.3%

Of those respondents identifying themselves as being in the private sector, they identified themselves as being primarily involved in the following cleantech segments:

What is your primary segment of focus?	Response Percent
Clean Energy (e.g., Renewable Energy, Energy Storage, Energy Infrastructure)	40%
Business and Professional Services (e.g., Legal, Finance, Carbon Markets, Consulting, Marketing, etc.)	28%
Energy Efficiency & Demand Side Management	13%
Clean Transportation & Fuels (e.g., Vehicles, Clean Fuels, Logistics)	6%
Materials, Industrial Components and Green Chemistry	5%
Green Building (e.g., Green Architecture or Construction)	5%
Air, Water, Waste & Environmental Remediation	4%

Survey Responses

When asked about their primary business activities, private sector respondents gave the following answers:

Which of the following best describes your firm's activities within the cleantech industry?	Response Percent
Legal, consulting and professional business services	28%
R&D (e.g., basic science; technology development and demonstration)	18%
Manufacturing / Production / Assembly	17%
Finance / Investment	13%
Cleantech Installation / Maintenance / Service Provider	10%
Sales / Marketing	6%
Information technology	5%
Distribution / Logistics	2%

In what year did your firm or organization begin working on cleantech issues?	Response Percent
1990 or earlier	10.7%
1991	2.0%
1992	0.7%
1993	0.7%
1994	2.0%
1995	2.0%
1996	2.0%
1997	7.4%
1998	0.7%
1999	3.4%
2000	2.7%
2001	7.4%
2002	4.0%
2003	7.4%
2004	10.1%
2005	15.4%
2006	12.8%
2007	8.7%

How many employees—including yourself—does your firm employ? (Include part-time employees)	Response Percent
1	7.7%
2-5	29.8%
6-10	7.7%
11-19	12.5%
20-49	14.4%
50-99	4.8%
100-249	9.6%
250-499	2.9%
500-999	0.0%
1,000-4,999	3.8%
5,000 or more	6.7%

How many employees in your firm work specifically on cleantech issues? (Include relevant part-time employees and support staff).	Response Percent
1	10.7%
2-5	33.0%
6-10	15.5%
11-19	10.7%
20-49	9.7%
50-99	1.9%
100-249	8.7%
250-499	2.9%
500-999	1.9%
1,000-2,999	1.9%
3,000 or more	2.9%

Do you currently have a cleantech or environmental product or service on the market?	Response Percent
Yes	64.8%
No	35.2%

How long has your firm been selling cleantech products or services?	Response Percent
Less than a year	21.9%
1-2 years	18.8%
3-5 years	25.0%
More than 5 years	34.4%

Approximately what was your firm's 2006 revenue from sales of cleantech products or services?	Response Percent
$0–$999	20.0%
$1,000–$9,999	4.0%
$10,000–$49,999	4.0%
$50,000–$99,999	6.0%
$100,000–$499,999	18.0%
$500,000–$999,999	4.0%
$1,000,000–$9,999,999	16.0%
$10,000,000–$49,999,999	14.0%
$50,000,000–$99,999,999	4.0%
$100,000,000 or more	10.0%

Approximately what percentage of your firm's total cleantech sales come from the following markets?	Response Average
Bay Area	49.1%
California (outside the Bay Area)	28.9%
U.S. (outside of CA)	43.4%
Canada/Mexico	3.1%
Asia	10.5%
Europe	22.4%
Other International	5.0%

Appendix B. Methodology Notes

Which of the following factors are most important in determining where your company/organization locates its offices/facilities?	Extremely Important	Somewhat Important	Not Important At All
Availability of skilled workforce	66	21	8
Proximity to public transit	31	35	19
Key executives live nearby	43	33	15
Availability of parking	9	36	35
Cost of commercial space	45	42	8
Access to cultural or urban amenities	7	41	33
Proximity to innovation centers, universities, R&D, etc.	38	36	20
Proximity to sources of financing	28	29	31
Proximity to customers	46	28	20
Proximity to key suppliers	14	27	44
Proximity to transport / shipping lines	14	21	46
Access to government incentives/support (e.g., tax breaks, subsidies, or economic development assistance)	33	30	27
Responsive local government and/or efficient permitting	34	26	28
Access to business development services (e.g., law firms)	22	32	28

How does San Francisco rate as a location to establish or operate a cleantech firm? (Please respond regardless of where you are located.)	Very Favorable	Favorable	Neither Favorable Nor Unfavorable	Unfavorable	Very Unfavorable
Availability of skilled workforce	46	44	12	4	0
Proximity to public transit	36	43	18	5	1
Availability of parking	3	3	36	38	22
Cost of commercial space	4	3	27	49	17
Access to cultural or urban amenities	45	37	17	0	0
Proximity to innovation centers, universities, R&D, etc.	43	40	18	4	0
Proximity to sources of financing	46	34	18	5	0
Proximity to customers	29	34	32	5	0
Proximity to key suppliers	13	18	51	16	1
Proximity to transport / shipping lines	20	34	40	3	0
Access to government incentives/support (e.g., tax breaks, subsidies, or economic development assistance)	19	32	43	7	2
Responsive local government and/or efficient permitting	14	23	42	18	4
Access to business development services (e.g., law firms)	29	41	22	7	1

Appendix B. Methodology Notes

How important would the following actions be in supporting the growth of the cleantech cluster in San Francisco?	Critically important	Very important	Somewhat important	Not important
Strengthening workforce development or training programs	31	31	30	7
Improving local public transit to job centers	22	37	31	9
Establishing more aggressive local climate targets	25	41	29	7
Establishing more aggressive local green building codes	29	36	30	7
Creation of an industry association to support the growth of the cleantech cluster	31	36	26	9
General improvement of urban amenities	10	19	50	20
Establishing an R&D consortium	15	24	44	17
Establishing a cleantech business park	19	36	36	12
Providing start-up assistance through commercialization centers or business accelerators	34	32	27	8
Attracting more venture capital and seed investment	42	31	22	8
Stimulating demand through local purchasing programs (public or private/utility)	41	42	14	4
Targeted reductions/exemptions in local taxes (e.g., expansion of the payroll tax exemption)	41	39	17	4
Increasing the outreach of economic development efforts	25	33	34	8
Consistent development of city policies designed to stimulate cleantech industry growth	54	31	14	4
Cleantech industry-government partnerships	42	36	20	5

From your perspective, which of the following would be the most attractive location for a cleantech business park?	Most Attractive	Somewhat Attractive	Less Attractive	Least Attractive
Hunter's Point Shipyard (San Francisco)	23	30	27	15
Pier 70 (San Francisco)	19	42	21	8
The Presidio (San Francisco)	36	28	21	9
Brisbane / South San Francisco	10	36	31	12
South Bay / Silicon Valley	46	16	20	18
Oakland / Emeryville / Berkeley	23	39	19	14

If your firm or organization was to consider moving or opening a new facility, what types of space would it seek?	Response Percent
Downtown office	40.5%
Suburban office	18.0%
Flexible, lower-cost office space (not downtown)	45.9%
Retail space	0.9%
Manufacturing / Industrial	26.1%
Warehouse	16.2%
Research Lab	17.1%
Undeveloped land	3.6%