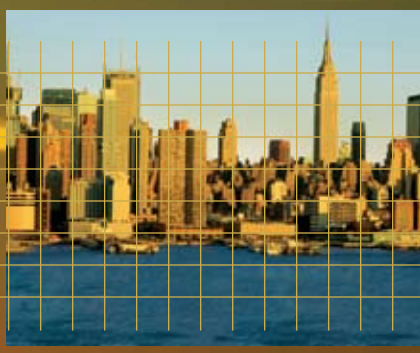
New York's Solar Roadmap

A plan for energy reliability, security, environmental responsibility and economic development in New York State

MAY 2007



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Solar Initiative of New York™
new energy new york

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The purpose of this New York Solar roadmap is to provide a reference document to all stakeholders of the industry. Its objective is to identify the state's specific needs and to recommend innovative solutions to meet the future challenges related to this industry. It enables all industry, university and government participants to plan ahead — based on known and anticipated trends in the industry — as they put in place substantial investments, consortia and commercial cooperative ventures.

A New York State solar energy business outreach workshop was held in February 2007 where about 30 experts convened and discussed the development of a coordinated state-wide commercialization roadmap for solar energy. Following the workshop and the development of a draft document, a second workshop was held in April 2007 to obtain additional recommendations for inclusion. Comments obtained were incorporated in the final Roadmap document released in May 2007.

EXECUTIVE SUMMARY

New York, like the rest of the country, faces rising energy costs, increasingly pressing environmental concerns and stiff economic competition. It is necessary to identify ways to meet our growing energy needs with clean, renewable sources and in so doing create new jobs and new business opportunities in the state. New York State recently announced plans to promote clean, renewable energy, and reduce New York's electricity consumption by 15 percent by 2015 to reduce energy bills, address global climate change and create new jobs. Based on New York's resources and needs, solar electric power should be an integral part of the solution.

Solar energy offers New York the promise of increased energy security, a cleaner environment, and significant economic benefits. New York, long a leader in the semiconductor industry, could become a regional leader in this new surging industry. According to the national solar roadmap[1] each megawatt of installed systems supports 32 jobs, a quarter of which are local installation and sales positions. By building a solar power manufacturing industry and expanding its demonstrated research and development capabilities in the state, most of these jobs can be created in New York State.

Solar power is particularly valuable in reducing stress on New York's electric grid and lowering the risk of major blackouts. Therefore, it is ideally suited for New York's renewable energy portfolio. This semiconductor based technology converts sunlight directly into electricity, with no moving parts, consuming no fuel, and creating no pollution. It is a distributed energy resource that can be deployed throughout the state, improve grid reliability, lower distribution and transmission costs, and be sited at the point of use with minimal or no environmental impact.

Similar to much of the United States, New York has ample solar resources and more sunshine annually than does Germany, which has installed nearly 3 GW of systems to date. In addition, peak power demand in New York occurs during the same time periods when the greatest sunlight is available (hot, sunny, summer afternoons).

The environment, economy, and energy consumers in New York State could all benefit substantially from a unique and unprecedented alignment of electricity supply, economic development, and high-tech-based manufacturing objectives through a new industry-led initiative to expand the manufacturing and deployment of solar power systems in New York. A private-sector industry initiative launched earlier this year by R&D, manufacturing, and industry leaders in New York State has developed the strategic goal to:

Increase solar power deployment in New York State from a current cumulative total of about 12 MW of grid-connected electricity as of January 2007 to over 2,000 MW by 2017.

As New York's energy needs continue to grow, its obligations to respond to the challenge of global climate change grow as well. According to the Clean Energy Estimator[2] 2,000 MW of solar electricity in New York State would improve air quality and reduce global warming emissions by removing about 2 million tons of CO_2, 1,800 tons of NO_x and 5,300 tons of SO_2 annually by 2017.

A solar program modeled on best practices would maintain and expand New York's role as a clean energy leader and bring many environmental, employment, and economic development benefits. Such a program would (i) make it easier for systems to **connect to the grid** and capture the value of energy

Utility representatives, elected officials, policy makers, regulators, and consumers were stunned in August 2006 when 100,000 residents in Queens, New York endured one of the hottest weeks of the summer without electricity. The unexpected disruption in electric service during peak summertime demand for air conditioning reminded many of the importance of a reliable, secure electricity supply.

they generate; (ii) establish **a long-term program of incentives** for residential and commercial owners that encourage installing and deploying solar power; (iii) promote an appropriate combination of private and public **investments in manufacturing, infrastructure**, and development to position New York to meet its sustainable demand for systems from within the state, and (iv) support the **creation of technology clusters** to advance the performance of solar systems and reduce cost.

New York can become a leading magnet for this industry, resulting in new manufacturing capacity, increased jobs, additional revenue, and 2,000 MW of clean, renewable, reliable solar power by the end of 2017. 3,000 direct installation or maintenance jobs and over 10,000 highly skilled manufacturing and integration jobs could be created over a period of ten years.

THE VISION AND MISSION

Solar power technology provides clean, reliable solar electricity in increasing amounts throughout the world. New York has growing energy needs and solar power is particularly well suited to meeting those needs. The mission for the Solar Initiative of New York is to aggressively pursue this technology over the next 10 years so that:

- It provides 5% of the peak electric capacity of the New York power grid by 2017
- It adds over 13,000 highly skilled direct jobs in New York by 2017
- New York becomes a leading center and magnet for research and technology development
- It produces electricity that is price-competitive with conventional energy sources

Essential to realizing the vision is establishing a clear, specific, ambitious, state-level goal: to install 2,000 MW of cumulative solar electric power in New York State by 2017 with the most appropriately designed policies and incentives.

The vision and goal will be realized through substantial and consistent investments by industry and government in research and technology development, manufacturing, infrastructure, training, and market deployment.

Photo: Atlantis Energy Systems

Solar Installation at New York's Whitehall Ferry Terminal

ABOUT SOLAR POWER

Solar electric power or *photovoltaic* (PV) technology is the term used to describe the conversion of sunlight directly to electricity. The *solar cells* available today use semiconductor materials (similar to those used in computer chips and flat panel displays) such as silicon, the major constituent of sand. The cells are basic building blocks of complete systems. To provide useful amounts of power, they are wired together in varying numbers to create solar modules (also called panels). A typical rooftop residential system may have one or two dozen modules. Because the electric grid provides alternating current (AC) power, these systems also include inverters that convert the direct current (DC) electricity produced by the modules into AC electricity. They even generate electricity on cloudy days, albeit less than on a bright sunny day.


Photo: PowerLight

Currently, over 2,000 MW of modules are being manufactured annually worldwide. More than 90% of these are made from silicon. Next generation thin-film solar cells based on semiconductor processing technologies are starting to make an impact in the market, offering the potential of comparable performance to silicon technology at far lower cost. They are expected to increase in market share over time. Meanwhile, researchers are working on alternative technologies for making solar cells that are aimed at achieving revolutionary performance, revolutionary cost reduction, or both.

SOLAR POWER MARKETS

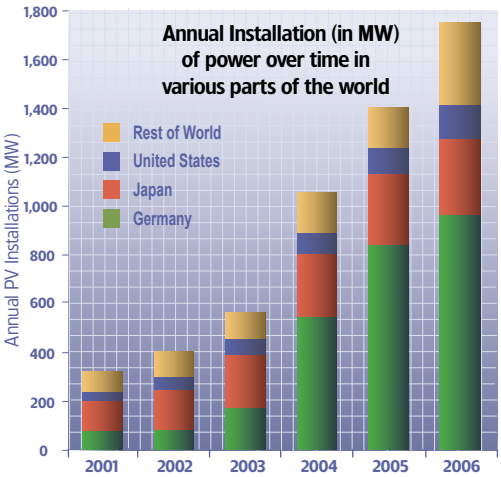
Solar electric energy has been one of the fastest growing markets in the world for nearly two decades. A key element of this expansion has been a steady decline in costs for technology driven by improved efficiency, improved manufacturing, and economies of scale. These trends are strengthened by increasing global consciousness of climate change and dwindling conventional resources.

As a result, the global market is booming. In 2006, annual installation of systems around the world exceeded 1,700 MW. In fact, more than half of all systems worldwide were installed in the last three years.[3] Annual global production levels rose above

Revenues for the global solar cell industry exceeded $10 B in 2006 and capital investments totaled $7 B that included more than $2 B in venture capital funding. This vigorous growth has occurred primarily in locations with substantial, long-term policies, incentives, enabling regulations, and strong economic development programs specifically directed at stimulating solar power manufacturing, deployment, and use.

2,000 MW in 2006, representing 36% year-over-year growth — global shipments have been growing at an average annual rate of more than 30% for several years.[3]

Germany's commitment to expand the industry has enabled nearly 1,000 MW to be installed in 2006 accounting for 55% of the world market. Japan led the world until recently and still comprises 17% of the



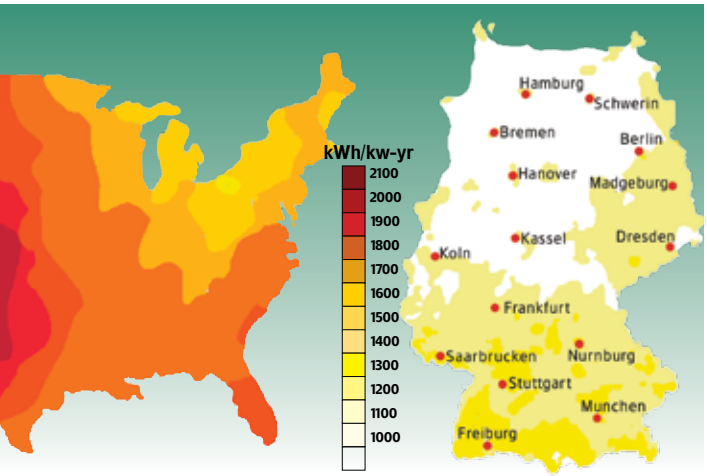
world market. The US market grew at a robust 33% in 2006 while the relatively new Spanish market tripled in size in one year.

New York has far better resources than Germany and New York's electrical usage patterns make solar power more effective. Germany has only 4 times the population of New York but currently has more than 300 times more installed capacity. New York offers substantial growth opportunities relative to Germany.

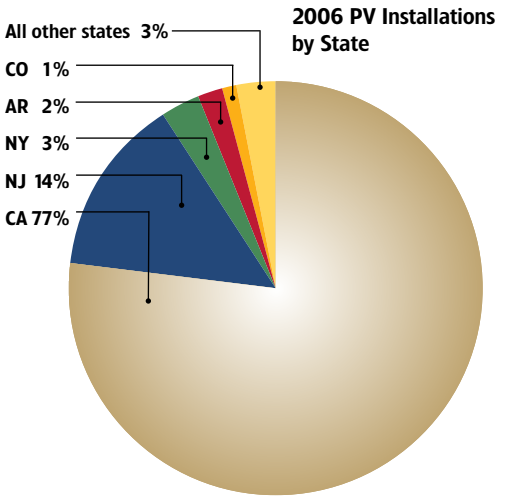
US Solar Markets

The US Department of Energy (DOE) developed a national solar power industry "roadmap" in 2004 which established a goal "to provide half of all new U.S. electricity generation by 2025[1]." As ambitious as the national roadmap is, it is specific state-level policies that are driving the solar electricity market today.

- As part of the Governor's Million Solar Roofs Program, California established the goal in 2006 of creating 3,000 MW of new solar electricity by 2017. A 10-year, $3 Billion "Go Solar California Initiative" is underway paid for by a surcharge on ratepayer's electric bill, estimated to cost a residential electric customer about $16 per year.[4]



Comparison of insolation maps of the eastern US and Germany that show the amount of sunshine received in each region



Market breakdown of solar power in the US by state

- In April 2006, the New Jersey Board of Public Utilities approved an expanded Renewable Portfolio Standard which calls for 20% Class I Renewables by 2020 and includes a minimum requirement of 2% New Jersey solar, corresponding to 1,500 MW.[5] New Jersey's Clean Energy Program has established rebates for installation of systems as well as Solar Renewable Energy Certificates, which can be sold by system owners to derive income from the output of their systems.
- Pennsylvania has approved a solar standard within the existing Alternative Energy Portfolio Standard that would bring the state to approximately 800 MW (one-half percent) by 2021.[6]

Solar module manufacturers usually locate part of their production close to stable markets, in states such as California, New Jersey and Pennsylvania. In turn, the states see increased solar module production and use as both an economic development opportunity as well as a renewable electricity supply opportunity.

DRIVERS AND CHALLENGES

Solar Power Costs A primary driver for recent industry growth is the reduction in cost of modules. Module prices have declined by more than a factor of ten — from about $32/Wp to $3/Wp in the last 20 years. However, the cost of current conventional electricity does not take into account tax incentives and so-called external costs, such as global warming and health damage from air pollution. Recent studies indicate that, in Europe, investments in renewable energy have avoided external costs of around €2.8 billion in 2005 alone.[7] Nevertheless, the capital cost of a solar power installation is the greatest challenge limiting their widespread use.

Countries and states experiencing rapid growth in this industry are those that have specific long-term incentives in place to help offset the price difference between solar and electricity from conventional sources. This enables the industry to mature, establish economies of scale, and develop infrastructure (for manufacturing, training and installation). For example, California's Solar Initiative provides incentives that decline gradually over

Reducing solar module production costs and the price of installed systems are key challenges the industry faces for its long-term expansion.

the 10-year life of their program, reducing to nothing by the end of 2017 — a program that is currently well ahead of schedule. Over time, as incentives and subsidies diminish, the industry is expected to become competitive without them as conventional energy prices and solar prices converge.

Technology Development Another key driver contributing to making solar power more competitive, particularly in the US, is continuing technology improvements, that include increased efficiency, advanced manufacturing techniques and economies of scale. Effective partnerships between industry, academia, and government are essential to achieving these goals.

Infrastructure With sustained annual growth at the 25% level, the industry faces great challenges in creating sufficient production capacity, a trained installation workforce, trained inspectors and other key infrastructure elements to keep pace. This represents a challenge in financial support, education and training, policy development, regulation and deployment logistics. The US has surrendered a number of technology markets to foreign suppliers in recent decades; it will take a concerted and substantial effort (in New York and other states) to avoid this outcome in this industry.

SOLAR POWER IN NEW YORK: TODAY

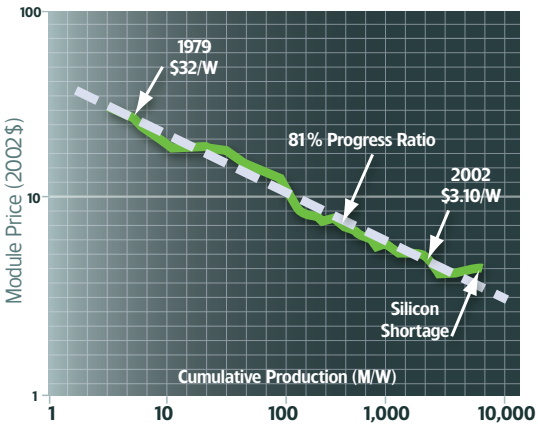
New York has a long history of producing a portion of the state's electricity from clean, sustainable, renewable energy sources. In 1994, New York was one of the first states in the US to establish a Renewable Portfolio Standard (RPS). As ordered by the New York State Public Service Commission (PSC), the state's RPS goal is to "increase the proportion of electricity attributable to renewable resources to at least 25% of electric energy used in NYS by the end of 2013."[8] As of January 2007, an estimated 19% of the state's electricity was generated from renewables. Solar power currently plays a minor role in this portfolio.

New York was an early leader in solar energy development in the eastern US, adopting a net metering policy and standard interconnection rules long before these were implemented in other states or countries.[9]

Most installations in New York have taken place under the auspices of three agencies: the New York State Energy Research and Development Authority (NYSERDA), the Long Island Power Authority (LIPA), and the New York Power Authority (NYPA).

The Solar Incentive program at NYSERDA has supported over 800 installations to date with a capital cost buy-down that is typically $4 per watt. As of early 2007, over 5 MW of systems have been installed under the program.[10] Funds for the program to date

Solar Panel Learning Curve



Cost reductions of solar modules with total production

come from the Systems Benefit Charge (SBC) assessed on ratepayers served by the six investor-owned utilities serving New York State.[11] Starting in September 2006, funds for installations from the SBC-funded Incentive are being phased out and replaced by funds from the NYSERDA-managed New York Renewable Portfolio Standard (RPS). NYSERDA also uses SBC funds for its New York Loan Program, which is a 10-year interest rate buy-down available to customers of energy-efficient and renewable energy technologies.

The Long Island Power Authority (LIPA) launched its Solar Pioneer Program in 2000 as part of a five-year, $32 million per year Clean Energy Initiative. In May 2003, LIPA extended the program another five years and increased funding levels by $5 million per year, to an annual investment of $37 million and a total investment of $185 million. This program is also a capital cost buy-down program that currently offers rebates of $3.75 per watt of installed capacity, limited to a maximum of 10 kW. As of early 2007, LIPA has issued rebates for 912 systems, constituting a total of 5.2 MW.[12] LIPA's early solar installation included the Fala Direct Marketing Building with 1.01 MW of power, which, at the time of the installation, was the largest privately-owned system in the United States. To accelerate the growth LIPA held a Solar Lottery Program and awarded 72 families with 660 watt systems. LIPA has a total of 988 systems installed for a total of 6.37 MW throughout Long Island.

The New York Power Authority (NYPA) does not have a dedicated fund for renewable energy, but has been actively involved in solar energy development since the early 1990s. By the end of 2005, NYPA had developed 24 projects totaling 633.7 kW.

In total there are more than 1,800 systems installed in New York with a cumulative capacity in excess of 12 MW. As a comparison, in the US as a whole, there were approximately 30,000 grid-tied systems by the end of 2006, with a total capacity of roughly 300 MW.

Residential Installation in New York

Comparison of existing PV installations for various countries and states relative to their population, and electricity generation capacity

	POPULATION (Millions)	PEAK[14] GENERATION CAPACITY (GW)	ELECTRICITY SALES (RETAIL) (TWH)	EXISTING[15] SOLAR POWER INSTALLATIONS (MW)
Arizona	6.2	25	69	13.7
New Jersey	8.7	18	82	27.1
New York	19.3	39	150	12
California	36.4	62	254	214
Germany	82.4	119	525	2,800
Japan	127.4	243	906	1,700

Over 90% of LIPA's projects and 80% of the NY-SERDA funds have gone to residential customers. Larger commercial systems scarcely exist in the state for several reasons. NYSERDA's incentive programs are limited to systems below 50 KW. In addition, current NYS legislation limits net metering to residential systems that are less than 10 kW.

New York City, with more than 40% of the state's population and an enormous appetite for electricity, represents a major potential market — especially with transmission and generation constraints threatening the city's energy future. Recent studies estimate that New York City could support between 6,000 and 15,000 MW of solar systems. Currently there are only about 50 installations in New York City producing an estimated 1 MW.[13] In part, this is because installations in dense urban environments are inherently more complex, and existing installers serving metropolitan New York cite higher installation costs due to local permitting, inspection, and other factors.

New York's population, electrical generation capacity and electrical demand rank high among US states and are significant even when compared to countries like Germany and Japan, which lead the world in solar power utilization. When it comes to installations, however, considerably smaller states with much lower electricity demand are ahead of New York.

New York is the third largest state in population and the fourth largest energy consuming state. It has similar residential use of electricity (34%) to the national average (37%) but much greater commercial use (51%) than the nation (35%). In contrast, industrial use of electricity in New York (at 13%) is much lower than the national average (28%).[16]

According to the EIA,[14] in 2005 New Yorkers paid the second-highest average retail electricity prices in the nation ($0.1395/kWh), second only to Hawaii. This makes solar electricity extremely attractive in New York relative to other states in the US.

BENEFITS OF SOLAR POWER IN NEW YORK

Addressing Peak Demand Although it is significant at the state-wide level, high solar power capacity is particularly relevant for the state's load pockets and distribution lines where local, clean peaking generation can make a difference between reliability and failure. New York's peak loads are synced up with the solar resources, where electricity usage follows air conditioning demand and business loads whose peaks are indirectly sun-driven.[17] In the context of weather-driven demand, solar power is installing ideally dispatchable power generation with no unscheduled downtime. Since more than half of New York's electricity is used by commercial customers, larger installations on commercial roofs can rapidly expand New York's capacity and have a significant effect on meeting peak demand.

Reducing Power Costs A recent study[18] compared solar output at the most expensive hours for electricity purchases. It found that about 1 GW, deployed across New England, would save between $130 and $280 million per year in power costs. Similar results are expected in New York where, simply reducing demand during the worst few hours of the year would decrease prices for ratepayers significantly.

Additionally, consumption of natural gas, oil and coal for power generation can be decreased. This helps the grid operate more efficiently by reducing transmission and distribution line losses. It also avoids building additional plants to meet peak summer demand. More capital investment savings can be achieved by delaying costly upgrades of new power lines and reducing stress on existing lines and infrastructure.

Protecting Against Blackouts Periods of maximum power demand lead to grid stress occasionally leading to major blackouts. It has been demonstrated[17] that power grid stress leading to rolling blackout or even regional blackouts could be avoided with solar power since these events usually occur when a nearly ideal amount of sunlight is available. The massive August 14, 2003 blackout is a case in point. Solar power availability

SunWize, Kingston, New York

With 2003 blackout cost estimates of $5–10 billion, these solar power installations would have paid for themselves many times over in just one day.

at the onset of the event was within 90% of ideal clear sky conditions. A detailed analysis of the outage shows that a few 100 MW dispersed in and around major northeastern cities could have averted the blackout by preventing specific cascading grid failures.

Enhancing Economic Development New York can become a regional leader in the surging new solar power industry. By implementing the proposed program in this roadmap, products made in New York State could provide 60 to 80% of the market demand in state, if private investments are matched with appropriate economic development programs to begin the build-out of manufacturing facilities.

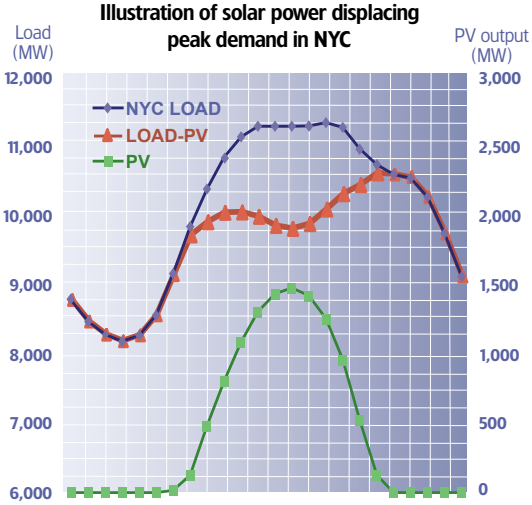
The value chain of the industry includes wafer, cell and module manufacturers, integrators of cells into systems, power electronics manufacturers, distributors, designers and system installers. According to the US Roadmap, each MW of installation supports 32 jobs along the entire value chain.

The program proposed (assuming that over 70% of the 500 MW annual demands of solar systems are manufactured in New York by 2017) could create 3,000 direct installation or maintenance jobs and over 10,000 highly skilled manufacturing and integration jobs by 2017.

The multiplier effect of this industry is expected to generate another 30,000 indirect jobs that would include service providers, suppliers, etc. This translates to New York's manufacturers needing employees who are trained in vacuum deposition, semiconductor manufacture, characterization, and power electronics, as well as line workers, and engineers and scientists from multiple disciplines. An estimate of direct employment of high paying skilled jobs that will be required in the next 5 and 10 years in New York is indicated in the table.

Improving the Environment: New York must find ways to reduce its carbon emissions. Nearly 59% of New York's power comes from burning hydrocarbons

Illustration of solar power displacing peak demand in NYC



Opportunity for job creation based on the roadmap

	2012	2017
Manufacturing	1,100	4,300
Engineering	200	700
Installers	750	2,900
Equipment	550	2,200
Sales/ Administrative	350	1,500
R&D	350	1,500
Total Jobs	**3,300**	**13,100**

to produce electricity, including coal, oil and natural gas. According to the Clean Energy Estimator[19] 2,000 MW of solar electricity in New York State would improve air quality and reduce global warming emissions by removing annually by 2017 about:

- 2 million tons of CO_2,
- 1,800 tons of NO_x and
- 5,300 tons of SO_2.

THE NEW YORK SOLAR ROADMAP

The key strategic steps required to achieve the vision and objectives of the roadmap are to:

1. Ensure that system owners can easily **connect to the grid** and capture the value of the energy they generate.

2. Establish a long-term program of **demand-pull incentives** for system owners. Incentives should be set at a level that results in a reasonable return on investment that encourages private investment, to build a strong regional market. The incentives should gradually decline over time.

3. **Create economic development regions** in New York State that include the entire supply chain of leading manufacturers, materials suppliers, integrators, designers, installers to enable robust employment and highly skilled job growth.

4. **Institute technology clusters of excellence** with specialized capabilities in technology development, prototyping, manufacturing development, engineering design, and scale-up to enable strong investment from private sources and to complement strengths of the economic development regions

1 Connecting to the Grid

There are many best-practice examples of connecting to the grid in other states that would be equally effective in New York.

Interconnection New York should update its Standardized Interconnection Rules (SIR), to be consistent with national best practices being embraced by other states that encourage installation of solar power for both large-scale commercial systems and smaller residential systems. Useful guidelines include:

- The IREC MR-I 2005 model, which provides an effective set of interconnection requirements that incorporates standards developed by various state governments, the Federal Energy Regulatory Commission (FERC), and the National Association of Regulatory Utility Commissioners (NARUC).[20]
- Recent best-practice guidance from US. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE) and Office of Electricity Delivery and Energy Reliability (OE).[21]
- Interconnection requirements that promote the installation of systems without requiring redundant and unique electrical codes, resulting in increasing costs, while not providing added benefits.
- Reviewing and updating the SIR periodically, to keep pace with advances in technology and installation techniques. Organizations in New York that have developed extensive expertise in SIR such as the Department of Public Service should be very useful as the technology and interconnection approaches continue to evolve.
- New York City's electrical grid presents unique problems for interconnecting large numbers of distributed generators. An independent, third-party study should be undertaken to better define these problems and to identify potential solutions.

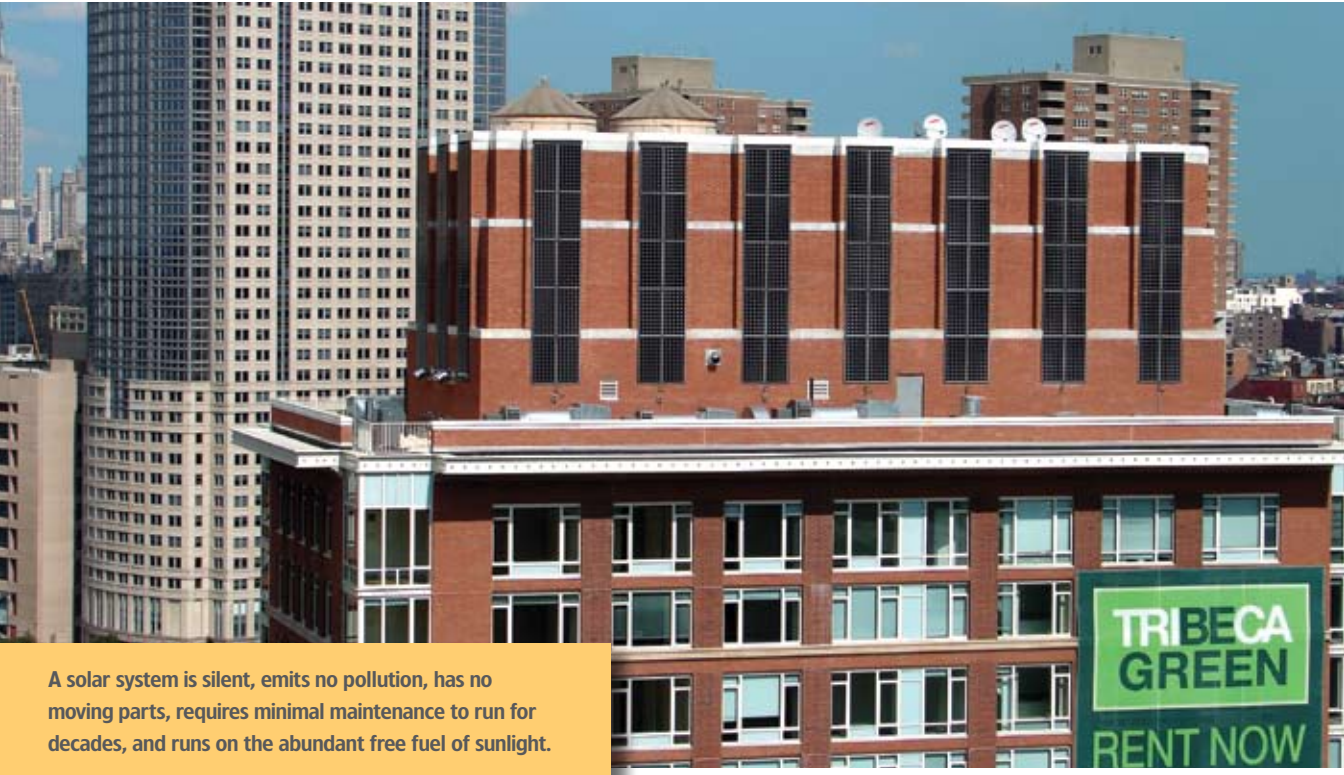
Net Metering New York should — similar to other states such as PA, NJ, MD, CA and NM — upgrade their net metering laws to provide for 2 MW (per meter) annualized, retail-rate net metering and to ensure net metering is available to all customer classes. This creates the foundation for rapid growth in distributed renewable energy technologies, complements state-incentive programs that are typically weighted towards relatively small residential systems, and helps make larger commercial installations more attractive. Larger systems are particularly effective at driving costs down which makes the technology more attractive for all users in the State.

Reducing Cost of Installations New York State should encourage cost reductions of installations with policies that: improve documentation requirements; streamline process requirements for permitting or approvals; reduce the need for inspections; use single meters for time-of-use customers; and separate certification/qualification of designers from electricians who perform installations. Cost reductions can also be accomplished by using advanced technology to implement electronic filing of permits and digital acquisition of system performance.

2 Establishing Demand-Pull Incentives

Providing incentives that make up the difference in cost or reduce payback periods of systems would create demand for the systems today. Moreover, enabling the deployment of larger systems by providing production incentives would help accelerate adoption. Such incentives have been seen in Japan, where a 1996 government program of declining incentives was gradually phased out until 2005, after which more than 60,000 solar homes were installed without subsidy.

Incentives can help make solar power cost-competitive with retail power. Through NYSERDA and LIPA, New York has developed the design and delivery of incentives such as tax credits, rebates, and loan guarantees to help reduce the overall cost to the customer. An expanded, longer-term incentive program should consider such existing incentive programs.



A solar system is silent, emits no pollution, has no moving parts, requires minimal maintenance to run for decades, and runs on the abundant free fuel of sunlight.

Moreover, the expanded program is expected to automatically encourage the private sector to take on the responsibility of developing advertising, outreach and worker training initiatives in order to develop a robust industrial sector.

The implementation of a 10-year, cumulative 2,000 MW solar power installation plan driven by the appropriate incentives will bring this industry into the mainstream in New York.

Proposed Incentives to Establish Demand-Pull An expanded 10-year New York incentive program can provide for dramatic growth of the **residential** solar market, as well as **not-for-profits** and, most importantly, **commercial** customers. An effective incentive plan must take into account the unique requirements of these distinct customer classes. For example, not-for-profits are not helped by tax incentives and therefore may need additional subsidies.

Residential Systems For these systems, incentives can continue the basic approaches already in place (through NYSERDA and LIPA), in the form of rebates, paid from the state's Systems Benefits Charge or alternative funding sources. Most programs throughout the country currently offer rebates that are typically $2.50–5/W for each installation and decline over time.

Commercial Systems In order to encourage maximum benefit from larger (primarily commercial) systems, performance-based incentives could be implemented as an effective alternative to buy-downs. These would be paid at a specific rate per kWh generated over a predetermined period as the system produces energy. Such feed-in tariffs ranging from $0.20 to $0.50/kWh are being offered in other locations. Similar to rebates for small systems, these incentives could be funded by ratepayer assessments such as the Systems Benefits Charge or by alternative funding sources.

We recommend that a detailed study be performed to determine the specifics of an appropriate incentive package that would include the impact of tax credits, clean air credits, depreciation, other potential offsets, system location, system type, and the resultant return on investment for each customer class.

Provide Long-Term Certainty A ten-year-long program provides visibility to a zero-incentive future, while providing enough certainty to permit long-term private investments on the part of the industry to evaluate establishing a major presence in New York.

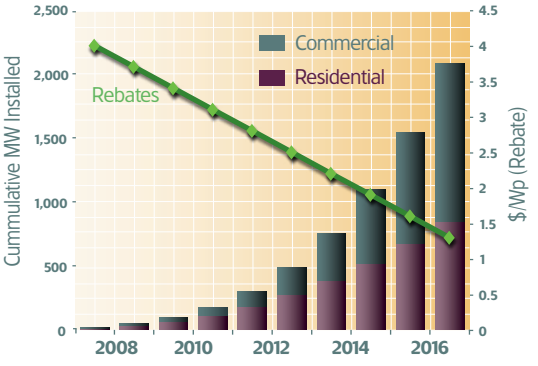
Reduce Incentives Over Time To maintain competitive pressure on industry and to capture cost reductions of solar technology, the proposed incentives will decline over time based on evaluation of market prices and solar installation progress by a suitable authority. Such a program would protect rate payers.

Model Example The total cost for a 10-year program to install 2,000 MW can be estimated based on assuming: an initial incentive of $4.00/Wp for residential systems and $0.40/kWh for commercial systems for the first five years of operation; a gradual phase-out of the initial incentives; a forecast 60%/40% ratio of commercial and residential megawatts installed; year-over-year growth of the program managed to reflect the ability of industry to supply and install systems; and allocation of funds based on aggregate MW limits. This model would require total "demand-pull" incentives of $2.2 billion over a 14-year period (large system production incentives would pay out for 4 years past the end of the 10-year program period) with a maximum annual outlay of around $280 million late in the program.

Why 2,000 MW? New York State's RPS commits to increasing the renewable contribution by at least 6% by 2013; this corresponds to over 9,000 GWh of new renewable energy per year.[14] Renewables such as wind power and biomass make good sense in New York and will be a big part of this total. However, solar electricity is the only renewable source that can be used in a distributed fashion virtually everywhere across the state and is the only renewable that can have a substantial presence in the New York Metropolitan area. Installing 2,000 MW of solar power in New York can provide over 2,200 GWh per year, or 24% of the RPS goal. With smart load management, 2,000 MW of PV could displace nearly the same capacity of current and planned peaking fossil power plants. It is comparable to the targets being set in states such as California, New Jersey and Maryland. A 2004 Navigant Consulting study[22] commissioned by the Energy Institute identified New York as the second largest potential market for solar power in the United States behind California. They projected an ultimate market in the state by 2025 of nearly 40,000 MW. Large commercial installations will rapidly expand New York's solar power capacity.

Under this scenario, more than half of the 2,000 MW would be installed during the last three years of the program when system costs (and incentives) would be at lower levels and when the infrastructure is in place to meet the large volume of business. These funds could be generated from rate payers, a bond fund or through a carbon tax program and is comparable to those implemented in other states. If the funds came only from ratepayers, the maximum annual cost for the average homeowner would be about $13.

Estimated growth of Solar Installations
(Residential and Commercial) based on model example



Provide Additional Flexibility The state should have additional freedom to mandate or institute extra targeted incentives in load pockets and other areas where solar power's contribution will be most beneficial in the short term. The potential for large-scale solar electric power plants should be explored.

3 Creating Solar Power Economic Development Regions

The Northeastern US is expected to be the nation's second largest solar power market[22] within the next ten years, and positioning New York adequately can make it the regional hub for the industry. Success for New York's initiative will result from a commitment to foster market development, ease of installation, manufacturing, and research and development. Investing and leveraging our present assets and technologies will enable New York to remain competitive with other states, Europe, and Japan.

Leveraging New York's assets New York State — and especially the City — provides one of the largest solar power markets in the US.

A cluster of jobs related to marketing and sales personnel, architects, system designers, installers, maintenance engineers, service providers is envisioned around the City to meet demand. Similarly, a cluster of system integrators is already developing around the Hudson Valley. Expertise in high-tech semiconductor manufacturing, R&D and pilot prototyping that can adequately serve the solar cell manufacturing industry exists around Tech Valley (Capital Region) and the Hudson Valley. Moreover, module manufacturing, wafer handling and processing could be developed in other parts of upstate New York.

Thus several regions can leverage existing strengths and organizations to support the fledgling manufacturing and integration industry across the entire state. New York State has already invested in educational programs and workforce training to attract, retain and grow semiconductor companies with similar skills that are required by solar cell manufacturers already providing access to a large skilled labor force.

Universities The Albany NanoTech Complex represents a consolidation of manufacturing, development, equipment design and a center of expertise in thin-film technologies that are attractive for many solar cell companies. Moreover, New York has several renowned engineering universities, both private (Renssalaer Polytechnic Institute, Syracuse University, University of Rochester, Cornell, Columbia, Clarkson) and public (University at Albany, Buffalo, Binghamton, and Stony Brook), some of which are already advancing state-of-the-art solar technology.

Industry New York is home to an emerging solar power industry with a thin-film manufacturer (DayStar Technologies), three inverter manufacturers (Advanced Energy Conversion, Wiley Electronics and Inverters Unlimited) and a roof-slate manufacturer (Atlantis). General Electric has entered the industry, and IBM is involved in developing solar power technologies, as are other semiconductor equipment manufacturers with a New York presence, such as Applied Materials and Tokyo Electron.

Infrastructure New York is the financial capital of the world with numerous private investment firms including institutional, venture capital and others that

provide access to opportunities within a very reliable investment environment. In addition, New York serves as a worldwide trading port with an advanced transportation, telecommunication and facilities infrastructure. The solar power supply chain offers strong investment opportunities, especially for collaboration between industry partners.

Encouraging partnerships between universities, government and industry to advance cells, BOS (Balance of System) manufacturing and product technologies will provide a significant benefit to industry in New York State. Local technology companies could enjoy an advantage over those importing products from other countries or states.

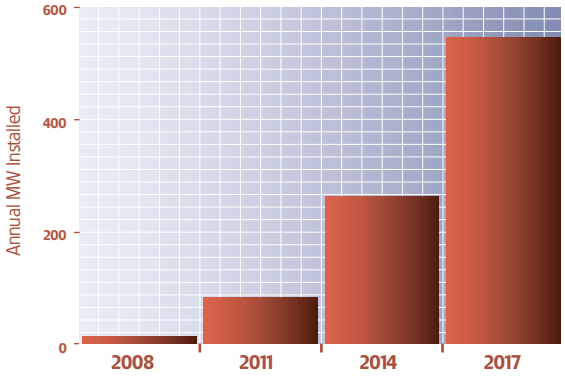
Incentives to Develop Clusters Proposed investments over five years, in economic development matching grants to private investments, would accelerate the formation of the in-state infrastructure and the high technology manufacturing industry in New York. The investments would be in the form of:

Economic Development Grants and Loans
Allocating investment grants over the first five years will help fund the acquisition of production equipment for manufacturing by small and medium sized companies (up to 50%) and for larger companies (up to 30%). It will also provide sufficient incentives for start-ups and large companies to locate manufacturing and product integration in proximity to one of the nation's largest markets to ensure a reliable, local supply of high-quality systems. These grants will ensure that over 500 MW of manufacturing facilities will be established to meet the supply needs of New York. The state can be the home of companies across the entire supply chain starting from the silicon feedstock through finished solar modules. Loans for facilities and site infrastructure including state-guaranteed loans will attract significant private capital for manufacturing in the state that will be extremely effective in bringing about a strong local industry.

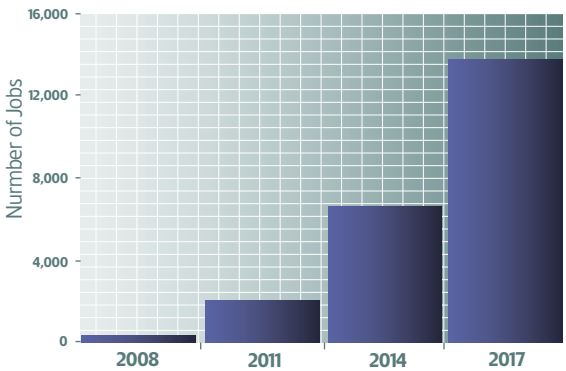
Offering a tax credit for each "MW Manufactured" in New York should be considered a key aspect of the program. This can be similar to a production tax credit and can make the state very attractive as a base. Moreover, allowing tax credits earned in New York to be sold for cash to others would add a lot of value to the Empire Zone's program as well as the "MW Manufactured" tax credit system. Other states have established similar successful credits-for-cash programs.

The rapid growth of the industry in recent years has been hampered by a shortage of silicon feedstock. The large amount of material required by industry growth rapidly outpaced production capability of the silicon industry, previously dominated by computer chip manufacturing. Although the raw material required (i.e. sand) is abundant, processing capacity was insufficient to meet growing demand. Providing attractive manufacturing incentives to the industry will enable addition of new manufacturing plants in New York to ensure sufficient supply of silicon wafers used for solar cells.

Estimated annual solar installations (MW) with Solar Initiative of New York



Estimated jobs created with Solar Initiative of New York



Workforce and Training Assistance Labor grants and training assistance over five years would serve as an attractive package. Directing these to in-state manufacturers will reduce costs while improving efficiency and equipment reliability. There should be continued and expanded education, training, and workforce development to ensure a qualified, skilled labor force able to successfully sell, design and install systems throughout the state.

Development of a stable solar workforce depends on the stability of the incentives both from the standpoint of the number of people training to do the work and the willingness of the industry to provide permanent jobs. Long-tem strategy, plans and incentives allow businesses to plan, grow and invest.

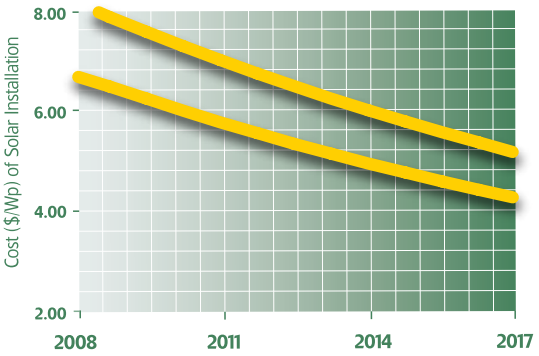
4 Instituting Technology Clusters of Excellence

Increasing technology development funding over five years, matched by private industry, at universities and other research organizations will enable increased focus on innovations to reduce cost, improve efficiency and develop faster processes. For example a university-based center to address manufacturing scale-up issues

for focused cost reduction and performance enhancement approaches would provide direct benefits to the manufacturing industry in New York State.

Technology for Cost Reduction The Department of Energy's Solar America Initiative (SAI) has set aggressive cost reduction targets and has initiated a multiyear program seeking to reduce the levelized cost of solar energy by 2/3 by the year 2015.[23] With modules comprising half the cost of current systems, a significant part of the effort is aimed at reducing their cost. Today, over 90% of the solar panels produced use either crystalline silicon or polysilicon that is cast into a brick and then sawed into

Estimated range of cost reductions for solar installations over time with Solar Initiative of New York



thin wafers. This significant amount of silicon limits the ultimate cost reduction that can be obtained and the industry is increasingly looking at thin-film technology for more dramatic reductions in solar cell costs. Although thin-film devices currently constitute only a minor share (well under 10%) of the current market, it is expected that their share will grow substantially over time. Thin-film technology uses similar approaches that are widely used in the semiconductor industry and can take advantage of the tools, techniques, and materials developed for integrated circuits, flat-panel displays and other products. Most importantly, thin-film cells use far less raw material than those made from silicon wafers. This can lead to much lower costs. A recent study predicted that thin-film technology would increase ten fold from the present production capacity of 170 MW to 1,800 MW in 2010.[24] New York has broad expertise in multiple aspects of thin-film technology and should focus manufacturing to play a major role in this area.

Support Pre-Commercial R&D New York should support and expand research programs in applied research at academic institutions to assist in solving the scientific challenges and technical barriers for cost reductions and efficiency improvements of thin film systems. It will be important to facilitate the transfer of scientific knowledge from academic institutions to its industry cluster. A solar innovation consortium should be formed to advance technology development and technology transfer within the state. As the industry matures, the consortium will be able to support itself from private funds.

Support Technology Development New York needs to cost-share funds for technology development with the private sector. This will simulate more private sector technology development and encourages industry to find technical solutions needed for commercialization. New York could attract more private and federal R&D funds to these cost-share initiatives.

Demonstrate Innovative Technologies in Integrated Systems Careful integration of prototype production, scale-up of thin film manufacturing and system integration is needed to rapidly increase supply of solar power technology and to realize the vast potential benefits in New York State. An accelerated prototyping and scale up program is needed to provide the stimulus to bridge the gap from development to manufacturing of components. Emphasis should be placed on thin-film cells, modules and integrated systems.

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SUMMARY AND RECOMMENDATIONS

The environment, economy, and energy consumers in New York could all benefit substantially from an alignment of electricity supply, jobs development, and high-tech-based manufacturing objectives through a new industry-led initiative to expand the manufacturing and deployment of solar power systems in New York. For New York to realize the significant economic, environmental, and employment benefits, the state will need to vigorously pursue market expansion, supportive policies, and targeted research and development.

As an overall strategic goal, the Solar Initiative of New York proposes to increase deployment in New York State from a current cumulative total of about 12 MW of grid-connected electricity as of January 2007 to over 2,000 MW by 2017. By achieving this goal, New York will:

- ☑ *Increase its peak generating capacity in the form of clean, renewable energy*
- ☑ *Reduce carbon emissions by 2 million tons annually*
- ☑ *Create more than 13,000 new jobs in New York*
- ☑ *Make New York a regional leader in the growing solar power industry*

To achieve these goals we have outlined specific recommended initiatives in four key areas:

Recommended Actions for Connecting to the Grid:

- Update Standardized Interconnection Rules in accordance with current national best practices to encourage both large-scale commercial systems and smaller residential systems
- Upgrade net metering laws to provide for 2 MW (per meter) annualized, retail-rate net metering for all customer classes

Recommended Actions for Establishing Demand-Pull Incentives:

- Adopt a 10-year incentive program to support the installation of 2,000 MW of residential, not-for-profit, and commercial solar power in the state
- Include and expand the rebate (or buy-down) program for residential systems
- Include a production incentive program for commercial systems based on kWh of generated power over a fixed period of time
- Reduce incentives over time to capture the value of the declining cost of solar technology

Recommended Actions for Creating Solar Power Economic Development Regions:

- Create solar power economic development regions leveraging New York's assets in universities, in industry, and in financial infrastructure
- Create a five-year program to promote economic development, develop manufacturing infrastructure, and expand New York's solar workforce
- Expand education, training, and workforce development to ensure a qualified, skilled labor force able to successfully sell, design and install systems throughout the state

Recommended Actions for Instituting Technology Clusters of Excellence:

- Provide funding over five years for universities and other research organizations to reduce cost, improve efficiency and advanced manufacturing for thin film solar power components
- Support pre-commercial R&D, Technology Development and demonstration of innovative technologies

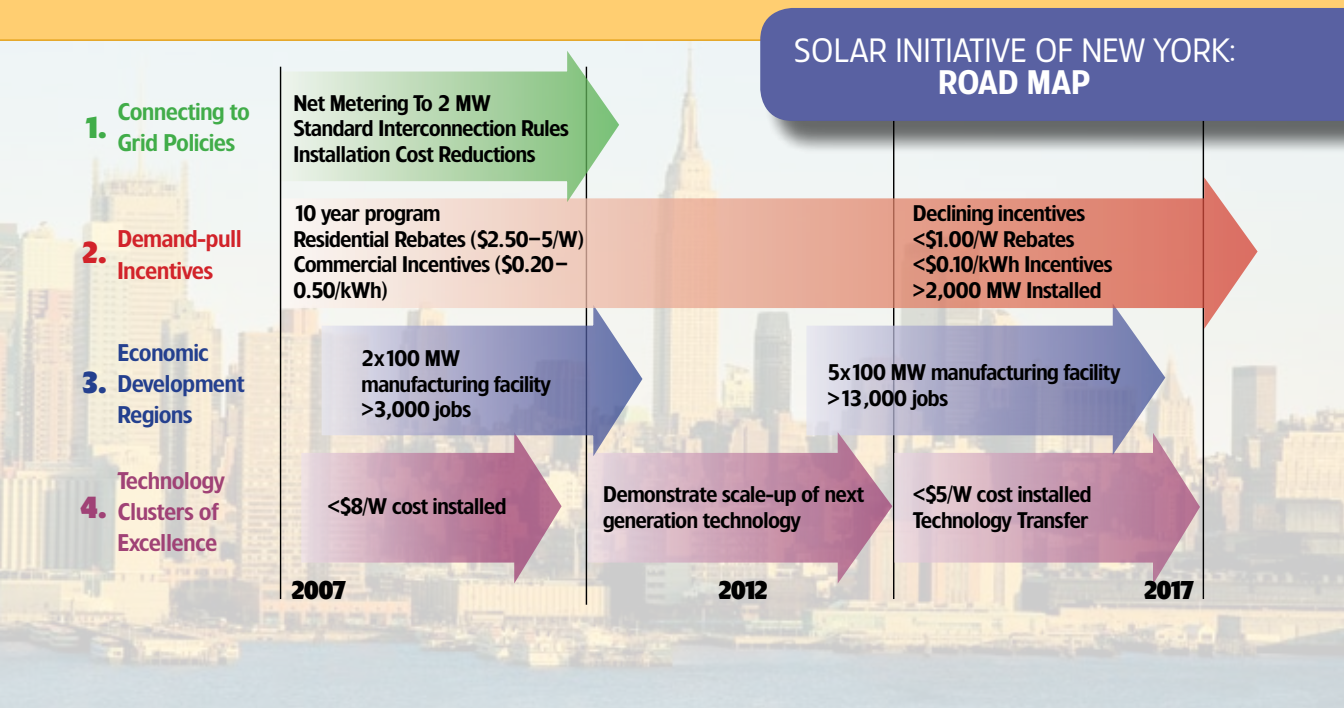

Photo: CNSE

The College of Nanoscale Science and Engineering (CNSE) of the University at Albany, State University of New York is the first college in the world devoted exclusively to the research, development and deployment of innovative nanoscience, nanoengineering and nanoeconomics concepts. In May 2006, it was ranked by Small Times magazine as the nation's number one college for nanotechnology and microtechnology.

CNSE is located in the most advanced research complex of its kind at any university in the world: the $3 billion, 450,000-square-foot Albany NanoTech complex, a fully-integrated research, development, prototyping, pilot manufacturing and education resource with a strategic portfolio of state-of-the-art laboratories, supercomputer and shared-user facilities and an array of research centers.

The Energy and Environmental Technology Applications Center (E2TAC) provides a critical platform for CNSE to leverage its intellectual power base and state-of-the-art infrastructure by providing an applications-targeted resource that supports technology development that leads to the integration of nanotechnology, advanced energy and environmental applications.

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