Cleantech: A New Engine of Economic Growth for New York State

January 2007
The New York City Investment Fund is the investment and economic development arm of the Partnership for New York City. The Investment Fund is the vision of Henry R. Kravis, founding partner of Kohlberg, Kravis, Roberts & Co., who serves as its Co-Chairman, along with Russell L. Carson, General Partner of Welsh, Carson, Anderson & Stowe. The Investment Fund has raised over $100 million to mobilize the city’s world financial and business leaders to help build a stronger and more diversified local economy. To that end, the Investment Fund has built a network of top experts from the investment and corporate communities who help identify and support New York City’s most promising entrepreneurs in both the for-profit and not-for-profit sectors.

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A. Executive Summary

Cleantech is an emerging sector of businesses that contribute to a cleaner, more energy efficient environment. Cleantech companies produce goods and services that promote conservation of natural resources and provide cost savings to the end user. The cleantech industry\textsuperscript{1} could offer a new source of jobs and economic growth for New York by leveraging the complementary assets of the Upstate and New York City Metro Area economies.

The Upstate region has an underutilized manufacturing base (both in expertise and sites), raw materials and research talent that are all necessary to the cleantech industry. The New York City Metro Area has investment capital, a large market for cleantech products, and the propensity to be an early adopter of new technologies that conserve natural and financial resources. Collectively, the Upstate and Downstate assets are very relevant to an industry that is heavily focused on developing and funding new technologies to increase domestic production of power and to maximize the reuse of local resources, including waste and water.

With global revenues in 2005 estimated at $150 billion, the cleantech industry is large and continues to expand. The industry has attracted substantial dollars from venture firms ($1.6 billion in 2005), as well as significant interest from the corporate sector. Leading corporations are increasingly launching cleantech business units or incorporating cleantech products and services into their business operations. Cleantech companies, in particular those focused on alternative energy, are expected to be a significant source of future job growth, creating diverse opportunities in technology, manufacturing, and professional services.

Investment in New York-based cleantech companies has not kept pace with the nationwide growth of investment activity in this sector. Most cleantech investment is going to America’s traditional centers of entrepreneurial tech-sector activity, namely California and Massachusetts. If this does not change, New York risks repeating its experience with the information technology and biotechnology industries, where companies came to New York to raise money and sell their products, but created most of their jobs and paid most of their taxes in other states.

New York is a leader with respect to “green” policies and incentives that support energy efficiency and a cleaner environment. However, the majority of these programs are focused on the adoption of cleantech technologies by local residents, businesses and government rather than on encouraging the creation of new companies or projects in the state. While the focus on deployment and consumption of clean technologies

\textsuperscript{1} Major segments of the industry include Alternative Energy & Power, Materials & Green Building, Transportation & Logistics, and Air & Water Technologies.
benefits New York by creating a cleaner environment and lowering certain operating costs, it does little to encourage growth in employment and tax revenue.

This report articulates the assets of both the Upstate and New York City Metro areas that can contribute to building this industry within the state, as well as the existing New York government programs focused on the cleantech industry. The report also recommends several actions for local government to encourage more entrepreneurial activity in the cleantech sector within the state. The recommendations include:

- Create a targeted effort to market the state’s cleantech-related assets to investors, entrepreneurs and corporations focused on this industry;
- Commit $150 million of New York State pension fund monies to investment managers that will invest in cleantech companies and projects located within New York;
- Establish other producer-related incentives, such as procurement from in-state companies, beta testing programs, and reorientation of NYSERDA to focus on local production;
- Leverage the opportunities presented by the Regional Greenhouse Gas Initiative to create jobs in the financial services sector and with related offset projects, such as landfill gas capture, forestation of non-forested lands, or projects that increase the efficiency of energy systems; and,
- Identify legislative and regulatory actions that could support the growth of the industry within the state, such as expanded net metering and targeted procurement.

With the combined assets of the Upstate and Downstate regions, New York can develop a leadership position in the cleantech industry, provided it can move quickly to attract investment capital to fund companies and projects that locate operations in the state. Although public policy is only one of several things that influences where a company is established, New York’s policies and incentives could more fully leverage the state’s assets to help build a vibrant local cleantech industry. Instead, the consumer orientation of New York’s public policy reflects the fact that environmental concerns have driven the agenda, rather than economic development.

New York City has taken an important step in addressing this issue. In October 2006, Mayor Bloomberg established the Office of Long Term Planning and Sustainability, which has a strong focus on economic development and job creation in connection with green and clean initiatives undertaken by City government. A similar shift in policy and incentives at the State level would send an important signal to the investment and corporate sectors that New York is serious about developing a vibrant cleantech industry.
B. Cleantech Industry Overview

The “cleantech”\textsuperscript{2} or clean technology industry produces goods and services that optimize the use of natural resources, while reducing ecological impact and adding economic value by significantly lowering cost. As compared to conventional competitors, a cleantech company would use energy, water and other raw materials more efficiently and productively; create less waste and toxic by-products; deliver equal or superior performance; and, improve profitability through cost reduction and increased revenues.\textsuperscript{3} While companies have been active in the environmental technology area for decades, the focus on the cleantech industry is fairly recent and is in response to several major developments in the world economy and geopolitical system. These include increased oil prices, issues of oil security and supply, and growing awareness and acceptance of climate change as a threat—especially to coastal areas and cities located on major waterways—as well as recognition that waste reduction is not just the “right” thing to do, but can result in real cost savings.

While the term cleantech refers to a wide variety of technologies, these technologies can be grouped into four major sectors:

<table>
<thead>
<tr>
<th>Alternative Energy &amp; Power</th>
<th>Materials &amp; Green Building</th>
<th>Transportation &amp; Logistics</th>
<th>Air &amp; Water Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Distributed and renewable energy generation (e.g. fuel cells, geothermal, wind, solar, biofuels, wave/tidal)</td>
<td>• Materials recovery and recycling</td>
<td>• Alternative-fueled vehicles (e.g. hybrid vehicles)</td>
<td>• Water purification (e.g. water recycling, ultrafiltration systems and desalination equipment)</td>
</tr>
<tr>
<td>• Energy storage and power quality</td>
<td>• Advanced and bio-based materials</td>
<td>• Logistics (e.g. logistics software)</td>
<td>• Water management (e.g. meters, sensors and automation systems)</td>
</tr>
<tr>
<td>• Energy infrastructure and management systems (including related Internet and IT-based services)</td>
<td>• Nanotechnology (i.e. precision manufacturing instruments)</td>
<td>• Green buildings and sustainable design</td>
<td>• Air quality (e.g. air testing equipment and services, emission scrubbers)</td>
</tr>
<tr>
<td>• Energy efficiency and transmission</td>
<td>• Green buildings and sustainable design</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Global revenues of the cleantech industry were estimated at $150 billion in 2005, with one of the largest segments being Alternative Energy & Power at approximately $40 billion. Since 2002, revenues in the solar market have grown at 47% on an annual compounded basis, in the fuel cell market at 34% and in the wind power market at 29%. Going forward, the Alternative Energy & Power segment is expected to increase to $167 billion in global revenues by 2015, which implies an annual compound growth rate of 15%.

Projected 10-Year Growth for the Alternative Energy & Power Sector

![Graph showing projected growth from 2005 to 2015 for various segments of the cleantech industry](image)

Other cleantech markets that are particularly relevant to New York are:

- Green building products and services, which had $7 billion of U.S. revenues in 2005, is expected to grow to between $10 billion and $20 billion by 2010.
- Energy management and efficiency technologies, which had estimated worldwide revenues of between $2 billion and $5 billion in 2004.

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4 Cleantech Venture Network, Cleantech Venture Investment: Patterns & Performance, March 2005
Impact on Labor Force

As it grows, the cleantech industry has the potential to create a wide range of high-wage and high-skilled jobs in research and development, design and manufacturing, and operations and maintenance. There are also the service industry jobs that support these positions (e.g. lawyers, accountants, bankers, and environmental consultants).

In a 2004 study by the University of California at Berkeley, researchers 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.”8 The study estimated that transitioning 20% of U.S. electricity generation from carbon-generated electricity to renewable sources by 2020 would result in the creation of 101,000 to 157,000 additional jobs in the U.S.

Capturing some of the manufacturing and installation of wind turbines and solar photovoltaics (PVs) would give New York the opportunity to recapture some of the manufacturing jobs lost in the last decade.9 A study conducted by the Renewable Energy Policy Project (REPP) found that if New York met its Renewable Portfolio Standard (RPS) goal of having 25 percent of all electricity purchased from renewable sources by 2013, approximately 15,880 new jobs would be created in the renewable energy sector.10 With respect to wind power, another REPP study concluded that the 20 states that would likely benefit the most from increased investment in wind projects were the same 20 states that have lost the most manufacturing jobs in the U.S since 2000.11 In New York, the REPP wind study estimates that approximately 6,500 jobs could be created from wind power alone.

The New York Office of the State Comptroller estimates that total job growth from renewable energy, including direct jobs, indirect jobs, jobs created in related industries, and job creation from increased household spending, would result in about 43,000 additional new jobs statewide by 2013.12 In addition, the Comptroller’s report cites other benefits for rural economies, such as additional income for farmers, energy crops that are easier to grow and improve soil quality, and biomass energy which can eliminate the cost of manure disposal.

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9 Algoso, Dave & Rusch, Emily, "Renewables Work: Job Growth for Renewable Energy Development in the Mid-Atlantic," New Jersey Public Interest Research Group, Spring 2004
Conclusion: The cleantech market is a large potential source of new jobs and offers attractive growth prospects for at least the next decade. The alternative energy segment in particular will also be a significant source of diverse types of jobs—from technology to manufacturing to professional services.
C. Investment Activity in Cleantech

The cleantech industry is receiving increasing attention from the investment and corporate communities. Mainline venture firms have started to make investments, and new venture funds have been established to focus exclusively on the sector. There has also been significant activity from corporations, which are increasingly investing in or acquiring cleantech companies, launching or expanding business units focused on cleantech technologies or services, or incorporating cleantech products and services in their own business operations. In addition, as the industry and interest from the investment community have grown, a number of new equity indices have been created to track the performance of publicly traded cleantech companies.

Venture Capital Investment

Since 2002, both the number of deals and the amount of venture capital dollars invested in the cleantech industry have been on an upward trend. In 2005, over $1.6 billion was invested across 246 venture cleantech deals in North America. Investment levels in the first nine months of 2006 significantly exceed that level.

As of the end of 2005, the cleantech sector represented the fifth largest category of venture capital investment in North America, surpassing the semiconductor industry and almost equaling the telecom industry.13

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In the first nine months of 2006, cleantech was the third largest investment category, behind software and biotech.

Of all dollars invested in cleantech, the Alternative Energy & Power sector has been the largest recipient of venture investment, receiving over 60% of venture dollars invested since 2002.
Companies located in California and Massachusetts received the majority of venture capital dollars invested in cleantech between 1999 and 2005. New York State was in fourth place, after Texas, and significantly trails California and Massachusetts.\textsuperscript{14}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{chart.png}
\caption{Top Ten States for Cleantech Venture Capital Investment, 1999-2005}
\end{figure}

As shown below, venture investment in cleantech companies within New York State has actually declined over the past several years, both in dollars invested and number of deals. In addition, whereas the manufacturing/industrial and materials recovery/recycling sectors together accounted for about 10\% of venture investment nationwide since 2002, in New York these sectors accounted for over 60\%. Therefore, New York does not appear to be attracting investment dollars in one of the more attractive sectors of this industry, Alternative Energy & Power, which is expected to generate a significant number of jobs.

\textsuperscript{14} Appendix C-1 provides information on all fifty states.
The source of the venture dollars going into cleantech companies is changing as well. Traditionally, this industry relied heavily on individuals or socially responsible funds for investment capital. In the past several years, though, a number of high profile venture funds have announced their intention or begun to invest in the cleantech space, such as:

- 3i
- Battery Ventures
- Kleiner, Perkins, Caufield & Byer
- Rho Capital Partners
- Sequoia Capital
- VantagePoint Partners
- Venrock Associates
- Warburg Pincus

However, of the 18 investments publicly announced by these funds, none are in New York State and 10 are in either California or Massachusetts.

There have also been a number of new funds that have successfully raised capital, many within the last two years, to focus more or less exclusively on cleantech investments. Of these, only five have offices in New York while ten have offices in California and/or Massachusetts. (Appendix C-2 has additional information on these funds.)
Fund | Amount Raised / Year
--- | ---
Abu Dhabi Future Energy Company | $250 mm / 2006
Braemar Energy Ventures | $60 mm / 2002; currently raising new $200 mm fund
Carlyle/Riverstone Renewable Energy Infrastructure Fund | $685 mm / 2006
Climate Change Capital | $830 mm / 2006
DFJ Element | $284 mm / 2006
EnerTech | $223 mm / 2000
Expansion Capital | $55 mm / 2006
Global Environment Fund | $800 mm / 1990
Inverness Capital | $125 mm / 2003
New Energy Capital | $30 mm / 2005
NGEN Partners | $180 mm / 2006
Nth Power | $200 mm / 2006
Rockport Capital Partners | $261 mm / 2006
Sail Venture Partners | Currently raising $150 mm fund
US Renewables Group | $80 mm / 2005; currently raising new $170 mm fund

**Pension Funds**

Several of the larger U.S. pension funds have started to allocate investment dollars to the cleantech industry. Their rationale for doing so includes high energy prices, energy security and climate risk (particularly as it pertains to real estate assets in coastal areas). Cleantech investments are seen as a way to generate investment returns, but also as a hedge against the potential devaluation of certain assets currently held by pension funds. Key pension fund activity in the cleantech area includes:

**California:** California pension funds have made the largest commitment to date:
- The CalPERS (California Public Employees’ Retirement System) board has $500 million invested in environmentally screened stock portfolios in the U.S. and overseas;
- CalPERS has targeted $200 million towards private equity stakes in environmental technology ventures, such as energy-efficient materials, PV and other renewable energy technologies; and,
- CalSTRS (California Teachers Retirement System) has made $188 million of clean sector investments, including about $150 million in renewable energy projects in Europe and the U.S.

**Pennsylvania:** In September 2006, the state treasurer announced a new Keystone Green Investment Strategy in which Pennsylvania will:
- Reallocate up to $50 million in Treasury assets to investment managers with a demonstrated track record of investing in clean technology stocks;
• Create a new $40 million investment fund to invest alongside the private sector in clean technology products and firms that benefit Pennsylvania’s economy; and,
• Develop new investment screens for its investment managers to use when evaluating a company’s potential exposure to environmental liabilities.

**New York:** In March 2005, the Office of the New York State Comptroller issued a report, which stated that New York State has the potential to produce more of its energy from renewable sources and contribute to the growth of the renewable energy sector. The report also concluded that growth of the renewable energy field could be a source of high-wage, high-skilled jobs for the state in addition to the potential for a positive environmental impact. The New York State Common Retirement Fund committed $30 million to the Carlyle/Riverstone Renewable Energy Infrastructure Fund I in 2006, but has not made an explicit financial commitment to the cleantech industry similar to California or Pennsylvania.

**Oregon:** In 2006, the Oregon State Treasurer's Office allocated $50 million to two fund managers focused on cleantech investments: First Reserve XI and Nth Power.

Additional detail is provided in Appendix C-3.

**Corporate Investment and Initiatives**

Leading businesses have increasingly become active in the cleantech industry, either through direct, venture-type investments, development or acquisition of cleantech business lines and/or adoption of green/carbon neutral business practices, including:

**Direct/Venture-type Investments:** BASF Ventures, BP, Chevron Technology Ventures, Citigroup, General Electric, Goldman Sachs, Morgan Stanley, Novartis, Shell Oil, Siemens, Unilever

**New Cleantech Business Lines:** AIG, BP, Corning, DuPont, General Electric, Interface Flooring, Siemens, Swiss RE


Addition detail is provided in Appendix C-4.
Public Markets

As the industry and interest from the investment community have grown, a number of new equity indices have been created to track the performance of publicly traded cleantech companies:

- WilderHill Clean Energy Index
- NASDAQ Clean Edge U.S. Index
- Cleantech Index (on the American Stock Exchange)
- Vortex-Cleantech Index

A description of each index is provided in Appendix C-5.

Conclusion: The increasing level of investment and business activity in the cleantech sector is an indicator of the seriousness with which the financial and corporate worlds view the potential of this industry. However, venture investment in New York has not kept pace with the overall growth of investment activity in this sector. By failing to capture venture investment dollars, New York risks losing this industry and the associated jobs and economic activity to other parts of the country.
D. Competitive Strengths of Downstate New York/New York City

The size, expected growth, and interest by the investment community in the cleantech industry suggest that it is a promising source of economic growth, diversification and job creation throughout New York State. The competitive strengths that the New York City Metro Area can contribute to this industry include the following:

1) One of the largest, most concentrated markets in the U.S. for both cleantech products and services
2) A receptive environment for early adoption of new technologies, reflecting the need to reduce high costs and a tradition of progressive leadership by individual consumers, business and local government
3) Significant access to investment capital dollars to fund new technologies and start-up companies
4) A strong network of service providers (e.g. consultants, bankers, architects and designers, non-governmental organizations (NGOs), lawyers, etc.)

The downside of these strengths, however, is that three of the four relate to the city’s capacity to consume products and services rather than its ability to create new technologies and companies. In other words, currently the New York City Metro Area is naturally a large consumer of cleantech products but less naturally a producer.

Market Size--Overall

The Downstate/New York City Metro region has a large market of both residential and commercial customers for cleantech products and services:

- With an estimated population of over 18.7 million, the New York City Metro Area is the largest in the U.S., approximately 50 percent larger than the second place Los Angeles Metro Area.

- The Gross Metropolitan Product (GMP) of the New York City Metro Area, over $901 billion, is almost twice as large as the Los Angeles Metro Area, which ranks second.

- New York City's gross city product (GCP) of $467 billion is roughly the same as the gross domestic product (GDP) of South Korea and is larger than the GDP of Switzerland and the Netherlands.
Market Size—Cleantech Related

With respect to certain of the cleantech segments—notably Alternative Energy & Power, Energy Management, Materials & Green Building—the New York City Metro area is a particularly attractive market.

Electricity

Not only is New York City currently the nation’s largest electric market, but demand for electricity is expected to grow in the coming years.
It is projected that New York City alone will need between 6,000 and 7,000 megawatts (MW) of new electricity resources by 2025 in order to meet the demands of both projected population growth and proposed residential and commercial development. New York City’s current population of 8.2 million is projected to reach 9.2 million over the next 25 years, representing growth of almost 12 percent. Also, there are 23 major development projects planned for the city that collectively will require 675 MW of this new required electric capacity.

In terms of cost, the state’s electricity costs are among the highest in the nation, at an average of 13.95 cents per kilowatt hour (KWh). As a result, New York should be one of the first states in the U.S. where existing electricity costs will be equivalent to those of alternative energy as those cost curves come down.

Average per KWh Electricity Price, Top 25 States – 2005

Scale of Commercial Office Market

New York City is also the largest commercial office market in the country with 439.5 million square feet in its central business districts versus 127.2 million square feet in Chicago, the second largest market. When combined with the fact that New York’s electricity costs are among the highest in the country, the market for technologies that more efficiently manage energy usage at commercial office buildings should be significantly larger in New York City than anywhere else in the U.S.

16 NYC Department of City Planning
17 Includes office buildings, transportation and infrastructure projects and comprehensive development projects (such as Hudson Yards, World Trade Center site).
Inventory of Central Business District Commercial Office Space  
(As of Third Quarter 2006)

Source: Collier's ABR, Inc

Energy Management Expertise

**ConsumerPowerline (CPL)** based in New York City is one of the largest providers of demand response solutions in the United States with more than 750 MWs under management. Founded in 2000, it currently has operations in the nation's largest energy markets, including New York, California, and New England. CPL helps large energy users (including some of the nation's largest commercial, residential and institutional building owners and managers) gain greater control over both their energy expenditures and assets. Its clients pay no fees, but instead share in the incremental revenues or savings that CPL generates. Currently, CPL is providing its demand response solutions to more than 75 million square feet of commercial real estate and more than 110,000 residential units. The company's customers include Fortune 1000 companies and some of the nation's largest commercial, residential and institutional facilities.

"At ConsumerPowerline, we're engaged in the process of helping companies strategically conserve and creatively manage their energy assets," commented Mike Gordon, CEO of ConsumerPowerline. "Here in New York, we've got the goods to do the job: an imaginative, well-educated, entrepreneurial, and grounded work force supported by high quality higher education, and a financial services industry that is mature, yet willing to take risks."
Alternative Waste Disposal & Recycling

While on a per capita basis, the level of waste production by New York City's residents and businesses is on par with other areas of the country, the sheer size and density of the city creates unique challenges and opportunities in waste management. As a result, there is significant market potential for products and services that allow the city to deal with its waste in a more cost effective and efficient manner.

With an estimated 50,000 tons of solid municipal, commercial, construction, and demolition waste generated daily, New York City accounts for roughly 4% of all trash produced annually in the U.S. In 2005, the amount of waste collected annually in the city was almost double that of the next largest city, Los Angeles. As of 2005, New York City’s recycling rate was about 37.5% of the 11.2 million annual tons of collected waste being recycled. While other cities, in particular San Francisco, have higher recycling rates, city comparisons may not be consistent in the type of materials included.

New York City’s municipal recycling program offers curbside collection of metal, glass, plastic and mixed paper to all residents in every housing type. This offers the potential for consistent streams of materials for secondary processing. Additional opportunities exist for those materials, such as bio-waste, which are not currently part of the city’s curbside recycling program.

Total Tonnage of Waste Collected and Recycling Rates—
Ranked by Total Tonnage Collected (2005)

![Graph showing total tonnage of waste collected and recycling rates ranked by total tonnage collected (2005)]


Since the closure of the city’s last active landfill, the city now exports all of its solid waste, and disposal costs have increased nearly 100 percent. 20 Currently, disposal fees are approximately $80 per ton and are expected to increase. As a result, the city’s disposal costs are among the highest in the nation.21

### Cleantech in Brooklyn

**Sims Hugo Neu Corporation** has agreed to construct a $50 million metal, glass and plastic processing facility in Brooklyn that will create 100 permanent new jobs. The facility will handle all of the metal, glass, and plastic, as well as a portion of the mixed paper, that the Department of Sanitation collects through its residential curbside recycling program. To keep trucking to a minimum, most of these materials will arrive and leave the facility via barge. The facility is part of a long term, 20-year agreement that will stabilize the City’s cost of processing recyclables and provide revenue sharing for the City when commodity prices are strong. Construction on the facility is expected to begin in 2007 and be completed by 2009. According to Bob Kelman, Senior VP of Sims Hugo Neu: "The concentration of people in NYC, all served by a single collection agency, creates a unique opportunity to develop processing infrastructure on a truly substantial scale. We also see opportunities to increase the variety, quantity and quality of recyclables coming out of NYC, which will lead to the creation of additional raw materials for other businesses." Sims Hugo Neu is part of the Sims Group, Ltd., the largest recycling company in the world.

**Solar Energy Systems, Inc.** is a Brooklyn-based renewable energy company that designs and installs solar electric systems for residential and commercial customers. The company provides a full complement of services from site assessment to equipment procurement to maintenance and monitoring, as well as assistance with permitting and securing financing and tax benefits. Working throughout the New York City Metro Area, the company’s projects have ranged from small, 2KW residential systems to more complete 50 KW supplemental energy systems for commercial facilities. David Buckner, President of Solar Energy Systems, comments: "As a NYC-based solar energy company, we get to create clean, homegrown electricity that supports the local grid while also benefiting the environment. It’s such an exciting time to be involved with green technology, and NYSERDA has some of the deepest incentives in the country, making solar power more cost effective for many New Yorkers."

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21 Mayor’s Management Report Fiscal Year 2006, Department of Sanitation
Green Building

The expected growth of the city’s population and economy should lead to significant construction activity, which is likely to drive demand for green building materials and expertise. The U.S. Green Building Council estimates that $4 billion will have been spent on green construction between 2005 and 2007 in New York, representing 25% of all new construction costs in the city.22 In October 2005, New York City passed Local Law 86, which requires that all new public buildings be certified to meet green standards. This legislation, which becomes effective January 2007, is expected to impact approximately $12 billion of construction in the City’s ten-year capital plan.23

New York State currently has 75 Leadership in Energy and Environmental Design (LEED)-registered projects,24 of which 66 have been certified. When measured in square feet, New York State has approximately 11 million square feet of LEED-certified residential and commercial space, second behind only California.25 (See Appendix D-1 for a list of selected LEED-certified projects.)

LEED-Certified Projects Ranked by Gross Square Feet—Top Ten States

(As of April 2006)

<table>
<thead>
<tr>
<th>State (Number of LEED-Certified Projects)</th>
<th>Gross Square Feet- GSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA (270)</td>
<td>30,000,000</td>
</tr>
<tr>
<td>NY (66)</td>
<td>25,000,000</td>
</tr>
<tr>
<td>PA (60)</td>
<td>15,000,000</td>
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<tr>
<td>IL (49)</td>
<td>15,000,000</td>
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<tr>
<td>WA (69)</td>
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<td>15,000,000</td>
</tr>
<tr>
<td>GA (39)</td>
<td>15,000,000</td>
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</tbody>
</table>


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23 New York City Council, Local Laws of the City of New York for the Year 2005: No. 86, passed September 15, 2005
24 The Leadership in Energy and Environmental Design (LEED) Green Building Rating System is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings.
Supportive Environment for Early Adoption

New York City has a tradition of progressive leadership by socially conscious consumers and supportive public policies by local political officials. In addition to the regulations and programs that are discussed in Section F, Mayor Michael Bloomberg’s Administration has recently made sustainability a key focus through a series of policy decisions:

- In October 2006, the Bloomberg Administration established the Office of Long Term Planning and Sustainability, which is charged with developing a plan for the city’s long-term growth and development that includes the integration of sustainability practices. The Mayor also appointed a high level Sustainability Advisory Board to assist the new Office in identifying the highest-priority issues; setting targets; and, choosing the best methods of achieving those goals.

- In May of 2005, Mayor Bloomberg, along with the mayors of 132 other U.S. cities, including Los Angeles and Seattle, pledged to have New York City meet the requirements of the Kyoto Protocol. This coalition of cities plans to reduce carbon emissions levels 7 percent below those of 1990.

- In October 2004, the Bloomberg Administration created an interagency sustainability task force to coordinate the integration of sustainability practices into City government operations. The task force includes representatives from all major City agencies.

Access to Venture Capital

New York State is among the top five states in the size of its venture capital industry, both in number of deals and dollars invested.

Venture Capital Investment in Top Ten States, 2004 & 2005

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**Strong Network of Service Providers**

The Downstate/New York City Metro area has a strong network of service providers – for example, environmental consultants, green architects and designers, NGOs, lawyers and bankers -- needed to accelerate deployment of new technologies and to develop the industry. Specifically:

- New York City has more LEED-certified professionals than any other city in the nation (see Appendix D-2)
- There are 88 legal practices in New York City that specialize in environmental law and related issues, making it a national center for environmental law and the leader in the number of these professionals nationwide.
- New York City is ranked among the top-five cities nationwide in the number of environmental consultants working on issues, such as sustainable design, air and climate, remediation, energy management, and environmental engineering.
- Many of the large investment banks have established cleantech-focused practices to offer corporate finance and advisory services to companies in this industry.

The existence of such a large concentration of green design professionals, environmental lawyers, environmental consultants, and bankers is important for the formation of a local cleantech industry for two reasons. First, these professionals provide valuable expertise and support services to cleantech firms at various stages of their development. Second, they are opinion leaders that can help drive the adoption of a particular technology.

**Conclusion:** The New York City Metro Area has the following assets that can support the growth of a vibrant cleantech industry in the state: the largest market in the U.S., early adopter, financial/venture resources, and a deep network of service providers. On their own, however, these assets relate principally to the city’s capacity to consume products and services rather than an ability necessarily to create new technologies and companies.

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27 Compiled from Lexis-Nexis/Martindale-Hubbell Expert Legal & Consultancy Search Service (March 2006)
E. Competitive Strengths of Upstate New York

Upstate New York has a number of resources that complement those of the New York City Metro Area, and together these can be important building blocks for a vibrant cleantech industry throughout the state. Specifically, Upstate New York contributes the following:

1) An abundance of natural resources and environmental assets needed to supply certain cleantech segments, especially the alternative energy sector
2) Cleantech-focused research and development (R&D) capabilities at both university and industry research centers
3) Manufacturing-related resources, such as management expertise, trained labor force and underutilized sites

Abundance of Natural Resources and Environmental Assets

Biofuels

New York is endowed with abundant supplies of woody biomass resources from a variety of sources. Large quantities of wood residues from primary and secondary wood product manufacturers are available; low value wood from forests can be harvested sustainably; and, biomass crops can be grown on underutilized open land. A SUNY study estimates that about 5.5 million tons of primary and secondary wood residues are produced annually in New York, of which an estimated 30% are not currently utilized. The state contains 18.6 million acres of forestland of which 15.4 million acres are outside of federal and state reserves. Net annual growth is 3 times greater than the current annual harvest. With respect to agricultural land, this same study estimates that 1.7 million out of 5.4 million acres of agricultural land in New York is underutilized and could be repurposed to grow short-rotation woody crops, such as willow.

With respect to the production of cellulosic ethanol, the availability and accessibility of plant material, including dedicated energy crops like switch grass or willow, agricultural and forestry residues, pulp and paper mill wastes, corn stalks, or municipal solid waste, can ensure a steady supply to support sustained growth of this nascent industry.

29 New York State Office of Science, Technology, and Academic Research, press release, May 9, 2006
The following chart illustrates biomass fuel resources across the U.S. in 2004:

**U.S. Biomass Fuel Resources**

In addition to renewable crops, New York State is also the third-largest dairy producer in the country, which makes it well suited to take advantage of methane from waste materials. The combined animal and agricultural waste produced by dairy farms is estimated to be enough to supply upwards of 31 percent of statewide residential electricity use.

**Wind Power**

At the end of 2005 the American Wind Energy Association (AWEA) estimated that the state had an installed wind power capacity of 186 MW. New York, which ranks 15th in the country for wind energy potential, has significant potential to grow its wind power industry since this installed base is a fraction of the potential capacity. Excluding environmentally sensitive areas, it is estimated that New York has a wind resource that can support the installation of 5,000 MW of land-based wind capacity, which is enough to provide 10 percent of the state’s demand.

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Additionally, offshore wind energy development south of Long Island could generate 5,200 MW.\textsuperscript{34} (Appendix E-1 contains a map of installed wind power capacity in the U.S. at the end of 2005.)

\textit{Solar Power}

New York State receives on average between 3,500 and 4,000-watt hours of solar energy per square meter each day, which is mid-range when compared to the rest of the country (see map below). This level of sunlight is sufficient to power an average size home equipped with solar roof panels.\textsuperscript{35} New York City averages approximately 107 sunny days per year, which is among the highest for a city not located in the south or southwest.\textsuperscript{36}

\textbf{U.S. Solar Resources}\textsuperscript{37}

(As measured by watt-hour per square meter)

\begin{figure}
\centering
\includegraphics[width=\textwidth]{solar_map.png}
\caption{U.S. Solar Resources}
\end{figure}

\textsuperscript{37} Source: U.S. Energy Department
**Innovative Solar Technology**

DayStar Technologies, Inc., is positioned to become the lowest-cost, high-volume producer of thin film photovoltaic (PV) products by enabling affordable energy from the sun. The Company will accomplish this by being the first to successfully implement a proprietary, high-throughput, manufacturing "Gigawatt (GW)-scale" methodology for the production of non-silicon, Copper Indium Gallium Selenide (CIGS)-based solar cells, thus enabling PV to compete with traditional power generation in the growing global electricity marketplace.

DayStar was formed in 1997 to further develop and commercialize technologies developed at the National Renewable Energy Laboratory (NREL) in Golden, CO. In June 2004, the Company accepted an $11 million relocation package from NY State and moved the company’s operations from California to the town of Halfmoon in the Albany Tech Valley region. It has since become the first publicly held company to achieve factory production of discrete CIGS solar cells.

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**Hydro and Tidal Power**

In terms of current hydropower production, New York ranks fourth in the U.S., with the Niagara River generating the highest level of electricity within New York State (2.4 million annual KW). While many of the most suitable hydropower sites in New York are already developed, replacing aging equipment and upgrading technology could add generation capacity. The New York State Energy Research and Development Authority (NYSERDA) estimates that upwards of 300 MW of additional hydropower could be generated by modernizing the state’s hydroelectric plants. (Appendix E-2 shows the top producing states of hydropower.)

In late 2006/early 2007, Verdant Power is scheduled to deploy a set of tidal turbines in the East River of New York City. If the $4.5 million project is successful, the generators will form one of the first farms of tide-powered underwater turbines and will have a capacity of up to 10 MW. NYSERDA has identified a potential of more than 1,000 MW of capacity that could be provided by tide-powered turbines in New York State.

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38 NYSERDA, a public benefit corporation created in 1975 by the New York State Legislature, is charged with developing solutions to energy and environmental problems via research and development, and energy efficiency projects.
Plug Power, Inc. (NASDAQ: PLUG) was founded in 1997 as a joint venture between DTE Energy, a diversified energy services company and parent of Detroit Edison (Michigan’s largest electric utility), and Mechanical Technology Inc., an early developer of fuel cells. Today, with more than 320 employees and headquarters in Latham, NY, Plug Power is an established leader in the development and deployment of clean, reliable, on-site energy products. The Company currently integrates fuel cell technology into backup power products for telecommunications, utility and uninterruptible power supply applications and is actively engaged with private and public customers in targeted markets, including the United States, Europe, Middle East, Russia, South Africa and South America.

Research & Development Capabilities

There are a significant number of people with advanced technical degrees in the state, which ranks:

- # 2 nationally in terms of the number of doctoral scientists (42,610);
- # 3 nationally in terms of the number of doctoral engineers (6,490);
- # 2 nationally in terms of the number of graduate students currently enrolled in science & engineering doctorate-granting programs; and,
- # 2 nationally in terms of the number of science & engineering degrees awarded annually with 2,124 such degrees being granted in 2005.

Three New York Cities, including Buffalo and Rochester, are ranked among the top ten in per capita science and engineering degrees, as shown below:

Cities Producing the Most Science & Engineering Graduate Degrees

![Bar chart showing the number of science & engineering graduate students per 100,000 inhabitants for various cities, with New York City leading at 338.5, followed by Boston (298.2) and Washington (235.8).]

Source: National Science Foundation and U.S Census Bureau, 2000

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There are also a number of academic and industry research centers in the state that focus on cleantech-related research, which further enhances the pool of skilled workers and research and development capabilities. Research and development is being conducted in most of the major segments of the cleantech industry, including alternative energy, nanotechnology-related applications, and materials/waste recovery. (Summary information on many of the institutions active in New York is provided in Appendix E-3.)

**Manufacturing Expertise and Resources**

New York State is ranked among the top ten states in terms of the size of its manufacturing workforce.

![Number of Manufacturing Jobs, Top 10 States (2005)](image)

Source: New York Federal Reserve Bank, Buffalo Branch

While there are no statistics on the size of the potential manufacturing workforce in New York that could transition to the cleantech industry, the size of the decline in manufacturing workforce can serve as a proxy. Over the last decade, manufacturing jobs in New York State declined nearly 40 percent as compared to about 20 percent across the entire United States.41

In 1995 there were over 810,000 people employed in New York’s manufacturing sector, compared to 580,000 in 2005. Buffalo and Rochester, the two New York cities with the most manufacturing jobs, have been hit hardest, with a decline of 33 percent and 49 percent, respectively, in the number of individuals employed in manufacturing from 1995 to 2005. While some of these individuals have probably left the state or are

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41 New York Federal Reserve Bank, Buffalo branch
working in other sectors, it is likely there remains a skilled pool of workers with manufacturing experience.

**Number of Manufacturing Jobs Lost from 1995 to 2005, Top 10 States**

![Bar chart showing the number of manufacturing jobs lost from 1995 to 2005, Top 10 States.](chart.png)

Source: New York Federal Reserve Bank, Buffalo Branch

This decline in manufacturing has left Upstate New York with an abundance of abandoned or underutilized former industrial sites, where reuse for cleantech manufacturing facilities is likely to be the better option when compared to other uses, such as housing or retail. Currently there is no comprehensive list of these sites; though, a list of the top 25-30 sites that could most easily accommodate cleantech-related facilities would be a helpful resource for companies that are considering a New York location.

**Conclusion:** Upstate New York has a number of assets for the cleantech industry—namely an abundance of natural resources or environmental assets to be used as feedstock, research and development expertise, and an underutilized manufacturing workforce and available sites. These resources are complementary to those of the New York City Metro Area. The more effectively these elements are combined, the greater the possibility that New York can attract cleantech companies and projects.
F. Role of Government

Through public policy and strategic incentives, New York State and City government can play a role in helping to attract some of the investment capital coming into the cleantech industry in order to leverage the various competitive strengths of the state. A 2006 study by Environmental Entrepreneurs and Cleantech Venture Network concludes that public policy does influence where venture capital firms invest. In a survey of cleantech investors:

- 79% of venture capitalists said that public policies (regulations, programs and incentives) are a factor in their cleantech investment decisions
- 91% said that a pro-environmental public policy stance can be a driver in bringing new business and investment to a state

Up to now, New York’s public policy and economic programs have focused principally on increasing consumption of cleantech products and services rather than encouraging companies and investment dollars to locate within the state.

Renewable Portfolio Standard

One key public policy already in place in New York is the Renewable Portfolio Standard (RPS), which requires electricity providers to obtain a minimum percentage of their power from renewable sources by a certain date. Some states have specified the technology mix and others have chosen to let the market determine the appropriate mix. There are 20 states plus the District of Columbia that have RPS policies in place; together, these states account for 42% of the electricity sales in the U.S. Two other states, Illinois and Vermont, have nonbinding goals for adoption of renewable energy rather than an RPS.

As shown below, New York currently has the most aggressive RPS in the nation. In 2004, Governor Pataki mandated a 25% RPS statewide to be implemented by 2013.

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In addition to an aggressive RPS, Governor Pataki issued Executive Order No. 111 in 2001, which directed agencies, departments and public authorities under State executive authority to become more energy efficient and increase their use of renewable energy. The order directs that: existing buildings increase their energy efficiency by 35% by 2010, relative to 1990 levels; green building guidelines be followed in future construction and renovation; energy-efficient products be purchased when replacing or buying new equipment; and, 100% of all light-duty vehicles should be alternative-fuel vehicles by 2010.

**Regional Greenhouse Gas Initiative**

Another key public policy action at the state level was the signing of the Regional Greenhouse Gas Initiative (RGGI) memorandum by seven northeast states in December 2005. Spearheaded by New York, RGGI mandates the reduction of carbon emissions at electric utilities and is a key step towards the development of a market for trading carbon credits in the U.S.

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43 U.S. Department of Energy <http://www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm#chart> (Accessed October 10, 2006). Appendix F-1 contains a list of all states that have enacted RPS.

44 Original signatories included the governors of Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont. Maryland will join the RGGI process by June 2007. In addition, Massachusetts, Rhode Island, DC, Pennsylvania, the Eastern Canadian Provinces, and New Brunswick are observers in the process. In October 2006, the governors of New York and California announced that their two states would explore ways to work together to link California’s future greenhouse gas emission credit market with the RGGI.
RGGI also incorporates the use of offset projects, such as landfill capture and combustion or methane capture from animal operations, as a way for utilities to meet their requirements. These offset projects could support growth in the use of clean technologies.

In Europe, the trading of carbon credits is a fast growing commodity market. In 2005, $8.2 billion of carbon allowance credits were traded through the European Union Emissions Trading Scheme, equivalent to 324 million tons of carbon, compared to only 8 million tons traded worldwide in 2004. During the first nine months of 2006, $18.8 billion of carbon allowance credits were traded, more than double what was traded in all of 2005. Current growth projections estimate that by 2010, 800 million tons of carbon will be traded in the global carbon market, the equivalent of $60-$100 billion.45

As RGGI is implemented, the expectation is that a market to trade carbon credits will develop in the Northeast, similar to the carbon credit markets that developed in Europe as a result of the Kyoto Protocol. These carbon trading markets represent an interesting opportunity for the financial services sector in New York City. The key risk, however, is that the trading market develops elsewhere, either in London, which has a first mover advantage, or possibly Chicago, since the Chicago Climate Exchange has been aggressively courting New York-based firms to use its existing voluntary exchange.

**System-Benefits Charge (SBC)**

Fourteen states, including New York, assess electric customers with a system-benefits charge46 as a way to support renewable energy within their respective states. Approximately $2 billion has been collected since 1998 by these fourteen states and an additional $1.5 billion is expected to be collected by 2012. More than half of this funding will be collected and spent in California.

Distribution of this funding varies from state to state and includes loans, equity investments, production incentives, and grants to subsidize project installations and support marketing, technical assistance, education and pilot/demonstration projects. In New York, NYSERDA administers the proceeds generated by the SBC. While these funds are used for projects based in New York, there is no requirement or explicit preference for the company receiving the funds to be located in New York. The cost of NYSERDA’s funds is more expensive, though, if the company locates its manufacturing outside New York.

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46 A system-benefits charge is a charge that cannot be passed on to electricity customers that is collected to fund public benefit programs.
In a 2001 study that analyzed SBC-funded renewable energy programs, New York ranked in the top half in terms of annual funding.  

**SBC Funding for Renewable Energy:**
**Comparison of Average Annual Funding by State**
**(1998-2012)**

[Graph showing funding levels for states]

**State Financial Incentive Programs**

In addition to implementing supportive policy initiatives, a number of states have created financial incentives to increase the use of renewable energy and to encourage energy efficiency. New York currently is a clear leader when compared to the other states, ranking #1 in terms of the number of financial incentives for energy efficiency and #2 in terms of the number of financial incentives for renewable energy. Many of these incentive programs are focused on reducing carbon emissions and promoting renewable energy use. The financial incentives, which are described in greater detail in Appendix F-2, include income, sales and property tax deductions, tax rebates, grants, loans and production incentives.

Of the 20+ incentive programs listed for New York State in the Database of State Incentives for Renewables & Efficiency, only 2 are targeted directly at cleantech

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48 Ibid

Notes: Some states such as CT ramp up funding levels over time, making 2001 a conservative estimate for the future, while others, such as OH & MA ramp down funding levels over time. Estimates for CT, MA, NY, OH & WI were averaged from ranges: CT is based on mean spending of between $15-30 million; MA, between $20-30 million; NY, between $6-14 million; OH, between $5-15 million; and WI, between $1.0-4.8 million. NYSERDA’s fuel cell budget is outside of the Energy $mart renewable R&D program and is not included in this chart, while fuel cell funding is included in the funding levels reported for other states.
entrepreneurs or businesses. Incentives for consumers are important because they help reduce the state’s dependence on imported fuel and will likely create jobs in the service/installation sector. However, consumer-oriented incentives do not necessarily result in increased entrepreneurial activity and company attraction within the state. Consumers are typically agnostic as to where a product is produced and so incentives geared to purchasers will drive higher end, sustainable job creation and economic development where the products are produced, rather than where they are sold and consumed.

**New York City**

New York City is by its nature and as a result of public policy one of the leading “sustainable” cities in the U.S. Its inherent density, extensive mass transit system and vertical construction result in one of most efficient per capita carbon footprints in the country. In addition, the City has undertaken a number of initiatives over the last several years to promote the use of clean/green technologies by local government and local citizens. These initiatives (which are discussed in further detail in Appendix F-3) have been directed at the city’s energy usage, green building, recycling, transportation and procurement.

Of these initiatives, one—the Hugo Neu recycling facility in Brooklyn— is related to growing a business in the city while the rest are related to purchases of goods and services. However, Mayor Bloomberg’s new Office of Long Term Planning and Sustainability has made economic growth and job creation a key priority, so there is a potential for new programs and projects that focus on business expansion.

**Conclusion:** New York is one of the leading states in the U.S. with respect to policies and incentives supportive of the alternative energy sector. However, the majority of these are focused on increasing the use of these technologies within the state as opposed to explicitly supporting the local development of the industry (e.g. companies, jobs, etc).

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49 This database does not include several new programs from the State’s 2006/2007 budget that are targeted at attracting alternative energy companies and projects to New York.
G. Conclusions and Recommendations

The cleantech industry represents a unique opportunity for New York to leverage the complementary strengths of its Upstate and Downstate economies to create a new engine of economic growth that benefits the entire state. As a sector, the cleantech industry has entered the mainstream economy. Venture capitalists and corporate investors are increasingly contributing resources to develop the industry, while major corporations are adopting green business strategies and developing green product lines in an effort to reduce operating costs and gain market share in the emerging “low carbon economy.”

In the last eighteen to 24 months, however, investment and entrepreneurial activity has been concentrated in California and Massachusetts, which are also leaders in growth fields such as biotechnology and information technology. Many of New York State’s incentives and policies are focused on increasing the use (or consumption) of cleantech technologies within the state. While these are important for reducing dependence on imported fuel and encouraging more widespread use of products that help the environment, they do not necessarily lead to high-tech or manufacturing jobs within the state. Therefore, the following actions, which encourage more entrepreneurial activity while continuing to address environmental concerns, are recommended:

**Recommendation #1: Create a targeted marketing effort**

New York City and State have a good story to tell about the depth and breadth of assets that are relevant to the cleantech industry. However, that story has not been told as effectively and widely as it could be. As a starting point, Empire State Development Corporation and New York City Economic Development Corporation (NYCEDC) could each designate a primary contact for the cleantech industry, similar to what NYCEDC has done for the bioscience industry. That contact would:

- Focus on attracting new cleantech companies to the city and state and on assisting existing cleantech companies with expansion and procurement opportunities;
- Develop both printed and on-line marketing materials that describe the key cleantech-related assets in the city/state;
- Actively market these city/state assets to the cleantech community at venture and industry conferences; and,
- Act as a liaison between local cleantech companies and various city/state agencies that run programs, have incentives or other resources, or have oversight responsibility (e.g. permitting) related to cleantech companies.

This industry contact is part informational (a one-stop source where various programs/incentives are located) and part advocate, assisting cleantech companies navigate a complex system.
Recommendation #2: Commit at least $150 million of investment capital to cleantech companies in the state

A commitment by the New York State public pension funds to allocate at least $150 million to fund managers that commit to invest those monies in cleantech companies and projects located within New York State would:

- Draw attention to the fact that the state is serious about growing the cleantech industry here and provide a broad-based platform to distribute the “New York Cleantech Story”;
- Provide incentives for the investment community to invest locally, while leaving individual investment decisions to the market; and,
- Attract new sources of private capital to cleantech projects in the state, assuming there is a requirement for the selected fund managers to match the State’s money on a 1-for-1 or 2-for-1 basis.

To attract a variety of projects and companies, the funds could be targeted to provide a mix of financial instruments, including equity and project finance debt.

The model for this type of allocation already exists. Between 1999 and 2006, the New York State pension fund allocated $425 million to 15 fund managers with the explicit condition that the State’s funds be invested in companies located in New York and that the state’s funds be matched dollar for dollar by that fund manager’s other investors.

In addition to equity, a loan guarantee program for New York State-based projects could be an incentive to encourage growth of this industry. The venture community is typically prepared to fund the technology development and pilot plant stages. However, given the capital requirements of alternative fuel and recycling projects, there currently are few sources of capital to fund the scale up of new technologies from pilot to full production. To the extent a loan guarantee program of scale was developed by the federal government, New York could provide enhanced incentives alongside a federal program.

Recommendation #3: Improve linkages between New York’s technology and investment capital

Once pension fund monies have been allocated, the State Comptroller’s office could work in partnership with regional business organizations to establish periodic forums in which the venture community is exposed to technology developed at university and research centers in New York.
Recommendation #4: Increase focus on producers versus consumers with respect to state/city incentives

In addition to the allocation of pension fund monies to New York-focused investment managers, the State/City could implement other incentives that are oriented to attracting cleantech companies to New York, such as:

- Establish in-city and in-state preferences for government procurement of cleantech products. New York City government made $175.4 million of "green" purchases in 2005\(^{50}\). Even a modest 5% to 10% in-city requirement could produce a demand of between $9 - 18 million for New York-based cleantech companies.
- Institute a local preference for NYSERDA funding by including a New York presence as one of the criteria used when evaluating applications. (i.e. the recipient needs to be headquartered within the state).
- Distribute some of the $875 million in Systems Benefit Charge III funding that is slated to be distributed through NYSERDA over the next 5 years through a state investment fund, rather than completely through existing NYSERDA programs. This investment fund could include a loan guarantee program.
- Review NYSERDA’s application process to ensure that it is as streamlined and user-friendly as possible.
- Create a city and/or state beta testing program for clean technology products and services developed at New York-based companies. A successful beta test with a reputable customer is often the key to securing additional customers and venture funding. Offering to test technology at the early stages, through an expedited process, will put the city/state in a position to attract entrepreneurs who are eager to market the fact that their products have been successfully piloted in America’s largest city. (A beta testing program could be structured so that there would be no automatic commitment for the City to use a product or service beyond the beta stage.)
- Develop a list of 25-30 ready-to-go manufacturing sites that would be appropriate for cleantech-related activities. The information could be disseminated through the state and city marketing offices.

Recommendation #5: Leverage the Regional Greenhouse Gas Initiative

RGGI provides an opportunity to create jobs in both New York City and Upstate New York. NYC is the logical location for trading and trading support jobs in the U.S., given the city’s dominant position in the global capital markets.

However, the Chicago Climate Exchange is actively recruiting New York City-based companies to join its Chicago-based operation, which could move the nexus of trading activity to Chicago. Reaching out to the city’s major financial institutions and including them fully in the process of establishing a city-based trading infrastructure will help maintain the focus on New York City as the nexus for these trading activities.

Upstate could benefit from the offset projects that are likely to be developed to satisfy RGGI’s requirement for carbon reductions. Currently there is no compelling reason to locate an offset project within New York State versus one of the other seven participating states. New York could develop a list of ready-to-go sites and/or eligible projects, in the areas of landfill gas capture and combustion, methane capture from animal operations, and forestation of non-forested land.

Recommendation #6: Legislative Activity

Identify legislative and/or regulatory changes that would encourage the development of a robust cleantech sector in New York, such as allowing expanded net metering in residential and commercial buildings and altering procurement regulations so that state and local governments could give preference to local cleantech companies, even if not the lowest bid.
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## Appendix C-1: Cleantech Venture Investment By State (1999-2005)

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<td>NE</td>
<td>6</td>
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<td>PA</td>
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<td>35</td>
<td>ME</td>
<td>4</td>
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<tr>
<td>WI</td>
<td>97</td>
<td>11</td>
<td>RI</td>
<td>4</td>
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</tr>
<tr>
<td>NH</td>
<td>88</td>
<td>11</td>
<td>KY</td>
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<td>MN</td>
<td>79</td>
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<td>KS</td>
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<tr>
<td>OR</td>
<td>71</td>
<td>12</td>
<td>MT</td>
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<td>2</td>
</tr>
<tr>
<td>OH</td>
<td>58</td>
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<td>2</td>
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<tr>
<td>VA</td>
<td>54</td>
<td>17</td>
<td>WY</td>
<td>3</td>
<td>2</td>
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<tr>
<td>IN</td>
<td>47</td>
<td>9</td>
<td>SC</td>
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</tr>
</tbody>
</table>

## Appendix C-2: Venture Capital Firms Investing in Cleantech

### Existing Funds

<table>
<thead>
<tr>
<th>Name (Location)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>3i (U.K., CA, MA, and NY)</td>
<td>• Current investments include companies involved with smart fuel cells and supply of electricity generators and power stations using various gases including natural gas, landfill gas, sewage gases, biogas</td>
</tr>
</tbody>
</table>
| Battery Ventures (MA, CA, and Israel) | • Currently focused on clean energy, clean transportation, clean water and clean materials  
• Recent investments in back-contact solar cells and modules, and lithium ion batteries |
| Kleiner, Perkins, Caufield & Byer (CA) | • Announced new $100 million clean technology focus in February 2006  
• Increased commitment to $200 million at Clinton Global Initiative in September 2006 |
| Rho Capital Partners (NY and CA) | • Recent cleantech investments in companies with products such as flywheel energy storage system and ethanol (ethyl alcohol) from cellulosic biomass materials |
| Sequoia Capital (CA)       | • Made its first investment in cleantech space in May 2006 in an alcohol-based fuel cell developer                                     |
| VantagePoint Partners (CA and NY) | • In October 2006, held a first close on its first fund dedicated exclusively to cleantech--raised about $74 million for a $150 million fund  
• Focus is on the application of technology to energy, water, and materials |
| Venrock Associates (CA, NY, and MA) | • Recent investments in the areas of alternative power solutions and lightweight and conformal solar cells                                |
| Warburg Pincus (NY and CA)  | • Recent investments in companies involved with gas-fired electric power generation and high-quality biodiesel production from recycled oils and fats |
## New Venture Funds with Primary Cleantech Focus

<table>
<thead>
<tr>
<th>Name (Location)</th>
<th>Comments</th>
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</table>
| Abu Dhabi Future Energy Company (UAE)               | • In September 2006, launched the $250 million Masdar Clean Tech Fund in partnership with Credit Suisse and Consensus Business Group of the U.K.  
  • Goal is to attract advanced energy and sustainability-related technologies to Abu Dhabi by leveraging the country’s energy expertise and financial resources |
| Braemar Energy Ventures (NY and MA)                 | • Closed $60 million fund in 2002 to focus on clean fuel processes and storage, advanced power conversion, pollution control, and energy intelligent networks  
  • Raising a new $200 million fund                                                                                                                        |
| Carlyle/Riverstone Global Energy and Power Fund (D.C. and NY) | • Private equity fund focused on the global energy and power industry with $5B+ under management  
  • Closed $685 mm Renewable Energy Infrastructure Fund I in 2006. Focus is on renewable energy projects, including hydroelectric plants, wind systems, geothermal and biomass facilities |
| Climate Change Capital (UK)                         | • In September 2006, created the world's largest private sector carbon fund with $830 million initially raised. CCC took only three months to raise the money and expects the total to top $1 billion by the second close  
  • Plans to focus investment on clean energy and a low carbon economy, principally investing in projects in developing countries that reduce the amount of greenhouse gases--specifically carbon--being emitted into the atmosphere  
  • Plans to acquire a diversified portfolio of carbon assets and derivatives and can invest in projects and companies which develop and generate greenhouse gas (GHG) reductions |
| DFJ Element (CA)                                    | • Closed $284 mm fund in June 2006 to focus on energy and power, water, air, and manufacturing/industrial sectors  
  • Partnership of Element Venture Partners and Draper Fisher Jurvetson                                                                                   |
<p>| Enertech (PA)                                       | • Closed two funds totaling $290 million to focus on alternative energy and cleantech industries; second fund of $234 million closed in 2000                                                                 |</p>
<table>
<thead>
<tr>
<th>Firm Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| Expansion Capital (CA and NY) | - Closed its $55 million Clean Technology Fund II in August 2006  
- Invests in US and Canadian enterprises with existing customer revenues of $2 million - $20 million  
- Invests across the cleantech sector including energy, advanced materials, water and waste water, manufacturing and transportation |
| Global Environment Fund (D.C.)| - International investment firm that invests in emerging markets, clean technology and forestry  
- Manages private equity funds totaling approximately $800 million  
- Was established in 1990 to provide financing and management support to companies that contribute to environmental quality, efficient use of energy, human health and the sustainable management of natural resources |
| Inverness Capital (PA and MA) | - Closed $125 million fund in 2003  
- Acquires or provides expansion capital to innovative industrial businesses and industrial technology providers  
- Targets businesses with strong sustainable margin potential and with current revenues between $5 million and $50 million  
- Target companies deliver productivity and efficiency gains, enable environmental compliance, improve resource utilization or offer other forms of product/service differentiation |
| New Energy Capital (MA)       | - Raised $30 mm in June 2005 to acquire, build, and operate renewable energy and distributed generation projects in North America  
- LPs are California State Teachers’ Retirement System (CalSTRS) and VantagePoint Venture Partners |
| NGEN Partners (CA and NY)     | - Closed its second venture fund with $180 million in September 2006  
- Current portfolio includes sustainable energy technologies; water purification, re-use and monitoring; pollution abatement and hazardous waste; solid state lighting; green buildings; batteries and fuel cells; clean coal; biomaterials |
<p>| Nth Power (CA)                | - Closed its fourth fund at $200 million in June 2006 to focus on alternative energy investments resulting from the restructuring of the global energy industry |</p>
<table>
<thead>
<tr>
<th>Company</th>
<th>Details</th>
</tr>
</thead>
</table>
| Rockport Capital Partners (MA) | • Closed RockPort Capital Partners II fund in January 2006 with commitments of $261 million  
                              | • To date has invested $380 million in energy and power, advanced materials, and process and prevention technologies |
| Sail Venture Group (CA and D.C.) | • Early stage fund in energy/cleantech sector. Raising $150 mm fund and sponsored by Odyssey Venture Partners.  
                              | • Current portfolio includes diesel fuel additive product manufacturing; energy efficiency and distributed energy storage; neurophysiological biomarker system; and conversion of waste to ethanol |
| US Renewables Group (CA and NY)| • Closed $80 mm fund in October 2005; currently raising new $170 mm fund  
                              | • Develops, acquires and operates renewable energy facilities (landfill methane, biomass, geothermal, gasification, ethanol, biodiesel and gas-to-liquid) |
Appendix C-3: Pension Fund Commitments to Cleantech

California
The board of CalPERS (California Public Employees’ Retirement System) has $500 million invested in environmentally screened stock portfolios in the U.S. and overseas. An additional $200 million has been targeted for private equity stakes in environmental technology ventures in such fields as energy-efficient materials, photovoltaics and other renewable energy technologies. Many of the ventures are based in California.

CalSTRS (California Teachers’ Retirement System) has made $188 million of clean sector investments, including $150 million in renewable energy projects in Europe and the U.S.

Pennsylvania
In September 2006, Pennsylvania’s State Treasurer, Robert P. Casey, Jr., announced that the state will be adopting a new approach to investing public funds with its Keystone Green Investment Strategy. Pennsylvania will put $90 million behind this plan to spur growth in clean and sustainable business development, and to promote these opportunities to other investors. The strategy consists of four elements:

(a) **The Keystone Green Fund** – a new investment fund Casey is establishing to attract and leverage private sector investments in clean technology products and firms that will benefit Pennsylvania’s economy. The Fund will include up to $40 million in Treasury assets and several million more from Pennsylvania-based energy funds.

(b) **Active Equity Management** – Casey will reallocate up to $50 million in Treasury assets from existing investment managers to those who can demonstrate a track record of providing superior returns on their investments in clean technology stocks.

(c) **Environmental Equity Screens** – Treasury will develop new investment screens for its investment managers and outside consultants to use when evaluating a company’s potential exposure to environmental liabilities.

(d) **Investor Network on Climate Risk** – Pennsylvania will formally join the INCR, a network of institutional investors and financial institutions that promotes better understanding of the financial risks and investment opportunities posed by climate change.

New York
The New York State Common Retirement Fund has made a $30 million commitment to the Carlyle/Riverstone Renewable Energy Infrastructure Fund I (CRF). CRF has raised $600 million to invest in renewable energy projects, including hydroelectric plants, wind systems, geothermal and biomass facilities. CRF has already invested in a wood burning power plant, ethanol plants, geothermal and solar power plants throughout North America.
Oregon
In 2006, the Oregon State Treasurer’s Office allocated $50 million to two fund managers focused on cleantech investments: First Reserve XI, which has extensive alternative energy technology holdings; and, Nth Power, a clean energy venture capital fund that is backing more than a dozen alternative energy companies.

Source: Investor Network on Climate Risk website
# Appendix C-4: Corporate Investment and Activity in the Cleantech Industry

The following provides a representative list of leading corporations that are investing in and pursuing other activities in the cleantech industry.

<table>
<thead>
<tr>
<th>Name</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M</td>
<td>• Since 1990, reduced its carbon emissions by 12.8%, removing 1.85 million metric tons primarily by cutting its energy consumption</td>
</tr>
<tr>
<td>Alcoa</td>
<td>• Since 1995, reduced its carbon emissions by 26%, removing 8.9 million metric tons from aluminum smelters in the past decade</td>
</tr>
</tbody>
</table>
| BP               | • In November 2005, announced an “Alternative Energy Initiative” and committed $8 billion in investment over the next ten years to wind, solar, hydrogen and natural gas power projects around the globe  
                   • Plans to grow its wind power capacity from 30MW to 450MW by 2008 and also add 73MW of new solar power capacity by the end of 2008. (To help meet this goal it recently expanded its solar panel manufacturing facility in Fredrick, Maryland.)  
                   • Announced plans to construct the Carson Hydrogen Power Project in California, a 500MW facility which will eliminate 4 million tons of carbon per year  
                   • In addition to these investments, BP made a symbolic gesture by re-branding itself from British Petroleum to Beyond Petroleum                                                                                                                                                                                                 |
| Catalyst Paper   | • Since 1995, reduced its carbon emissions by 61%, removing 280,000 metric tons during the past decade as a result of efficiency gains                                                                                                                                                                                                                                                                 |
| Citigroup        | • Recently invested in Balrampur Chini Mills Ltd. (ethanol related in India) and Chrysalix Energy (cleantech VC fund)  
                   • In early 2006, announced a goal to reduce its global emissions by 10%, from 2005 level, by the year 2011  
                   • In 2005, purchased 10,478 MW of certified green electric power, and expects to purchase more than 30,000 MW for its operations around the world by 2007                                                                                                                                 |
| Conservation     | • Pledged to achieve net zero U.S. GHG emissions by 2006 and maintain that level through 2010                                                                                                                                                                                                                                                                                                           |
| Services Group   |                                                                                                                                                                                                                                                                                                                                                                                                   |
| Corning Inc.     | • In 2004, opened a $370 million manufacturing plant in Erwin, N.Y., producing catalytic converter substrates and advanced particulate filters for medium-and heavy-duty diesel applications, such as trucks and buses                                                                                                                                                                                                       |
| Cummins Inc.     | • Pledged to reduce global GHG emissions by 25 percent per dollar revenue from 2005 to 2010                                                                                                                                                                                                                                                                                                             |
| Deutsche Bank | • 60 Wall Street headquarters certified as environmentally compliant under ISO 14001 at beginning of 2006 |
| DuPont | • In 2006, allocated 10% of its $1.3 billion research budget to extract ingredients from carbohydrates (which are renewable) rather than hydrocarbons¹  
• Expects 25% of its products will be derived from non-petrochemical substances by 2010 (up from 10% in 2005)  
• Since 1995, reduced its carbon emissions by 72%, removing 65 million metric tons as a result of reduced energy consumption  
• Pledged to reduce total global GHG emissions by 15 percent from 2004 to 2015  
• Has set $6 billion revenue goal for ‘sustainability’ products (expand its business offerings addressing safety, environment, energy and climate challenges in the global marketplace) |
| EcoPrint | • Pledged to achieve net zero U.S. GHG emissions by 2006 and maintain that level through 2010 |
| Entergy Corporation | • Pledged to reduce total U.S. GHG emissions by 20 percent from 2000 to 2010 |
| General Electric | • In May 2005, announced its “Ecomagination” Initiative and pledged to double revenue from green products from $10 billion in 2004 to $20 billion in 2010 and to double research spending to $1.5 billion by 2010 for environmentally friendly technologies  
• GE Financial Services is establishing $3 billion renewable energy fund by 2008 ²  
• Has committed to increase the energy efficiency of company operations by 30% by 2012. To help meet these targets, GE is currently developing a wind farm in upstate New York |
| Goldman Sachs | • Committed to investing $1 billion in renewable energy³; purchased Zilkha Renewable Energy (wind-energy facilities) in mid-2005  
• In May 2006, invested $30 million (CDN) in Iogen Corp’s renewable cellulose ethanol technology  
• Pledged to take environmental considerations more seriously when considering investment opportunities, for instance refusing to invest in projects that do not comply with local environmental laws  
• Intends to become more active in shaping environmental public policy, including the establishment of a think-tank to promote market-based approaches for dealing with environmental concerns |

² “VCs Get Pumped,” Bloomberg Markets August 2006  
<table>
<thead>
<tr>
<th>Company</th>
<th>Actions/Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSBC</td>
<td>In 2006, its operations became “carbon neutral”</td>
</tr>
<tr>
<td>IBM</td>
<td>Since 1995, reduced its carbon emissions by 38%, removing 1.7 million metric tons</td>
</tr>
<tr>
<td>Intel Corporation</td>
<td>Pledged to reduce global GHG emissions by 30 percent per production unit from 2004 to 2010</td>
</tr>
<tr>
<td>Interface Flooring</td>
<td>Introduced the carpet industry’s first climate neutral carpet, Cool Carpet, as well as the only carpet created from bio-based, plant-derived fiber; In 2003, became the first carpet company to receive Environmentally Preferable Product (EPP) certification for its products; In 2003, announced a partnership to convert naturally occurring methane gas from a local landfill into a green energy source to fuel two heaters and a boiler at an Interface plant</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>New Jersey facilities completed more than 40 energy and cost saving projects to avoid 4,391 tons of carbon dioxide emissions; Installed the most PV solar projects nationwide, including one of the largest projects in NJ; Committed to: 7% absolute reduction in carbon dioxide emissions from stationary sources, based on levels in 1990; 30% decrease in fleet vehicle emissions per mile driven, based on levels in 2003; 10% absolute reduction in hazardous and non-hazardous waste generation</td>
</tr>
<tr>
<td>J.P. Morgan Chase</td>
<td>Committed to investing $250 million in renewable energy; Established an internal carbon-reduction strategy and promulgated environmental guidelines for its investment and commercial bankers to use when making financing decisions: Added “carbon disclosure and mitigation” into its client review process; Began quantifying the financial cost of GHG emissions in financial analyses for prospective clients; Will report annually the aggregate GHG emissions from its power sector projects; Committed to accommodate higher debt-to-income ratios for homes that are energy efficient; and, Will actively seek investments in low-income green housing</td>
</tr>
<tr>
<td>Morgan Stanley</td>
<td>Over the next five years, plans to invest in about $3 billion of carbon/emissions credits, projects and other initiatives aimed at lowering greenhouse gas emissions</td>
</tr>
<tr>
<td>North Bay Construction</td>
<td>Pledged to reduce total U.S. GHG emissions by 20 percent from 2005 to 2010</td>
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<table>
<thead>
<tr>
<th>Company</th>
<th>Action/Initiative</th>
</tr>
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</table>
| Novartis                   | • In April 2006, Syngenta (the combination of Novartis and AstraZeneca’s agribusiness unit) launched $100mm fund, LSP BioVentures, with focus on biomaterial and biofuel technologies  
                              • It will be managed by Life Sciences Partners, a European VC, and based in Boston                                                                                                                                                                                                                     |
| Raytheon Company           | • Pledged to reduce U.S. GHG emissions by 33 percent per dollar revenue from 2002 to 2009                                                                                                                                                                                                                                                                          |
| Shaklee Corporation        | • Pledged to maintain net zero U.S. GHG emissions from 2006 to 2009                                                                                                                                                                                                                                                                                              |
| Shell Oil Company          | • Invested $1 billion in biofuels, wind, solar and hydrogen projects in 2005  
                              • Currently progressing with wind projects in Texas, Wyoming, Idaho, West Virginia, California, and Hawaii and is in the process of perfecting the CIS ‘thin film’ coating for solar installations                                                                                                                                                            |
| Siemens                    | • Offers a product line of 50 and 60 Hz gas and steam turbines (ranging from 4 to 340 MW for gas turbines and up to 1100 MW for steam turbines)  
                              • Stationary Fuel Cells division completing the commercialization of solid oxide fuel cells  
                              • VC arm has invested in SmartSynch (provider of wireless grid technology which gives users real-time energy metering information to help them conserve energy) and NGEN (an advanced materials VC with cleantech focus)                                                                                               |
| Sonoma Wine Company        | • Pledged to reduce total U.S. GHG emissions by 15 percent from 2005 to 2010                                                                                                                                                                                                                                                                                     |
| Sterling Planet            | • Pledged to achieve net zero U.S. GHG emissions by 2006 and maintain that level through 2010                                                                                                                                                                                                           |
| STM Microelectronics       | • Since 1995, reduced its carbon emissions by 50%, removing 850,000 metric tons                                                                                                                                                                                                                      |
| Unilever                   | • Formed €50 million, Unilever Technology Ventures to focus on nanotechnology and biotechnology within the cleantech space                                                                                                                                                                                                                                      |
| Walgreen’s                 | • Announced the installation of solar photovoltaic systems on the roofs of 112 of its stores and distribution centers in California and New Jersey  
                              o Cited as the largest solar project undertaken in US  
                              o Installations will generate more than 13.8 million kWh of electricity per year and provide up to 50% of each store’s energy needs                                                                                                                      |
| Wal-Mart | Announced an environmental initiative aimed at both improving its own environmental performance and diversifying its product lines to better account for their environment impacts, including:  
| o Elimination of all PVC packaging from its private brands;  
| o Use of only compostable food containers in all of its Sam’s Club stores;  
| o Reduction of its solid waste tonnage by 25% by the end of 2008;  
| o Improvement in the fuel efficiency of its 51,600 vehicle fleet by 25% by the end of 2008; and,  
| o Commitment to develop a prototype store which reduces energy use by 25% and reduces greenhouse gas emissions by at least 30%, compared to today’s stores, by the end of 2009  |
| Whole Foods Market | In 2006, completed a purchase of renewable energy credits from American wind farms to offset 100% of its electricity consumption |
Appendix C-5: Cleantech Equity Indices

The following equity indices have been created to track the performance of publicly-traded cleantech companies:

*WilderHill Clean Energy Index*: Launched in 2004 by WilderShares. The index tracks the market performance of 40 clean energy stocks.

*NASDAQ Clean Edge U.S. Index*: Launched in May 2006 as a modified market capitalization weighted index designed to track the performance of companies that are primarily manufacturers, developers, distributors and/or installers of clean energy technologies. The index covers five subsectors: renewable electricity generation, renewable fuels, energy storage and conversion, energy intelligence, and advanced energy-related materials.

*Cleantech Index*: Launched in February 2006 by The Cleantech Capital Group LLC and the American Stock Exchange. Comprised of 75 companies that have at least fifty percent of their sales obtained from cleantech products and services; combined market capitalization of index companies is in excess of $100 billion. On a pro forma historical basis, the Cleantech Index would have significantly outperformed the S&P 500 and NASDAQ indices for the past three and five years.5

*Vortex-Cleantech Index*: Launched in 2004 and is comprised of 182 U.S.-traded cleantech stocks with a combined market cap of nearly $100 billion. The index rose in value by 267 percent in the decade ending May 2004 compared with a 181 percent gain in the Nasdaq Composite Index and a 146 percent rise in the Russell 2000 Index6.

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Appendix D-1: Green Buildings in New York City

The following green building projects are currently planned for development or were recently completed in New York City:

- Seven World Trade Center (*completed summer 2006*)
- One Bryant Park/Bank of America headquarters
- Goldman Sachs’ new downtown headquarters
- Citibank’s new Long Island City annex
- The Hearst Corporation’s new midtown headquarters (*completed summer 2006*)
- Four Times Square (*completed 2000*)
- Cooper Union academic building
- Fieldston School in the Bronx
- Brooklyn Children’s Museum
- Queens Botanical Gardens auditorium
- Bronx Zoo Lion House
- Kensington branch library

Green residential projects in New York City include:

- 1400 on 5th, 1400 5th Avenue
- The Helena, 601 West 57th
- Kalahari, West 116th Street
- Millennium Towers, 25 Battery Place
- 1 River Terrace
- Riverhouse, 1 Rockefeller Park
- The Solaire, 20 River Terrace
- Tribeca Green, 325 North End Avenue
- The Verdesian, 211 North End Avenue
- 70 Little West Street

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Appendix D-2: U.S. Cities Ranked by Number of LEED-Certified Professionals

American Cities with the Most LEED-Certified Professionals

![Bar chart showing the number of LEED-certified professionals in various American cities. The cities listed are New York City, San Francisco, Chicago, Atlanta, Boston, Houston, and Los Angeles. The numbers of LEED-certified professionals are 820, 749, 706, 599, 523, 448, and 407 respectively.]

Appendix E-1: Wind Power Capacity by State (as of 2005 Year End)

United States - 2005 Year End Wind Power Capacity (MW)

Total: 9,149 MW
(As of 12/31/05, based on data available through 1/19/06)


Source: Energy Information Administration, 2006
Appendix E-3: Research Centers Focused on Cleantech-related Research

The following is a list of academic and corporate centers in New York that are conducting research related to the cleantech industry. The list is based on publicly disclosed information.

<table>
<thead>
<tr>
<th>Name</th>
<th>Activities</th>
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</thead>
<tbody>
<tr>
<td>Alfred University / Center for Environmental and Energy Research – Alfred, NY</td>
<td>Conducts research in renewable energy, particularly hydrogen-based technologies and materials efficiency. CEER has received grants from NYSERDA, as well as numerous federal and industrial partners, including Niagara-Mohawk.(^8)</td>
</tr>
<tr>
<td>Brookhaven National Laboratory – Upton, NY</td>
<td>Part of the Federal Department of Energy, the Environmental Research and Technology Division at Brookhaven applies and develops technology and software for environmental research, remediation, and management problems. Emphasis is on environmental restoration, environmental assessment, waste treatment, and meteorological services.(^9)</td>
</tr>
<tr>
<td>City University of New York – New York, NY</td>
<td>Conducts research on materials related to electrochemical energy storage and conversion for fuel cells and lithium ion and lithium batteries. Has collaborations with several NYS-based companies, Plug Power, Ultralife and Greatbatch. CUNY’s Institute for Sustainable Cities focuses on accelerated deployment of sustainable technologies in NYC, including workforce training.</td>
</tr>
<tr>
<td>Clarkson University / Center for the Environment – Potsdam, NY</td>
<td>Conducts research in collaboration with Syracuse Center of Excellence in turbine development, biomass/biofuel, fuel cells, and cleantech workforce development.(^10)</td>
</tr>
<tr>
<td>Columbia University / Lenfest Center for Sustainable Energy – New York, NY</td>
<td>Focuses primarily on the technological and institutional development of the three energy resources sufficient to support the world’s projected population in 2100 without increased carbon emissions: solar, nuclear, and fossil fuels combined with carbon capture and storage</td>
</tr>
</tbody>
</table>

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\(^8\) Center for Environmental and Energy Research at Alfred University, <http://ceer.alfred.edu/research.html> (Accessed November 28, 2006)


<table>
<thead>
<tr>
<th>Institution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia University / Henry Krumb School of Mines – New York, NY</td>
<td>Research into biomass, zero-emission coal energy, and photovoltaic materials.</td>
</tr>
<tr>
<td>Cooper Union / Nerken School of Engineering – New York, NY</td>
<td>Conducts research in environmental engineering, with recent patents in clean coal technology, a new hydroelectric process, and new fuel cell processes.</td>
</tr>
<tr>
<td>Cornell University - Ithaca, NY</td>
<td>College of Engineering conducts research in energy, environment, and sustainable development. Announced goal is to be nation’s premier research university in these areas by 2010. Current research includes methane-capture, biofuel, clean combustion, brownfield remediation.</td>
</tr>
<tr>
<td>Cornell University / Center for the Environment - Ithaca, NY</td>
<td>Conducts research on pollution mitigation, environmental complexity, and energy sustainability.</td>
</tr>
<tr>
<td>Cornell University / Fuel Cell Institute – Ithaca, NY</td>
<td>Founded in 2002, its mission is to develop new materials to improve fuel cell efficiency in anode and cathode electrocatalysts, polymer electrolyte membranes, non-carbon catalyst support materials, interfaces and electrode structure. Has $120,000 partnership with Ford, $150,000 partnership with GM, and $30,000 from NYSERDA.</td>
</tr>
<tr>
<td>General Electric (GE) – Niskayuna, NY</td>
<td>In 2002 undertook a $100 million renovation of its Global Research Center in Niskayuna, NY and in 2004 announced plans to add 85,000 additional square feet of space as part of a $25 million expansion. The center develops new technologies for GE’s biosciences, nanotechnology and renewable energy divisions.</td>
</tr>
</tbody>
</table>

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15 “GE to Invest $100 Million in Global Research Center,” New York Times December 26, 2002
IBM – Yorktown Heights, NY

Current research is focused on identifying novel materials and processes for lower cost solar power, as well as the integration of multiple sources of solar power into national power grid. The center is also designing data centers that optimize use of electrical power and power efficiency.

Polytechnic University – Brooklyn, NY

In June 2004, received $1.1 million DARPA contract to conduct research into enzyme-based plastic-fuel conversion processes. Contract is a follow-on to $350,000 grant received in 2003. Department of Advanced Natural Gas Fired Energy Systems conducts research in microturbines, gas-fired air compressors, heat pumps, and gas-fueled engines.

Rensselaer Polytechnic Institute-Troy, NY

Has installed a biplane tracking photovoltaic system, which is able to track the sun both horizontally and vertically, increasing the efficiency of PVS by 25 percent over stationary models. Operates a clean energy business incubator, providing office and research space to startup renewable energy businesses.

Rensselaer Polytechnic Institute / Center for Future Energy Systems – Troy, NY

$20 million joint venture between RPI, Cornell Fuel Cell Institute, and Brookhaven National Laboratory to support university-industry collaborative research on energy. In 2005, Center received $10 million in state funds.

Rochester Institute of Technology / Hydrogen Technology Learning Center – Troy, NY

Conducts research on hydrogen-based power sources and is one of four nationwide centers able to teach the latest advancements in fuel cell technology. Delphi Energy and General Motors have also located fuel cell research centers in Rochester.

Rochester Institute of Technology / NanoPower Research Labs – Troy, NY

Dedicated to the development of new materials and devices for power generation and storage for microelectronic components and micro-electromechanical systems.

Saratoga Technology + Energy Park

A 280-acre site master-planned for 1.25 million square feet of office, lab, and light manufacturing. STEP is one of the nation’s first business incubators designated specifically for the development of

<table>
<thead>
<tr>
<th>Location</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>(STEP) – Saratoga, NY</td>
<td>Clean technology companies. Incentives include all Empire Zone credits and tax incentives. Announced plans include a state-of-the-art alternative fuel research lab. Tenants include Advanced Energy Conversion (efficiency), Daystar Technologies (solar), Global Resource Options (solar).</td>
</tr>
<tr>
<td>SUNY Albany / Center of Excellence in Nanoelectronics – Albany, NY</td>
<td>Established the Energy and Environmental Technology Applications Center (E2TAC) to support integration of microelectronics and nanotechnology in energy and environmental applications. Technology focus is on solar cells, fuel cells, superconductors, hydrogen storage, environmental sensors. Working with Plug Power, a fuel cell company located in Latham, NY that has partnerships with GE and DTE Energy Technologies, on the incorporation of nanotechnology into the construction of fuel cells.</td>
</tr>
<tr>
<td>SUNY Albany / Center for Advanced Technology in Thin Films – Albany, NY</td>
<td>Working with MTI Instruments, an Albany-based company, to develop sensors that could improve the efficiency and safety of fuel cells.</td>
</tr>
<tr>
<td>SUNY College of Environmental Science and Forestry – Syracuse, NY</td>
<td>Has conducted over $12 million worth of research in biomass energy, including the reliability and feasibility of molten carbonate fuel cells, which operate on coal derived fuels or natural gas and use one of only five carbonate fuel cells in the nation. Also studying the integration of biomass with fuel cells, which use a gasifier to convert wood into biofuel, which is then used to power the fuel cell.</td>
</tr>
<tr>
<td>SUNY Farmingdale / Solar Energy Center – Farmingdale, NY</td>
<td>The site of the first utility-scale PV project in the Northeast. Provides training in the installation and maintenance of PV panels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUNY Stony Brook / Advanced Energy Research and Technology Center - Stony Brook, NY</th>
<th>In 2006, Stony Brook, in partnership with KeySpan corporation, received $35 million of state funds for a new advanced energy research center, to be open by 2009. Plans include research into broad renewable energy sources, building on current work in hydrogen, fuel cells, and biomass.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syracuse University / Center of Excellence in Environmental and Energy Systems – Syracuse, NY</td>
<td>Construction is underway on a new $200 million Center of Excellence in Environmental and Energy Systems at Syracuse University. NYS contributed $44 million to the construction cost, as well as a $15 million NYSTAR grant towards operations. A collaboration between Syracuse and a number of other academic institutions across the state, the center will focus on indoor environmental quality and renewable and clean energy sources from wind and solar power to geothermal and fuel cells.</td>
</tr>
</tbody>
</table>
Appendix F-1: Renewable Portfolio Standards by State

The following states had all passed Renewable Portfolio Standards as of November 2005 and are ranked based on the percentage of state electricity sales that must be obtained from renewable sources.

<table>
<thead>
<tr>
<th>State</th>
<th>Amount</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York</td>
<td>25.00%</td>
<td>2013</td>
</tr>
<tr>
<td>Illinois*</td>
<td>25.00%</td>
<td>2017</td>
</tr>
<tr>
<td>California</td>
<td>20.00%</td>
<td>2017</td>
</tr>
<tr>
<td>Hawaii</td>
<td>20.00%</td>
<td>2020</td>
</tr>
<tr>
<td>Nevada</td>
<td>20.00%</td>
<td>2015</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>18.00%</td>
<td>2020</td>
</tr>
<tr>
<td>Montana</td>
<td>15.00%</td>
<td>2015</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>15.00%</td>
<td>2020</td>
</tr>
<tr>
<td>District of Columbia</td>
<td>11.00%</td>
<td>2022</td>
</tr>
<tr>
<td>Colorado</td>
<td>10.00%</td>
<td>2015</td>
</tr>
<tr>
<td>Connecticut</td>
<td>10.00%</td>
<td>2010</td>
</tr>
<tr>
<td>Maine</td>
<td>10.00%</td>
<td>2017</td>
</tr>
<tr>
<td>New Mexico</td>
<td>10.00%</td>
<td>2011</td>
</tr>
<tr>
<td>Vermont*</td>
<td>10.00%</td>
<td>2013</td>
</tr>
<tr>
<td>Maryland</td>
<td>7.50%</td>
<td>2019</td>
</tr>
<tr>
<td>New Jersey</td>
<td>6.50%</td>
<td>2008</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>4.00%</td>
<td>2009</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>2.20%</td>
<td>2011</td>
</tr>
<tr>
<td>Arizona</td>
<td>1.10%</td>
<td>2007</td>
</tr>
<tr>
<td>Texas</td>
<td>5,880 MW</td>
<td>2015</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1,125 MW</td>
<td>2010</td>
</tr>
<tr>
<td>Iowa</td>
<td>105 MW</td>
<td>2010</td>
</tr>
</tbody>
</table>

*Non-binding

Source: U.S. Department of Energy

New York ranks #1 in terms of state incentive programs for energy efficiency and #2 in for programs targeted at renewable energy. However, as shown in the charts below, the majority of incentives are targeted at consumers of these technologies rather than firms that produce them.

State Financial Incentive Programs for Energy Efficiency

State Financial Incentive Programs for Renewable Energy

## New York State Incentives for Producers

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| Advanced Clean Coal Power Plants               | • Creation of $50 million Clean Coal Initiative Fund and commitment by NY Power Authority to negotiate a long term power purchase agreement with a private sector developer of a NYS-based clean coal power plant. Must act as a host site for the research, development, and deployment of carbon dioxide capture and/or sequestration  
  • Also up to $1 billion of the state’s federal tax exempt volume cap allocation (capped at $200 million/year) will be available  
  • Awards will be based on a competitive solicitation  
  • To be implemented but included in 2006/2007 State Budget                                                                                                                                   |
| Advanced Vehicle R&D                           | • Up to $5 million in matching capital funding will be awarded to NYS-based start-up companies that develop, demonstrate and deploy next generation vehicle technologies, such as vehicle batteries, vehicle propulsion systems and lightweight vehicle parts and components  
  • NYSERDA will issue a competitive solicitation  
  • To be implemented but included in 2006/2007 State Budget                                                                                                                                                                          |
| Biofuel Fuel Production Tax Credit             | • New York-based producers of renewable fuels will receive a 15 cent tax credit for each gallon of biofuel produced after the first 40,000 gallons  
  • Credit is capped at $2.5 million per taxpayer per year  
  • To be implemented but included in 2006/2007 State Budget                                                                                                                                                                                                                       |
| Cellulosic Ethanol Pilot Plant                 | • $20 million will be available to a project sponsor that successfully demonstrates the capability to construct a pilot-scale cellulosic ethanol facility and transfer the resulting production capacity to commercial scale in NYS  
  • NYS Department of Agriculture is in the process of conducting an RFP  
  • Included in 2006/2007 State Budget                                                                                                                                                                                                                                                                 |
| Clean Energy R&D Tax Incentive                 | • Clean energy companies located anywhere within NYS will receive Empire Zone benefits. Specific criteria being established by The Empire State Development Corporation, in consultation with NYSERDA  
  • Empire Zone benefits allow companies to operate virtually free of taxation  
  • To be implemented but included in 2006/2007 State Budget                                                                                                                                                                                                                       |
| Renewable Energy Technology Manufacturing Incentive Program | • Provides funding for renewable-energy technology manufacturers to develop or expand facilities to produce certain systems and components, including those related to solar-electric, wind-electric, bio-electric and hydroelectric technologies  
  • NYSERDA offered a total of $4 million in grants under a solicitation issued in 2005, with a maximum individual award of $1 million                                                                                                                                              |
Renewables R&D Grant Program

- Involves a multi-step approach to assist companies in the development, testing and commercialization of renewable-energy technologies that will be manufactured in New York
- Eligible technologies include solar thermal electric, photovoltaics, hydropower, alternative fuels, wind, landfill gas, and biomass

New York State Incentives for Consumers

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
</table>
| Assisted Home Performance Grants  | • Subsidies to low-income home owners for up to 50% of costs for energy efficient improvements  
• Eligible equipment includes clothes washers/dryers, dishwashers, refrigerators/freezers, dehumidifiers, ceiling fans, water heaters, lighting, furnaces, heat pumps, duct/air sealing, and building insulation  
• $5,000 for single-home owners, $10,000 per building for 2-4 family units  
• Program budget: $5 million/year |
| Assisted Multifamily Program      | • Grant program implemented by Hamilton, Rabinovitz & Alschuler, Inc. on behalf of NYSErDA to lower the energy bills of low- and middle-income families whose income is 80% or less of the state’s median income  
• Maximum amount: $500 per unit of gap funding  
• Program budget: $70 million over 5 years |
| Elimination of Motor Fuel Taxes on Renewable Fuels | • Tax exemption (motor fuel, petroleum business, fuel use, sales and compensating use) for renewable fuels, such as E85, B20, CNG and Hydrogen  
• Expected to reduce price differential by 40 cents/gallon  
• Included in 2006/2007 State budget |
| EmPower New York                  | • Focuses on cost-effective electricity reduction measures, particularly lighting and refrigerator replacements, as well as other cost-effective home performance strategies such as insulation, and health and safety measures |
| Energy Conservation Improvements Property Exemption | • Residences that install qualifying energy conservation measures are exempt from added property tax resulting from costs associated with these conservation measures  
• Eligible technologies: equipment insulation, furnaces, boilers, heat pumps, programmable thermostats, energy management systems/building controls, caulking/weather-stripping, duct/air sealing, building insulation, windows, doors |
| Energy $mart New Construction Program | • Accelerates the incorporation of energy efficiency and renewable-energy resources into the design, construction and operation of commercial, industrial, institutional and multi-family buildings  
• Eligible renewable/other technologies: passive solar space heat, geothermal heat pumps, daylighting |
<table>
<thead>
<tr>
<th>Program Name</th>
<th>Program Description</th>
</tr>
</thead>
</table>
| Energy $mart Loan Fund                           | • Incentive amount: 50-75% of incremental costs, depending on type of project  
• Program budget: $12 million (June 2006 solicitation)  
• Provides reduced-interest rate loans through participating lenders to finance renovation or construction projects that improve a facility’s energy efficiency or incorporate renewable energy systems  
• Applicable sectors include commercial, industrial, residential, nonprofit, local government, state government, federal government, multi-family residential, agricultural, institutional, healthcare facility  
• Maximum amount: $20,000 for residential construction; $1 million for multifamily new construction and all other non-residential (plus additional $500,000 for green building improvements); $2.5 million ($5,000/unit) for existing multi-family construction, plus an additional maximum of $2,500,000 for projects that include advanced meters |
| Energy Star Home Builders                        | • Encourages more industry involvement in the building of Energy Star Standard homes (i.e. homes that score at least an 86 on the Home Energy Rating System (HERS) scale; additionally, the home should include a minimum of 600 kWh’s of electrical savings from residential appliances)  
• Energy Star Home Builder is eligible for a direct cash incentive of $750 to $1,250. If the house is used as a model home, a larger incentive is available, up to $3,000 |
| Freeport Electric – Commercial Energy Efficiency Partnership Rebate Program | • Freeport Electric offers an incentive for its business customers to increase the energy efficiency of their facilities through their Efficiency Partnership Program  
• Participating companies can receive up to $1,000 in equipment rebates from Freeport Electric to help pay for energy efficient retrofits or facility additions |
| Green Building Tax Credit                        | • Up to $2 mm/building to increase energy efficiency, improve air quality and reduce environmental impacts of large commercial/residential building  
• Credit against corporate, personal income, insurance or banking corporation taxes |
| Home Heating System Upgrade                      | • $500 tax credit to consumers that have high efficiency heating equipment installed by a certified technician |
| Home Performance with Energy Star – Loan Program | • Unsecured loan for the installation of qualified energy efficient and renewable energy measures  
• Amount: $2,500 - $20,000 unsecured  
• Terms: 5.99% APR; fixed loan terms of 3, 5, 7 and 10 years |
| Hydrogen Vehicles | NYSERDA to issue a $5 million competitive solicitation to attract the development of hydrogen fueling stations across New York, as well as the conversion of existing internal combustion vehicles to operate on hydrogen fuel  
| | Included in 2006/2007 State Budget |
| Long Island Power Authority (LIPA) - Solar Pioneer Program | Offers rebates that are approximately 50% of the costs for a PV system  
| | Incentive amount: residential and commercial: $3.75/watt DC; schools, nonprofits, government agencies: $4.75/watt DC |
| LIPA - Energy Efficient Commercial Construction Rebate Program | Incentives offered by LIPA for its non-residential customers to increase the energy efficiency of their facilities  
| | Maximum incentive: $100,000 per project, $300,000 per building |
| LIPA - Residential Energy Efficiency Rebate Program | Incentives offered by LIPA for its residential customers to increase the energy efficiency of their homes  
| | Eligible efficiency technologies: heat pumps, air conditioners |
| Plug-In Hybrid Vehicles | NYSERDA will issue a competitive solicitation ($10 million initiative) to hire a contractor to retrofit the state’s fleet of roughly 600 hybrid vehicles to convert them into plug-in hybrid vehicles  
| | Included in 2006/2007 State Budget |
| PV Incentive Program | Provides incentives of $4 to $4.50 per watt (DC) to eligible installers for the installation of approved, grid-connected photovoltaic (PV) systems  
| | Maximum incentive: 60% of total installed costs  
| | Program budget: $15.9 million (2002-2006) |
| $smart Equipment Choices Program | Accelerates the installation of small renovation and equipment replacement in non-residential structures  
| | Maximum incentive: Up to $10,000 per applicant for electric efficiency equipment; up to $25,000 for gas efficiency equipment |
| Solar and Fuel Cell Tax Credit | Personal income tax credit applied to expenditures on equipment for passive solar space heat, solar water heat, solar space heat, PVs and fuel cells used on residential property  
| | 25% credit for solar-electric and solar-thermal systems; 20% for fuel cells  
| | Credit is capped at $3,750 for solar-energy systems placed in service before September 1, 2006, and capped at $5,000 for solar-energy systems placed in service on or after September 1, 2006 |
| Solar Sales Tax Exemption | Exempts the sale and installation of residential solar-energy systems from the state's sales and compensating use taxes  
| | Incentive valid through December 1, 2009 |
| Solar, Wind & Biomass Energy Systems Exemption | • 15-year real property tax exemption for the following eligible technologies: solar water heat, solar space heat, solar thermal electric, solar thermal process heat, photovoltaics, wind, biomass, daylighting, anaerobic digestion  
• Exemption applies to systems that are existing or constructed prior to July 1, 1988, or constructed subsequent to January 1, 1991, and prior to January 1, 2011 |
| Small Commercial Lighting Incentives Program | • Provides incentives and information for businesses to install energy-efficient lighting in small commercial spaces  
• Maximum incentive: $35,000  
• Program budget: $250,000 through June 30, 2007 |
| Wind Incentive Program | • Encourages the development of a network of eligible installers who will install end-use wind turbines for all sectors  
• Incentive amount: 15% - 70% based on system size and application  
• Maximum incentive: $100,000 |

Appendix F-3: New York City Cleantech Initiatives

New York City government has undertaken the following cleantech-related initiatives:

Energy Usage

- In 2002, the New York City Department of Transportation completed the replacement of all 11,600 traffic lights and crosswalk signals from conventional fixtures to light-emitting diodes (LEDs), which use 90% less energy. New York was the first, as well as the largest, city in the nation to undertake such a transformation of its signal system. While the installation cost $28.2 million, the city estimates that it has saved $6 million per year, through 2005, in energy and maintenance costs.\(^{25}\)

- By 2004, the New York City Housing Authority had replaced all 180,000 refrigerators with energy efficient models in its public housing projects, each of which uses 25% less energy than conventional models.\(^{26}\)

- New York has also committed to improving the energy efficiency of many of its older built structures through the ENCORE program, which is a collaboration between the City government and the New York Power Authority. Since 1997, approximately 250 projects have led to the installation of high-efficiency lighting systems, motors and sensors; replacement of coal and heavy-oil fired boilers with clean dual fuel light-oil or natural gas burners; and the elimination of chillers that use ozone-depleting refrigerants. All of these upgrades have enabled the City government to reduce the energy load by 22 MW.\(^{27}\)

Transportation

- The New York Metropolitan Transportation Authority recently converted 800 of its 4,400 buses to hybrid/electric configurations. As a result of this conversion, New York now has the largest hybrid bus fleet in the country. Direct savings are projected to be $1.9 million in 2007; $2.8 million in 2008; and $4.4 million in 2009.\(^{28}\)

- In 2005, New York became one of the first cities in the nation to debut hybrid/electric taxis. An initial pilot period program concluded in the summer of 2006.


\(^{26}\) Ibid

\(^{27}\) New York City Office of Environmental Coordination

Green Building

- In 1999 the New York City Department of Design & Construction developed a set of its own green building guidelines that encouraged environmentally-sound building methods to be used for municipal projects. So far these guidelines have resulted in a total of 25 projects, with total construction costs of approximately $950 million. Four of these projects are completed, five are in the development stage and sixteen are in the design stage.\textsuperscript{29}

- The New York City Department of Housing Preservation & Development will soon be incorporating LEED points as a competitive advantage in its Request for Proposals (RFP) process for municipal projects.\textsuperscript{30}

- The Battery Park City Authority drafted green building guidelines for residential buildings in 1999 and for commercial buildings in 2002. These guidelines require that all construction meet strict sustainability criteria. All nine buildings constructed since 1999 will be certified gold under the LEED rating system; three of which may be rated platinum.\textsuperscript{31}

- In October 2005, the City Council enacted Local Law 86, which requires that all new public construction projects and renovations to existing structures adhere to green building guidelines that promote sustainable site planning, good indoor air quality, and efficient use of water, energy, and materials.

Recycling

- In 2004, the City announced the development of a new metal, glass and plastic recycling facility on the Brooklyn waterfront to be operated by Hugo Neu Corporation. Hugo Neu will invest $25 million to build a state-of-the-art, $45 million facility that will recycle all the city’s residential metal, glass and plastic waste. The city will benefit to the extent that the market price for the plant’s output increases over the life of the 20-year contract.

\textsuperscript{29} New York City Economic Development Corporation, “The Big Green Apple: Energy Efficiency in New & Existing Buildings” (Unpublished draft talking points, NYEDC, 2006)


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