



New York State  
**Clean Energy  
Technologies**  
Innovation Metrics

**2015** Final Report



NEW YORK  
STATE OF  
OPPORTUNITY.

NYSERDA

## **NYSERDA's Promise to New Yorkers:**

NYSERDA provides resources, expertise, and objective information so New Yorkers can make confident, informed energy decisions.

### **Mission Statement:**

Advance innovative energy solutions in ways that improve New York's economy and environment.

### **Vision Statement:**

Serve as a catalyst – advancing energy innovation, technology, and investment; transforming New York's economy; and empowering people to choose clean and efficient energy as part of their everyday lives.

# **New York State**

## Clean Energy Technologies Innovation Metrics

### **2015**

Final Report

**Prepared for:**

New York State Energy Research  
and Development Authority (NYSERDA)  
Albany, NY

Jacques Roeth  
*Project Manager*

**Prepared by:**

SRI International

Jennifer Ozawa  
Elizabeth Tennant  
*Project Managers*

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# Table of Contents



<b>Executive Summary</b> . . . . .	3
<b>Background and Approach</b> . . . . .	9
<b>Research and Innovation</b> . . . . .	11
Key Findings . . . . .	12
Competitive R&D Awards . . . . .	13
University R&D Activity . . . . .	15
R&D Outputs . . . . .	17
Commercialization Activities . . . . .	27
<b>Business Environment</b> . . . . .	30
Key Findings . . . . .	31
Venture Capital . . . . .	32
Exits . . . . .	36
Workforce . . . . .	39
Cost of Doing Business . . . . .	41
<b>Industry Development</b> . . . . .	45
Key Findings . . . . .	46
Green Economy . . . . .	47
Business Creation and Growth . . . . .	50
Exits . . . . .	55
<b>Clean Energy Market</b> . . . . .	56
Key Findings . . . . .	57
Energy Consumption . . . . .	58
Energy Price . . . . .	62
Energy Production . . . . .	63
Consumer Market Behavior . . . . .	64
Energy Policy . . . . .	68
<b>Appendix</b> . . . . .	72
Bibliography . . . . .	73
List of Indicators . . . . .	75
Acronyms and Abbreviations . . . . .	79
Photo Credits and Captions . . . . .	80

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NYSERDA would also like to thank Frank M. Surdey, Managing Economist, NYS Department of Labor and James R. Held, Research Director, Empire State Development for providing their broad expertise in economics and metrics.

An aerial, top-down view of a large, circular architectural structure. The structure features a central green island with several trees and a paved walkway. A person is visible on the walkway, looking out. The structure is surrounded by a series of concentric, curved walkways or railings. The overall design is modern and geometric, with a hexagonal pattern overlaid on the image. The text "Executive Summary" is centered in a dark hexagonal shape.

# Executive Summary

Inventors in NYS rank in the **top three** states nationally in total number of cleantech patents awarded.

NYS cleantech companies jumped from 11th to 5th in cleantech venture capital dollars attracted.<sup>1</sup>

## New York State: A national leader in cleantech

New York State (NYS) is a leader in supporting cleantech innovation, new company formation, and market expansion. This leadership is evident in New York State's ranking on a number of cleantech innovation and economic indicators, according to this 2015 New York State Clean Energy Technologies Innovation Metrics Report.

New York is among a small group of top-ranked states driving cleantech innovation, including California, Massachusetts, Colorado, and Michigan. NYSERDA debuted its first baseline metrics report in 2012. Data presented in this 2015 report shows that New York has been able to maintain or improve its standing in many of these indicators three years later.

Notably, inventors in NYS rank in the top three states nationally in total number of cleantech patents awarded, and NYS cleantech companies jumped from 11th to 5th in cleantech venture capital dollars attracted.<sup>1</sup> This report highlights examples of NYS cleantech startups that have attracted significant private investment or have made successful exits.

### Definition of Cleantech

Clean technology, or cleantech, is an umbrella term that refers to technologies that generate commercial benefits to customers while addressing environmental concerns, such as global climate change, sustainability, and energy security. It spans many vertical industries and includes technologies that fall into the following eight categories, as defined by Kachan & Co. (2012): renewable energy generation, energy storage, efficiency (energy and building), transportation, air and environment (emissions, recycling, and waste), clean industry (design, materials, production), water, and agriculture. This report focuses on clean energy technologies and has chosen to exclude metrics on environment, water, and agriculture.

### About This Benchmarking Study

The *New York State Clean Energy Technologies Innovation Metrics* report tracks the development of the State's cleantech industrial base and innovation system using a suite of indicators. These metrics were selected based on input from private sector focus groups regarding the type of information deemed important in making cleantech investment, expansion, and operations decisions. Aggregating input from nearly 100 individuals in New York and Silicon Valley help to represent the perspective of cleantech startups, incubator directors, risk capital investors, established cleantech companies, trade associations, universities, and economic development organizations. These stakeholders were surveyed in 2015 to gather feedback about which of the cleantech metrics used in the 2012 edition report they found most useful and how the information could be further improved and disseminated. These suggestions were incorporated into this 2015 edition of the report.

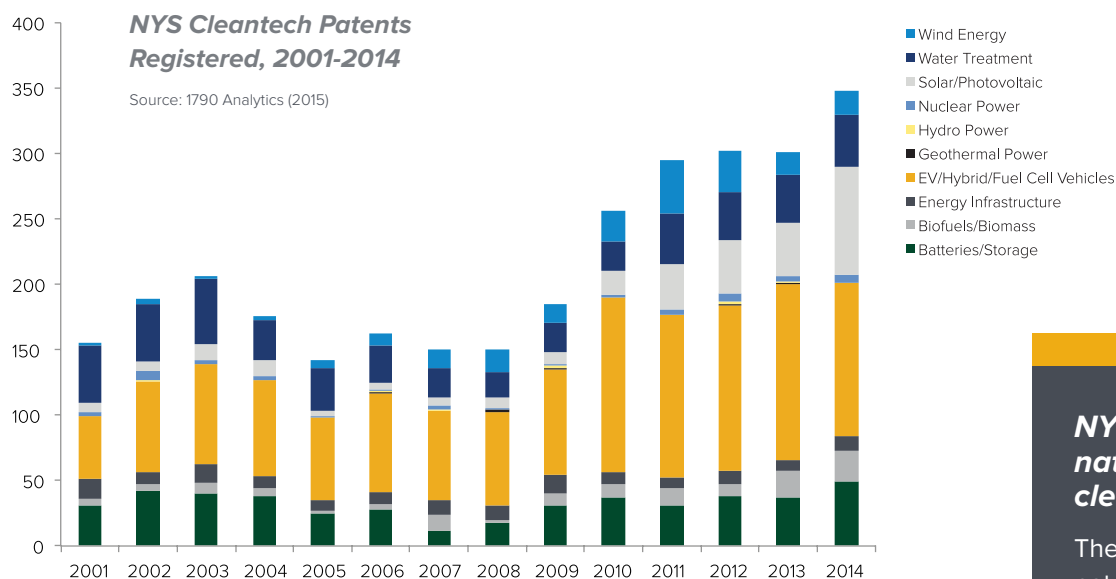
The following four indicator groups further illustrate NYS' cleantech landscape.

<sup>1</sup> Based on data from Cleantech Group (2015); this is not a time-series data source, therefore comparison of 2012 and 2015 report rankings should be interpreted with caution. To account for venture capital volatility, SRI totaled cleantech venture capital investments for five-year time periods, 2008-12 for the 2012 ranking and 2010-14 for the 2015 ranking.

## Research and Innovation:

### How competitive is New York State in winning R&D funding and commercializing new technologies?

Research universities, government labs, and companies in NYS rank in the top 10 nationally in several Research and Innovation indicators, including university research expenditures and licensing, U.S. Department of Energy (DOE) and Advanced Research Projects Agency-Energy (ARPA-E) R&D funding, cleantech patenting, and Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) seed funding.



**NYS ranks 3rd nationally in cleantech patents.**

The number of cleantech patents awarded to NYS inventors has risen each year since 2008. NYS cleantech patent activity is particularly high in the electric vehicle (EV)/hybrid/fuel cell vehicles and solar sectors.

#### Research and Innovation Dashboard

Indicator	Relative State Rankings	
	2012	2015
Total number of clean technology patents	2	3
Total university research expenditures	2	3
Number of licenses & options executed by universities	3	3
Total value of competitive DOE awards	5	3
Industry-sponsored university research expenditures	4	4
Total value of SBIR/STTR Phase I/II awards	5	5
Total value of ARPA-E awards	5	6
Total number of SBIR/STTR Phase I/II awards	7	6
Total value of DOE contracts	10	9
Industry share of sponsored university research expenditures	17	11

**NYS ranks 5th in both cleantech venture capital dollars and deals from 2010 to 2014.**

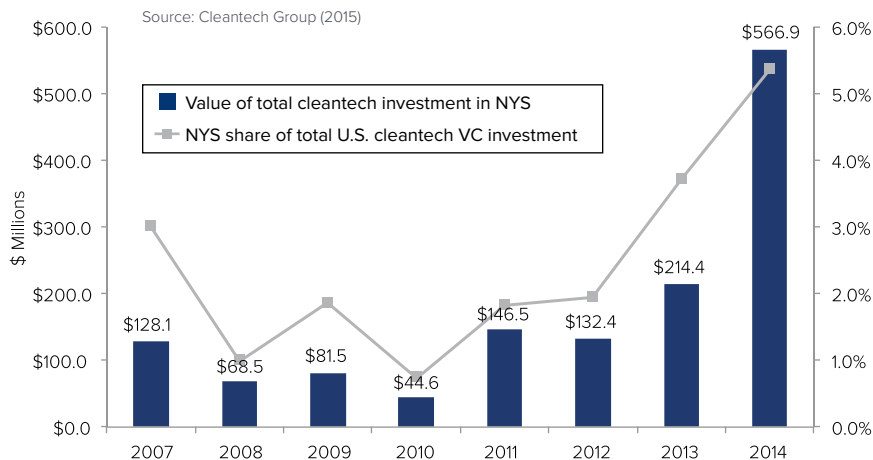
NYS companies attracted nearly \$1.1 billion in cleantech venture capital (VC) investment from 2010 to 2014. This number includes \$291 million of VC investment in the energy efficiency sector and \$107 million in the energy storage sector from 2010 to 2014. NYS experienced strong growth in cleantech VC deals over this same period, increasing from 17 deals in 2010 to 49 deals in 2014.

**Business Environment:**

How attractive is New York State’s business environment for expanding cleantech companies?

NYS ranks highly in many business environment categories, including access to risk capital and availability of skilled workforce. However, relatively high taxes add to the cost of doing business in the State.

**NYS Cleantech Venture Capital Investment, 2007-2014**



**Business Environment Dashboard**

Indicator	Relative State Ranking	
	2012	2015
Total number of STEM degrees granted	2	2
Total venture capital dollars invested	3	3
TechAmerica high-tech employment rank	3	3
Private sector Green Goods and Services jobs	4	3
Cleantech venture capital dollars invested*	11**	5
Cleantech venture capital deals*	5**	5
Per capita number of STEM degrees granted	19	17
Total Effective Business Tax Rate	41	41

\* This is not a time-series data source, therefore comparison of 2012 and 2015 report rankings should be interpreted with caution.

\*\*2012 report rank re-calculated using updated data and methods.



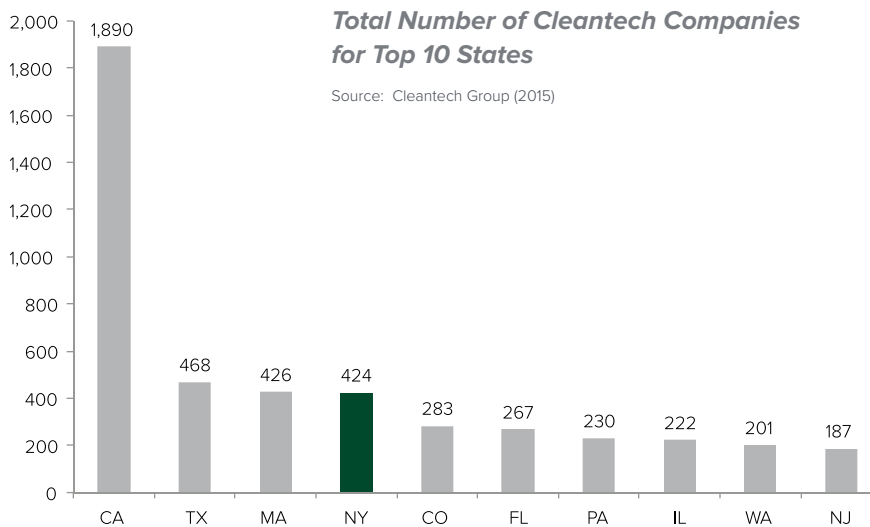
## Industry Development:

### How developed is New York State's cleantech industry base and related sectors?

NYS has the 3rd largest state economy and per capita GDP, and the 4th largest number of cleantech companies. NYS also ranks 3rd for average annual number of companies on Deloitte's Technology Fast 500 companies (2012-2014), a ranking of the fastest-growing private technology companies in North America.

**NYS ranks 4th nationally in number of cleantech companies.**

NYS has the 4th highest number (424) of cleantech companies, according to the Cleantech Group. Although California is the clear front runner with 1,890 companies, NYS is close behind Texas (468) and Massachusetts (426), which rank 2nd and 3rd, respectively.



### Industry Development Dashboard

Indicator	Relative State Ranking	
	2012	2015
Size of economy (gross state product)	3	3
Average number of Technology Fast 500 companies (3 fiscal year average)	3	3
Private sector Green Goods & Services jobs	4	3
Per capita real gross state product	6	3
Total number of cleantech companies*	4	4

\* Due to the nature of the data source and/or methodology changes, rankings from the 2012 and 2015 reports may not be directly comparable.

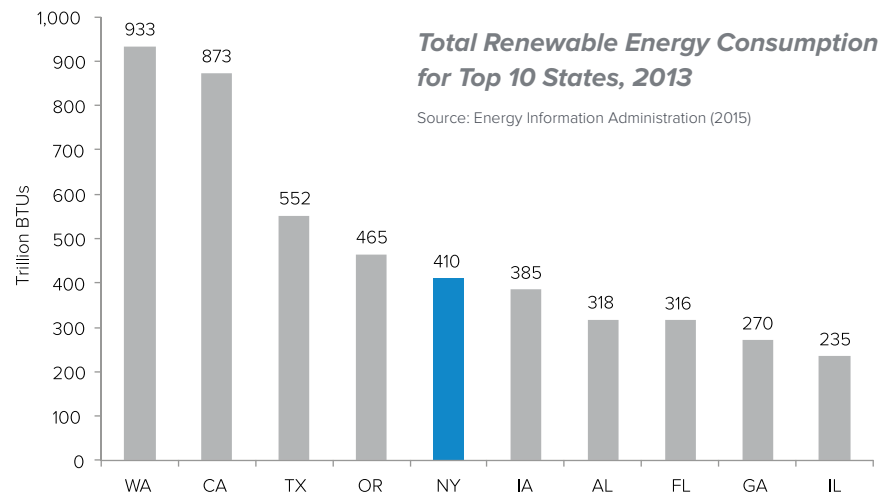
**New York State ranks 5th in renewable energy consumption.**

Only Washington, California, Texas, and Oregon consumed more renewable energy than NYS in 2013. The 410 million Btu of renewable energy consumed in NYS in 2013 comprise more than 11% of the State's total energy consumption, one of the highest shares in the country.

**Clean Energy Market:**

**What is the market size for renewable energy and energy efficiency products and services?**

NYS represents a sizable market for renewable energy and energy efficiency companies, ranking 5th nationally in renewable energy consumption. In addition, *Reforming the Energy Vision* (REV) is Governor Andrew M. Cuomo's comprehensive energy strategy to transform New York State's utility business model and overhaul its energy efficiency and renewable energy programs. This strategy aims to grow New York clean energy markets.



**Clean Energy Market Dashboard**

Indicator	Relative State Ranking	
	2012	2015
Total electric and gas efficiency program budget	2	2
Total LEED-certified square footage*	6	4
Number of alternative fuel vehicles	5	4
Total renewable energy consumption	4	5
Total number of net metering customers	5	6
ACEEE State Energy Efficiency Policy Score	3	7
Total energy consumption	8	8
Per capita LEED-certified square footage*	15	11
Net metering customers per capita	18	21
Alternative fuel vehicles (share of total)	28	26

\* 2012 report rank re-calculated to match methods used in the 2015 report.

A blurred background image of a business meeting with people in white shirts and ties gathered around a table. A white hexagonal grid is overlaid on the image. A dark grey hexagon in the lower right contains the text 'Background and Approach'.

# Background and Approach

# Tracking the Development of New York State's Cleantech Sectors

The *New York State Clean Energy Technologies Innovation Metrics* report tracks the development of the State's cleantech industrial base and innovation system using a suite of indicators.

## Metrics Selection

The metrics presented in this report provide data and information of interest to private sector stakeholders, as reflected in the original focus groups and follow-up survey. It is NYSERDA's intent to track and report these metrics over time.

Metrics were selected based upon input from nearly 100 individuals in New York State and Silicon Valley representing the perspective of cleantech startups, incubator directors, risk capital investors, established cleantech companies, trade associations, universities, and economic development organizations. The objective of these focus groups was to bring an informed, "market" perspective to bear and identify the type of information most important to making cleantech investment, expansion, and operations decisions.

## Themes

Four major themes and categories of indicators were developed based on this feedback. The set of cleantech innovation metrics seek to address four key questions:

- **Research and Innovation:** How competitive are New York State companies, research universities, and government labs in winning federal R&D funding and commercializing new technologies?
- **Business Environment:** How attractive is the New York State business environment for new and expanding cleantech companies?
- **Industry Development:** How developed is the New York State cleantech industrial base and how competitive are enabling economic sectors, such as manufacturing and IT/software?
- **Clean Energy Market:** What is the size and current potential market for renewable energy and energy efficiency products and services in New York State and the larger Northeast Region?

## User Feedback

In 2015, many of the same stakeholders who contributed to the development of the cleantech indicators were surveyed to gather feedback on which metrics in the 2012 report they found most useful and how the information could be further improved and disseminated.<sup>2</sup> A short, Web-based survey was distributed to approximately 90 stakeholders in New York State and Silicon Valley and 47 valid survey responses were recorded, for a response rate of more than 50%. Findings and suggestions from this survey are incorporated in the 2015 version of the report.

Based on survey feedback, cleantech venture capital investment data has been presented in more detail in the 2015 metrics: specifically, in addition to aggregate figures, investments are now also broken down by stage of deal and by cleantech sector. Also based on survey feedback, NYS SBIR/STTR grants are now broken down by funding agency. No indicators have been eliminated based on the survey findings, as all metrics were found to be useful to at least a large minority of survey respondents. Two indicators did have to be removed from the 2015 metrics because updated data are not available from the reporting agencies: ENERGY STAR® qualified appliance retail sales (formerly published by ENERGY STAR) and the State and Local Business Tax Competitiveness Index (previously published by Ernst & Young LLP and the Council on State Taxation).

## About the Data

The data used to construct the *New York State Clean Energy Technologies Innovation Metrics* report were selected based on validity, reliability, and fitness for purpose following an extensive search and review of accessible data sources. When possible, sources were selected that collect and publish reliable time-series data at the state level on an annual or sub-annual basis, making them suitable for comparison across states and time. Although the majority of data met these criteria, reliable time-series data was not available in some cases. For example, data about cleantech companies is a snapshot in time from a continually updated database. Because growth in observed values may be due to improved access to data, direct time-series comparisons are likely to be biased. Even with reliable data, the inherent volatility of some indicators may limit the usefulness of short-term temporal comparison. The report provides benchmarks across states via rankings to control for macro trends and data biases, and use multi-year averages for naturally volatile metrics.

<sup>2</sup> This survey was not designed to demonstrate impact, but instead to better understand stakeholder use of the 2012 report and gather qualitative suggestions for improved content and dissemination in the 2015 update. The sample was opportunistic (not random) and the results should not be interpreted as representative of the larger Clean Energy Technology community.



Research and  
Innovation



NYC ACRE incubator

## Research and Innovation:

### How competitive is New York State in winning R&D funding and commercializing new technologies?

An innovation system is the network of actors whose activities create, acquire, modify, and diffuse new technologies. These actors include research and development (R&D)-intensive companies, research universities, government labs, incubators and accelerators, investors, government funding and regulatory agencies, educational institutions (including community colleges), and customers (private sector and government procurement). The strength of a region's innovation system can be measured by the strength and connections between the actors. Both factors impact a region's industrial competitiveness and economic growth.

The Research and Innovation indicator group tracks how well NYS' companies, universities, and government labs are generating new ideas, clean technologies, and intellectual property compared to other states. As indicated in the dashboard table below, NYS ranks highly according to a range of Research and Innovation metrics.

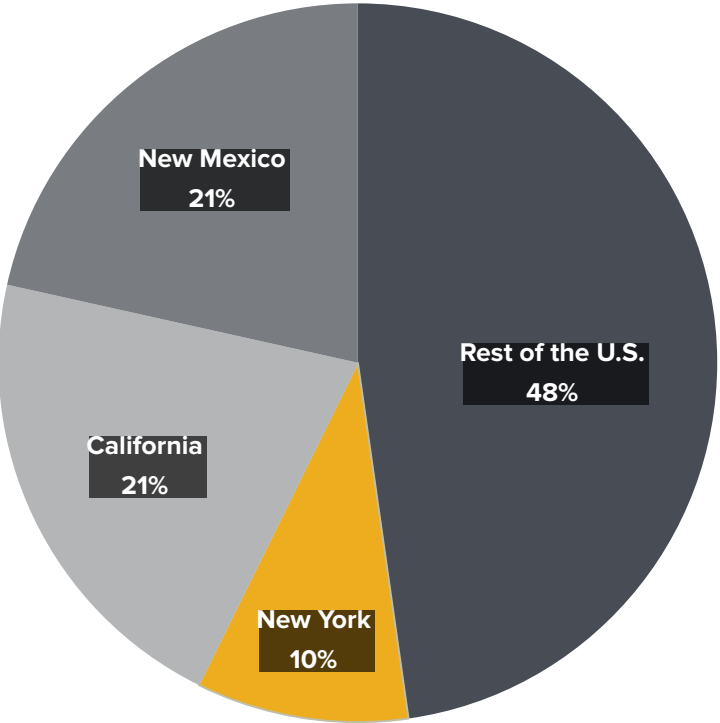
Research and Innovation Dashboard			
Indicator	Relative State Rankings		Change in Rank
	2012	2015	
Total number of clean technology patents	2	3	▼
Total university research expenditures	2	3	▼
Number of licenses & options executed by universities	3	3	—
Total value of competitive DOE awards	5	3	▲
Industry-sponsored university research expenditures	4	4	—
Total value of SBIR/STTR Phase I/II awards	5	5	—
Total value of ARPA-E awards	5	6	▼
Total number of SBIR/STTR Phase I/II awards	7	6	▲
Total value of DOE contracts	10	9	▲
Industry share of sponsored university research expenditures	17	11	▲

# New York State ranks 3rd: Nearly \$1 billion in U.S. Department of Energy R&D funding.

NYS' federal R&D funding from the DOE totaled \$940 million in federal fiscal year (FY) 2013, according to the National Science Foundation. NYS' share accounts for 10% of total DOE R&D funding and is surpassed only by New Mexico and California, which have multiple DOE national laboratories and lead all other states by a wide margin. California, New Mexico, and New York together received more than half of DOE R&D funding in FY 2013.

**Share of U.S. Department of Energy R&D Funding FY 2013**

Source: National Science Foundation (2015)



Source: National Science Foundation (2015)

**Federal R&D Funding from the U.S. Department of Energy for the Top 10 States, 2009 (\$ Millions)**

1. New Mexico . . . . . \$2,117
2. California . . . . . \$2,084
- 3. New York . . . . . \$940**
4. Tennessee . . . . . \$872
5. Illinois . . . . . \$871
6. Pennsylvania . . . . . \$552
7. Washington . . . . . \$367
8. Colorado . . . . . \$359
9. Idaho . . . . . \$277
10. Nevada . . . . . \$255

Source: National Science Foundation (2015)

**The U.S. Department of Energy is the 3rd largest source of federal funding for NYS.**

NYS received a combined \$4.6 billion in federal R&D awards from across all agencies in FY 2013.

- 42.9%**  
U.S. Department of Health and Human Services
- 25.0%**  
U.S. Department of Defense
- 20.4%**  
U.S. Department of Energy

## New York State awarded \$677 million in U.S. Department of Energy contracts (FY 2014).

With \$667 million in DOE contracts in FY 2014, NYS ranks 9th among states in DOE contracting in terms of value. New Mexico is the clear front runner with \$5.4 billion in DOE contracts. Note that in contrast to data presented on the previous page, these figures are not R&D specific and include contracts only (excluding grants, loans, and other financial assistance).

### Total Value of U.S. Department of Energy Contracts for the Top 10 States, FY 2014 (\$ Millions)

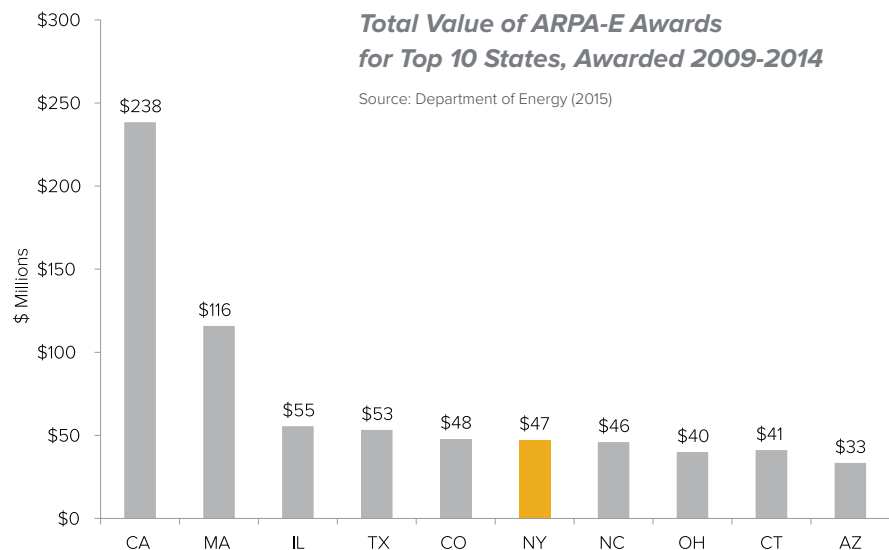
1. New Mexico . . . . .	\$5,441
2. Tennessee . . . . .	\$3,799
3. Washington . . . . .	\$3,034
4. California . . . . .	\$2,895
5. South Carolina . . . . .	\$1,997
6. Idaho . . . . .	\$1,255
7. Illinois . . . . .	\$1,136
8. Pennsylvania . . . . .	\$998
<b>9. New York . . . . .</b>	<b>\$677</b>
10. Missouri . . . . .	\$662

Source: Department of Treasury (2015)

### NYS ranks 6th nationally in total value of ARPA-E awards.

ARPA-E is the Advanced Research Projects Agency-Energy within DOE and is modeled after the successful Defense Advanced Research Projects Agency (DARPA). ARPA-E's mission is to fund the development of transformational, high-impact energy technologies. NYS recipients of ARPA-E awards include GE Global Research, Columbia University, CUNY Energy Institute, Alliant Techsystems, Brookhaven National Laboratory, Cornell University, Rensselaer Polytechnic Institute, and Bettergy. The average value of ARPA-E awards in NYS is \$2.2 million.

NYS ranks 6th in the cumulative value of its ARPA-E awards (over \$47 million) since the inception of the program in 2009. The top two states, California and Massachusetts, received a disproportionate share of ARPA-E awards, amounting to \$354 million, or 34.1% of the nation's total. The top 10 states account for 69.2% of all ARPA-E awards in value.





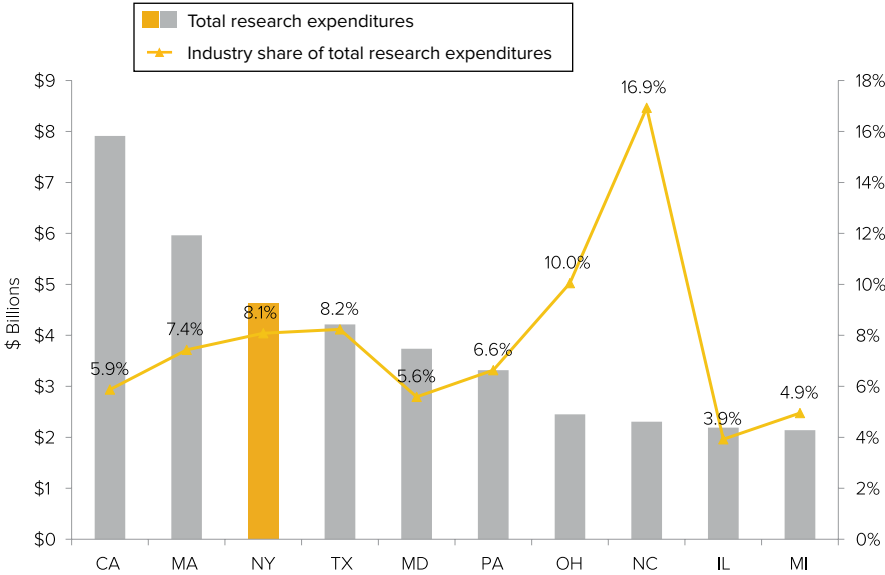
## New York State universities rank 3rd: \$4.6 billion in total research expenditures.

R&D expenditures at major research universities in NYS totaled \$4.6 billion in 2013, placing NYS behind California (\$7.9 billion) and Massachusetts (\$6.0 billion), according to the Association of University Technology Managers (AUTM).

According to the same research expenditure data from AUTM, NYS ranks 4th in the nation in total industry-sponsored university research, with \$374.3 million of expenditures in 2013. In terms of the industry-sponsored share (percentage) of total university research expenditures, NYS ranks 11th. In 2013, the share of total research expenditures at NYS universities funded by industry was 8.1%, placing NYS above California (5.9%), Massachusetts (7.4%), and the nationwide average (6.8%).

### Total Research Expenditures at Universities and Industry-Sponsored Share in Top 10 States, 2013

Source: Association of University Technology Managers (2014)



**Upward trends in research funding at NYS universities.**

Total research funding expenditures at NYS universities have increased from \$2.3 billion in 2003 to \$4.6 billion in 2013. Meanwhile, industrial research funding at NYS universities in 2013 reached its highest share of total research expenditures for the decade, increasing from 4.6% in 2003 to 8.1% in 2013. Among the top 10 states for total university research expenditures in 2013, NYS experienced the greatest increase in its industry-sponsored share of research over the past decade.

## OLEDs

Organic light emitting diodes – a next generation lighting technology



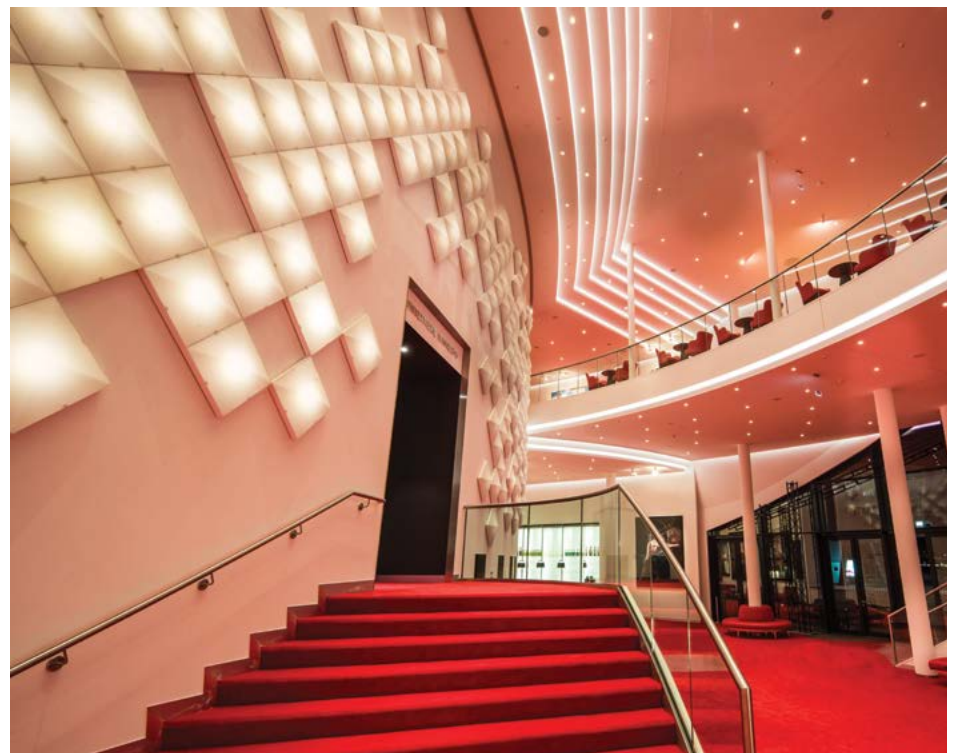
## Corporate Innovation to Startup

### OLEDWorks: Next-generation lighting technology

Headquartered in Rochester, NY, OLEDWorks is a developer and manufacturer of organic light emitting diodes (OLEDs), the next generation of lighting technology. Compared to light emitting diodes (LEDs), which are point sources less than 1 millimeter (mm) in size, OLEDs are a naturally diffuse large (greater than 100 mm) planar light sources that can be less than 1 mm thick. This diffuse light that mimics the full spectrum of the sun, thus providing a pleasing lighting experience. Like LEDs, OLEDs are a solid state lighting technology that is highly efficient, easily controllable, and dimmable.

OLEDWorks was founded in 2010 by David DeJoy and two principal scientists, Dr. John Hamer and Dr. Michael Boroson, who previously worked for Eastman Kodak where OLED technology was invented. The company has raised class A equity funding and has a long-term strategy that includes a \$73.6 million expansion of its OLED lighting fabrication facility in Rochester, NY. OLEDWorks recently announced acquisition of key parts of the Phillips OLED lighting business, including its lighting production facility in Aachen, Germany.

OLEDWorks' story is representative of Upstate New York's rich history of manufacturing and innovation. "New York State's research commercialization support through NYSERDA has been tremendously important for accelerating new manufacturing technology development for OLED lighting here in Rochester," said OLEDWorks Chief Operating Officer John Hamer.

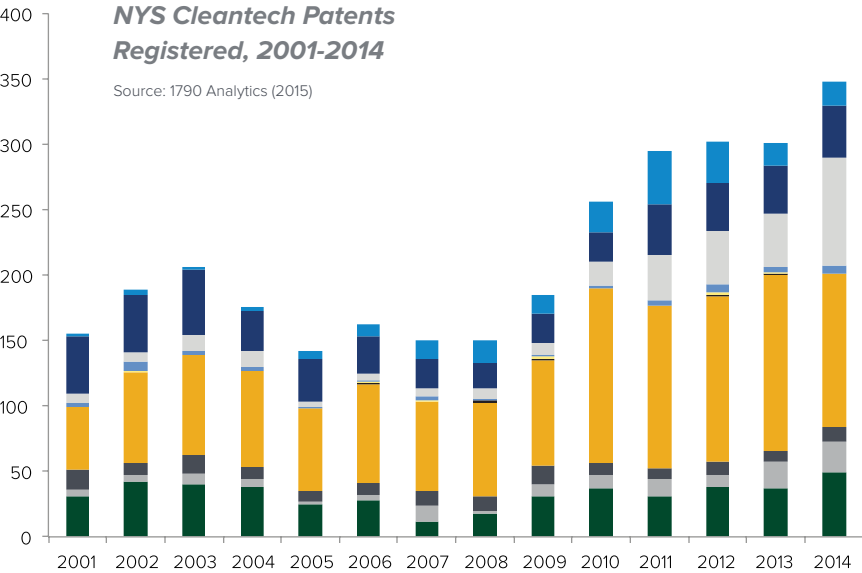


## New York State ranks 3rd: 927 cleantech patents (2012-2014).

From 2012 to 2014, NYS inventors registered 927 patents, according to 1790 Analytics. NYS follows California and Michigan, which registered 2,790 and 1,159 cleantech patents over the same period of time, respectively. California has consistently held the first place ranking from 2004 to 2014, while NYS and Michigan have alternated between the 2nd and 3rd place rankings.

### *NYS cleantech patents are on the rise.*

In 2014, NYS recorded its highest annual number of cleantech patents over the past decade with 339 patents registered, representing a 15% increase from 2013 (294 cleantech patents) and a 96% increase from 2004 (173 cleantech patents). According to 1790 Analytics, cleantech patent activity in NYS has been on an upswing since the mid-2000s.



- Wind Energy
- Water Treatment
- Solar/Photovoltaic
- Nuclear Power
- Hydro Power
- Geothermal Power
- EV/Hybrid/Fuel Cell Vehicles
- Energy Infrastructure
- Biofuels/Biomass
- Batteries/Storage

**Total Cleantech Patents Registered in Top 10 States, 2012-2014**

1. California . . . . . 2,790
2. Michigan . . . . . 1,159
- 3. New York . . . . . 927**
4. Texas . . . . . 747
5. Massachusetts . . . . . 581
6. Pennsylvania . . . . . 517
7. Illinois . . . . . 464
8. Florida . . . . . 437
9. Ohio . . . . . 417
10. Colorado . . . . . 408

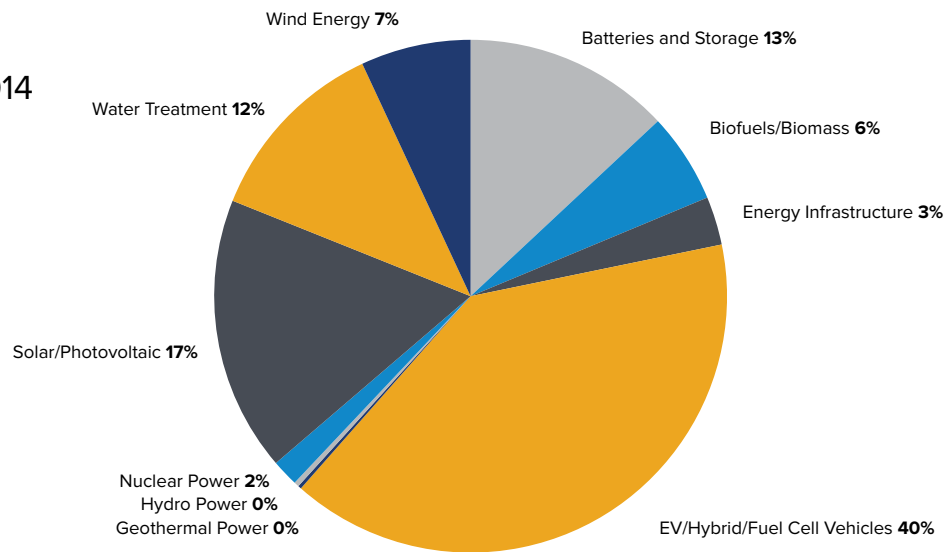
Source: 1790 Analytics (2015)

New York State has a proportionately greater share of cleantech patent activity in electric vehicle (EV)/hybrid/fuel cell vehicles and solar technology, relative to the U.S.

In NYS, 40% of cleantech patents registered from 2012 to 2014 were in EV/hybrid/fuel cell vehicle technology, significantly more than the share nationally (24%). Also, 17% of NYS cleantech patents were in solar technology (also known as photovoltaic or PV), relative to the 14% share for the U.S. overall during the 2012-2014 period.

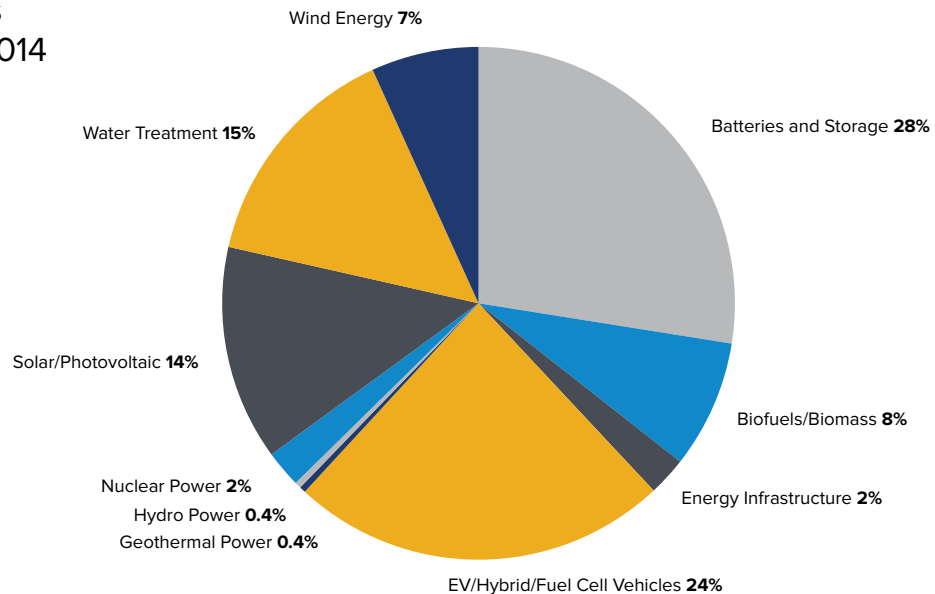
**NYS Cleantech Patents by Technology, 2012-2014**

Source: 1790 Analytics (2015)



**U.S. Cleantech Patents by Technology, 2012-2014**

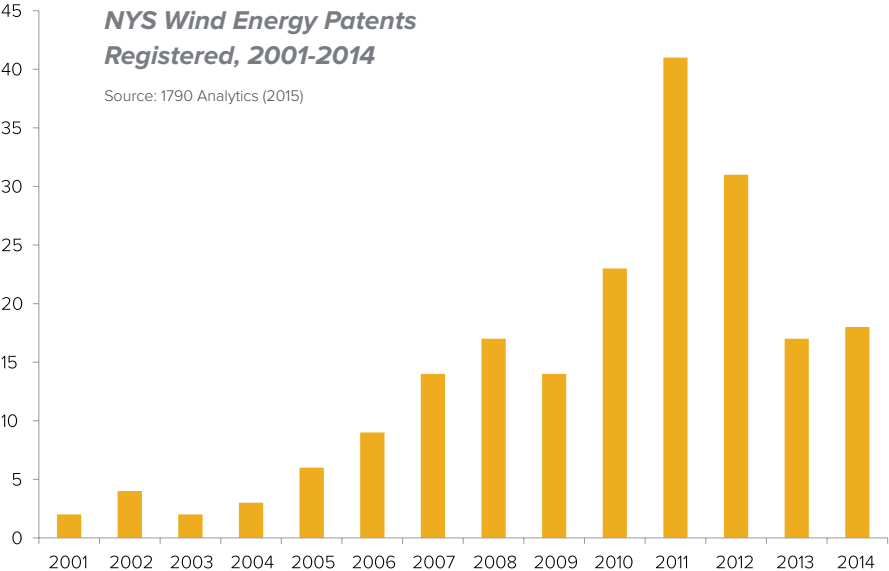
Source: 1790 Analytics (2015)



## New York State ranks 3rd nationally in wind energy patents.

NYS registered 66 patents in wind energy technologies from 2012 to 2014, up from just 9 in the 2002-2004 period. Wind energy patents peaked in NYS in 2011 following a period of strong growth in the 2000s, then declined in the early 2010s.

General Electric is by far the predominant inventor in NYS, with 152 wind energy technology patents assigned from 2001 to 2014.



### Wind Energy Patents Registered in Top 10 States, 2012-2014

1. California . . . . .	115
2. South Carolina . . . . .	102
<b>3. New York . . . . .</b>	<b>66</b>
4. Texas . . . . .	50
5. Massachusetts . . . . .	40
6. Florida . . . . .	39
7. Virginia . . . . .	30
8. Michigan . . . . .	25
9. Colorado . . . . .	21
10. Arizona . . . . .	20

Source: 1790 Analytics (2015)

### NYS Top 10 Patent Assignees: Wind Energy, 2001-2014

1. General Electric Company . . . . .	152
2. Vestas Wind Systems A/S . . . . .	3
3. Spellman High Voltage Electronics Corp . . . . .	2
4. United Technologies Corp. . . . .	2
5. SkyWolf Wind Turbine Corp. . . . .	3
6. The Green Electric Co . . . . .	1
7. Via Verde LTD. . . . .	1
8. Energy Harvesters LLC . . . . .	1
9. IBM Corp . . . . .	1
10. Dana Holding Corp . . . . .	1

Source: 1790 Analytics (2015)

**Solar Patents  
Registered in Top 10  
States, 2012-2014**

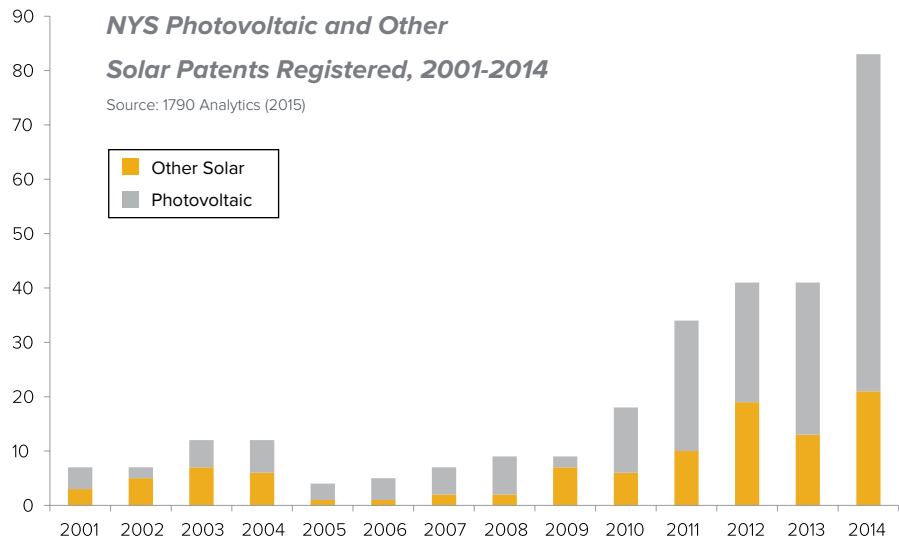
1. California . . . . .	855
<b>2. New York . . . . .</b>	<b>165</b>
3. Massachusetts . . . . .	123
4. Colorado . . . . .	109
5. Texas . . . . .	89
6. Michigan . . . . .	87
7. Pennsylvania . . . . .	85
8. Florida . . . . .	79
9. Arizona . . . . .	74
10. New Jersey . . . . .	72

Source: 1790 Analytics (2015)

**New York State ranks 2nd nationally  
in solar technology patents.**

From 2012 to 2014, NYS registered 165 patents in solar technologies including solar electric or photovoltaic technology. NYS maintained its 2nd place ranking from 2002-2004 to 2012-2014, but the number of solar patents registered by NYS inventors fell significantly behind California, which registered over five times as many solar patents (855) during the 2012-2014 period.

IBM registered the highest number of solar technology patents for NYS from 2001 to 2014, followed by General Electric and Precursor Energetics.



**NYS Top 10 Patent Assignees: Solar Technology, 2001-2014**

1. IBM Corp. . . . .	78	6. Lockheed Martin Corp. . . . .	5
2. General Electric Company. . . . .	49	7. Corning Inc . . . . .	4
3. Precursor Energetics Inc. . . . .	6	8. First Solar Inc. . . . .	4
4. eSolar Inc . . . . .	5	9. Accuflux Inc. . . . .	4
5. Total SA . . . . .	5	10. Dynoraxx Inc. . . . .	3

Source: 1790 Analytics (2015)

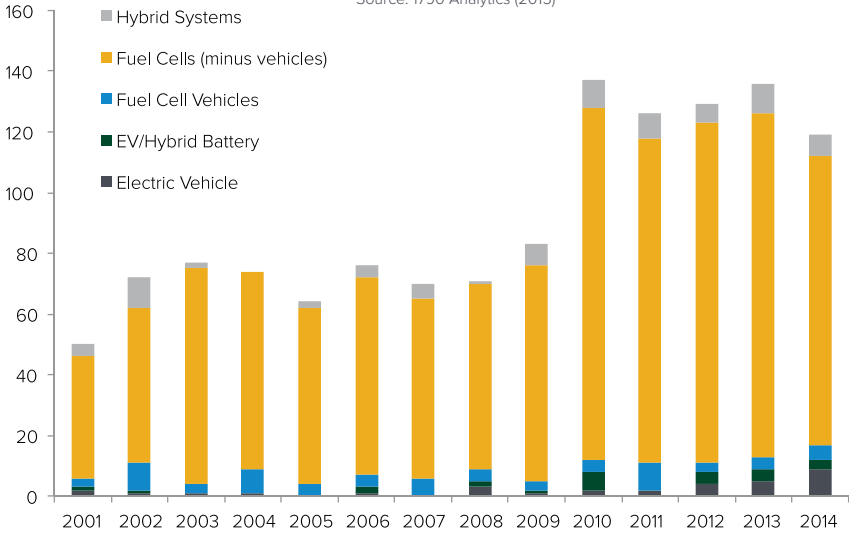
## New York State ranks 3rd nationally in electric vehicle/hybrid/fuel cell patents.

NYS registered 378 patents in electric vehicle, hybrid, and fuel cell technologies from 2012 to 2014, a 72% increase from the 220 patents registered from 2002 to 2004. California has second place with 411 patents. The top three states make up a disproportionate share of patents registered, accounting for 53% of the national total of electric vehicle/hybrid/fuel cell patents over the 2012-2014 period.

General Motors leads NYS patent assignees with 602 patents from 2001 to 2014. Other notable assignees include Delphi Automotive, Plug Power, and General Electric.

**NYS Electric/Hybrid/Fuel Cell Patents Registered, 2001-2014**

Source: 1790 Analytics (2015)



### Electric Vehicle/Hybrid/ Fuel Cell Patents Registered in Top 10 States, 2012-2014

1. Michigan . . . . . 642
2. California . . . . . 411
- 3. New York. . . . . 378**
4. Connecticut . . . . . 139
5. Massachusetts . . . . . 101
6. Ohio . . . . . 94
7. Illinois . . . . . 74
8. Minnesota . . . . . 68
9. Pennsylvania . . . . . 67
10. Florida . . . . . 60

Source: 1790 Analytics (2015)

### NYS Top 10 Patent Assignees: Electric Vehicle/Hybrid/ Fuel Cell Patents, 2001-2014

- |   |  |
|---|--|
| 1. General Motors Corp . . . . . 602      | 6. Revo Inc . . . . . 43                         |
| 2. Delphi Automotive Plc . . . . . 110    | 7. Corning Inc . . . . . 33                      |
| 3. Plug Power Inc . . . . . 109           | 8. FuelCell Energy Inc . . . . . 14              |
| 4. General Electric Company. . . . . 75   | 9. BAE Systems Plc . . . . . 12                  |
| 5. Mechanical Technology Inc . . . . . 45 | 10. Brookhaven Science Associates LLC . . . . 11 |

Source: 1790 Analytics (2015)

**Energy Infrastructure Patents Registered in Top 10 States, 2012-2014**

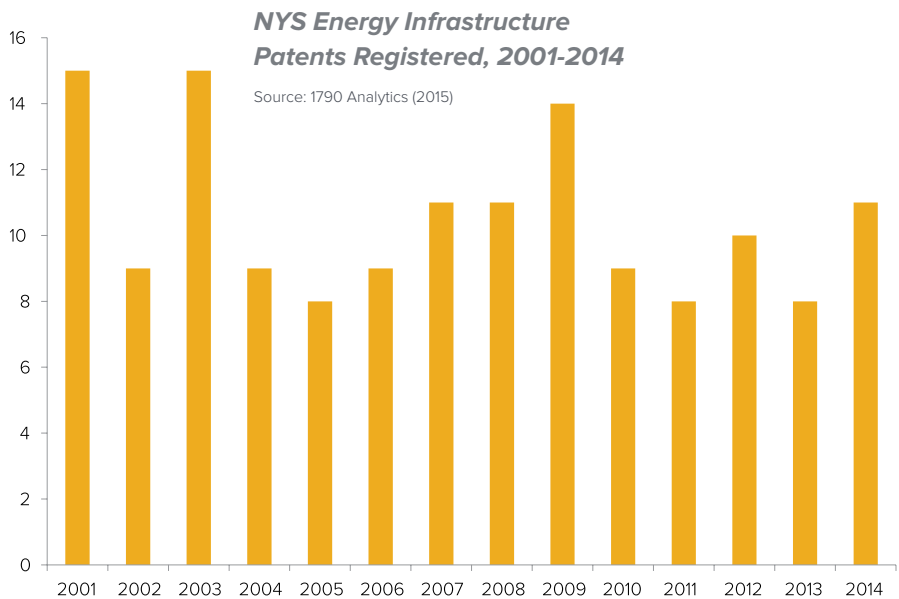
1. California . . . . .	80
2. Washington . . . . .	45
<b>3. New York . . . . .</b>	<b>29</b>
4. Georgia . . . . .	25
5. Texas . . . . .	24
6. North Carolina . . . . .	23
7. Florida . . . . .	19
8. Minnesota . . . . .	16
9. Massachusetts . . . . .	15
10. Pennsylvania . . . . .	12

Source: 1790 Analytics (2015)

**New York State ranks 3rd nationally in energy infrastructure patents.**

Energy infrastructure technology includes power transmission, smart grid, and smart meter technology. NYS registered 29 energy patents from 2012 to 2014. NYS registered 33 patents from 2002 to 2004, and NYS ranked 2nd in energy infrastructure patents at that time.

Electro Industries Gauge Tech, General Electric, Current Communications Group, and Legrand are top NYS assignees in this category, measured by patents registered from 2001-2014.



**NYS Top 10 Patent Assignees: Energy Infrastructure, 2001-2014**

1. Electro Industries Gauge Tech Inc. . . . .	19	6. Quadlogic Controls Corp . . . . .	7
2. General Electric Company. . . . .	18	7. International Business Machines Corp . . . . .	7
3. Current Communications Group LLC. . . . .	15	8. DGI Creations LLC . . . . .	6
4. Legrand S.A. . . . .	14	9. TII Industries Inc . . . . .	3
5. Leviton Manufacturing Co. Inc . . . . .	9	10. Honeywell International Inc . . . . .	3

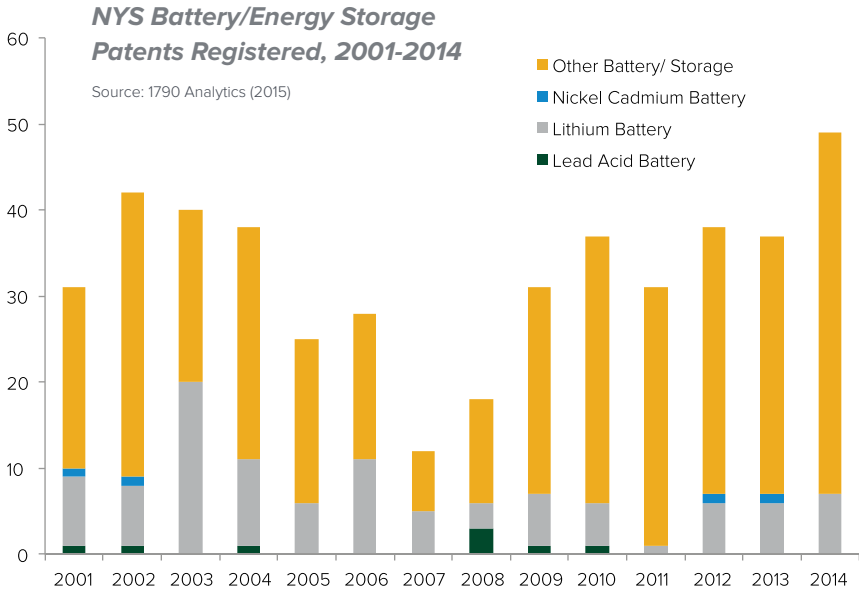
Source: 1790 Analytics (2015)



## New York State ranks 5th nationally in battery/energy storage patents.

NYS inventors registered 124 patents in battery/energy storage technology from 2012 to 2014. Although still a leader in battery/energy storage technology patenting, NYS' ranking fell relative to the 2002-2004 period when it ranked 2nd.

Greatbatch Inc. is NYS' top inventor in battery/energy storage technologies, followed by General Electric, Motorola, and General Motors.



### Battery/Energy Storage Patents Registered in Top 10 States, 2012-2014

1. California . . . . .	650
2. Michigan . . . . .	298
3. Ohio . . . . .	130
4. Massachusetts . . . . .	125
<b>5. New York . . . . .</b>	<b>124</b>
6. Texas . . . . .	115
7. Illinois . . . . .	104
8. Minnesota . . . . .	77
9. Pennsylvania . . . . .	70
10. Wisconsin . . . . .	64

Source: 1790 Analytics (2015)

### NYS Top 10 Patent Assignees: Battery/Energy Storage, 2001-2014

1. Greatbatch Inc . . . . .	164	6. Honeywell International Inc . . . . .	12
2. General Electric Company . . . . .	42	7. IBM Corp. . . . .	10
3. Motorola Solutions Inc . . . . .	23	8. Reveo Inc . . . . .	7
4. General Motors Corp . . . . .	19	9. Canadus Power Systems LLC . . . . .	6
5. Energizer Holdings Inc. . . . .	12	10. Eastman Kodak Company . . . . .	6

Source: 1790 Analytics (2015)

**Biofuels/Biomass  
Patents Registered  
in Top 10 States,  
2012-2014**

1. California . . . . .	299
2. Texas . . . . .	188
3. Illinois . . . . .	125
4. Pennsylvania . . . . .	91
5. Colorado . . . . .	89
6. Massachusetts . . . . .	82
7. Arizona. . . . .	57
<b>8. New York. . . . .</b>	<b>54</b>
8. Michigan . . . . .	54
10. Washington . . . . .	52

Source: 1790 Analytics (2015)

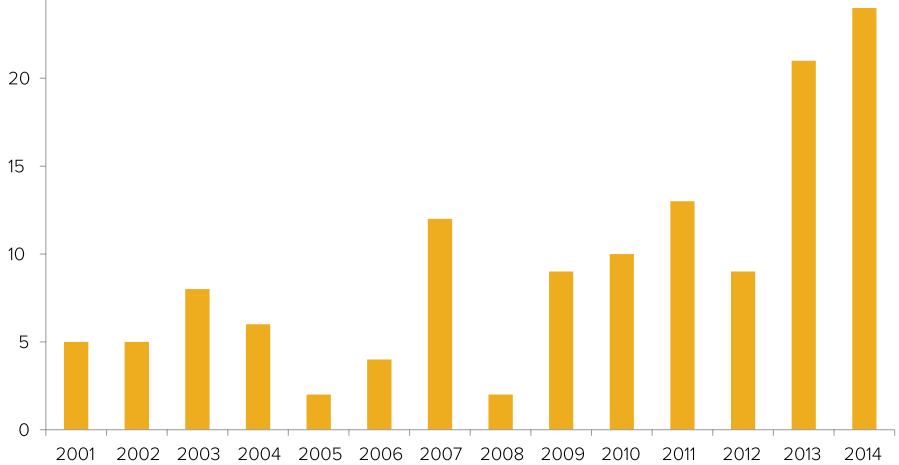
**New York State ranks 8th nationally  
in biofuels/biomass patents.**

With 54 patents registered from 2012 to 2014, NYS shares the 8th rank nationally in biofuels/biomass patents with Michigan. NYS ranked 4th in this category in the 2002-2004 period.

The NYS patent assignees with the highest number of biofuels/biomass patents registered from 2001 to 2014 are Praxair, General Electric, and the State University of New York (SUNY).

**NYS Biofuels/Biomass Patents Registered,  
2001-2014**

Source: 1790 Analytics (2015)



**NYS Top 10 Patent Assignees: Biofuels/Biomass, 2001-2014**

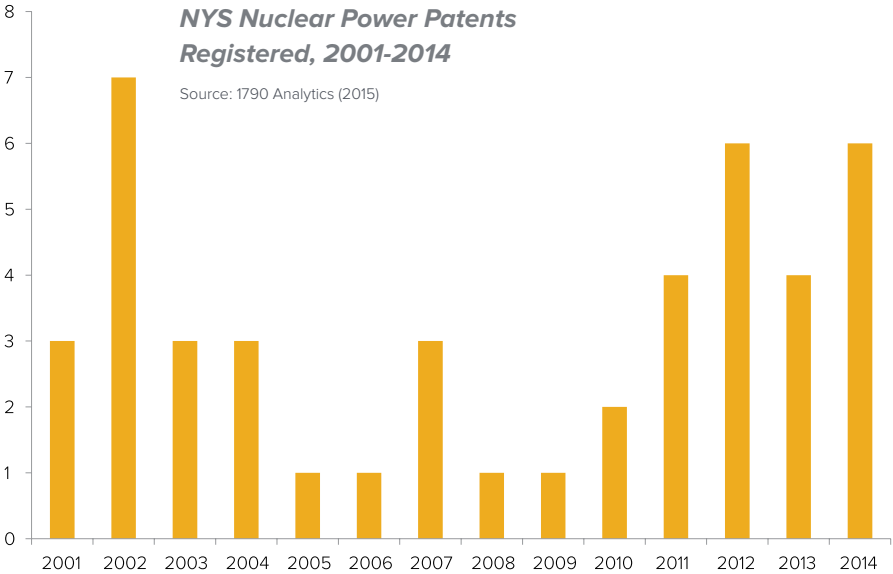
1. Praxair Inc . . . . .	25	6. Chevron Corporation . . . . .	4
2. General Electric Company. . . . .	15	7. Zeropoint Clean Tech Inc . . . . .	4
3. State University of New York (SUNY). . . . .	10	8. Syracuse University . . . . .	3
4. AB-CWT LLC . . . . .	7	9. ExxonMobil Corp . . . . .	3
5. Andritz AG . . . . .	5	10. BASF SE . . . . .	3

Source: 1790 Analytics (2015)

## New York State ranks 8th nationally in nuclear power technology patents.

NYS registered 16 patents in nuclear power technologies from 2012 to 2014, up from 13 during the 2002-2004 period. Faster growth in patenting among a number of other states resulted in NYS' ranking dropping from 5th during the 2002-2004 period to 8th during the 2012-2014 period.

The primary assignee for nuclear patents in NYS is General Electric, with 28 patents from 2001-2014.



### Nuclear Power Patents Registered in Top 10 States, 2012-2014

1. North Carolina . . . . .	73
2. California . . . . .	70
3. Pennsylvania . . . . .	41
4. Virginia . . . . .	27
5. South Carolina . . . . .	24
6. Washington . . . . .	22
7. Florida . . . . .	18
<b>8. New York . . . . .</b>	<b>16</b>
9. Oregon . . . . .	14
10. Texas . . . . .	10

Source: 1790 Analytics (2015)

### NYS Top Patent Assignees: Nuclear Power, 2001-2014

1. General Electric Company . . . . .	28	6. City University of New York . . . . .	1
2. Cornell University . . . . .	3	7. Corning Inc. . . . .	1
3. Global Technologies Inc. . . . .	2	8. Hitachi Ltd. . . . .	1
4. Global Nuclear Fuel Americas LLC . . . . .	2	9. Widetronix Inc . . . . .	1
5. Brookhaven Science Associates LLC . . . . .	1		

Source: 1790 Analytics (2015)

**Water Treatment Patents Registered in Top 10 States, 2012-2014**

1. California . . . . .	353
2. Texas . . . . .	208
3. Pennsylvania . . . . .	148
4. Florida . . . . .	128
<b>5. New York . . . . .</b>	<b>114</b>
6. Illinois . . . . .	98
7. Wisconsin . . . . .	92
8. Massachusetts . . . . .	90
9. New Jersey . . . . .	89
10. Ohio . . . . .	81

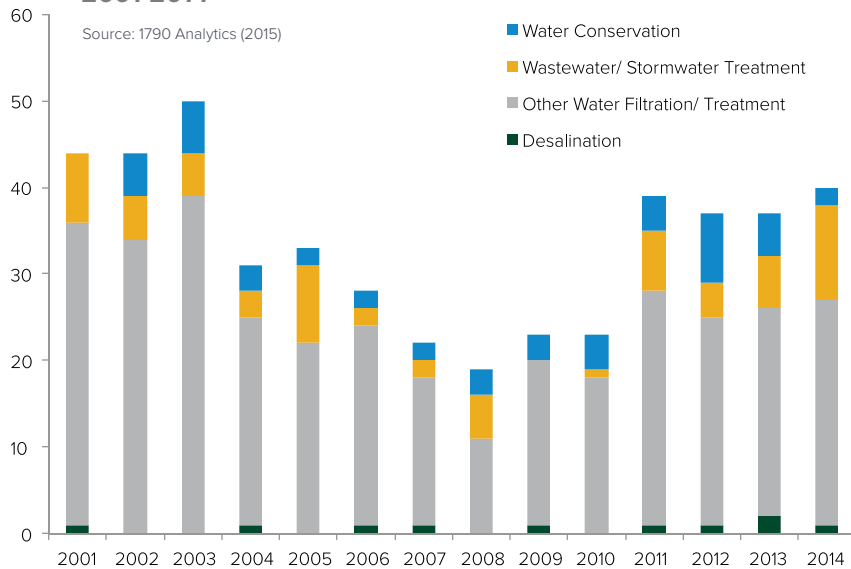
Source: 1790 Analytics (2015)

**New York State ranks 5th nationally in water treatment patents.**

NYS inventors registered 114 patents for water treatment technologies from 2012 to 2014, ranking the state 5th nationally. NYS maintained its 5th place ranking from the 2002-2004 period. California and Texas lead the country in water treatment technology patenting, holding the 1st and 2nd place rankings in both the 2002-2004 and the 2012-2014 periods. Pennsylvania rose from 7th in the 2002-2004 to 3rd in the 2012-2014 period in the national rankings.

In NYS, General Electric, General Motors, and Praxair are the lead inventors of water treatment technologies, as measured by patents registered from 2001 to 2014.

**NYS Water Treatment Patents Registered, 2001-2014**



**NYS Top Patent Assignees: Water Treatment, 2001-2014**

1. General Electric Company . . . . .	31	6. Columbia University . . . . .	10
2. General Motors Corp . . . . .	27	7. Mechanical Technology Inc . . . . .	9
3. Praxair Inc. . . . .	12	8. Corning Inc . . . . .	8
4. Helen of Troy Ltd . . . . .	11	9. Eastman Kodak Company . . . . .	6
5. Heartland Technology Partners LLC . . . . .	10	10. Saudi Basic Industries Corp . . . . .	6

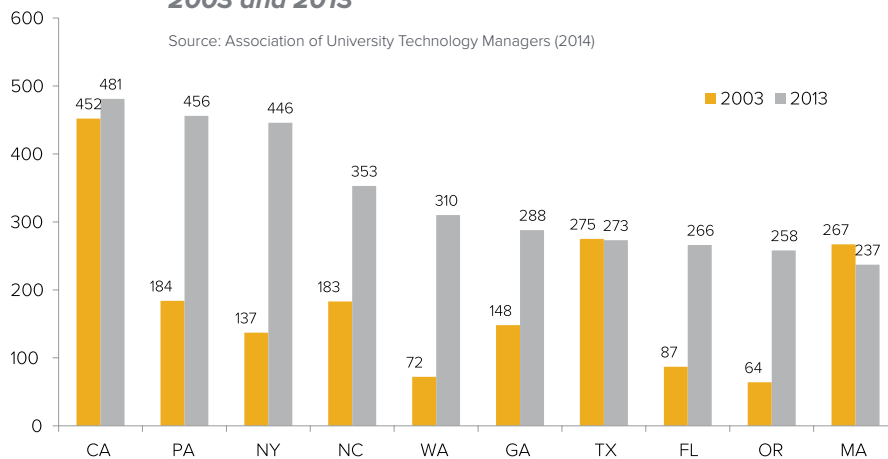
Source: 1790 Analytics (2015)

## New York State universities rank 3rd in technology licenses (446), as well as 3rd in growth rate (12.5% annual average).

In 2013, NYS universities executed 446 licenses and options, up from 137 in 2003. On average, this number increased by 12.5% annually from 2003 to 2013, which is the 3rd highest growth rate among the top 10 states.

**Number of University Licenses and Options Executed for Top 10 States, 2003 and 2013**

Source: Association of University Technology Managers (2014)



Hospitals and Research Institutes are not included.

Universities license technologies that stem from university-based research to existing companies and startups. Therefore, the number of licenses and options executed is one indicator of a university's commercial impact. The amount of industry-sponsored research performed at a university is another indicator of commercial impact, and in this case companies may own rights to the intellectual property (IP) without having to license the technology.

This indicator provides a measure of the commercial-orientation of a university's research faculty and the strength of its technology transfer office. Compared to other U.S. states, NYS ranks highly in this indicator.

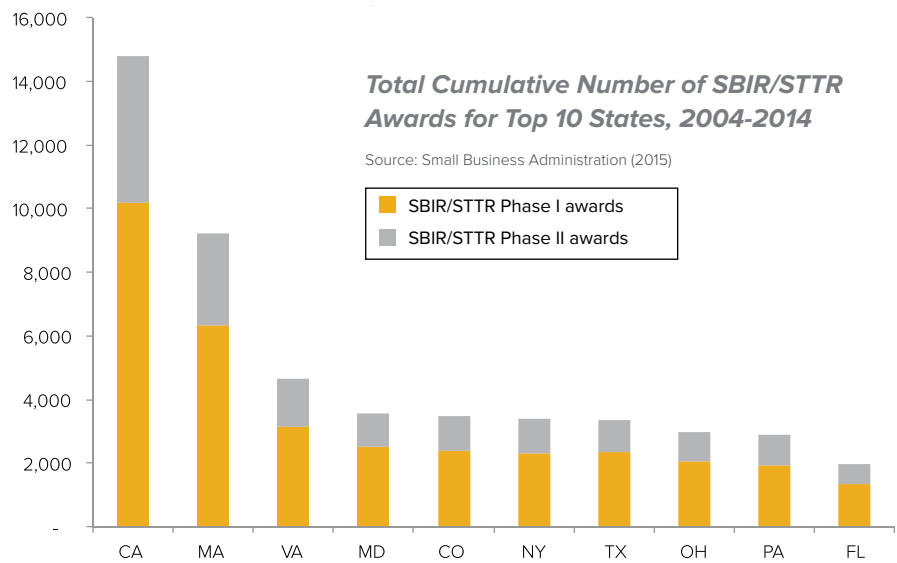
**High average value for SBIR/STTR awards in NYS.**

Among the top 10 states for companies receiving SBIR/STTR awards, NYS ranks 2nd in the average values of both its Phase I and Phase II awards. NYS companies received an average of \$138,016 per Phase I award and \$832,197 per Phase II award.

**New York State early-stage companies rank 6th: \$1.2 billion in SBIR/STTR awards last 10 years.**

The intent of the Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) federal program is to provide federal seed capital for technology commercialization by early-stage companies.

From 2004 to 2014, NYS companies received 3,394 SBIR/STTR Phase I and II awards, which is the 6th highest total in the nation. Cumulatively, SBIR/STTR awards in NYS amounted to \$1.2 billion, the 5th highest value in the U.S.



**Total Number and Value of SBIR/STTR Awards for Top 10 States, 2004-2014**

Rank (Based on Total Number of Phase I and II Awards)	Phase I			Phase II		
	Total Number	Total Value (\$ Millions)	Average Value	Total Number	Total Value (\$ Millions)	Average Value
1. California	10,192	\$1,362	\$133,625	4,611	\$3,754	\$814,244
2. Massachusetts	6,330	\$806	\$127,349	2,908	\$2,415	\$830,402
3. Virginia	3,156	\$334	\$105,832	1,501	\$1,145	\$762,872
4. Maryland	2,504	\$359	\$143,457	1,060	\$913	\$861,487
5. Colorado	2,382	\$275	\$115,551	1,098	\$882	\$803,308
<b>6. New York</b>	<b>2,283</b>	<b>\$315</b>	<b>\$138,016</b>	<b>1,111</b>	<b>\$925</b>	<b>\$832,197</b>
7. Texas	2,354	\$293	\$124,486	1,006	\$787	\$782,712
8. Ohio	2,068	\$257	\$124,129	926	\$766	\$827,378
9. Pennsylvania	1,941	\$259	\$133,412	933	\$761	\$815,232
10. New Jersey	1,346	\$155	\$115,159	626	\$487	\$778,264

Source: Small Business Administration (2015)

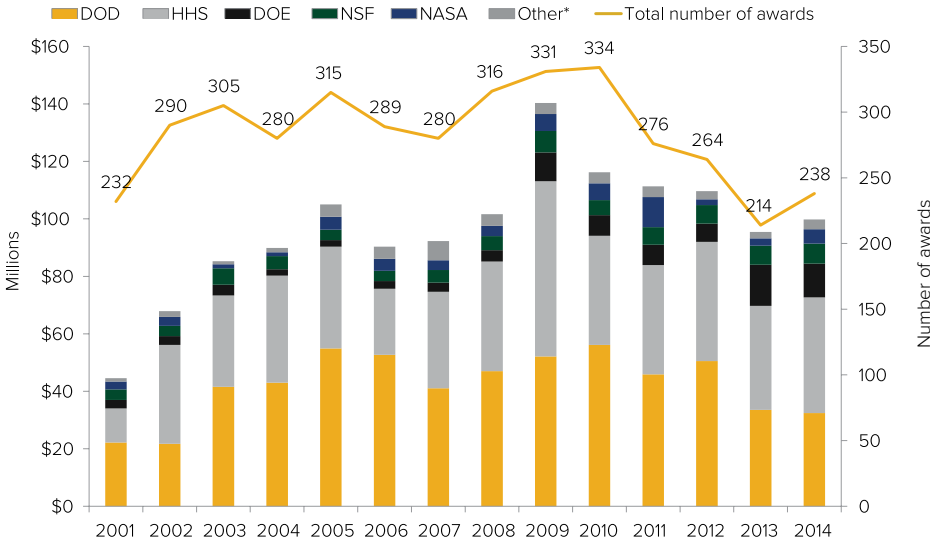
# SBIR/STTR awards from DOE account for an increasing share (12% in 2014) of New York State’s total SBIR/STTR funding.

NYS has experienced rapid growth in the value of SBIR/STTR awards received from the U.S. Department of Energy, increasing from approximately \$3.0 million in 2001 to \$11.8 million in 2014. As funding from other agencies has remained flat or decreased, DOE accounts for a greater share of the NYS’ total SBIR/STTR funding.

NYS has followed national trends in the number and value of its SBIR/STTR awards. The value of SBIR/STTR award funding rose rapidly in NYS in the early 2000s, then leveled off before declining after 2009.

## NYS SBIR/STTR Awards: Total Number and Value by Agency, 2001-2014

Source: Small Business Administration (2015)  
\*Includes DHS, Education, USDA, DOT, DOC, EPA



A background image of a business meeting with a hexagonal grid overlay. A hand is holding a smartphone, and a laptop keyboard is visible. A white coffee cup sits on a saucer on a wooden table. The text 'Business Environment' is centered in a dark blue hexagon.

Business  
Environment



## Business Environment:

### How attractive is New York State’s business environment for expanding cleantech companies?

Cleantech innovation and industry growth requires inventors and innovators, access to capital, availability of skilled workers, access to customers, and a competitive cost of doing business. The Business Environment indicator group benchmarks how attractive the NYS business environment is for new and expanding technology companies. It tracks NYS trends in: venture capital (VC) activity; small business loan activity; science, technology, engineering, and mathematics (STEM) graduates and workforce availability; regional average wages; tax competitiveness; and cost of energy.

NYS consistently graduates an above-average number of STEM students per capita and is home to a large, highly skilled workforce. NYS’ cleantech companies attract significant venture capital, including a high volume of cleantech deals. NYS’ rankings on these and other business environment metrics are summarized in the dashboard table below.

Business Environment Dashboard			
Indicator	Relative State Rankings		Change in Rank
	2012	2015	
Total number of STEM degrees granted	2	2	—
Total venture capital dollars invested	3	3	—
TechAmerica high-tech employment rank	3	3	—
Private sector Green Goods and Services jobs	4	3	▲
Cleantech venture capital dollars invested*	11**	5	▲
Cleantech venture capital deals*	5**	5	—
Per capita number of STEM degrees granted	19	17	▲
Total Effective Business Tax Rate	41	41	—

\* This is not a time-series data source, therefore comparison of 2012 and 2015 report rankings should be interpreted with caution.

\*\*2012 report rank re-calculated using updated data and methods.

## New York State ranks 2nd in number of venture capital deals, accounting for 10% of the U.S. total.

From 2007 to 2014, NYS significantly outpaced the national average growth in venture capital investment dollars and deals. The value of venture capital investment in NYS companies more than tripled from 2007 to 2014, and now accounts for about 9% of total U.S. venture capital investment dollars. NYS ranks 2nd in venture capital deals, accounting for over 10% of U.S. deals in 2014.

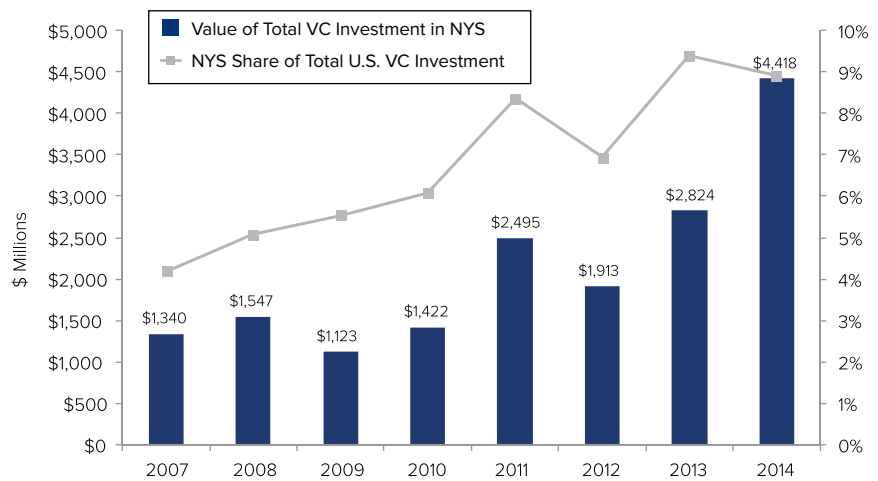
### Total Value of Venture Capital Investment for Top 10 States, 2014 (\$ Millions)

1. California . . . . .	\$28,395
2. Massachusetts . . .	\$4,631
<b>3. New York . . . . .</b>	<b>\$4,418</b>
4. Texas . . . . .	\$1,418
5. Washington . . . . .	\$1,169
6. Illinois . . . . .	\$1,069
7. Florida . . . . .	\$861
8. Utah . . . . .	\$801
9. Colorado . . . . .	\$795
10. Pennsylvania . . . .	\$787

Source: Pricewaterhouse Coopers, National Venture Capital Association (2015)

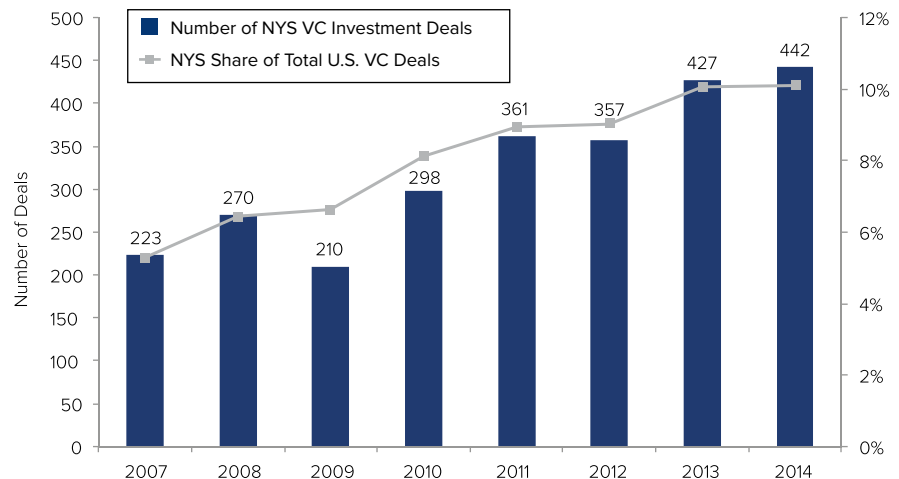
### NYS Venture Capital Investment, All Industries, 2007-2014

Source: Pricewaterhouse Coopers, National Venture Capital Association (2015)



### NYS Venture Capital Deals, All Industries, 2007-2014

Source: Pricewaterhouse Coopers, National Venture Capital Association (2015)

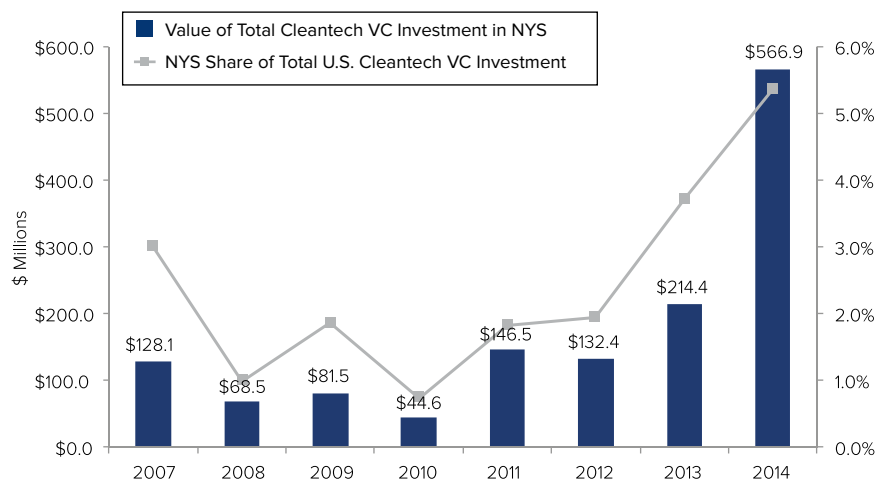


## New York State ranks 5th: Attracted \$1.1 billion in cleantech venture capital dollars (2010-2014).

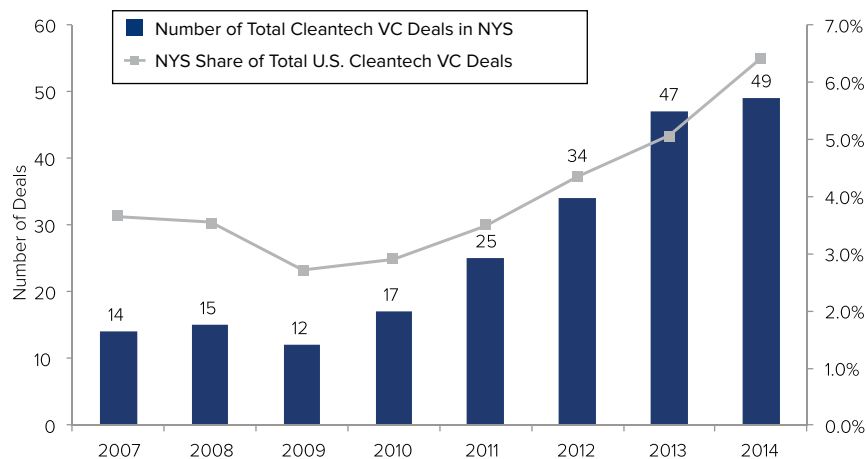
From 2010 to 2014, NYS cleantech companies attracted \$1.1 billion in venture capital investment. California led all other states in this field by a wide margin, accounting for 55% (\$20.5 billion) of total U.S. cleantech venture capital investment, followed by Massachusetts (\$3.1 billion), Texas (\$3.0 billion), and Colorado (\$1.3 billion).

### NYS Cleantech Venture Capital Investment, 2007-2014

Source: Cleantech Group (2015)



### NYS Cleantech Venture Capital Deals, 2007-2014



**The number of NYS cleantech venture capital deals grew to 49 in 2014.**

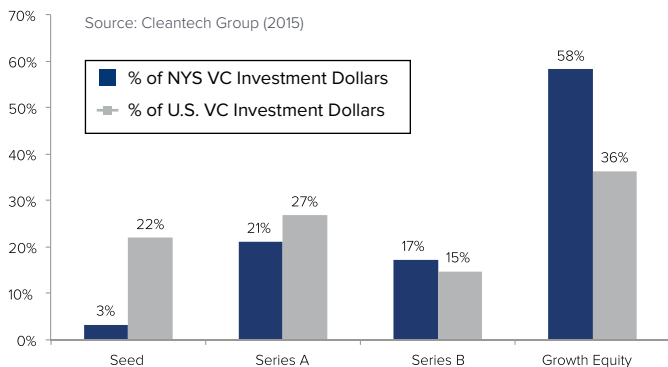
The number of cleantech venture capital deals in NYS grew from 17 deals in 2010 to 49 deals in 2014, ranking NYS as 5th nationally from 2010 to 2014. NYS' share of total U.S. cleantech venture capital deals has increased each year since 2010.

## New York State energy efficiency and energy storage companies attracted \$398 million in venture capital investment from 2010 to 2014.

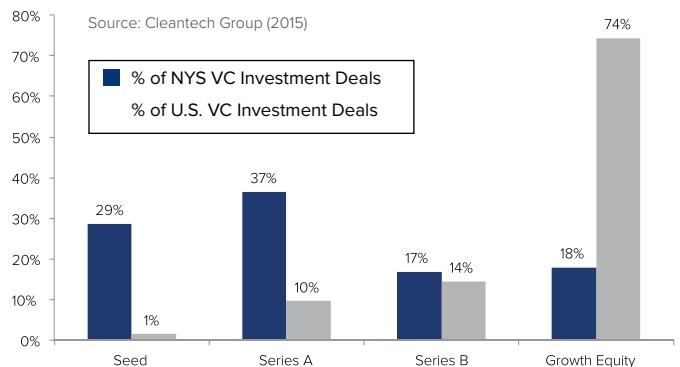
The cleantech sectors in which NYS companies attracted the most venture capital dollars included energy efficiency, energy storage, agriculture and food, and wind. In each of these cleantech sectors, NYS accounted for 4% or more of total U.S. cleantech venture capital dollars from 2010 to 2014. Most of the cleantech venture capital deals completed in NYS from 2010 to 2014 were later-stage investments, but the venture capital dollars invested in NYS cleantech were more evenly distributed across seed, series A, series B, and growth equity investments.

Sector	Venture Capital Investment Activity		Share of U.S. Sector Investment
Energy Efficiency	40 deals	\$291 million	5%
Energy Storage	25 deals	\$107 million	6%
Agriculture & Food	18 deals	\$71 million	4%
Transportation	13 deals	\$63 million	1%
Advanced Materials	19 deals	\$44 million	3%
Recycling & Waste	5 deals	\$20 million	2%
Wind	4 deals	\$19 million	4%
Biofuels & Biochemicals	5 deals	\$18 million	0%
Water & Wastewater	7 deals	\$15 million	2%
Air	2 deals	\$15 million	3%

**Cleantech Venture Capital Dollars by Investment Type in NYS and U.S., 2010-2014**



**Cleantech Venture Capital Deals by Investment Type in NYS and U.S., 2010-2014**



174 investors made venture capital investments in NYS cleantech companies from 2010 to the second quarter of 2015.

The investors depicted on this page have made at least two investments in NYS cleantech companies, including at least one venture capital investment.

Source: Cleantech Group

### Legend

Size correlates with number of venture capital investments made in NYS cleantech companies. Investors with locations in NYS are in blue.

*Note—This is not an inclusive list of all NYS cleantech VC investors.*

21Ventures • 83North • AltEnergy • ARCH Venture Partners • Bain Capital • Benchmark Capital • Brooklyn Bridge Ventures • Contour Venture Partners • Credit Suisse • Eastern New York Angels • Energy Technology Ventures • EnerTech Capital • Excell Partners • Fidelity Investments • Fisher Brothers • Formation 8 • Founder Collective • Generation Investment Management • Great Oaks Venture Capital • Greycroft Partners • Harvard Management • JP Morgan Chase • Long Island Angel Network • Morgan Stanley • NJR Clean Energy Ventures • Northwater Capital Management • NRG Energy • SPK Partners • Stark Capital • Thrive Capital Partners • TopSpin Partners • True Ventures Village Ventures • Wave Equity Partners • .406 Ventures • 3M New Ventures • Bessemer Venture Partners • Braemar Energy Ventures • DFJ Gotham Ventures • DOEN Participaties BV • Emil Capital Partners • Empire State Development • ff Venture Capital • I2BF Global Ventures • NGEN Partners • Norwest Venture Partners • Pure Energy Partners • R/GA • RockPort Capital Partners • TechStars • Aster Capital • Cayuga Venture Fund • Draper Fisher Jurvetson • Goldman Sachs • Index Ventures • Lux Capital • Mount Royal Ventures • New York City Investment Fund • Physic Ventures • Rudd-Klein Alternative Energy Ventures • Top Tier Capital Partners • Andreessen Horowitz • Kleiner Perkins Caufield & Byers • Lerer Hippeau Ventures • Rand Capital Corporation • RRE Ventures • Sigma Partners • The Westly Group • Union Square Ventures • National Science Foundation • NYC ACRE • U.S. Department of Energy • New York State Energy Research and Development Authority

## New York State cleantech startups making successful exits (2010 – 2015).

Cleantech “exits” are an important indicator for potential angel investors and venture capitalists, because exits are how they realize return on their investments. Three primary exit strategies for startups are initial public offerings (IPO), mergers, or acquisitions by larger companies. Over the past five years, several NYS cleantech start-ups have exited via mergers or acquisitions. Acquired companies represent a variety of cleantech sectors, including energy efficiency, advanced materials, solar, smart grid, and water or wastewater.

**NOTE: The NYS Cleantech Company Exits metric relates to both the Business Environment and Industry Development categories and appears in both sections for the reader’s convenience.**

NYS Cleantech Exits, 2010-Q1 2015	
<b>Ephesus Lighting</b> was acquired by <b>Eaton Corp.</b> in <b>2015</b>	<i>Multiple NYS university development partners; Company received support from the Clean Tech Center business incubator in Syracuse, a NYSERDA-supported incubator; Investment by NYSERDA</i>
<b>Havelide Systems</b> was acquired by <b>Petro River Oil</b> in <b>2015</b>	<i>Client of the Clean Energy Business Incubator Program (CEBIP) at Stony Brook University, a NYSERDA-supported incubator</i>
<b>Urban Green Energy (UGE)</b> began trading publicly in <b>2014</b>	<i>Investment by: Tamra-Tacoma Capital Partners, Energine</i>
<b>EnergyHub</b> was acquired by <b>Alarm.com</b> in <b>2013</b>	<i>Investment by: Physic Ventures, .406 Ventures, New York City Investment Fund, Acadia Woods Partners, NYSERDA</i>
<b>Wind Analytics</b> merged with <b>Talco Electronics</b> in <b>2013</b> to form <b>United Wind</b>	<i>Merger of: Wind Analytics, Talco Electronics; Client of NYC-ACRE Cleantech Incubator, a NYSERDA-supported incubator; Investment by NYSERDA</i>
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<b>Crystal IS</b> was acquired by <b>Asahi Kasei Chemicals</b> in <b>2011</b>	<i>Investment by: 3i Group, ARCH Venture Partners, Credit Suisse, Harris &amp; Harris Group, Lux Capital, ARCH Venture Partners, Asahi Kasei, Credit Suisse, Lux Capital; Investment by NYSERDA</i>
<b>Primet Precision Materials</b> was acquired by <b>Dow Chemical</b> in <b>2011</b>	<i>Investment by: Morgan Stanley, Draper Fisher Jurvetson (DFJ), Cayuga Venture Fund, ATEL Ventures, NYSERDA, Dow Chemical, US Army, NYSTAR</i>
<b>Palantiri Systems</b> was acquired by <b>ThingWorx</b> in <b>2011</b>	<i>Client of the Rochester Institute of Technology’s Clean Energy Incubator (CEI), a NYSERDA-supported incubator</i>
<b>CPower</b> was acquired by <b>Constellation Energy</b> in <b>2010</b>	<i>Investment by: Intel Capital, Aster Capital, Bessemer Venture Partners, Consensus Business Group, Expansion Capital Partners, Mayfield Fund, NYC Investment Fund</i>
<b>Advanced Energy Conversion</b> was acquired by <b>loxus</b> in <b>2010</b>	<i>Founded based on research at Rensselaer Polytechnic Institute; Investment by NYSERDA</i>

## Successful Exit

### Palantiri Systems: Continuous communication among people, devices, and business systems

Founded in 2007, Palantiri Systems developed and commercialized the AlwaysOn™ Product Suite, a secure technology platform that enables continuous communication and collaboration between people, connected devices, and business systems. AlwaysOn allows for remote monitoring, management, and repair of technical systems, thereby saving time, energy, and money. For example, solar farms and wind farms are often located in remote locations requiring a high degree of connectivity to maximize performance or for connecting smart meters in an advanced metering infrastructure.

Palantiri Systems was an early resident of the Rochester Institute of Technology's Clean Energy Incubator (CEI), a NYSERDA-supported incubator, and benefitted from the assistance of its entrepreneurs-in-residence (EIRs). The EIRs helped Palantiri Systems define its message as it looked for its first external funding. "Resources like NYSERDA, the EIR program, and High Tech Rochester are extremely valuable to startups just getting off the ground," said John Canosa, founder of Palantiri Systems. "New York State's higher education system also provides a tremendous amount of science and engineering talent, especially in our technology space and particularly in the Rochester area," he added.

Palantiri Systems negotiated a merger in 2011 with another startup, ThingWorx, which integrated AlwaysOn into its software platform designed to rapidly build and run Internet of Things applications for connecting people, systems, and devices. In 2013, ThingWorx was acquired by PTC, a technology solutions provider for manufacturers, for approximately \$130 million.



“Resources like NYSERDA, the EIR program, and High Tech Rochester are extremely valuable to startups just getting off the ground,”

- John Canosa,  
founder of Palantiri Systems

## Successful Exit

### Ephesus Lighting: Bright, energy-efficient illumination for arenas and commercial spaces

Ephesus Lighting designs and engineers LED lighting products used primarily for commercial and industrial spaces, such as arenas, warehouses, manufacturing facilities, parking lots, and stadiums.

Amy and Joe Casper returned to Syracuse, NY, and started the company in 2010. “When we came back to Syracuse 23 years later, we didn’t expect to find anything new and exciting. But we were very surprised to see the investment New York State had made to advance new technologies,” said Joe Casper.

He created the LED chip based on gallium nitride on diamond while working at Lockheed Martin with research teams. The technology efficiently removed heat, but didn’t fit Lockheed’s research goals.

The Caspers developed the technology with the Lighting Research Center at Rensselaer Polytechnic Institute, and the prototype was built and produced at the SUNY College of Nanoscale Science and Engineering. Through Clarkson University, they found a manufacturer. Much of the product testing and packaging was conducted at Binghamton University. The Caspers then turned to Syracuse University and The Clean Tech Center business incubator for mentoring, connections, and help in writing a comprehensive business plan.

The company’s first project was developing an LED street light under a NYSERDA grant. In December 2011, 15 streetlights in Baldwinsville, NY, were retrofitted with Ephesus lighting fixtures, which are engineered to last twice as long and glow 20% brighter while using 20% less power. In 2012, Ephesus did its first large project: upgrading the lighting at the War Memorial Arena, home of the Syracuse Crunch hockey team and housed in the Oncenter in downtown Syracuse. The LED installation improved the arena’s brightness, and was expected to save Onondaga County more than 85% in the arena’s annual energy costs. Since then, Ephesus’ LED lighting systems have been installed at numerous other sports arenas and recreation facilities across North America, including Superbowl XLIX in Glendale, AZ, on February 1, 2014.

In 2015, Ephesus was purchased by Eaton Corp., the owner of industrial lighting manufacturer Crouse-Hinds. “We were pleased to acquire Ephesus Lighting in late October,” said Alexander M. Cutler, Eaton chairman and chief executive officer, in a report about Eaton’s third-quarter performance. “Ephesus is a leader in LED lighting for stadiums and other high lumen outdoor and industrial applications. Its sales over the last 12 months were \$22 million.”



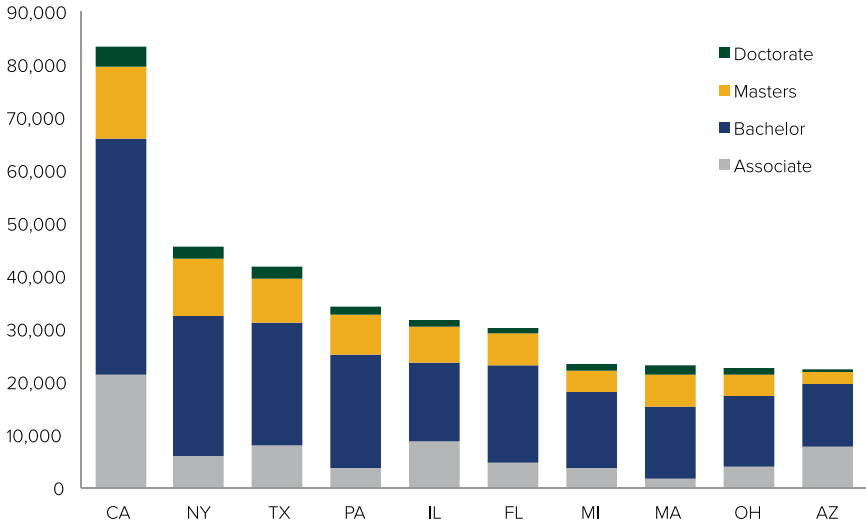


# New York State ranks 2nd: More than 45,000 science, technology, engineering and mathematics (STEM) degrees awarded annually.

NYS awarded over 45,000 STEM degrees during the 2014 academic year accounting for approximately 7% of U.S. STEM graduates. NYS ranks 17th in STEM degrees awarded per capita.

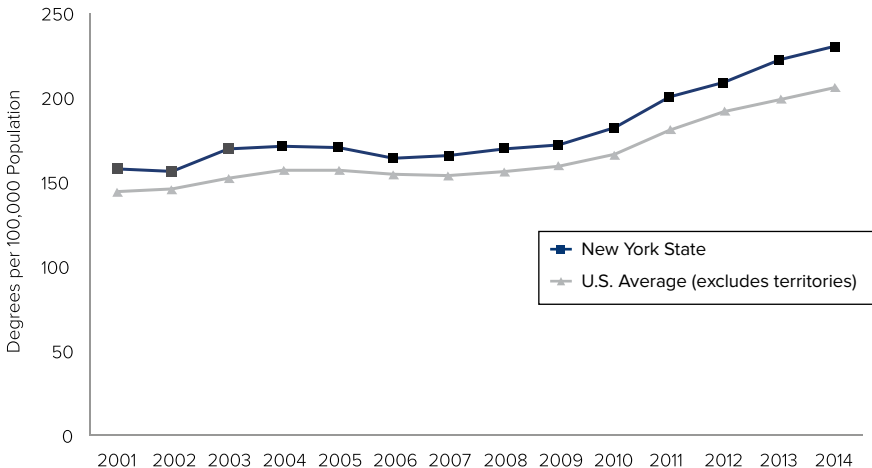
### Top 10 States for STEM Degrees Awarded, 2014

Source: National Center for Education Statistics (2015)



### STEM Degrees per Capita in NYS and U.S., 2001-2014

Source: National Center for Education Statistics (2015); U.S. Census Bureau (2015)



**NYS consistently awards an above-average number of STEM degrees per capita.**

NYS institutes of higher education awarded 231 STEM degrees per 100,000 population in 2011, well above the national average of 206 degrees. The number of STEM degrees awarded has increased nationally in recent years. However, from 2004 to 2014, NYS STEM awards grew at an average annual rate of 3.0%, outpacing the national average rate of 2.7%. These figures include associate, bachelor’s, master’s, and doctoral degrees.

**NYS Employment, 2014: Managerial, professional, and technical (MPT) employment**

**2,963,210 jobs**

MPT jobs comprise 33.6% of NYS employment

MPT jobs comprise 31.1% of U.S. employment

**NYS Employment, 2014: Science, technology, engineering, and mathematics (STEM) employment**

**940,810 jobs**

STEM jobs comprise 10.7% of NYS employment

STEM jobs comprise 12.6% of U.S. employment

Source: Bureau of Labor Statistics (2015)

**New York State ranks 3rd nationally in tech industry employment.**

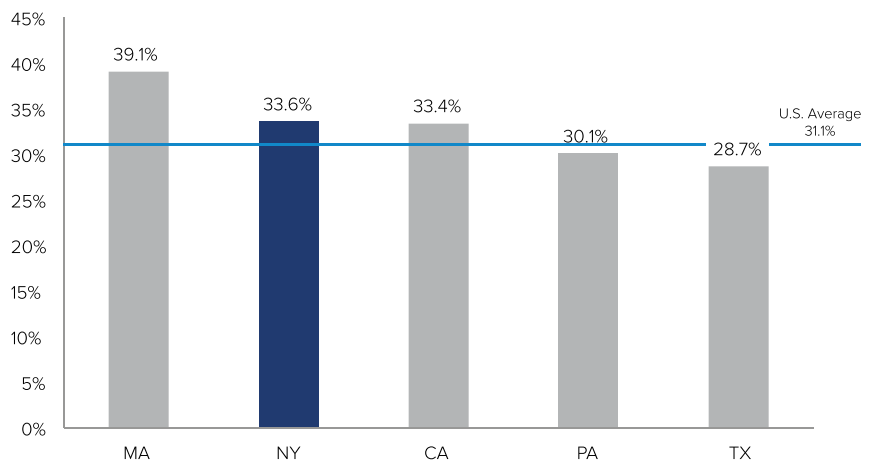
According to CompTIA's 2015 Cyberstates report, approximately 346,500 people were employed in the NYS tech industry in 2014. Only California (1,087,800) and Texas (581,200) had higher levels of tech industry employment than NYS.

According to data from the U.S. Bureau of Labor Statistics, NYS has an above-average concentration of workers in managerial, professional, and technical jobs relative to the national average and other cleantech states. NYS is also home to a large science, technology, engineering, and mathematics (STEM) workforce. See box for details.

**Managerial, Professional & Technical Jobs as a Share of Total Employment, by State\*, 2014**

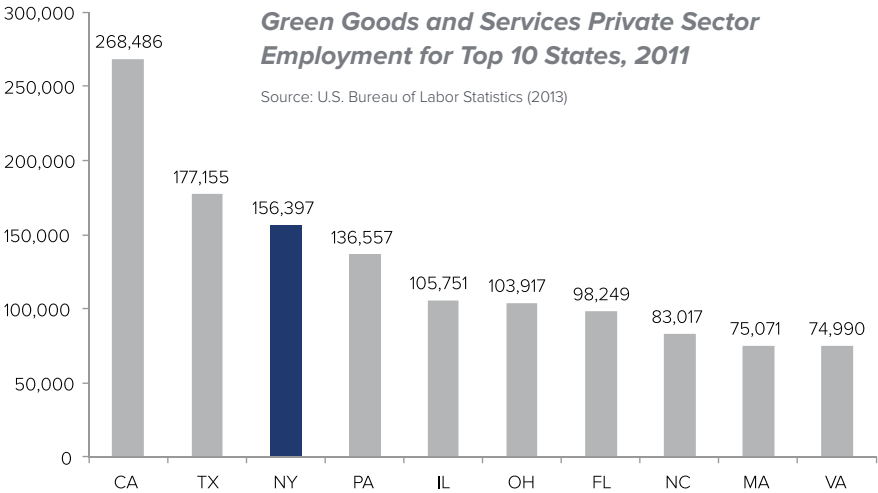
Source: Bureau of Labor Statistics (2015)

\*Note that these five states do not represent the top 5 states for MPT employment.



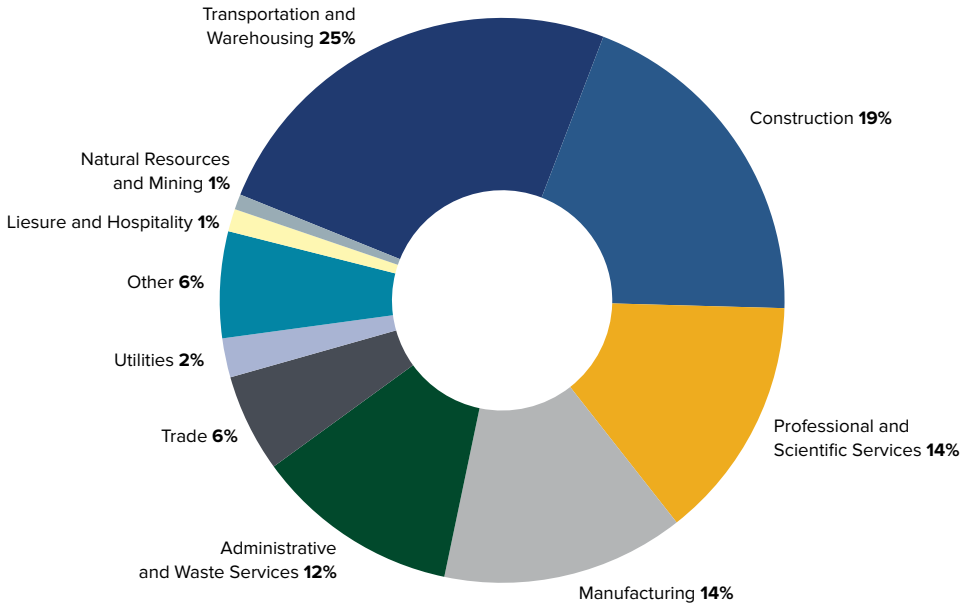
## NYS ranks 3rd nationally in green goods and services employment.

With over 156,000 people employed in industries that produce goods or services that benefit the environment or conserve natural resources in 2011, NYS ranks 3rd behind California (268,000) and Texas (177,000). Green goods and services (GGS) employment serves as a metric for the size of the green economy in NYS. This employment data is based on the U.S. Bureau of Labor Statistics' GGS Survey, which was discontinued after the 2011 survey.



**NYS Green Goods and Services Employment by Industry, 2011**

Source: U.S. Bureau of Labor Statistics (2013)



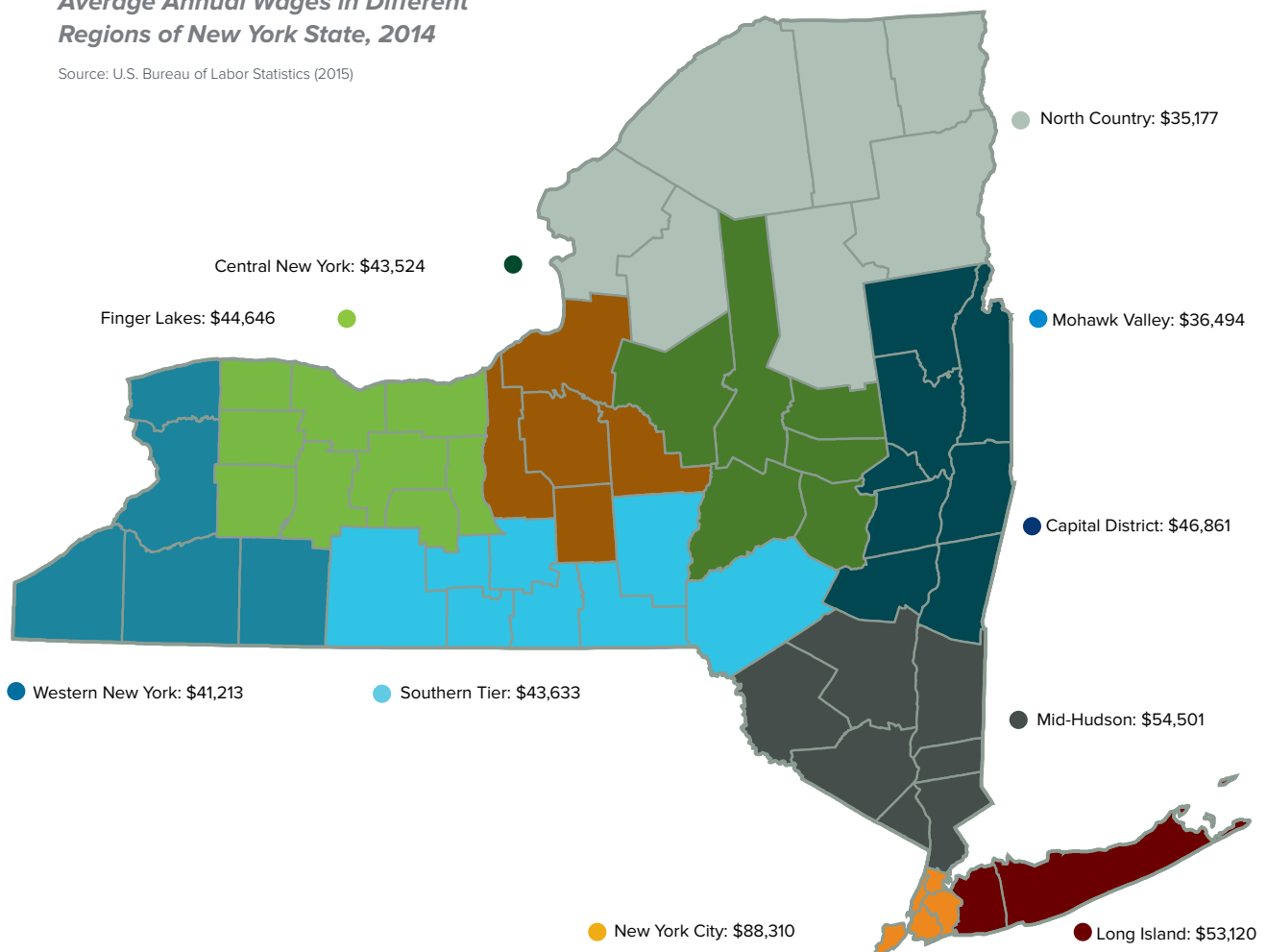
## Cost of labor varies regionally across New York State, and many regions are cost competitive with national average.

**The U.S. average annual wage is \$51,295**

Average annual wages are a rough indicator of the cost of labor, and by extension the cost of doing business in a region. In 2014, average regional wages in Upstate New York ranged from \$35,177 per year (North Country) to \$46,861 per year (Capital District); well below the national average wage of \$51,295. Wages in the New York City metropolitan area (including Long Island and the Mid-Hudson region) are above the national average.

### Average Annual Wages in Different Regions of New York State, 2014

Source: U.S. Bureau of Labor Statistics (2015)



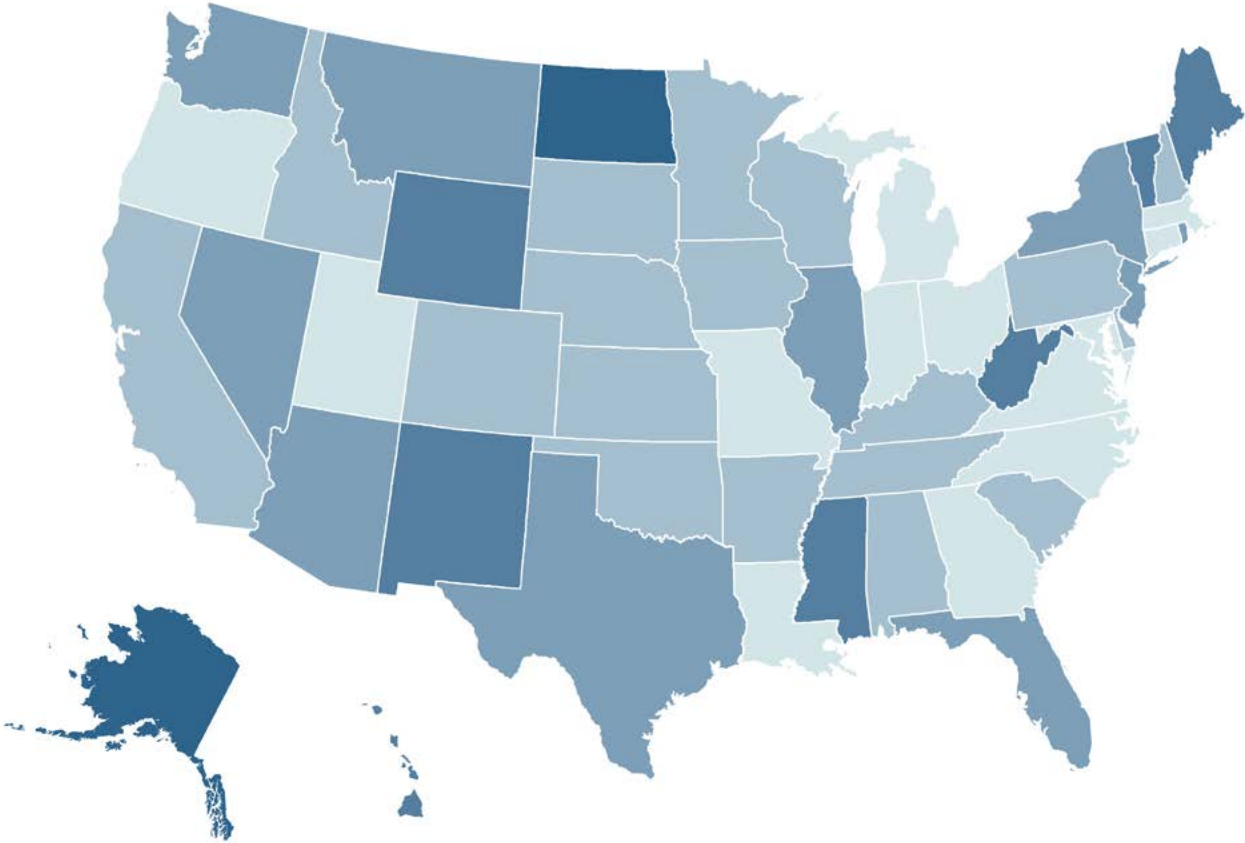
# New York State’s total effective business tax rate is higher than the national average.

With a total effective business tax rate (TEBTR) of 5.8%, compared to the U.S. average of 4.7%, NYS ranks 41st nationally (lower tax rates are assigned higher rankings). State and local business taxes as a percent of gross state product (GSP) is an indicator of the average effective tax burden on existing businesses. However, there is substantial variation in state and local tax structures and across business types and sectors, and the TEBTR is not effective as a measure of the taxation of investment in new or expanded facilities.

### **Total Effective Business Tax Rate (TEBTR): State & Local Business Taxes as a Percentage of Private Sector Gross State Product (GSP), 2014**

Source: Ernst & Young LLP (2014)

Low TEBTR  High TEBTR



***NYPA: Low-Cost Hydropower Incentives for Expanding Companies***

The New York Power Authority (NYPA) sets aside significant blocks of low cost hydropower under NYS law as incentives for job-creating companies that are considering investments in new facilities or expansions of existing facilities in Western NYS. The power allocations are granted for a specified number of kilowatts or megawatts and for a particular term date, e.g., seven years. NYPA is the largest state public power organization in the U.S., and 70% of the electricity it produces is renewable hydropower.

New York State’s industrial electricity prices are slightly below the national average, while residential and commercial rates are above average.

NYS residential and commercial electricity prices exceeded the national average in 2014, but grew at a similar rate to the U.S. average from 1994 to 2014. Industrial rates have in fact decreased slightly since 1994, and in 2014 were slightly below the national average price.

Higher electricity prices can spur greater demand for renewable energy and energy efficiency products and services, but also contribute to higher operational costs for companies.

Average Electricity Prices for New York State and U.S., 1994 and 2014				
		Price (Cents per kWh) 1994	Price (Cents per kWh) 2014	Change in Price 1994-2014
Residential	NYS	13.55	20.05	48%
	U.S. Overall	8.38	12.50	49%
Commercial	NYS	11.67	16.11	38%
	U.S. Overall	7.73	10.75	39%
Industrial	NYS	6.77	6.50	-4%
	U.S. Overall	4.77	7.01	47%

Source: U.S. Energy Information Administration (2015)



# Industry Development



Buffalo, NY

## Industry Development:

### How developed are New York State’s cleantech industry and related sectors?

The translation of clean technologies into new products and services, new companies, and new jobs is an important long-term economic development objective of NYS’ support for cleantech.

The Industry Development indicator group tracks the development of the NYS’ cleantech industry base in terms of the number of cleantech companies, employment, startup activity, investment, and NYS’ competitiveness in related, enabling economic sectors, such as manufacturing and IT/software. NYS is at the forefront in many of these indicators.

Industry Development Dashboard			
Indicator	Relative State Rankings		Change in Rank
	2012	2015	
Size of economy (gross state product)	3	3	—
Average number of Technology Fast 500 companies (3 fiscal year average)	3	3	—
Total number of cleantech companies*	4	4	—
Private sector Green Goods & Services jobs	4	3	▲
Per capita real gross state product	6	3	▲

\* Due to the nature of the data source and/or methodology changes, rankings from the 2012 and 2015 reports may not be directly comparable.



## New York State ranks 4th nationally in number of cleantech companies.

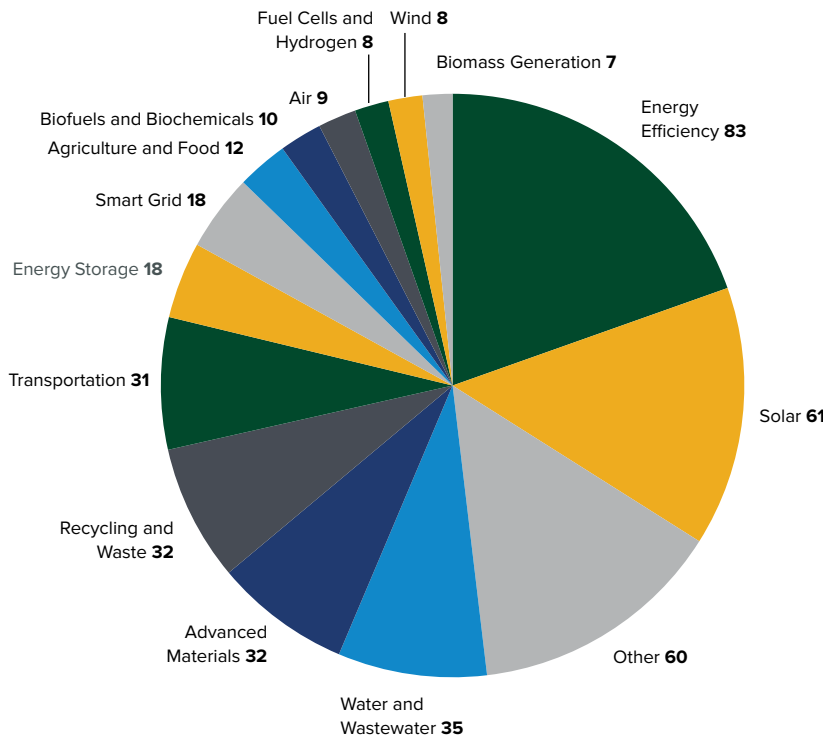
NYS has the 4th largest number (424) of cleantech companies, according to the Cleantech Group. Although California is the clear front runner with 1,890 companies, NYS is close behind Texas and Massachusetts, which rank 2nd and 3rd, respectively.

### *Energy efficiency, solar, and advanced materials are among NYS' top five cleantech sectors.*

Companies are categorized by the cleantech sectors defined by the Cleantech Group.

### Number of NYS Cleantech Companies by Sector

Source: Cleantech Group (2015)



### **NYS Economy by the Numbers:**

- 3rd largest economy in the U.S. (gross state product [GSP] of \$1.40 trillion)
- 3rd highest real per capita GSP in the U.S. (\$64,818; U.S. average is \$49,469)
- High manufacturing workforce concentration compared to the national average (10.5%):
  - Rochester Metropolitan Statistical Area (MSA) (13.9%)
  - Buffalo-Niagara Falls MSA (11.7%)
  - Syracuse MSA (10.0%)

Source: U.S. Bureau of Economic Analysis & U.S. Bureau of Labor Statistics

### **Total Number of Cleantech Companies for Top 10 States**

1. California . . . . . 1,890
2. Texas . . . . . 468
3. Massachusetts . . . . . 426
- 4. New York . . . . . 424**
5. Colorado . . . . . 283
6. Florida . . . . . 267
7. Pennsylvania . . . . . 230
8. Illinois . . . . . 222
9. Washington . . . . . 201
10. New Jersey . . . . . 187

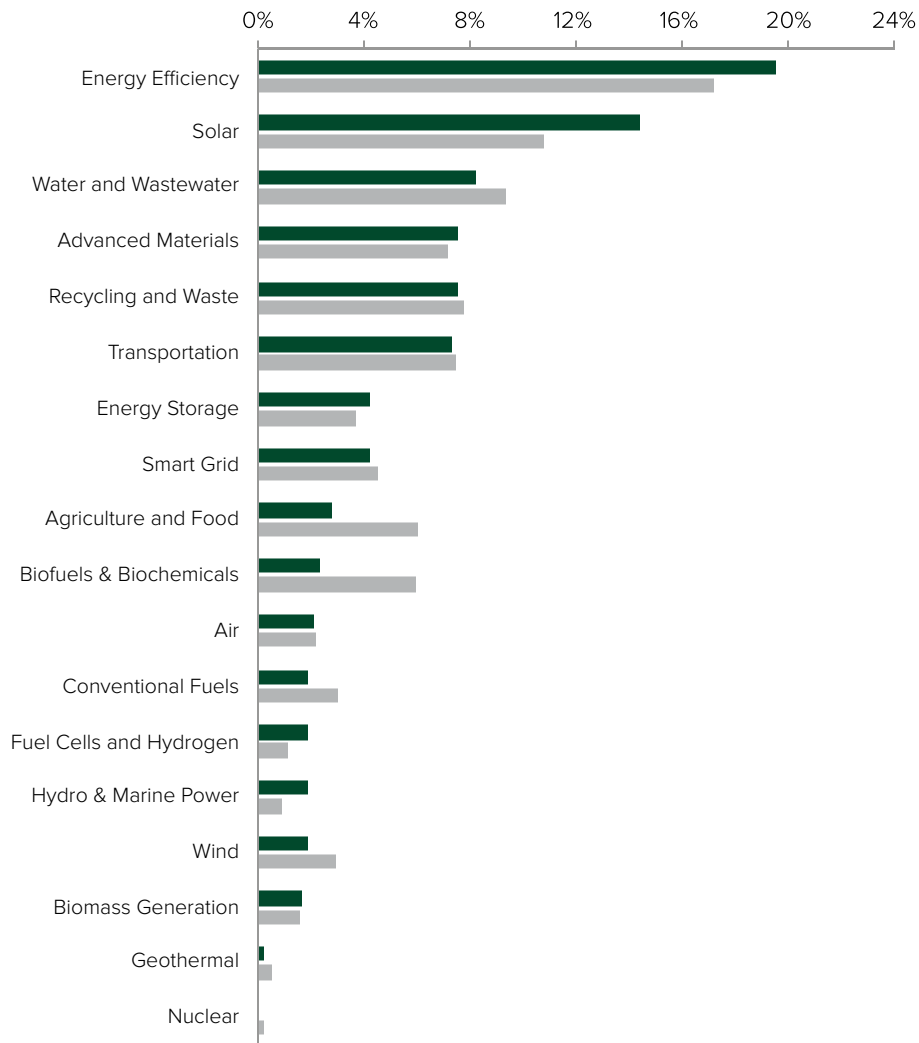
Source: Cleantech Group (2015)

## New York State has a high concentration of energy efficiency and solar companies.

Energy efficiency and solar companies comprise more than one-third of cleantech companies in NYS, and are more concentrated in NYS than the national average. NYS' cleantech economy includes companies across a broad set of sectors, similar to the U.S. overall.

**Share of Total Cleantech Companies by Sector, NYS and U.S.**

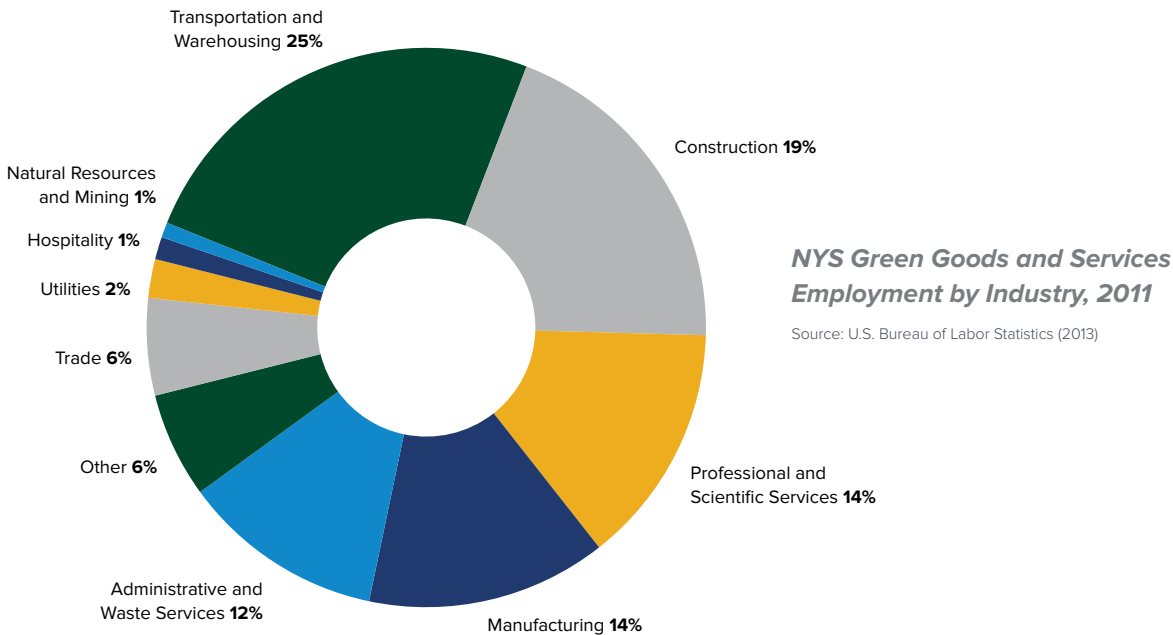
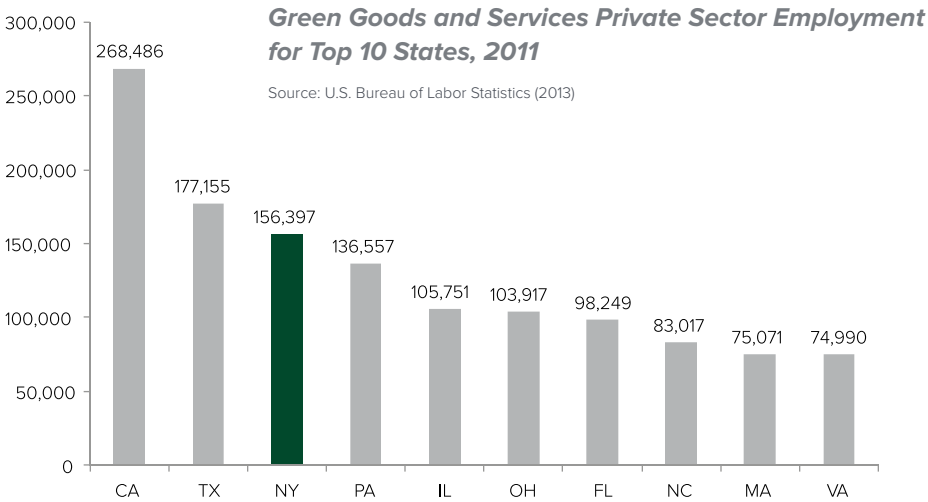
Source: Cleantech Group (2015)



# New York State ranks 3rd nationally in green goods and services employment.

With over 156,000 employed in industries that produce goods or services that benefit the environment or conserve natural resources in 2011, NYS ranks 3rd behind California (268,000) and Texas (177,000). Green goods and services (GGS) employment serves as a metric for the size of the green economy in NYS.

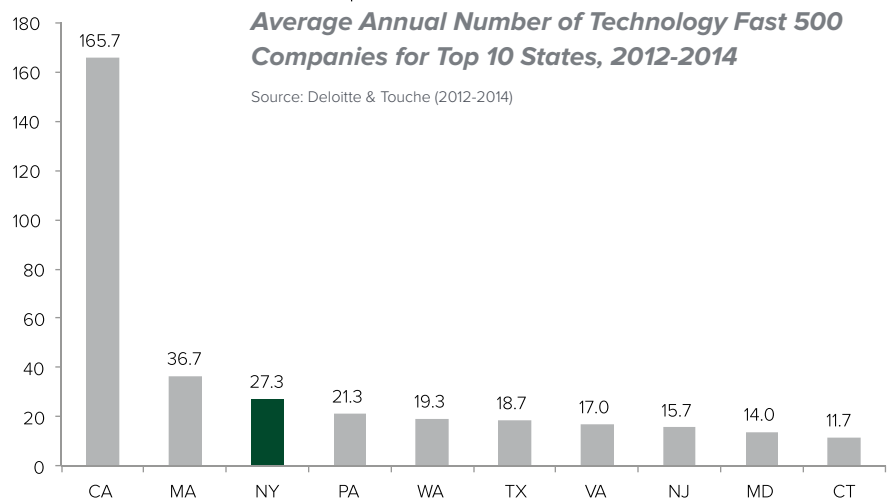
This employment data is based on the U.S. Bureau of Labor Statistics' GGS Survey, which was discontinued after the 2011 survey.



## New York State ranks 3rd in number of Technology Fast 500 companies.

NYS had the third highest average annual number (27.3) of Technology Fast 500 award-winning companies from fiscal years 2012-2014, after California (165.7) and Massachusetts (36.7). NYS cleantech companies in the Technology Fast 500 include Clever Devices in Woodbury (2014); Ioxus, Inc., in Oneonta (2013); and Cemtrex, Inc., in Farmingdale (2012).

Deloitte's Technology Fast 500, a technology awards program, ranks the fastest-growing technology, media, telecommunications, life sciences, and cleantech companies in North America based on revenue growth, and serves as an indicator of how well NYS' business environment fosters the rapid scale-up and growth of technology companies.



## Capital for Growth

### loxus: High-performance ultracapacitors for energy storage and delivery

loxus is a manufacturer of high-performance ultracapacitors that rapidly store and deliver energy for applications in transportation, industrial automation, and renewable energy. Major advantages of loxus ultracapacitors over existing batteries include the amount of power they can deliver, their significantly longer cycle life, and operating temperature up to 85°C.

Headquartered in Oneonta, NY, loxus has grown rapidly since spinning out from another New York electronics company in 2009. In its early years, loxus benefitted from NYSERDA R&D commercialization grants and other NYS and local incentives. The company has expanded dramatically since then, raising over \$56 million through multiple rounds of corporate strategic and venture capital investment. “New York State offers excellent resources for startups in the cleantech sector,” said Mark McGough, the company’s president and CEO. “The State’s strong manufacturing base, and commitment to clean energy technology commercialization through programs like NYSERDA, have been essential to helping loxus scale and enter new markets.”

loxus is experiencing strong demand for its ultracapacitors in the U.S., Europe, Japan, and China. Applications include hybrid buses, where loxus products increase fuel efficiency and reduce pollution up to 72%. The company recently opened its second manufacturing facility in Oneonta and employs about 100 people. It continues to invest in R&D to keep its products at the cutting edge of ultracapacitor technology.



“New York State offers excellent resources for startups in the cleantech sector,”

Mark McGough,  
President and CEO, loxus



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## NYSERDA's six cleantech incubators foster the viability and growth of New York State's most promising early-stage cleantech companies.

Since 2009, NYSERDA's six incubators have assisted 137 client companies across New York State. These clients have commercialized 152 new products, and have attracted more than \$200 million in private capital from investors as well as more than \$76 million in public funding.

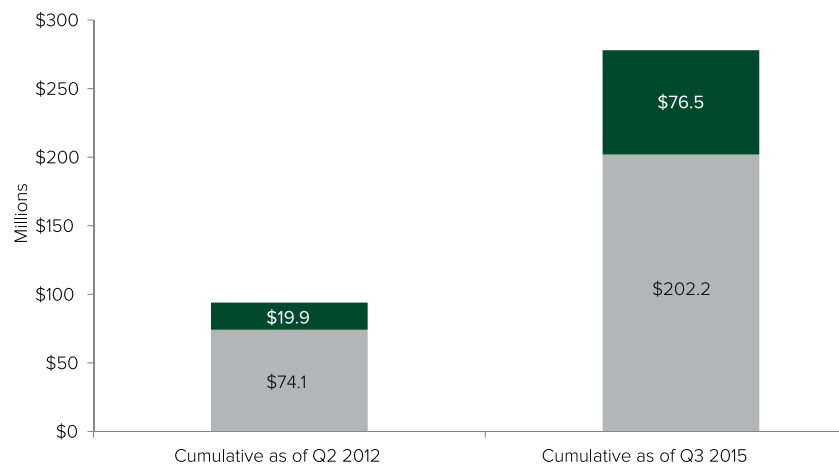
NYSERDA-Supported Cleantech Incubator Client Metrics		
	Q2 2012	Q3 2015
Total number of client companies (cumulative)	94	137
Total investment (cumulative USD)	\$93,956,798	\$278,818,226
Total private capital (cumulative USD)	\$74,062,400	\$202,262,878
Total public funding (cumulative USD)	\$19,894,398	\$76,555,348
Number of new products commercialized (cumulative)	48	152

Source: NYSERDA (2015)

### Total Cumulative Investment Attracted by NYSERDA Incubator Client Companies, Q2 2012 and Q3 2015



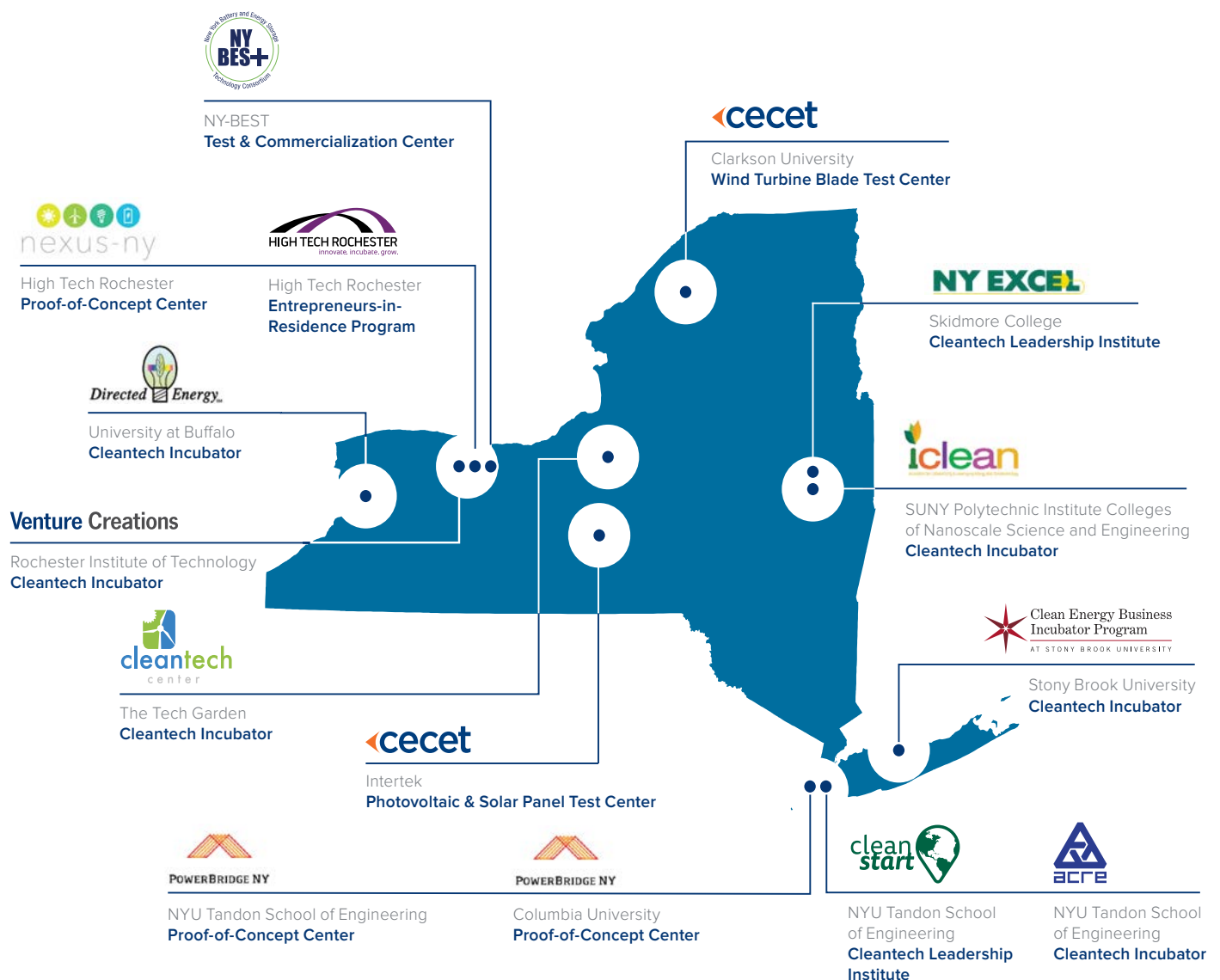
Source: NYSERDA (2015)



## NYS' infrastructure supports cleantech companies.

NYSERDA sponsors a range of programs to support cleantech businesses:

- **Proof-of-Concept Centers** translate innovations into market-validated and scalable businesses.
- **Incubators** foster the viability and growth of New York State's promising early-stage cleantech companies.
- **Entrepreneurs-in-Residence** offer mentoring and strategic business advice for cleantech startups.
- **Cleantech Leadership Institutes** provide boot camps where successful professionals from other industries can quickly learn about cleantech.
- **Test and Commercialization Centers** measure and certify performance of solar panels, wind turbine blades and energy storage components.



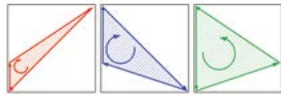
Source: NYSERDA (2015)

## Promising Startup

### ThermoLift: Next-Generation Heat Pump

Founded in 2012, ThermoLift is developing a natural gas-powered heat pump for “all-in-one” heating, cooling, and hot water for residential and commercial buildings. The single system reduces the cost to consumers, avoids the use of environmentally harmful hydrofluorocarbons, and is more efficient than conventional heating and cooling systems.

ThermoLift benefited from New York State’s support for cleantech startups through its incubators, entrepreneurs-in-residence, and technology commercialization funding programs. Time spent in the NYSERDA-supported Clean Energy Business Incubator at Stony Brook “was an enormous transition point for us,” said Paul Schwartz, ThermoLift’s president and CEO. Schwartz credits the assistance received with helping the company make invaluable connections to investors, technical experts, and potential customers. In addition, the company was awarded a competitive grant of \$482,000 from NYSERDA to develop its first prototype. Since then, the company has raised nearly \$6 million in funding, including a \$2.75 million round of venture capital investment from Topspin Partners and the Long Island Angel Network in 2015.



ThermoLift, Inc.

ThermoLift benefited from New York State’s support for cleantech startups through its incubators, entrepreneurs-in-residence, and technology commercialization funding programs.



The company is currently developing a demonstration-scale prototype for deployment in the field. Its partners include Oak Ridge National Laboratory, Stony Brook University, and National Grid. ThermoLift is a client of the NYSERDA-sponsored Clean Energy Business Incubator located at Stony Brook University’s Advanced Energy Center Research and Technology Center.



## New York State cleantech startups making successful exits (2010 – 2015).

Cleantech “exits” are an important indicator for potential angel investors and venture capitalists, because this is how they realize return on their investments. Three primary exit strategies for startups are initial public offerings (IPO), mergers, or acquisitions by larger companies. Over the past five years, several NYS cleantech start-ups have exited via mergers or acquisitions. Acquired companies represent a variety of cleantech sectors, including energy efficiency, advanced materials, solar, smart-grid, and water/wastewater.

**NOTE: The NYS Cleantech Company Exits metric relates to both the Business Environment and Industry Development categories and appears in both sections for the reader’s convenience.**

NYS Cleantech Exits, 2010-Q1 2015	
<b>Ephesus Lighting</b> was acquired by <b>Eaton Corp.</b> in <b>2015</b>	<i>Multiple NYS university development partners; Company received support from the Clean Tech Center business incubator in Syracuse, a NYSERDA-supported incubator; Investment by NYSERDA</i>
<b>Havelide Systems</b> was acquired by <b>Petro River Oil</b> in <b>2015</b>	<i>Client of the Clean Energy Business Incubator Program (CEBIP) at Stony Brook University, a NYSERDA-supported incubator</i>
<b>Urban Green Energy (UGE)</b> began trading publicly in <b>2014</b>	<i>Investment by: Tamra-Tacoma Capital Partners, Energine</i>
<b>EnergyHub</b> was acquired by <b>Alarm.com</b> in <b>2013</b>	<i>Investment by: Physic Ventures, .406 Ventures, New York City Investment Fund, Acadia Woods Partners, NYSERDA</i>
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# Clean Energy Market

## Clean Energy Market:

### What is the size of the market for renewable energy and energy efficiency products and services?

Innovation requires strong market drivers and a customer base that is willing to adopt new business models and technologies. In the U.S., NYS is the third largest economy and the eighth largest consumer of energy. NYS enacted progressive renewable portfolio standards and energy efficiency mandates that make it a good “test bed” for cleantech companies seeking to launch new goods and services.

The Clean Energy Market indicator group benchmarks the size of the current and potential market for renewable energy and energy efficiency products and services in NYS and the larger Northeast Region. It includes metrics and trends in total energy consumption, renewable energy consumption and generation, electricity prices, funding for energy efficiency programs, as well as indicators that suggest “early adopter” consumer behavior with regard to clean energy products and services. NYS’ Clean Energy Market rankings are summarized in the dashboard below.

Clean Energy Market Dashboard			
Indicator	Relative State Rankings		Change in Rank
	2012	2015	
Total electric and gas efficiency program budget	2	2	—
Total LEED-certified square footage*	6	4	▲
Number of alternative fuel vehicles	5	4	▲
Total renewable energy consumption	4	5	▼
Total number of net metering customers	5	6	▼
ACEEE State Energy Efficiency Policy Scorecard	3	7	▼
Total energy consumption	8	8	—
Per capita LEED-certified square footage*	15	11	▲
Net metering customers per capita	18	21	▼
Alternative fuel vehicles (share of total)	28	26	▲

\*2012 report rank re-calculated to match methods used in the 2015 report.

**From FY 2014 to FY 2016, NYSERDA will invest more than \$2.8 billion in energy efficiency and renewable energy programs.**

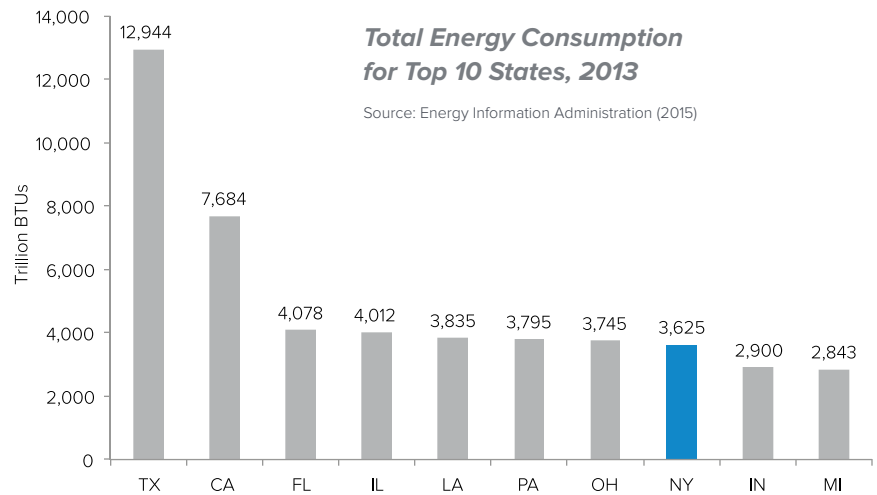
These programs help NYS residents and businesses access renewable energy options and new energy-saving products, build NYS' market infrastructure to deliver clean energy, and help increase the market potential of commercially available energy efficiency and renewable energy technologies in NYS.

### NY-Sun Initiative

Since the launch of Governor Andrew M. Cuomo's NY-Sun initiative in 2012, 316 MW of solar electric technology has been installed or is under contract in NYS. This public-private partnership is driving growth of the solar industry through financial incentives, advancing technology, and reducing costs through a balance-of-systems program. Governor Cuomo has extended the initiative through 2023, and nearly \$1 billion has been authorized over 10 years to meet the statewide target of installing 3 gigawatts of capacity.

New York State is the 3rd largest state economy but the 8th largest consumer of energy in the U.S.

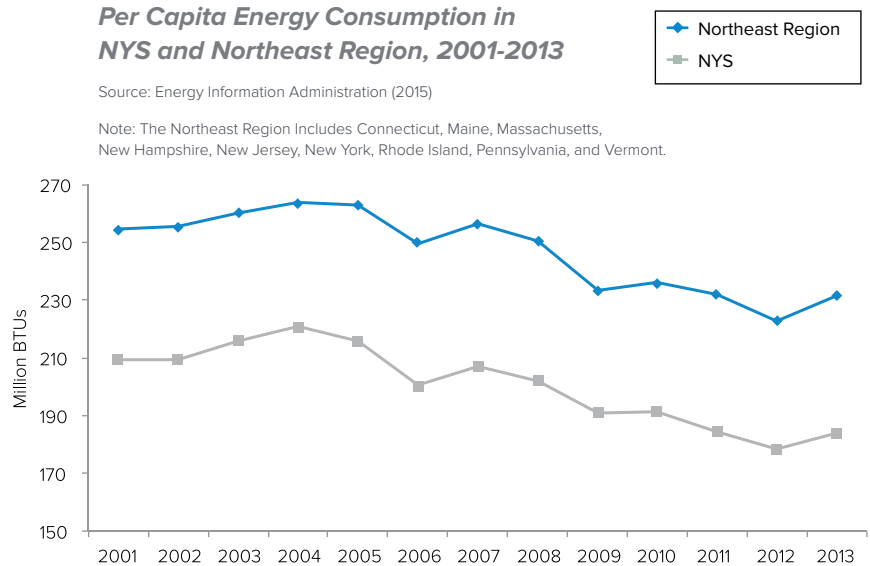
As a significant state economy, NYS consumed over 3,600 trillion Btu of energy in 2013. However, energy consumption declined by 9.2% from 2001 (3,995 trillion BTUs) to 2013 (3,625 trillion Btu).



### Per Capita Energy Consumption in NYS and Northeast Region, 2001-2013

Source: Energy Information Administration (2015)

Note: The Northeast Region Includes Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Pennsylvania, and Vermont.

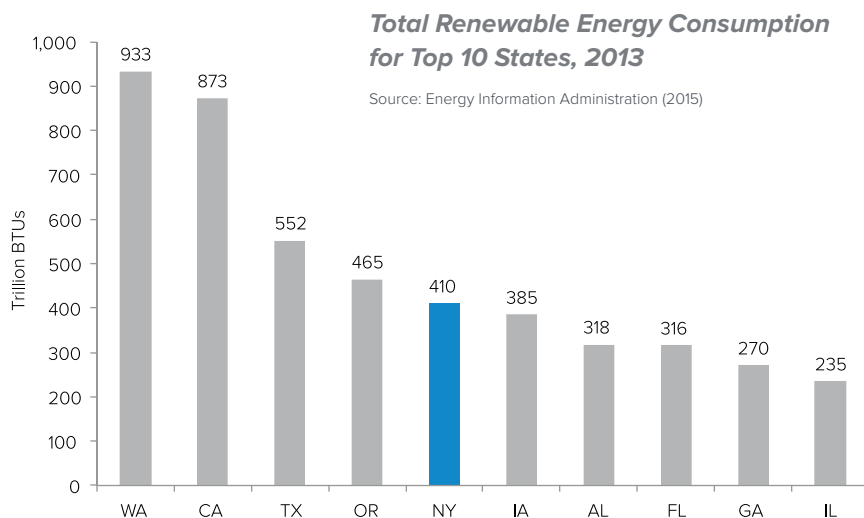


**NYS has the 2nd lowest per capita energy consumption among the Northeast states.**

Per capita energy consumption in NYS is the lowest of all other Northeast states, following Rhode Island.

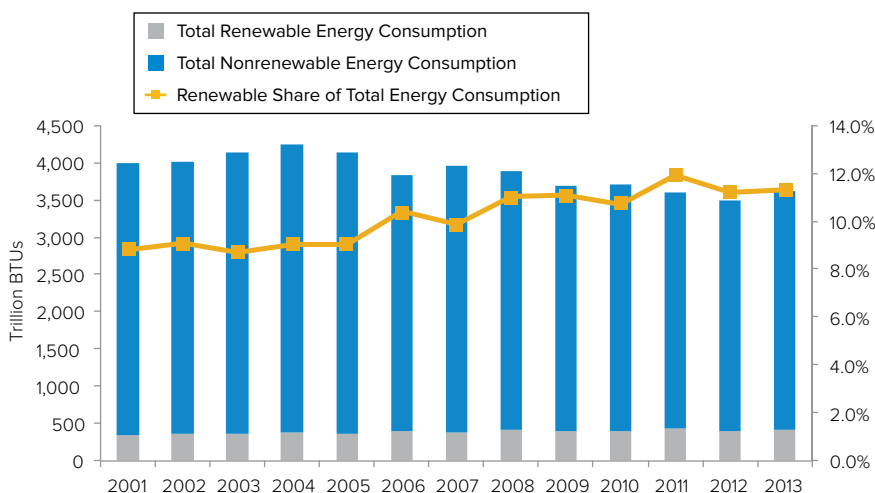
## NYS leads the East Coast in consumption of renewable energy, and ranks 5th in the nation (2013).

Only Washington, California, Texas, and Oregon consumed more renewable energy than NYS in 2013. The 410 trillion Btu of renewable energy consumed in NYS in 2013 comprised 11.3% of total energy consumption, the 17th highest ratio in the country. New York State net renewable energy consumption and the renewable share of total energy consumption have both grown over the past decade (2003-2013), but fluctuate significantly from year to year.



### Breakdown of NYS Total Energy Consumption by Renewable/Nonrenewable, 2001-2013

Source: Energy Information Administration (2015)

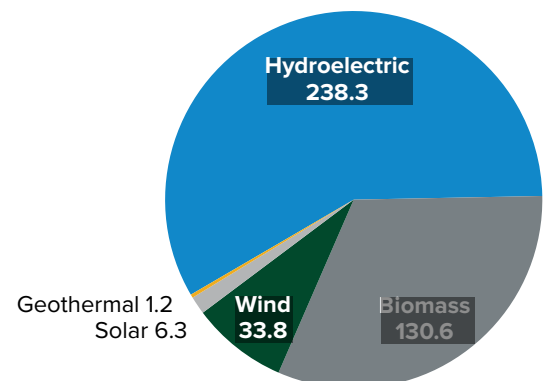


**Hydroelectric and biomass are the leading sources of renewable energy in NYS, but other renewable sectors are growing.**

Although hydroelectric and biomass are by far the leading renewable energy sources in NYS, both their overall level and share of renewable energy consumption has been volatile and declining in recent years. Meanwhile, other renewable sources are growing. Solar more than doubled from 2010 to 2013, growing to 1.5% of total renewable energy consumption. Wind's share of renewable energy consumption has grown from 6.4% in 2010 to 8.2% in 2013. Geothermal grew by 9.1% from 2010 to 2013, but remains a very small share of renewable energy consumption (only 0.3% in 2013).

### NYS Total Renewable Energy Consumption by Source, 2013 (Trillion Btus)

Source: Energy Information Administration (2015)



Electricity and natural gas prices in New York State exceed the U.S. average, creating a market opportunity for renewable energy and energy efficiency products and services.

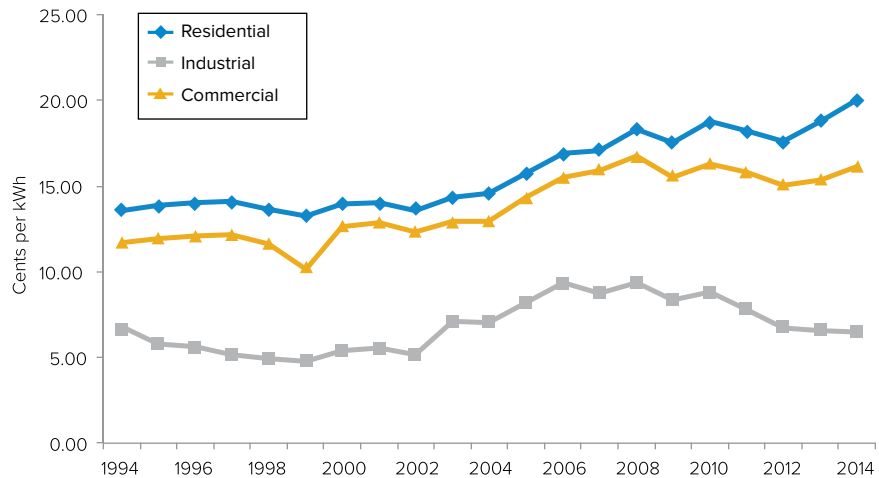
Higher electricity prices spur greater demand for renewable energy and energy efficiency products and services. However, energy prices are a cost-competitiveness issue for companies. For this reason, the New York Power Authority (NYPA) allocates low-cost hydropower for job-creating companies in NYS.

In 2014, NYS residential and commercial **electricity** prices (20.1 and 16.1 cents per kilowatt-hour [kWh], respectively) exceeded the U.S. average price (12.5 and 10.8 cents per kWh, respectively). However, industrial electricity in NYS (6.5 cents per kWh) was lower than the U.S. average (7.0 cents per kWh).

In 2014, NYS residential and industrial **natural gas** prices (12.5 and 8.1 dollars per thousand cubic feet, respectively) were more expensive than the U.S. average (11.0 and 5.5 dollars per thousand cubic feet, respectively). Commercial prices in NYS have fallen below the national average (at 8.3 dollars per thousand cubic feet in NYS, compared to 8.9 for the U.S.).

**Average Annual Retail Electricity Prices for NYS, 1994-2014**

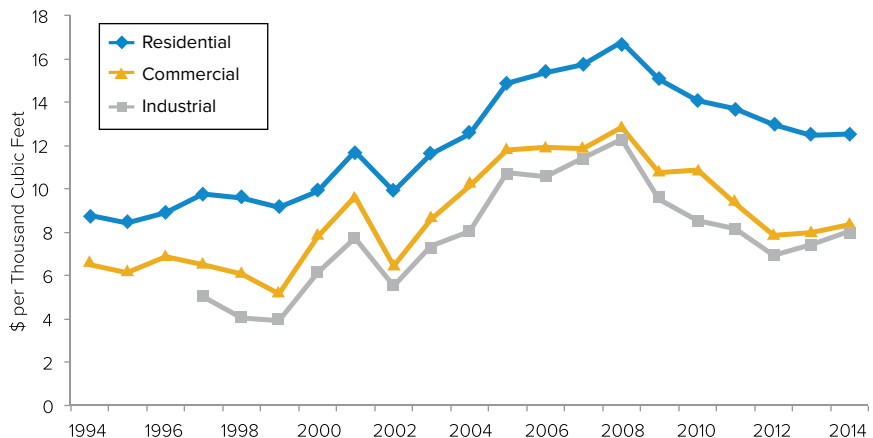
Source: Energy Information Administration (2015)



**Average Annual Natural Gas Prices in NYS, 1994-2014**

Source: Energy Information Administration (2015)

Note: Data not available for the Industrial Sector prior to 1997.



## Leveraging NYS Resources/Support

### Ener-G-Rotors: Waste Heat to Power

Ener-G-Rotors, Inc. is commercializing technology that turns waste heat into carbon-free power. The company's patented devices use low-grade waste heat generated as a by-product of industrial processes, combined heat and power plants, and commercial buildings. These devices are designed to be economical with a three-year payback period.

Founded in 2004, Ener-G-Rotors' CEO Mike Newell said, "New York State provides significant support to cleantech startups. Our partnership with NYSERDA has been instrumental in demonstrating and marketing our technology to customers, and getting it into the field for testing." The company has received multiple rounds of competitive funding from NYSERDA totaling \$2.4 million.

To date, Ener-G-Rotors has raised nearly \$3.5 million in angel and venture capital investment, including a \$1.5 million seed round from Bright Capital. Ener-G-Rotors was named the Most Promising Technology at the Cleantech Forum XXI in San Francisco and was selected to participate in the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) Technology Showcase.



"New York State provides significant support to cleantech startups. Our partnership with NYSERDA has been instrumental in demonstrating and marketing our technology to customers, and getting it into the field for testing.

Mike Newell,  
CEO, Ener-G-Rotors

**Hydroelectric remains the primary renewable electricity source in NYS, but its share has declined slightly as other sources, including wind and solar, have started to grow.**

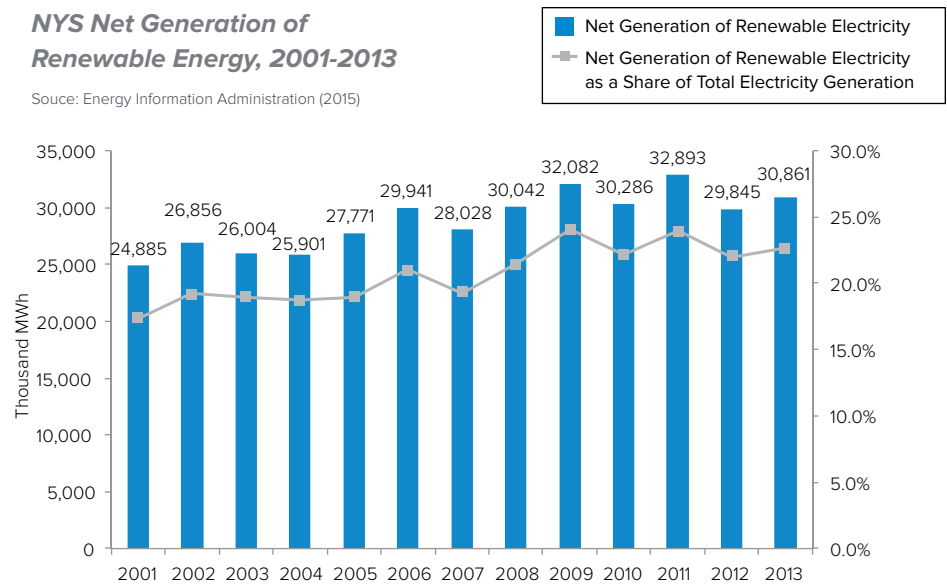
Hydroelectric accounted for nearly 81% of NYS renewable electricity generation in 2013, followed by wind (11.5%), other biomass (5.4%), and wood waste (2.0%). Solar generation was only 0.2% of total renewable electricity generation in 2013, but grew significantly from 2010 to 2013. Wind has also shown a solid upward growth trend in NYS, whereas wood waste grew from 2012 to 2013 after a few years of negative growth.

## In New York State, 23% of net electricity generation is from renewable sources.

From 2001 to 2013, net generation of renewable electricity grew from 24,885 to 30,861 million megawatt-hours (MWh), increasing from 17.3% to 22.7% as a share of total electricity generation in NYS. However, generation of both renewable and nonrenewable electricity varies significantly from year to year.

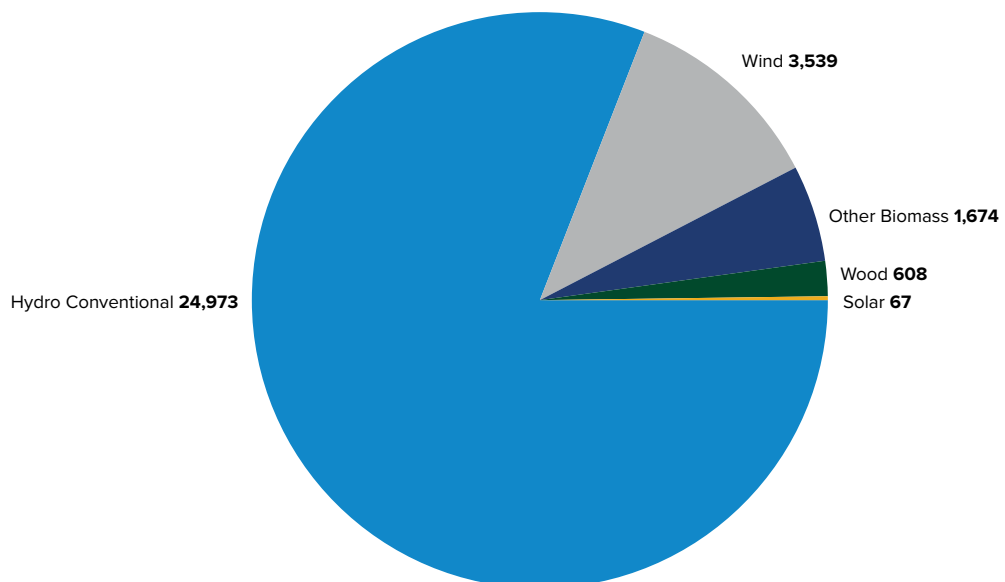
**NYS Net Generation of Renewable Energy, 2001-2013**

Source: Energy Information Administration (2015)



**NYS Net Renewable Electricity Generation by Top Sources, 2013 (Thousand MWh)**

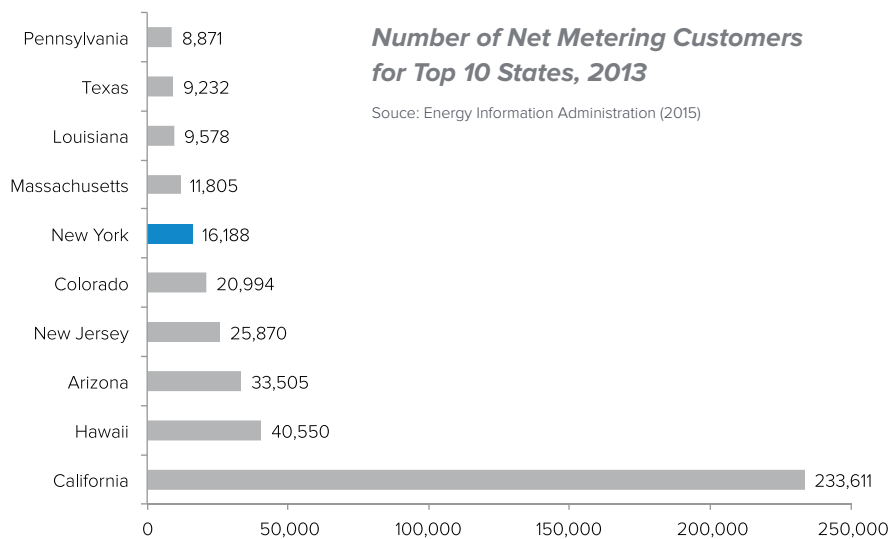
Source: Energy Information Administration (2015)





## New York State ranks 6th: over 16,000 net metering customers in 2013.

With over 16,000 net metering customers in 2013, NYS ranks 6th nationally in number of net metering customers. California leads the U.S. in net metering with over 233,000 net metering customers.



### ***NYS ranks 21st in net metering customers per capita.***

NYS ranks comparatively lower in net metering on a per capita basis. In 2013, NYS had 822 net metering customers per million people, ranking 21st among all U.S. states.

### ***New policies target net metering in NYS.***

In 2008, NYS laws were amended and nonresidential solar and wind installations were made eligible for net metering tariffs. Legislative amendments have expanded the acceptable scale of net metering installations, allowing increasingly higher-output facilities to qualify for a tariff. The NYS Public Service Commission (PSC) has ramped up the minimum limit on net metering from 1% of 2005 peak demand up to 6% in December 2014 for all regulated, investor-owned utilities. The PSC has also directed utilities to accept net metering applications exceeding the 6% limit until the next net metering tariff level is determined.

***Net metering is a system in which renewable energy generators are connected to a utility power grid and surplus power is transferred onto the grid, allowing customers to offset the cost of power drawn from the utility.***

### ***Net Metering Customers Per Million People for Top 10 States and NYS, 2013***

1. Hawaii . . . . . 28,780
2. California . . . . . 6,079
3. Arizona . . . . . 5,050
4. Vermont . . . . . 4,476
5. Colorado . . . . . 3,982
6. New Mexico. . . . . 2,997
7. New Jersey . . . . . 2,903
8. Louisiana . . . . . 2,069
9. Oregon . . . . . 1,963
10. Delaware . . . . . 1,778

**21. New York . . . 822**

Source: U.S. Energy Information Administration (2015)

**LEED®-Certified Square Footage for Top 10 States, May 2015 (Millions of square feet)**

1. California . . . . .	557.2
2. Texas . . . . .	324.6
3. Illinois . . . . .	273.8
<b>4. New York . . . . .</b>	<b>223.5</b>
5. Virginia . . . . .	148.8
6. Washington . . . . .	131.3
7. Nevada . . . . .	113.4
8. Colorado . . . . .	112.7
9. Georgia . . . . .	106.8
10. Massachusetts . . . . .	106.8

Source: U.S. Green Building Council (2015)

Note: District of Columbia (128.8 million LEED-certified square feet) was omitted to improve comparability of state rankings.

New York State has been adding LEED®-certified square footage at a faster rate than most other states.

The U.S. Green Building Council's LEED® (Leadership in Energy and Environmental Design) program provides third-party verification of building factors such as water efficiency, energy efficiency, and indoor environmental quality.

Among the top 10 states, NYS has experienced the second highest growth rate in LEED-certified square footage, growing by a factor of five from 2009 to 2015. In per capita terms, with 11.3 LEED-certified square feet per person in 2015, NYS ranks 11th (up from 15th in 2009).

**Per Capita LEED®-Certified Square Footage for Top 11 States, May 2015 (Square Feet)**

State	Square Feet Per Capita
1. Nevada	39.9
2. Illinois	21.3
3. Colorado	21.0
4. Washington	18.6
5. Virginia	17.9
6. Oregon	16.4
7. Massachusetts	15.8
8. Maryland	14.5
9. California	14.4
10. Texas	12.0
<b>11. New York</b>	<b>11.3</b>

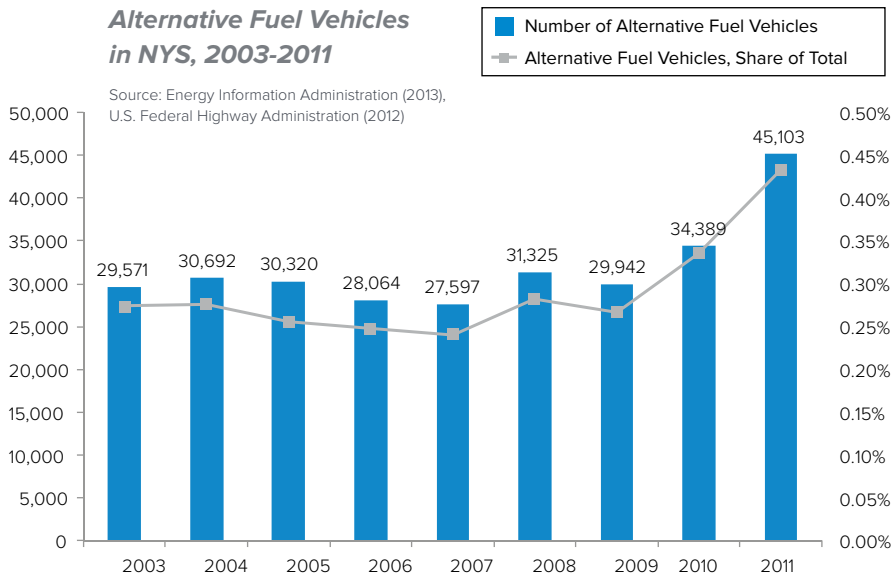
Source: U.S. Green Building Council (2015)

Note: District of Columbia (195.5 LEED-certified square feet per capita) was omitted to improve comparability of state rankings.

New York State ranks 4th in the number of alternative fuel vehicles registered in 2011, but ranks lower as a share of total registered vehicles.

The total market for alternative fuel vehicles in NYS is large and growing rapidly. Over 45,000 alternative fuel vehicles were registered in NYS in 2011, up 53% since 2003. However, as a share of total registered vehicles, NYS ranks 26th among all U.S. states in alternative fuel vehicle use. Alternative fuel vehicles remain a small but growing share of total registered vehicles in NYS, at 0.43% in 2011.

**Alternative Fuel Vehicles in NYS, 2003-2011**



**Alternative Fuel Vehicles as a Share of Total Registered Vehicles in Top 10 States and NYS, 2011**

1. New Mexico	1.29%	7. North Dakota	0.65%
2. Arizona	1.02%	8. Hawaii	0.64%
3. South Dakota	0.89%	9. South Carolina	0.62%
4. Maryland	0.72%	10. Nevada	0.61%
5. Utah	0.71%	<b>26. New York</b>	<b>0.43%</b>
6. North Carolina	0.70%		

*Alternative fuel vehicles (AFVs) include all vehicles designed to operate on an alternative fuel, such as compressed natural gas, propane, or electricity. AFVs do not include gasoline- and diesel-electric hybrids (as their primary fuel is gasoline or diesel).*

**Number of Alternative Fuel Vehicles in Top 10 States, 2011**

1. California . . . . . 176,619
2. Texas . . . . . 118,913
3. Arizona . . . . . 52,323
- 4. New York . . . . . 45,103**
5. Florida . . . . . 44,531
6. North Carolina . . . . . 43,913
7. Illinois . . . . . 42,865
8. Virginia . . . . . 36,174
9. Georgia . . . . . 33,509
10. Michigan . . . . . 31,548

Source: U.S. Energy Information Administration (2013)

Source: U.S. Energy Information Administration (2013) and U.S. Federal Highway Administration (2012)

Note: District of Columbia (5.39% market share) was omitted to improve comparability of state rankings.

*According to the scorecard, NYS is a leader in state energy efficiency policies, with strong rankings (among the top 10 states) in these areas:*

- **Transportation policies**
- **State government initiatives**
- **Utility and public benefit programs and policies**

## New York State ranks 7th in the State Energy Efficiency Scorecard by ACEEE.

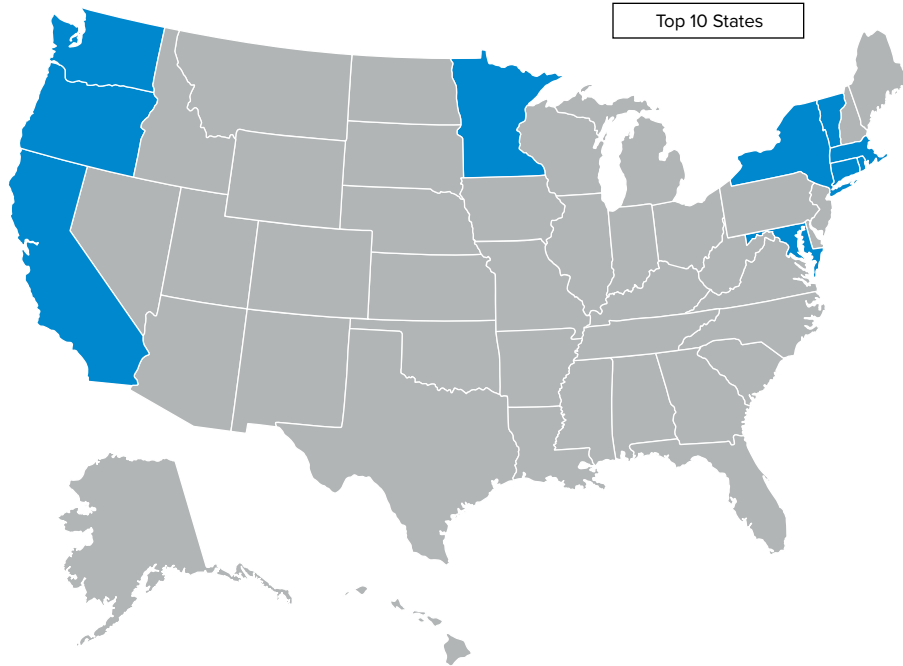
The American Council for an Energy-Efficient Economy's (ACEEE) State Energy Efficiency Scorecard ranks states on their energy efficiency policy and program efforts, examining six primary policy areas: utility and "public benefits" programs and policies, transportation policies, building energy codes, combined heat and power policies, state government-led initiatives around energy efficiency, and appliance efficiency standards.

According to the 2014 scorecard, NYS is a leader in state energy efficiency policies, with strong rankings (among the top 10 states) in the areas of transportation policies, state government initiatives, and utility and public benefit programs and policies.

### ***About ACEEE Scorecard***

ACEEE's scorecard highlights the overall visibility and expansion of NYS-led energy efficiency initiatives, as well as NYSERDA leadership in the State's energy efficiency and renewable energy R&D activities. NYS was an early adopter of statewide building energy codes and appliance and equipment efficiency standards, and paved the way for other states to adopt residential building energy disclosure laws in the 1980s. NYS is also a leader in energy-efficient transportation policies. It is one of the few states in the nation to have a concrete vehicle-miles-traveled reduction target, and it has signed a memorandum of understanding with other states to put a combined 3.3 million zero-emission vehicles on the road by 2025. These efforts complement its adoption of California's stringent vehicle emissions standards in 2005.

State Energy Efficiency Policy Rankings, 2014



State Energy Efficiency Policy Rankings and Scores for Top 10 States, 2014

State	Utility and Public Benefits Programs & Policies (20 pts.)	Transportation Policies (9 pts.)	Building Energy Codes (7 pts.)	Combined Heat & Power (5 pts.)	State Government Initiatives (7 pts.)	Appliance Efficiency Standards (2 pts.)	Total Score (50 pts.)	Change in rank from 2013
1. Massachusetts	20	7	5.5	4.5	5	0	42	0
2. California	12.5	8.5	7	4	6.5	2	40.5	0
3. Oregon	15	7	5.5	3.5	5.5	1	37.5	1
3. Rhode Island	20	5	6	3	3	0.5	37.5	3
3. Vermont	18.5	6	6	3	4	0	37.5	4
6. Connecticut	14	5	5	4.5	6	1	35.5	-1
<b>7. New York</b>	<b>13.5</b>	<b>8</b>	<b>5.5</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>35</b>	<b>-4</b>
8. Washington	13	7	6	2.5	4.5	0.5	33.5	0
9. Maryland	10.5	5	6	3	5	0.5	30	0
10. Minnesota	14	3.5	4.5	1.5	5.5	0	29	1

Source: American Council for an Energy-Efficient Economy (2014)

**REV is a strategy to build a clean, resilient, and affordable energy system for all New Yorkers.**

REV Goals



**Making energy more affordable for all New Yorkers**



**Building a more resilient energy system**



**Empowering New Yorkers to make more informed energy choices**



**Creating new jobs and business opportunities**



**Improving our existing initiatives and infrastructure**



**Supporting cleaner transportation**



**Cutting greenhouse gas emissions 80% by 2050**



**Protecting New York's natural resources**



**Helping clean energy innovation grow**

REV is building an integrated energy network able to harness the combined benefits of the central grid with clean, locally generated power.

*Reforming the Energy Vision* (REV) is Governor Cuomo's comprehensive energy strategy for New York to help consumers make better and more informed energy choices, enable the development of new energy products and services, protect the environment, and create new jobs and economic opportunity throughout New York State.

The 2015 State Energy Plan is the blueprint for REV and calls for a comprehensive approach to New York's energy challenges.

**Specific REV funding opportunities include:**

**K-Solar:** Helping schools (kindergarten through 12th grade) statewide go solar at reduced costs. This opportunity will save schools money on their electric bills, allowing them to spend less on utilities and more on educating New York's children. So far, more than 800 schools have signed up.

**NY Prize:** Offering \$40 million in awards to communities that build their own local energy systems, known as microgrids. The less electricity traveling long distances across electrical lines, the cheaper and more reliable it can become.

**NY-Sun:** Helping finance 3,000 megawatts worth of solar projects in the next 10 years. NY-Sun is investing in communities that need it, committing \$13 million to projects in low-to-moderate income communities. That means cheaper and cleaner energy for everyone.

**BuildSmart NY:** Working to cut energy use NYS buildings 20% by 2020. The government's plan to lead by example is good for the environment and it will save taxpayers tens of millions of dollars on NYS electricity bills.

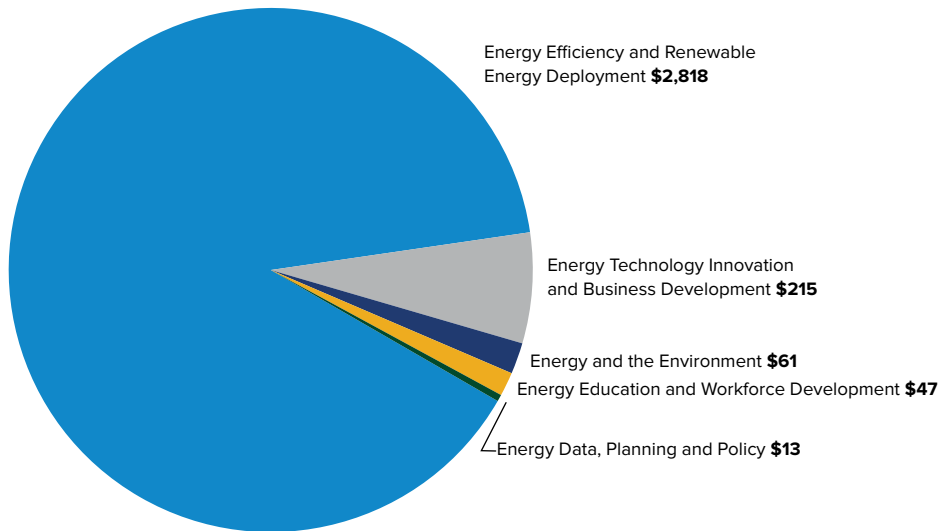
**NY Green Bank:** Working with partners in the finance community to invest \$1 billion in clean energy technologies and projects. NY Green Bank is the largest green bank in the country with a goal to make both public and private sector financing available for clean energy projects, and to keep reinvesting those funds in building New York's clean energy future.

## New York State is investing over \$2.4 billion (2014-2016) in clean energy technologies and energy efficiency upgrades.

From FY 2014-2016, NYSERDA will invest over \$2.8 billion in energy efficiency and renewable energy deployment programs. Another \$215 million will be invested in NYS companies and research institutions for clean technology development and commercialization.

### ***NYSERDA Funding Applied to Program Portfolios, FY 2014-2016 (\$ Millions)***

Source: NYSERDA (2014)



### **Regional Greenhouse Gas Initiative (RGGI)**

RGGI is the first market-based mandatory cap-and-trade program in the U.S. designed to reduce greenhouse gas emissions. NYS participates along with eight other Northeast and Mid-Atlantic States. Revenues from the sales of emission allowances are invested in energy efficiency, renewable energy, and carbon abatement programs.

### **NY Green Bank**

In 2014, Governor Cuomo announced the start of business operations for NY Green Bank. It is the largest green bank in the nation, and the \$1 billion initiative was announced in the Governor's 2013 State of the State address. NY Green Bank will accelerate the deployment of energy efficiency improvements and renewable energy systems by offering mechanisms to address market barriers for private sector financing.

In 2014, only California allocated a larger budget to its electric and gas efficiency programs.

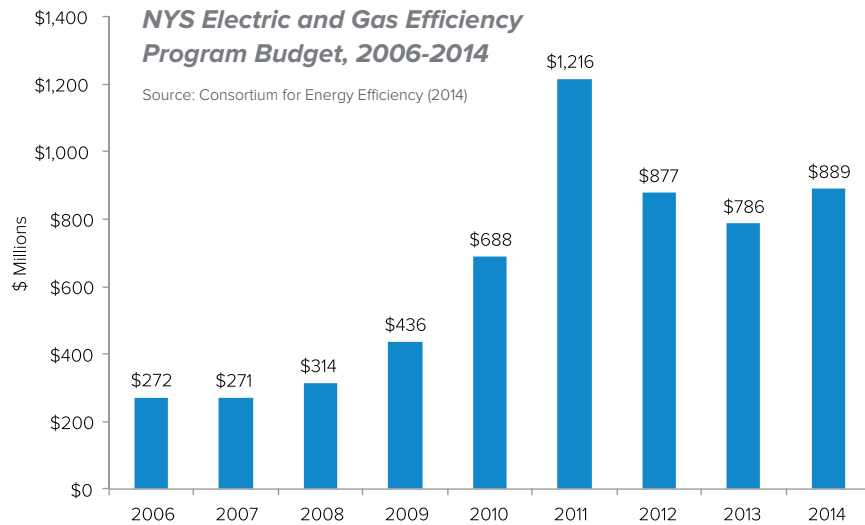
## New York State has the 2nd largest electric and gas efficiency program budget.

NYS' electric and gas efficiency program budget in 2014 was \$889.1 million, according to the Consortium for Energy Efficiency (CEE). The CEE surveys utility and non-utility energy efficiency program administrators to compile energy efficiency program budget data. In interpreting trends over time, note that the decrease in NYS from 2011 to 2012 is at least in part due to an artifact of budget cycle reporting inconsistencies (it is likely that some of the 2011 reported budget was in fact spent in later years).

Many cities, states, and utilities operate energy efficiency programs that encourage consumers to become more energy efficient. A number of these organizations are members of the CEE.

### Electric and Gas Efficiency Program Budgets for Top 10 States, 2014 (\$ Millions)

1. California . . . . . \$1,710
- 2. New York . . . \$889**
3. Massachusetts . . . . \$681
4. Florida . . . . . \$554
5. New Jersey . . . . . \$467
6. Illinois . . . . . \$333
7. Maryland . . . . . \$292
8. Pennsylvania . . . . . \$284
9. Texas . . . . . \$237
10. Michigan . . . . . \$227



Source: Consortium for Energy Efficiency (2014)



## University Spinout

### Ecovative: Green packaging pioneer

Ecovative is a biomaterials company that produces environmentally friendly packaging to protect electronic products and furniture during shipping. Its proprietary materials are derived from mushrooms and agricultural byproducts, like corn stalks and husks, and serve as a cost-competitive, compostable replacement to petroleum-based synthetic materials, such as Styrofoam.

Eben Bayer and Gavin McIntyre founded Ecovative shortly after their graduation from Rensselaer Polytechnic Institute in 2007. "NYSERDA played a tremendously important role as an early funder providing Ecovative with capital to develop our technology, as well as conducting early technical and market validation work," said Gavin McIntyre, chief scientist of Ecovative. Since then, the company has raised two rounds of venture capital investment totaling \$17 million. In February 2015, Ecovative expanded its manufacturing capacity with the opening of a new plant in Troy, NY, to produce its packaging products for Sealed Air Corporation, one of the world's leading packaging companies. "We are thrilled to open another manufacturing facility in New York State where there is a talented workforce and strong infrastructure," said McIntyre.





Appendix

### **Background and Approach**

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## Research and Innovation

### Competitive R&D Awards

#### *DOE R&D Funding*

Federal R&D funding from the U.S. Department of Energy, by state . . . . .	13
Top five states' share of U.S. Department of Energy R&D funding. . . . .	13
Federal R&D funding in NYS, by agency . . . . .	13

#### *DOE Contracts*

Total value of U.S. Department of Energy contracts, by state. . . . .	14
---	----

#### *ARPA-E Awards*

Total value of ARPA-E awards, by state. . . . .	14
NYS recipients of ARPA-E awards . . . . .	13

### University R&D Activity

#### *Research Expenditures at Universities*

Total sponsored research expenditures at major research universities, by state. . . . .	15
Industry share of total sponsored research expenditures at major research universities, by state . . .	15
Total industry sponsored research expenditures at major research universities, by state. . . . .	15

### R&D Outputs

#### *Patents*

Number of clean technology patent registrations in NYS, by year: total and by technology . . . . .	17
Number of clean technology patent registrations, total by state in past three years . . . . .	17
Share of clean technology patents by technology, for NYS . . . . .	18
Share of clean technology patents by technology, for the U.S. . . . .	18
Number of clean technology patent registrations in NYS, by technology and subcategory and year . . . . .	18
Number of clean technology patent registrations, by technology and state . . . . .	19-26
Number of clean technology patent registrations in NYS, by technology and assignee. . . . .	19-26

### Commercialization Activities

#### *University Licenses and Options Executed*

Number of licenses and options executed by major research universities, by state . . . . .	27
--	----

#### *SBIR/STTR Awards*

Total number of SBIR/STTR awards, total and by Phase I/II, by state. . . . .	28
Total value and average value of SBIR/STTR awards, total and by Phase I/II, by state . . . . .	28

## Business Environment

### Venture Capital

#### *Venture Capital Investment*

Total value of venture capital investments, by year, for NYS & U.S., and NYS share of U.S. . . . .	32
Number of venture capital investment deals, by year, for NYS & U.S., and NYS share of U.S. . . . .	32
Total value of venture capital investments, by state . . . .	32

#### *Cleantech Venture Capital Investment*

Annual value of cleantech venture capital investments, by state, 5-year total . . . . .	33
Annual value of NYS cleantech venture capital investments, by year, USD and as a % of U.S. total. . . . .	33
Number of cleantech venture capital deals, for top 10 states, 5-year total. . . . .	34
Number of cleantech venture capital deals for NYS, total number and as a % of U.S. total. . . . .	34
Annual value & number of deals of cleantech venture capital investments, by sector, for NYS & NYS share of U.S. investment value, 5-year total . . . . .	34
Annual value of cleantech venture capital number of deals and total investment as % of total, by investment type, for NYS and U.S., 5-year total. . . . .	34
Number & list of investors that have made a venture capital investment in a NYS cleantech company . . . . .	35

### Exits

#### *Cleantech IPOs and M&As*

List of cleantech exits by mergers and acquisitions for NYS . . . . .	36
List of NYS cleantech exits . . . . .	36

### Workforce

#### *STEM Degrees*

Number of Science, Technology, Engineering, and Mathematics (STEM) degrees awarded, by state, by degree type . . . . .	38
Number of Science, Technology, Engineering, and Mathematics (STEM) degrees awarded per 100,000 people, for NYS and U.S. average, by year . . . . .	38

#### *Managerial, Professional and Technical Jobs*

Number of managerial, professional, and technical (MPT) jobs, in NYS and U.S. . . . .	40
Number of managerial, professional, and technical jobs as a percentage of total state employment, for NYS, MA, CA, PA, TX, and U.S. . . . .	40

#### *High-tech Jobs*

High-tech employment in NYS . . . . .	40
---------------------------------------	----

#### *Science, Technology, Engineering and Mathematics Jobs*

Number of STEM jobs in NYS . . . . .	40
STEM jobs as a percentage of total employment, NYS and U.S. average . . . . .	40

#### *Green Goods and Services Jobs*

Green goods and services private sector employment, for top 10 states. . . . .	41
Green goods and services private sector employment in NYS, by industry . . . . .	41

### Cost of Doing Business

#### *Average Annual Pay*

Average annual pay for private establishments by NYS region and U.S. average . . . . .	42
--	----

#### *Tax Competitiveness*

Total Effective Business Tax Rate: State & Local Business Taxes as % of Private Sector GSP, by state (Existing Businesses). . . . .	43
---	----

#### *Cost of Energy*

Residential average residential electricity price & 20-year % change, NYS and U.S. Average . . . . .	44
Commercial average residential electricity price & 20-year % change, NYS and U.S. Average . . . . .	44
Industrial average residential electricity price & 20-year % change, NYS and U.S. Average. . . . .	44

## Industry Development

### Green Economy

#### *State Economy*

Gross state product for NYS . . . . .	47
Per capita real gross state product for NYS (in chained 2009 dollars) . . . . .	47

#### *Regional Manufacturing Sector*

Manufacturing employment as a share of total private sector employment, by NYS region and U.S. average . . . . .	48
--	----

#### *Cleantech Companies*

Total number of cleantech companies, for top 10 states . . . . .	47
Number of cleantech companies by sector for NYS . . .	49
Share of total cleantech companies by sector, for NYS and U.S. average . . . . .	49

#### *Green Goods and Services Jobs*

Green goods and services private sector employment, for top 10 states. . . . .	49
Green goods and services private sector employment in NYS, by industry . . . . .	49

### Business Creation and Growth

#### *Technology Fast 500 Companies*

Average annual number of Technology Fast 500 companies in top 10 states, 3-year average. . . . .	50
Names and number of clean technology Tech Fast 500 companies in NYS, most recent three years . . . . .	50

#### *NYSERDA Incubators*

Number of NYSERDA-Supported Cleantech Incubator client companies, cumulative . . . . .	52
Total public capital invested in NYSERDA-Supported Cleantech Incubator client companies, cumulative . . . . .	52
Total private capital invested in NYSERDA-Supported Cleantech Incubator client companies, cumulative . . . . .	52
Total public capital attracted by NYSERDA-Supported Cleantech Incubator client companies, cumulative . . . . .	52
Number of new products commercialized by NYSERDA-Supported Cleantech Incubator client companies, cumulative . . . . .	52
Location of NYSERDA-funded Clean Energy Business Incubators and Client Companies . . . . .	53

### Exits

#### *Cleantech IPOs and M&As*

List of cleantech exits by mergers and acquisitions for NYS . . . . .	55
List of cleantech exits by IPO for NYS. . . . .	55

## Clean Energy Markets

### Energy Consumption

#### *Energy Consumption*

Total energy consumption in top 10 states . . . . .	58
Per capita energy consumption in NYS and northeast region, by year . . . . .	58

#### *Renewable Energy Consumption*

Total renewable energy consumption in top 10 states . . . . .	59
Total renewable and nonrenewable energy consumption in NYS, by year . . . . .	59
Renewable share of total energy consumption in NYS, by year . . . . .	59
NYS total renewable energy consumption by source . . . . .	59

### Energy Prices

#### *Electricity Prices*

Average annual retail electricity prices (residential, industrial, and commercial) for NYS, by year, and compared to U.S. overall . . . . .	60
---	----

#### *Natural Gas Prices*

Average annual liquid natural gas prices (residential, industrial, and commercial) for NYS, by year, and compared to U.S. overall . . . . .	60
---	----

### Energy Production

#### *Electricity Generation from Renewable Sources*

Net generation of renewable electricity in NYS, by year . . . . .	62
Net generation of renewable electricity as a share of total electricity generation in NYS, by year . . . . .	62
Net renewable electricity generation by source in NYS . . . . .	62

### Consumer Market and Behavior

#### *LEED®-Certified Square Feet*

Total number of net metering customers, by state . . . . .	63
Total number of net metering customers per capita, by state . . . . .	63

Total LEED®-certified square footage in top 10 states . . . . .	64
Per capita LEED®-certified square footage in top 10 states . . . . .	64

#### *Alternative Fuel Vehicle Use*

Number of alternative fuel vehicles (electric, natural gas, hybrid) in top ten states . . . . .	65
Alternative fuel vehicles (electric, natural gas, hybrid) as a share of total registered vehicles in top 10 states and NYS . . . . .	65
Number of alternative fuel vehicles in NYS, by year . . . . .	65
Alternative fuel vehicles as a share of total registered vehicles in NYS, by year . . . . .	65

### Energy Policy

#### *State Energy Efficiency Policy Scores and Rankings*

State energy efficiency policy rankings: top 10 states . . . . .	67
State energy efficiency policy scores: top 10 states . . . . .	67
Utility and public benefits programs and policies sub-score . . . . .	67
Transportation policies sub-score . . . . .	67
Building energy codes sub-score . . . . .	67
Combined heat and power sub-score . . . . .	67
State government initiatives sub-score . . . . .	67
Appliance efficiency standards sub-score . . . . .	67

#### *NYSERDA Funding*

Funding for NYSERDA's program portfolio (FY 2014), by program . . . . .	69
---	----

#### *Energy Efficiency Program Budgets*

Electric and gas efficiency program budgets in top 10 states . . . . .	70
Electric and gas efficiency program budget in NYS, by year . . . . .	70



**ACEEE** – American Council for an Energy-Efficient Economy

**AFVs** – alternative fuel vehicles, which are designed to operate on an alternative fuel, such as compressed natural gas, propane, or electricity. AFVs do not include gasoline and diesel-electric hybrids (as their primary fuel is gasoline/diesel).

**ARPA-E** – Advanced Research Projects Agency-Energy – a division of the U.S. DOE

**AUTM** – Association of University Technology Managers

**BTU** – British Thermal unit – a measure of heat energy

**Cleantech** – Commonly consists of four areas (also referred to as clean energy): renewable energy generation, energy storage, efficiency (energy and building), transportation, plus four areas excluded from this report: air and environment (emissions, recycling and waste), clean industry (design, materials, production), water, and agriculture.

**CUNY** – The City University of New York

**DARPA** – Defense Advanced Research Projects Agency

**DOD** – U.S. Department of Defense

**DOE** – U.S. Department of Energy

**EIA** – U.S. Energy Information Administration

**FY yyyy** – fiscal year

**ETR** – effective tax rate

**EV** – electric vehicle

**GGS** – green goods and services

**GDP** – gross domestic product

**GSP** – gross state product (state equivalent to GDP for USA)

**KW** – kilowatt – a measure of electrical power

**kWh** – kilowatt-hour, a measure of electrical energy

**IP** – intellectual property

**IPO** – initial public offering (typically of stock)

**LEED®** – Leadership in Energy and Environmental Design – a voluntary, consensus-based, market-driven program that provides third-party verification of green buildings

**M&As** – mergers and acquisition

**MSA** – metropolitan statistical area

**MW** – megawatt = 1,000 Kilowatts, a measure of electrical power

**MWh or MWhr** – Megawatt-hour = 1000 Kilowatt-hours – a measure of electrical energy

**NSF** – National Science Foundation

**NYPA** – New York Power Authority

**NYS** – New York State

**NYSERDA** – New York State Energy Research and Development Authority

**PV** – photovoltaic (panels to generate electricity from the sun); also referred to as solar electric

**Qx yyyy** – quarter – one of four quarters in a year

**R&D** – research and development

**REV** - Reforming the Energy Vision ([www.dps.ny.gov/REV/](http://www.dps.ny.gov/REV/))

**RPS** – Renewable Portfolio Standard

**SBIR** – Small Business Innovation Research

**Sq.Ft.** – square feet

**STEM** – science, technology, engineering, and mathematics

**STTR** – Small Business Technology Transfer

**TEBTR** – total effective business tax rate

**Tech Fast 500** – Technology awards program in United States and Canada run by Deloitte (<http://www.deloitte.com/us/fast500/>)

**VC** – venture capital, a type of business investment

## Appendix

### Photo Credits and Captions

**Cover:**

Rooftop solar panels in Brooklyn, NY.

*Credit: NYSERDA*

**Page 2:**

Ecovative's Mushroom® Materials, created from the vegetative growth stage of fungi.

*Credit: Ecovative*

OLEDWorks's organic light emitting diode (OLED) lighting technology used in a theater.

*Credit: OLEDWorks*

TEC-SMART in Malta, NY.

*Credit: Hudson Valley*

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**Page 3:**

Spiraling staircase.

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**Page 9:**

Researching and analyzing data.

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**Page 11:**

Ecovative's flame-resistant Mushroom® Material.

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**Page 12:**

NYC ACRE's clean technology and renewable energy incubator in Brooklyn, NY.

*Credit: Ecovative*

**Page 16:**

Desk light that uses organic light emitting diode (OLED) technology.

*Credit: OLEDWorks*

OLEDWorks's organic light emitting diode (OLED) lighting technology used in a theater.

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**Page 30:**

Business environment.

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**Page 38:**

Ephesus LED Lighting fixtures used in a hockey arena.

*Credit: Ephesus Lighting*

**Page 45:**

Valeant/Bausch + Lomb solar project in Rochester, NY.

*Credit: Valeant*

**Page 46:**

Buffalo, NY.

*Credit: Getty Images*

**Page 51:**

loxus high-performance ultracapacitors for energy storage and delivery.

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**Page 54:**

Yacov Shamash, Bob Cattell, and Paul Schwartz.

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**Page 56:**

TEC-SMART in Malta, NY.

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**Page 61:**

Ener-G-Rotors 5LB installed at Con Edison's Hudson Avenue Steam Plant.

*Credit: Ener-G-Rotors*

**Page 71:**

Eben Bayer and Gavin McIntyre, founders of Ecovative.

*Credit: Ecovative*

Mushroom® Materials.

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Packaging.

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Ecovative's engineered wood alternative.

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*NYSERDA, a public benefit corporation, offers objective information and analysis, innovative programs, technical expertise, and support to help New Yorkers increase energy efficiency, save money, use renewable energy, and reduce reliance on fossil fuels. NYSERDA professionals work to protect the environment and create clean-energy jobs. NYSERDA has been developing partnerships to advance innovative energy solutions in New York State since 1975.*

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**New York State  
Energy Research and  
Development Authority**

17 Columbia Circle  
Albany, NY 12203-6399

**toll free:** 866-NYSERDA  
**local:** 518-862-1090  
**fax:** 518-862-1091

[info@nyserderda.ny.gov](mailto:info@nyserderda.ny.gov)  
[nyserderda.ny.gov](http://nyserderda.ny.gov)



**NYSERDA**

**State of New York**

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