Clean Economy Profile

2012

Prepared for

Delaware Department of Natural Resources, Division of Energy and Climate

by Clean Economy Solutions and Collaborative Economics

Report prepared for

Delaware Department of Natural Resources, Division of Energy & Climate whose mission is to serve the people of Delaware by reducing adverse impacts of energy use on our environment, health and economy. We educate, lead by example, and build partnerships to increase energy efficiency and renewable energy, promote sustainable growth, and prepare for a changing climate.

Report produced by

Clean Economy Solutions - Clean Economy Solutions is a clean economy accelerator serving as advisors, coaches and facilitators for metro regions, helping them maximize their opportunities in the clean economy sector, envisioning how it could grow, charting a roadmap for getting there, and bringing the plans to fruition. Clean Economy Solutions acts as a matchmaking service bringing metro regions, businesses, investors, and markets together. We make it easier for companies, investors and regions to get up and running with lower risks levels and faster returns on investment.

Richard C. D. Fleming, Chair of the Board
Andre Pettigrew, Executive Director

Clean Economy Solutions • Advancing America's economy region by region • www.cleaneconomysolutions.org

Report prepared by

Collaborative Economics - Collaborative Economics works with senior executives from business, foundations, government, education and community sectors - helping them create breakthroughs in how people think and act regarding their region. Collaborative Economics' clients have the passion, vision and commitment to blaze a new pathway for their community. They understand that a new kind of leadership is required to create great places, with thriving economies and world-class quality of life.

Collaborative Economics • Advisors to Civic Entrepreneurs • www.coecon.com

Doug Henton
John Melville
Clare Brown
Janine Kaiser
Francie Genz
Renae Steichen
Kim Held
Jessie Oettinger
Truitt Gossett

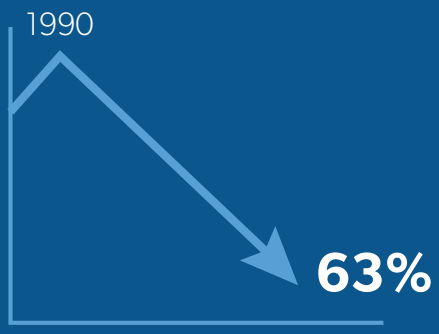
Report Design: Bridget Gibbons

CONTENTS

Delaware's growing clean economy has produced jobs, helped lower the state's emissions, and increased the state's energy efficiency.

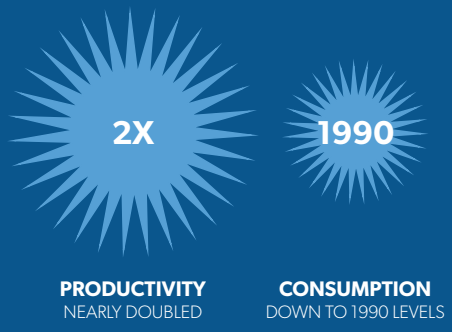
The state's clean economy has added new jobs and businesses that aid industry, government, and residential consumers conserve energy, reduce waste, and save money. Taken together, the core clean economy sectors--from advanced materials to energy generation--have attracted growing investment, created innovative products and services, and experienced sustained job growth, even adding employment in the middle of the national economic downturn.

CARBON EMISSIONS



Delaware requires less carbon to fuel its economy. In 1990, the state was close to the national average in terms of carbon emissions produced to generate economic output (i.e., Gross Domestic Product [GDP]). By 2009, it was among the top states on this measure, producing less emissions relative to GDP than forty-seven states.

ENERGY EFFICIENCY

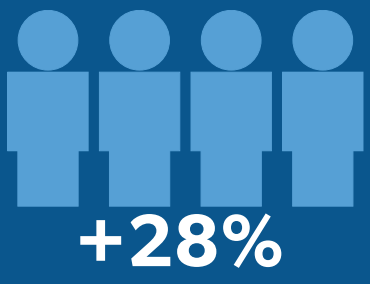


Delaware's economy has become much more energy efficient. Since 1990, the state's energy productivity (i.e., the ratio of GDP to total energy consumption) has almost doubled. In fact, Delaware's total energy consumption is now down to its 1990 level, even though the state's population is about one-third larger. The state's energy productivity grew three times faster than the rest of the nation between 1990 and 2010. From 2009 to 2010 Delaware's energy productivity experienced an eight percent gain compared to a one percent loss in U.S..

ENERGY PRODUCTIVITY

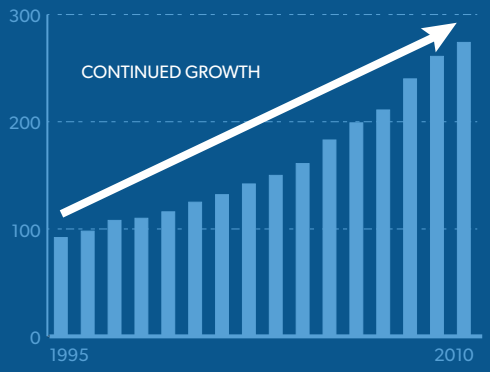
Delaware saves millions due to its energy productivity. In 2010, the overall electricity bill for Delaware as a share of GDP (2.17%) was less than the average for the rest of the U.S. (2.56%). That difference saved Delaware $262 million on its electricity bill--money which was available to grow and retain jobs, or for other savings and investment, rather than spent powering operations.

CLEAN EMPLOYMENT



Delaware's clean economy sectors have grown jobs much faster than the rest of the state's economy. Employment in thirteen clean economy sectors providing products and services that help their customers conserve energy, reduce waste, and save money grew 28 percent between 1996 and 2010, while jobs in the rest of Delaware's economy increased only two percent. Jobs in these sectors are diverse--from research and development (R&D) and manufacturing to installation and service--and now number more than 11,000.

CLEAN ESTABLISHMENTS



Delaware's clean economy sectors have continued to prosper despite the national downturn. Even during the recent recession, these thirteen sectors showed impressive resilience-- growing 0.8 percent between 2009 and 2010. Entrepreneurship has also flourished in these sectors, with sustained growth in the number of business establishments before, during, and after the recession.

CLEAN PATENTS

Delaware has attracted increasing levels of investment and generated growing numbers of patents in its clean economy sectors--with a particularly strong specialization in advanced materials. Advanced materials includes chemical composites, biomaterials, and nano-materials used to improve energy efficiency and develop cleaner products and processes. In 2011, advanced materials companies secured nearly $10 million in federal R&D funding. Patents in chemical and organic compounds and materials topped 500 during the 2008-2010 period, up eleven percent from 2005-2007. Chemical processing technology patents also rose 17 percent during this period. Together, clean technologies patents including wind, fuel cells, solar, batteries, and water (65 total patents) grew roughly 55 percent from 2004 to 2011 compared to the previous seven year period (42 total patents). Not only has Delaware's clean economy sectors grown over time, but they have attracted investment and generated innovations that will likely benefit the state in the future.

A CLEANER, MORE EFFICIENT ECONOMY

The following indicators help illustrate the relationship between economic performance (i.e., GDP) and greenhouse gas (GHG) emissions, and how this relationship has changed over time. By evaluating domestic and international trends in the carbon economy, carbon efficiency and intensity, energy use, electricity use, and transportation fuel consumption, we can track Delaware's performance over the long term and identify potential areas for improvement.

DOMESTIC & INTERNATIONAL CARBON ECONOMY TRENDS

Carbon-based fuels drive the distribution networks of ocean shipping, air cargo, trains and trucks, and are the basis of electricity generation. However, Delaware's carbon emissions have steadily declined over the past 20 years, indicating that as the economy grows it is becoming cleaner. While Delaware's carbon emissions per GDP were noticeably higher than other low carbon economy states in 1990, since then, Delaware's carbon economy has dropped at a faster rate (63%) than these states and the rest of the U.S.

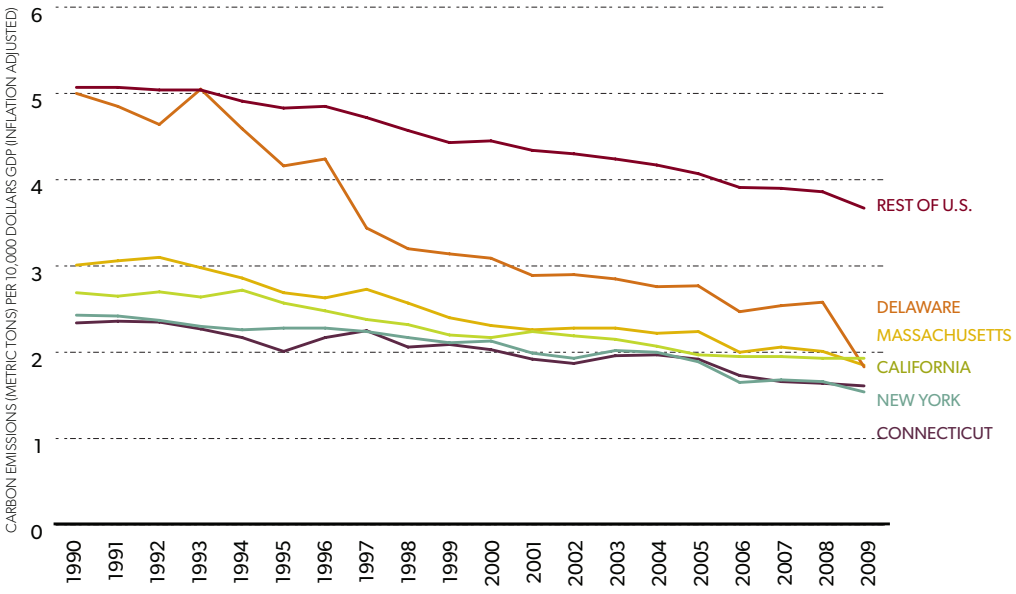
Delaware is now among the lowest carbon economy states in the country. In 2009, Delaware reported the fourth lowest carbon economy in the nation, following the District of Columbia, New York and Connecticut. The nation's carbon economy as a whole (not including DelawaWre) is just a third as efficient as Delaware's.

Through collaboration with the University of Delaware and the Delaware Technology Park, **Crey Bioresins** is developing bio-based technologies to replace petroleum products in a range of industrial processes, helping industrial companies increase the sustainability of their businesses. Crey Bioresins uses non-toxic, natural oils to replace the petroleum-based products used in adhesives for everyday products such as postage stamps and Scotch tape. Crey Bioresins is currently working to develop and scale its technologies to industrial levels.

NATIONAL CARBON ECONOMY	
2009 Lowest Carbon Economy	
District of Columbia	1
New York	2
Connecticut	3
Delaware	4
Massachussets	5
California	6

THE CARBON ECONOMY

Carbon Emissions (Metric Tons) Per 10,000 GDP (Inflation Adjusted)
Delaware, California and Rest of the U.S.



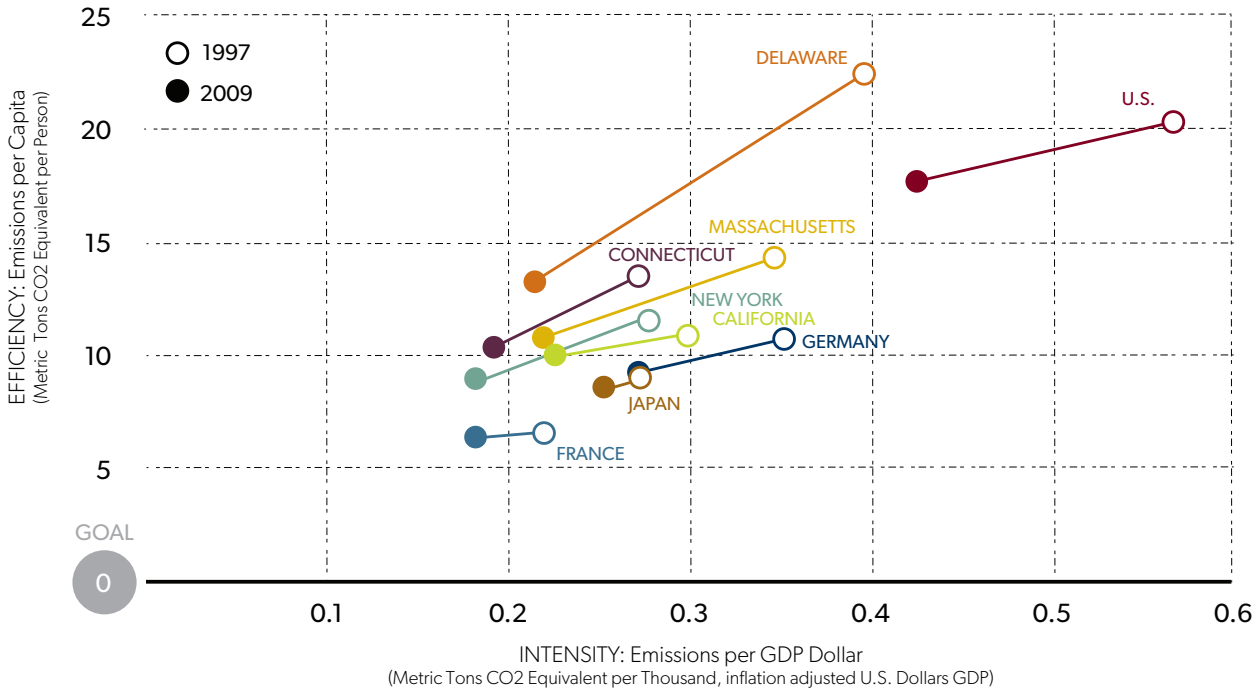
DataSource: U.S. Energy Information Administration, State CO2 Emissions; U.S. Department of Commerce, Bureau of Economic Analysis
Analysis: Collaborative Economics

The carbon impact, measured by carbon efficiency (emissions per capita) and carbon intensity (emissions per dollar of GDP), of Delaware, the U.S. and other developed economies has improved since 1997, but at varying rates. In 2009, Delaware emitted 13.3 metric tons of carbon dioxide equivalent (MTCO2e) per person and 0.2 MTCO2e per GDP dollar. Domestically, Delaware surpassed Massachusetts and California in terms of emissions emitted per GDP and has shown significant improvement over the 12-year period in minimizing emissions per capita and decreasing intensity.

Delaware has continued to reduce its carbon impact since 1997. Over this period, the state's carbon intensity has fallen a remarkable 46 percent, the largest drop of the low carbon economy states. The region's carbon efficiency trails many regions around the world, including the low carbon economy states, but strong progress has been made, falling 42 percent since 1997, more than all other regions.

GLOBAL FOSSIL FUEL COMBUSTION IN DELAWARE & OTHER REGIONS

Carbon Intesity and Efficiency, 1997-2009



DataSource: U.S. Energy Information Administration, International Energy Statistics and State CO2 Emissions; Bureau of Economic Analysis, U.S. Department of Commerce; U.S. Census Bureau, Population Estimates Branch; The California Department of Finance
Analysis: Collaborative Economics

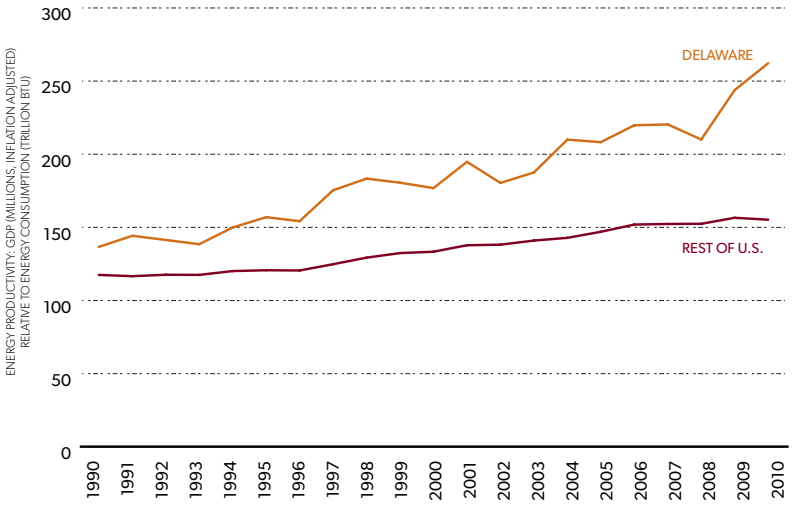
DynaSep, Inc. uses supercritical fluids or liquefied gasses to extract products with value from waste byproducts that would have otherwise not had value stream. The process facilitates a form of recycling; DynaSep's projects have included recovering oil from metal cuttings laden with oil with zero emissions, and capturing coffee oil from used coffee grounds, which is a flavoring agent.

Based in Newark, Delaware DynaSep spun off as a supercritical fluids specialty group from the parent company Accudyne Systems, Inc. in 2007. The founder of DynaSep, Brian Waibel, is a serial entrepreneur involved in various sustainable chemistry initiatives both in the United States and Israel. The company is bootstrap funded, and generates revenue by offering supercritical technical services and equipment, or the option to license proprietary patents. DynaSep, Inc. currently has five full-time employees.

ENERGY EFFICIENCY

ENERGY PRODUCTIVITY

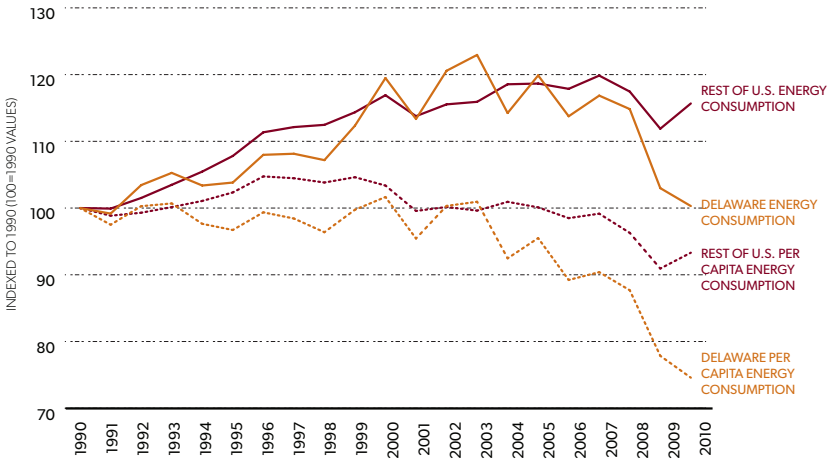
GDP Relative to Total Energy Consumption
Delaware and Rest of the U.S.



DataSource: U.S. Energy Information Administration, State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis
Analysis: Collaborative Economics

TOTAL ENERGY CONSUMPTION RELATIVE TO 1990

Total Consumption and Per Capita
Delaware and Rest of the U.S.



DataSource: U.S. Energy Information Administration, State Energy Data System; U.S. Census Bureau, Population Estimates Branch
Analysis: Collaborative Economics

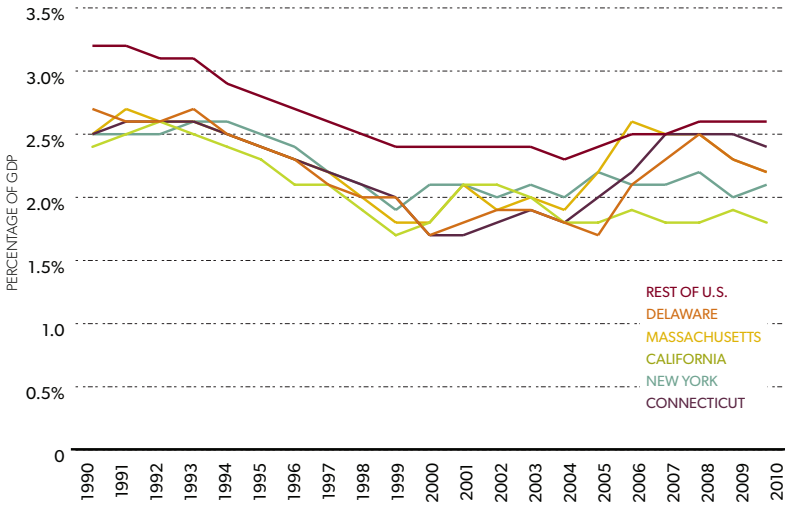
Energy productivity, calculated as the ratio of GDP (economic output) to energy consumed (input), was 69 percent higher in Delaware than in the rest of the country in 2010. In other words, Delaware is operating more efficiently while still growing its economy. Delaware's GDP grew by $2.62 for every 10,000 British Thermal Units (BTU) of energy consumed. In comparison, the rest of the nation's economy grew by $1.55 for every 10,000 BTU of energy consumed.

Since 1990, energy productivity in Delaware has nearly doubled (92%); this is almost three times the growth rate of the rest of the U.S. Most recently, from 2009 to 2010, energy productivity increased eight percent in Delaware while decreasing one percent in the rest of the U.S.

Since 2003, Delaware has become more energy efficient, decreasing total energy consumption at a faster rate than the rest of the U.S. Total consumption has fallen 18 percent since 2003, and Delaware's consumption levels have returned to their 1990-levels despite a population gain of 34 percent. The rest of the U.S. experienced peak consumption in 2007. Modest declines since then have brought U.S. energy use back to 2003-levels; though this still represents a net increase over the last two decades of 15 percent. Per capita consumption in Delaware reached a high in 2000. A decade later, residents can boast a 27 percent decline in per capita consumption compared to a ten percent decline in the rest of the U.S.

STATEWIDE ELECTRICITY BILL AS A FRACTION OF GDP

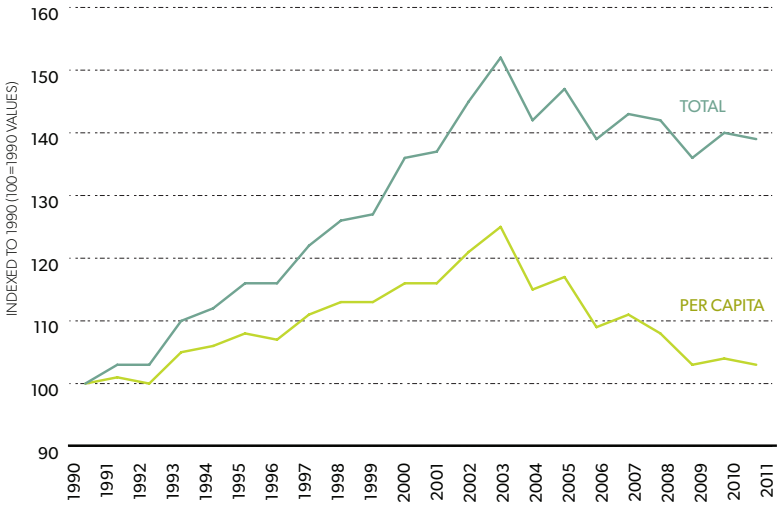
Delaware, California, Connecticut, Massachusetts, New York and Rest of the U.S.



DataSource: U.S. Energy Information Administration, State Energy Data System; U.S. Department of Commerce, Bureau of Economic Analysis
Analysis: Collaborative Economics

ELECTRICITY CONSUMPTION RELATIVE TO 1990

Total and Per Capita, Delaware



DataSource: U.S. Department of Energy, Energy Information Administration; U.S. Census Bureau
Analysis: Collaborative Economics

The cost of electricity relative to the state's economic activity overall is a measure of energy efficiency. Money not spent on energy costs, whether by a household, business or public entity, can be used for other activities, such as investing in capital upgrades that boost productivity or creating new jobs. In 2010, Delaware's statewide electricity bill fell to 2.2 percent of the total state economy, a slight decrease (0.1%) from 2009 levels. If Delaware spent as much of its GDP on electricity as the rest of the U.S. (2.6%), the state would have spent nearly $262 million more on its electricity bill in 2010.

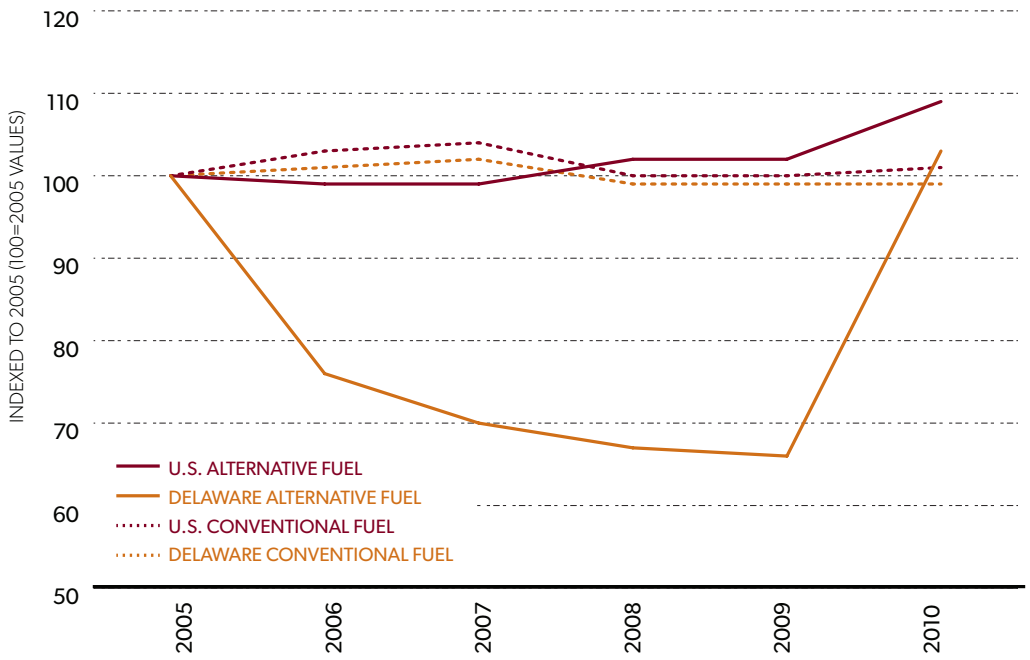
Between 1990 and 2011, Delaware's total electricity consumption increased 39 percent and per capita consumption increased three percent. Since peaking in 2003, total electricity consumption and per capita consumption have fallen 8.6 percent and 17.8 percent respectively. From 2010 to 2011, total electricity consumption fell 0.7 percent and per capita consumption dropped 1.5 percent.

TRANSPORTATION

Alternative fuel consumption in Delaware declined between 2005 and 2009, with a significant surge in 2010. Nationwide, alternative fuel consumption grew nine percent and conventional gas consumption decreased one percent over the same time period. In 2010, 98 percent of alternative fuel consumption in Delaware came from either ethanol or liquefied petroleum gas, which accounted for 72 percent and 26 percent of the total respectively.

ALTERNATIVE FUEL & CONVENTIONAL GAS CONSUMPTION

Relative to 2005
Delaware and Rest of the U.S.



Note: Alternative Fuel includes compressed natural gas, electricity, ethanol, 85 percent, liquefied natural gas, and liquified petroleum gas.
DataSource: Alternative Fuels Data - EIA Coal, Nuclear, Electric and Alternate Fuels Division. Motor Gasoline Data - U.S. Energy Information Division
Analysis: Collaborative Economics

H2OPE Biofuels recently relocated to Delaware from Colorado to collaborate with other Delaware-based clean technology companies, such as Elcriton Inc., and to take advantage of the supportive environment for the clean technology sector as a whole. H2OPE Biofuels technology has the potential to transform hydrogen production from an energy- and capital-intensive process by using algae that consumes carbon while creating hydrogen at a low cost. Once they identify a facility to partner with in the pilot phase, H2OPE Biofuels plans to build a production facility in Delaware for the next stage of development.

RISING CLEAN ECONOMY INVESTMENT & INNOVATION

Innovation can be measured by tracking investment and patent activity, and plays an important role in achieving economic and environmental goals. Investment in early-stage technology or established companies can take different forms and come from various sources, such as venture capital (VC) investment or Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) funding. These trends in cash flows into Delaware represent potentially high-value business opportunities. In addition to capital, these investments represent access to talent and other forms of support.

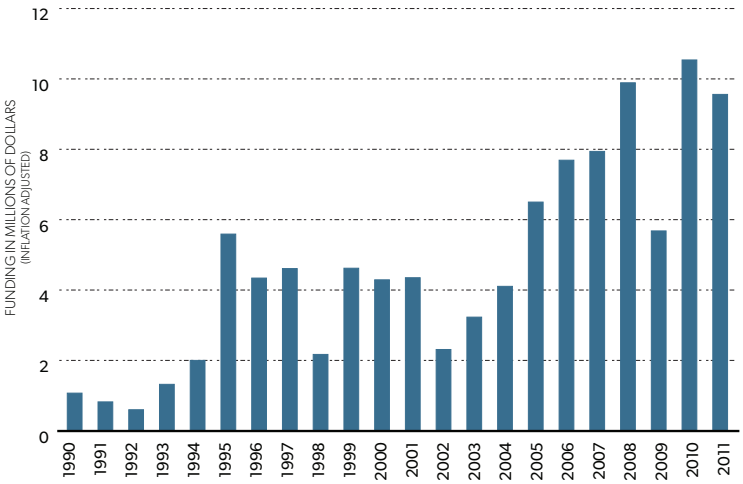
SBIR & STTR AWARDS

The SBIR and STTR programs provide funding to small innovative companies to spur development and the commercialization of ideas into products and services. The SBIR Program is a highly competitive federal grant program that enables small companies to conduct proof-of-concept (Phase I) research on technical merit and idea feasibility and prototype development (Phase II) building on Phase I findings. Unlike many other federal research grants and contracts, SBIR grants are reserved for applicant teams led by for-profit companies with fewer than 500 employees. The program is intended to address the technology needs of federal agencies while encouraging companies to profit from the commercialization of research. Participants in the SBIR program are often able to use the credibility and experimental data developed through their research to develop commercial products and to attract strategic partners and investment capital.

Despite falling nine percent from 2010 to 2011 and year to year fluctuation, SBIR and STTR award funding in Delaware has grown 849 percent since 1990 and steadily increased over that time. The state's 2011 SBIR funding went largely to companies in the advanced materials-related field.

SBIR & STIR AWARDS FUNDING

Delaware



DataSource: U.S. Small Business Administration, Office of Technology Small Business Innovation Research Program
Analysis: Collaborative Economics

SBIR & STTR AWARDS 2011		
AGENCY	COMPANY NAME	FUNDING
Department of Commerce ($89,999)	Sepax Technologies, Inc.	$89,999
Department of Defense ($849,971)	EM Photonics	$849,971
Department of Energy ($2,898,003)	Compact Membrane Systems, Inc.	$2,898,003
Department of Health & Human Services (3,689,512)	Advanced Material Technology, Inc.	$403,156
	B & W tek, Inc.	$104,021
	Compact Membrane Systems	$3,182,335
National Aeronautics & Space Administration ($2,199,846)	AlphaSense, Inc.	$699,995
	EM Photonics	$799,859
	Princeton Optronics, Inc.	$699,992
TOTAL		$9,727,331

DataSource: U.S. Small Business Administration, Office of Technology Small Business Innovation Research Program
Analysis: Collaborative Economics

VENTURE CAPITAL INVESTMENT

From 2006 to 2011, total VC investment in Delaware increased 349 percent - from $13.1 to $59 million - driven by financial services, industrial/energy, information technology (IT) services and software investment. New VC investment emerged in IT services, which was the third largest investment industry in the 2010 - 2011 period. Total VC investment dropped between the 2008 - 2009 and 2010 – 2011 periods, due to large investment fluctuations in the financial service industry as well as the industries of semiconductors and software.

TOTAL VENTURE CAPITAL INVESTMENT BY INDUSTRY

In Millions Of Dollars

	2006-07	2008-09	2010-11	% Change 2006-11
Financial Services	7.3	73.0	24.0	227
Business Products & Services	0	0	1.3	--
Industrial/Energy	4.1	0.3	21.0	407
IT Services	0	0.3	9.7	--
Semiconductors	0	17.0	0	--
Software	1.7	11.4	3.0	84
TOTAL	13.1	101.9	59.0	349

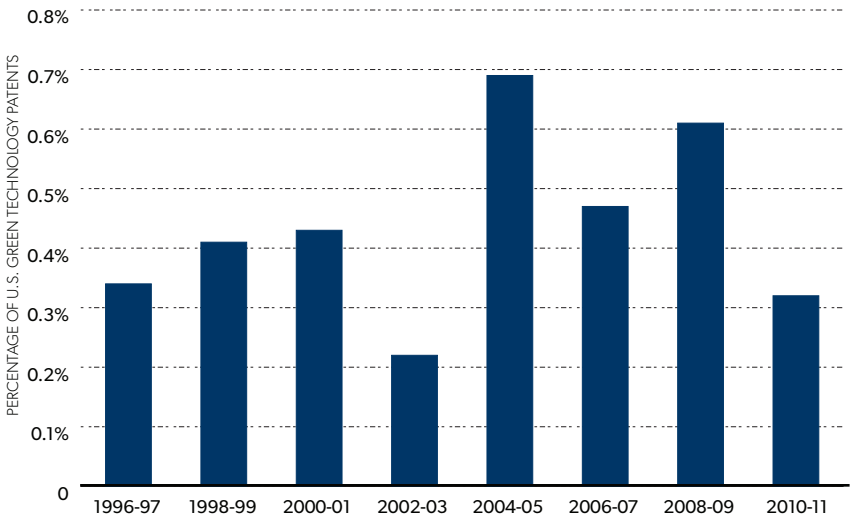
DataSource: PricewaterhouseCoopers/National Venture Capital Association MoneyTree Report
Analysis: Collaborative Economics

PATENTS

Patent activity is another key indicator of innovation activity. Patents are the leading form of legal codification and ownership of innovative thinking and its application. Levels of patenting activity indicate the capacity to codify and translate research into unique technology with commercial potential. Delaware's clean technology patent activity represented roughly 0.4 percent of total U.S. patent registrations over the 15-year period.

PORTION OF TOTAL U.S. GREEN TECHNOLOGY PATENTS

Delaware



DataSource: 1790 Analytics, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

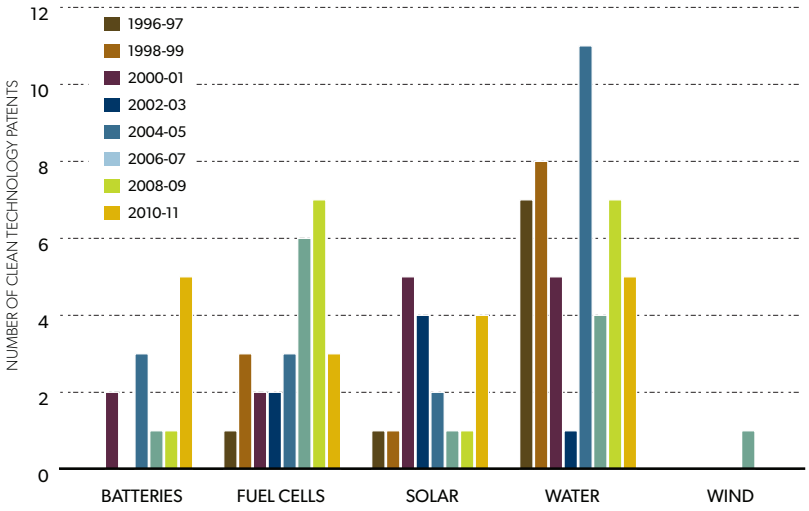
Sanosil International is a Delaware-based company that manufactures innovative disinfectant technologies with a range of applications from infectious disease control to water purification. The company was established four years ago, when a team of Delaware-based investors secured licensing rights to manufacture and market Sanosil's biocide technology. While traditional disinfectant products are difficult to transport, store and can have hazardous environmental impacts, Sanosil's technology uses a patented blend of hydrogen peroxide and silver that is environmentally preferred, cost-effective, safe, and easy-to-use. The sustainable formulation is coupled with an innovative dry misting device called the Halo Fogger(TM) for applications in surface disinfection. Having received multiple EPA approvals and secured funding including a loan from the Delaware Strategic Fund in 2010 to expand its operations and create jobs in Delaware, Sanosil is now in commercialization phase. Sanosil disinfectant technology is being used in the U.S. and around the world in hospitals, life-science research laboratories, re-circulating industrial cooling water and by non-governmental organizations that work to bring safe drinking water to developing countries.

Compact Membrane Systems was founded in 1993 to commercialize an innovative Teflon membrane technology. Today, Compact Membrane technology is used to increase the cost-effectiveness of wind energy and biofuels, among other applications. By removing water from lubricating oils, Compact Membrane technology can extend the life of wind energy systems from 5 to 25 years. In addition, the technology removes water from biofuels, making these fuels a more reliable alternative to petroleum. Bridge grants from the State of Delaware have helped commercialize Compact Membrane technology and the company is now poised for growth in the wind energy and biofuel industries.

Since 1996, Delaware has had robust patent registration activity in water and fuel cell technology. Recent years have also seen growth in solar and battery technology patent registrations.

CLEAN TECHNOLOGY PATENT TRENDS

By Technology Type Over Time
Delaware

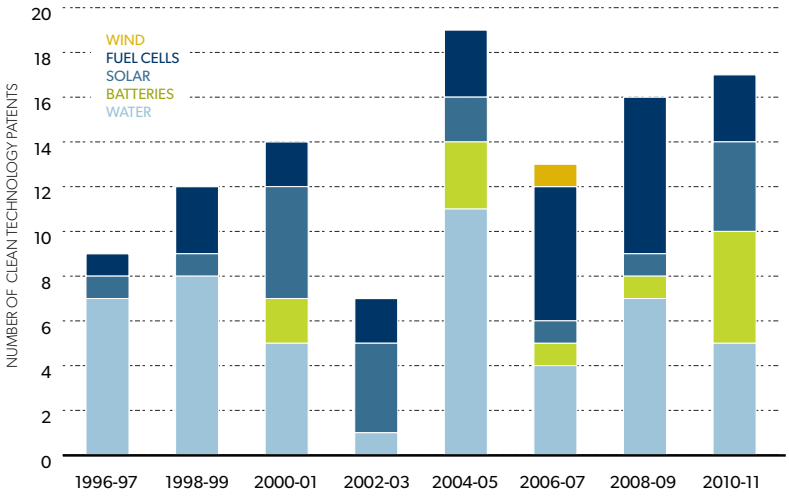


DataSource: 1790 Analytics, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

Clean technology patents including wind, fuel cells, solar, batteries, and water (65 patents total) grew more than 50 percent from 2004 to 2011 compared to the previous seven year period (42 patents total).

CLEAN TECHNOLOGY PATENT TRENDS

By Technology Type
Delaware



DataSource: 1790 Analytics, Patents by Technology; USPTO Patent File
Analysis: Collaborative Economics

Patent registrations related to chemical and organic compounds/materials dominated the state's total patents from 2008 to 2010, an increase of 11 percent from the previous three-year period. Overall, patents remained stable, dropping one percent from 2005 to 2010.

PATENT REGISTRATIONS

By Technology Area

	2005-06	2008-10	% Change
Chemical & Organic Compounds/Materials	450	500	11
Health	120	110	-8
Chemical Processing Technologies	76	89	17
Computers, Data Processing & Information Storage	37	65	76
Food, Plant & Animal Husbandry	110	64	-42
Measuring, Testing & Precision Instruments	52	50	-4
Manufacturing, Assembling, & Treating	49	28	-43
Electricity & Heating/Cooling	34	21	-38
Communications	11	18	64
Teaching & Amusement Devices	11	12	9
Dispensing & Material Handling	13	11	-15
Furniture & Receptacles	8	11	38
Construction & Building Materials	9	8	-11
Other	18	8	-56
Apparel, Textiles & Body Adornment	11	7	-36
TOTAL	1,009	1,002	-1

Note: Other includes Transportation/Vehicles, Ammunition & Weapons, and Superconducting Technology
DataSource: U.S. Patent and Trademark Office
Analysis: Collaborative Economics

Modular Carpet Recycling (MCR), based in New Castle, Delaware, has developed an efficient and innovative process to derive high purity nylon from used carpet fibers. Not only does MCR's product offer a means of reducing the over three billion pounds of carpet waste generated in the United States each year, the process used to purify the nylon fibers is regionally based, which requires lower transportation costs, and generates valuable, high purity recycled nylon. At present, typical carpet recycling processes require shipment to large central locations, which adds cost, and the recycled end products may not be as valuable as high purity nylon. As a consequence, only roughly ten percent of waste carpet is recycled.

Founder Ron Simonetti has a background in recycling, and identified the opportunity to add value to the traditional recycling methods of carpet. He sought recycling technologies that would clean nylon fibers, and licensed a patent from the University of Auburn in Alabama. Building off that intellectual property, MCR has developed new patents and original, region-based processes, eventually creating its signature product Renewlon®, which is over 99.8 percent nylon purity, one of the highest purity post-consumer nylon products in the market.

Private investment has facilitated the company's growth, and a low-interest loan from the Delaware Economic Development Office supported the business' purchase of equipment early in the commercialization process. The company is now in pilot production phase at its new commercial plant, and will begin commercial scale production levels during 2013 in Delaware.

THIRTEEN SEGMENTS OF DELAWARE'S CORE CLEAN ECONOMY

SEGMENT	DESCRIPTION	
Energy Generation	Renewable energy generation (all forms of solar, wind, geothermal, biomass, hydro, marine and tidal, hydrogen, co-generation) Research and testing in renewable energy	Renewable Energy consulting services Associated equipment, controls, and other management software and services
Energy Efficiency	Energy conservation consulting and engineering Building efficiency products and services Energy efficiency research	Alternative energy appliances (solar heating, lighting, etc.) Energy efficiency meters and measuring devices
Clean Transportation	Alternative fuels (biodiesel, hydrogen, feedstock-neutral ethanol infrastructure) Motor vehicles and equipment (electric, hybrid, and natural gas vehicles, diesel technology)	Logistics (traffic monitoring software, transportation efficiencies)
Energy Storage	Advanced batteries (e.g. Li-Ion, NiMH, ultra capacitors, charging, thin film, nickel zinc) Battery components and accessories	Fuel cells (methanol, PEM, solid oxide, zinc air, systems integrators) Hybrid systems (flywheels) and Uninterruptible Power supply
Air & Environment	Environmental consulting (environmental engineering, sustainable business consulting) Emissions monitoring and control	Environmental remediation
Recycling & Waste	Consulting services Recycling (paper, metal, plastics, rubber, bottles, automotive, electronic waste and scrap)	Recycling machinery manufacturing Waste treatment
Water & Wastewater	Water conservation (control systems, meters and measuring devices) Development and manufacturing of pump technology Research and testing	Consulting services Water treatment and purification products/ services
Agricultural Support	Sustainable land management and business consulting services Sustainable supplies and materials	Sustainable aquaculture
Research & Advocacy	Organizations and research institutions focused on advancing science and public education in the areas of: renewable energy and alternative fuels and transportation	
Finance & Investment	Investment Advisory, asset management and brokerage (venture capital and private equity investment)	Project financing (e.g. solar installations, biomass facilities, etc.) and insurance Emission trading and offsets
Advanced Materials	Nano (additives, detectors, sensors, gels, coatings, lubricants, films) Bio (advanced processes, biodegradable products)	Chemical (composits, polymers) New materials for improving energy efficiency
Green Building	Design and construction Building materials	Site management Green real estate and development
Energy Infrastructure	Consulting and management services	Cable and equipment

GROWING CLEAN ECONOMY BUSINESSES & JOBS

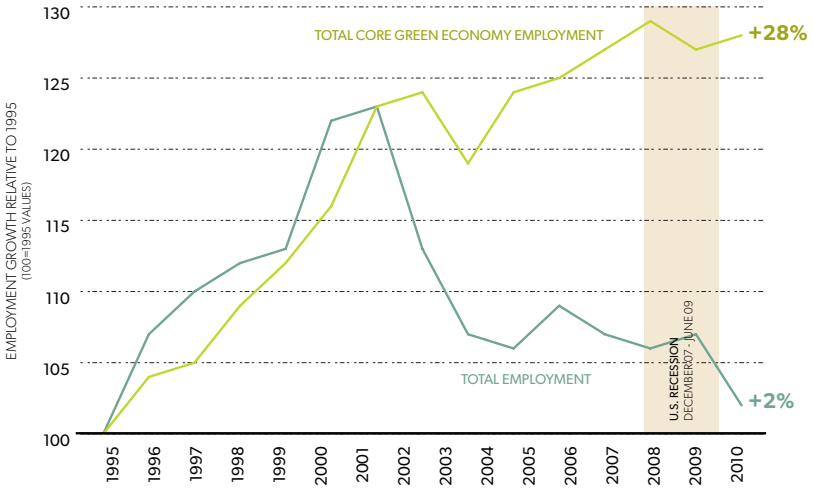
The following indicators track the growth of business and employment in thirteen segments related to the provision of products and services that enable the shift to a cleaner, resource efficient and carbon free economy (see table on page 15). Core clean economy jobs increased 28 percent between January 1996 and January 2010, while the jobs in the overall economy grew only two percent.

Delaware's clean economy showed signs of greater resilience than the economy as a whole during the economic downturn. Core clean economy jobs experienced only a one percent decrease between January 2008 and January 2010 compared to a four percent decrease in jobs across Delaware.

Clean employment would have displayed an unbroken, upward trend from January 1996 to January 2004 were it not for a 20 percent decrease in Energy Generation employment, caused mostly by one company.

Core clean economy jobs recovered quickly after the national recession and achieved a 0.8 percent increase from January 2009 to January 2010, whereas overall Delaware's employment continued to drop, experiencing a 4.7 percent decrease.

EMPLOYMENT GROWTH RELATIVE TO 1995
Delaware



DataSource: Green Establishment Database
Analysis: Collaborative Economics

Bloom Energy and the Delaware STAR Campus

When the Newark Chrysler plant closed in 2008, 1,100 workers lost their jobs. The plant had been producing large SUVs that were selling poorly as consumers demanded more fuel-efficient vehicles. An innovative expansion of the University of Delaware, Newark campus, however, transformed the Chrysler site into a 272-acre research park dedicated to supporting science and technology initiatives and acting as a job-creating engine in the state.[1] The Science, Technology, and Advanced Research (STAR) campus is a hub that connects the university to the business community and also houses a business incubator for technology startups.

Most recently, Bloom Energy, a leading, Silicon Valley-based fuel cell manufacturer broke ground on a new factory on the STAR campus that will produce 'Bloom Boxes,' stacks of fuel cells that generate electricity while producing lower greenhouse gases. The facility, which will open in 2013, is the company's largest expansion to date. It is expected to create 900 full time jobs and 600 full time indirect jobs in the region. Bloom Energy is collaborating with two departments at the University of Delaware to develop curriculum and certificate courses to prepare workers for the lean manufacturing processes it will use in the new factory. [2]

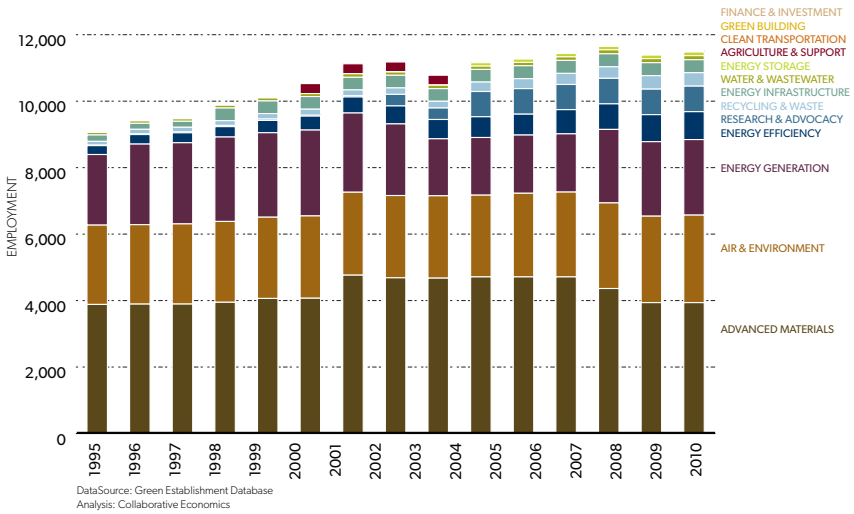
[1] Kipp, Rachel. University of Delaware Builds its Future. Feb. 2010. Web.
[2] Hurdle, Jon. Bloom Energy Breaks Ground on New Delaware Facility. Apr. 2012. DFM News. Web.

Twelve of the thirteen core clean economy employment segments increased or maintained the number of jobs during the recession. Advanced Materials was the one exception, with a 9.7 percent decrease in employment numbers from January 2008 to January 2010, due to a loss of 425 employees in one company, Hercules Incorporated. Despite these job losses, Advanced Materials has consistently employed the largest proportion of workers in the state's core clean economy, amounting to over one-third of employment in January 2010. In the most recent year (January 2009 - January 2010), two out of the three largest core clean economy segments, Air & Environment and Energy Generation, displayed growth, 1.2 and 1.4 percent, respectively. The fourth largest segment, Energy Efficiency, had a 3.2 percent growth during this same time period.

Changes in the core clean economy can also be examined by tracking business activity, measured by the number of individual establishments by segment in the state. Core clean economy establishments in Delaware continued to grow and diversify during the recession, increasing 16 percent between January 2008 and January 2010, with impressive growth rates in Energy Storage (67%) and Energy Generation (46%). In addition, none of the 13 sectors experienced losses in establishment figures during the recession. The total number of core clean economy establishments has increased threefold since 1996 with segment growth rates of 50 to 400 percent.

EMPLOYMENT BY CORE CLEAN ECONOMY SEGMENT

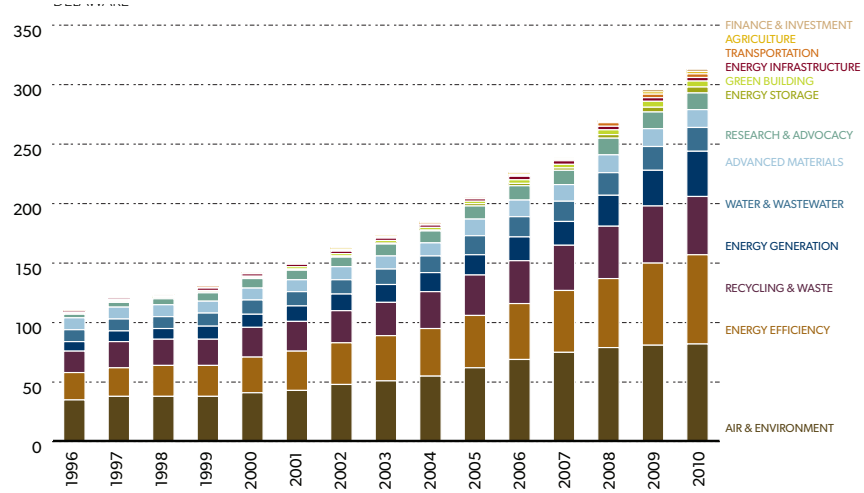
Delaware



DataSource: Green Establishment Database
Analysis: Collaborative Economics

ESTABLISHMENTS BY CORE CLEAN ECONOMY SEGMENT

Delaware



DataSource: Green Establishment Database
Analysis: Collaborative Economics

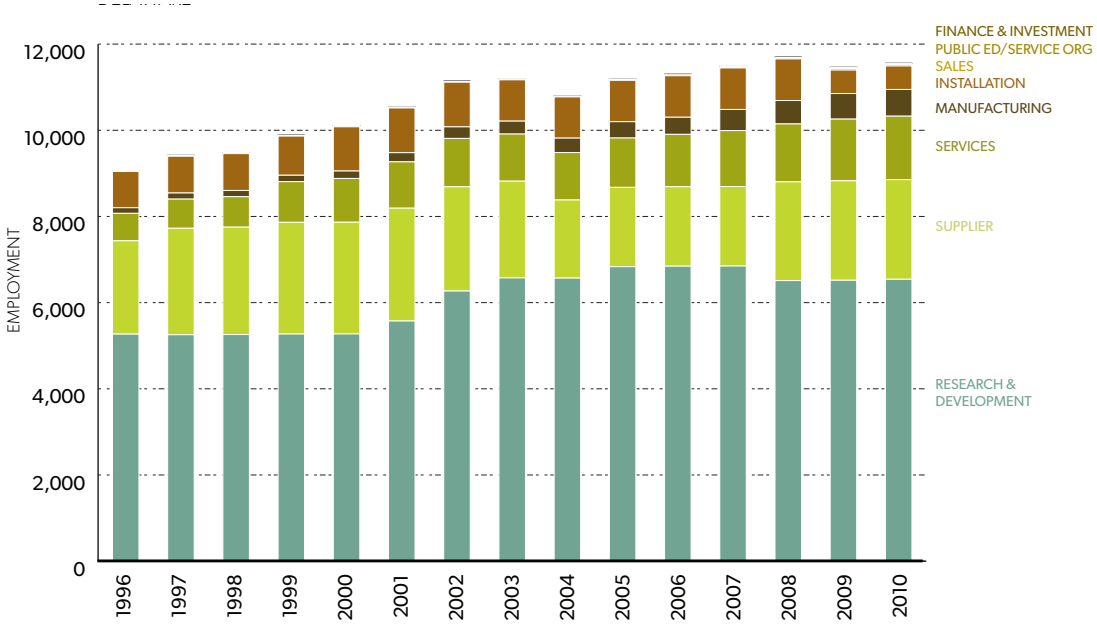
The Delaware Technology Park (DTP) exemplifies Delaware's emphasis on networks and leveraged resources to cultivate a strong technology-based startup community within the clean economy. The DTP serves as hub and incubator for promising development-stage startup businesses in life science, information technology, advanced materials or renewable energy sectors. It offers resident businesses access to testing facilities, connections to the adjacent University of Delaware, and the benefits of clustered activity (networking, increased visibility for the investment community and creative competition and collaboration). The center has grown through strategic partnerships between the private sector, public funding from local, state and federal levels and the University of Delaware. Since 1992, the park has supported over 75 new businesses, 25 of which have gone on to become fully commercially viable.

In addition to examining the Delaware core clean economy by segment, or by the field of application of products and services, the core clean economy businesses can be viewed by primary function along the production value chain. From the point of conception until delivery to the consumer and product maintenance, there are distinct activities that can be traced in the economy. These value chain activities include research and development, manufacturing, supply, installation, sales, services, and public education/service organizations. All of these activities are represented to varying degrees in Delaware's core clean economy, which means the state possesses: 1) wide-ranging job opportunities across the skills spectrum, and 2) strong potential for continued core clean business growth building on a diverse business base rich with interrelated competencies.

The majority of Delaware's core clean economy is in Research & Development jobs (57% in 2010) -- which includes not only PhD scientists, but technical, administrative and other support personnel. Other jobs in Supplier and Services constitute 33 percent of total core clean jobs.

Core clean economy employment continued to expand despite the economic downturn. The one exception was manufacturing (which decreased between January 2008 and January 2009), corresponding to the national decrease in that segment. Employment across the value chain increased in each segment since 1996.

CORE CLEAN EMPLOYMENT ALONG THE VALUE CHAIN
Delaware



DataSource: Green Establishment Database
Analysis: Collaborative Economics

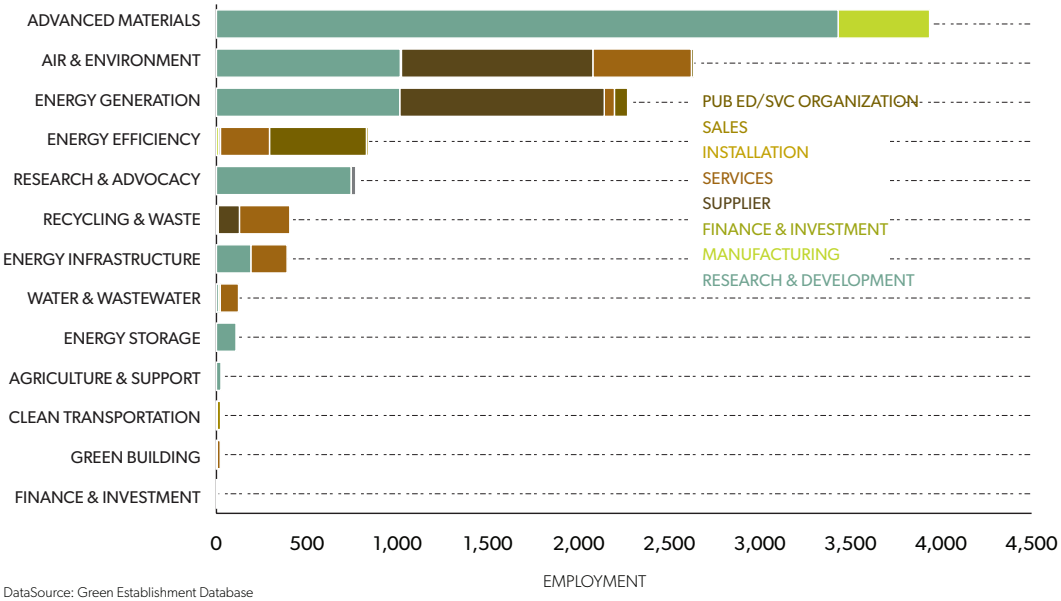
AnCatt, Inc. is a start-up company based in Newark, Delaware whose chief technology officer and investigator is a former scientist at Dupont and University of Delaware. AnCatt Inc. won the national first place at the American Chemical Society Green Chemistry Institute inaugural green chemistry business plan competition in June 2012 at the Green Chemistry & Engineering Conference in Washington D.C. for its break-through work on novel heavy-metal free heavy-duty anti-corrosive coatings for metals. AnCatt has developed a conducting polymer nanodispersion based coating that has very high effectiveness in anti-corrosion pilot applications. At present, the most effective anti-corrosive coatings contain the carcinogenic hexavalent chromate , and sometimes also lead. The more frequently used alternative for industrial, military, marine, and structural applications contains zinc and does not perform as well as the chromates. There are no heavy metals in AnCatt's product, and its coating has significantly outperformed chromates under classic corrosion tests such as salt fog and cyclic weathering. AnCatt is currently actively seeking financing to ramp up operations to commercial scale.

The role of workers in the value chain varies by segment. Advanced Materials employs mostly Research & Development workers (87%) but is also the largest employer of Manufacturing (93%) workers in the core clean economy.

Roles in the Air & Environment segment are relatively evenly distributed among Research & Development, Supplier, and Services. Similarly, Energy Generation has nearly half of its workers in Research & Development and the other half in Supplier roles.

A few core clean economy segments dominate roles across the value chain. For example, most Supplier jobs (49%) are in the Energy Generation segment with a large proportion of remaining jobs focused in Air & Environment (46%). Installation jobs are another example, with 86 percent of the jobs in Energy Efficiency.

VALUE CHAIN EMPLOYMENT
Delaware 2010



DataSource: Green Establishment Database
Analysis: Collaborative Economics

As a global leader in innovation and science, Wilmington-based **DuPont** has been a major driver of the cleantech economy in Delaware. DuPont has worked closely with the University of Delaware to sponsor academic initiatives and to foster collaboration between researchers and industry. In addition, many Delaware-based cleantech companies emerged from DuPont, when former employees established new start-ups or left the company to pursue their own ideas. DuPont has also been an important supporter of the Delaware Technology Park, a facility that is home to several cleantech companies.

APPENDIX

A CLEANER, MORE EFFICIENT ECONOMY

The Carbon Economy: Carbon Emissions Relative to GDP: Emissions data come from the U.S. Department of Energy, Energy Information Administration (EIA), State CO2 Emissions, Table 1: State Emissions by Year. Please note: This data is the latest data available as of August 22nd, 2012 and is updated yearly. GDP data come from the Bureau of Economic Analysis, U.S. Department of Commerce, GDP by state (millions of current dollars). GDP values are inflation adjusted and reported in first half 2012 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics. Population data comes from the U.S. Census Bureau, Table 1. Annual Estimates of the Resident Population for the United States, Regions, States, and Puerto Rico.

Global Fossil Fuel Combustion in Delaware and Other Regions: For U.S. and other countries, data for Total Carbon Dioxide Emissions from the Consumption of Energy (Million Metric Tons), Carbon Intensity using Market Exchange Rates (Metric Tons of Carbon Dioxide per Thousand Year 2005 U.S. Dollars), gross domestic product (GDP), and population are from U.S. Energy Information Administration (EIA), International Energy Statistics. Note: No 1990 Carbon Dioxide Emissions Consumption values were reported for Germany, therefore, 1991 values were used. State level emissions data come from EIA, State CO2 Emissions; Table 1. State emissions by year (1990-2009). State GDP data come from the Bureau of Economic Analysis (BEA), U.S. Department of Commerce, Real GDP by state (millions of chained 2005 dollars). Both state and country level GDP data are Real GDP values (millions of chained 2005 dollars) as the EIA, International Energy Statistics used Real GDP to calculate a country's carbon intensity. State population data come from the U.S. Census Bureau, Population Estimates Branch. International data for carbon dioxide emissions from the consumption of energy include emissions due to the consumption of petroleum, natural gas, and coal, and also from natural gas flaring. This data does not include emissions from geothermal power generation, cement production and other industrial process, or municipal solid waste combustion.

2009 NATIONAL RANKING			
	GHG Emissions per capita (rank)	GDP per capita (rank)	% of Total U.S. GDP
Delaware	15	2	0.4%
New York	1	1	0.7%
Connecticut	11	34	5.2%
Massachusetts	23	32	2.8%
California	5	13	13%

PERCENT CHANGE 2008-09		
	GHG Emissions per capita	GDP per capita
Delaware	-27%	3%
New York	-8%	-1%
Connecticut	-5%	-3%
Massachusetts	-9%	-1%
California	-4%	-4%
U.S. Without Delaware	-8%	-3%

DataSource: Energy Information Administration, U.S. Department of Energy; Bureau of Economic Analysis, U.S. Department of Commerce; Population Division, U.S. Census Bureau.
Analysis: Collaborative Economics

Energy Productivity, GDP Relative to Total Energy Consumption: Energy Productivity Energy consumption data are from the U.S. Department of Energy, Energy Information Administration's State Energy Data System, Consumption Estimates, 1960-2010. Data is for total energy consumption is in British Thermal Units (Btu) and includes all of the following sources: petroleum, natural gas, electricity retail sales, nuclear, coal and coal coke, wood, waste, ethanol, hydroelectric, geothermal, solar, and wind energy. GDP data come from the Bureau of Economic Analysis, U.S. Department of Commerce, GDP by state (millions of current dollars). GDP values are inflation-adjusted and reported in first half 2012 dollars, using the CPI for the U.S. City Average from the Bureau of Labor Statistics.

Total Energy Consumption Relative to 1990: Total Energy Consumption Relative to 1990 energy consumption data are from the U.S. Department of Energy, Energy Information Administration's State Energy Data System, Consumption Estimates, 1960-2010. Data is for total energy consumption is in British Thermal Units (Btu) and includes all of the following sources: petroleum, natural gas, electricity retail sales, nuclear, coal and coal coke, wood, waste, ethanol, hydroelectric, geothermal, solar, and wind energy. Per capita values were calculated using annual population estimates from the U.S. Census Bureau's Population Division.

Statewide Electricity Bill as a Fraction of GDP: Data to calculate electricity bills are from 1990 - 2010 Retail Sales of Electricity by State by Sector Provider (EIA-861) and 1990 - 2010 Average Price by State by Provider (EIA-861), published by the U.S. Department of Energy, Energy Information Administration. Gross Domestic Product data are from the U.S. Department of Commerce, Bureau of Economic Analysis "Gross Domestic Product by State (millions of current dollars)."

Electricity Consumption Relative to 1990: Electricity consumption data are from the U.S. Department of Energy, Energy Information Administration, Current and Historical Monthly Retail Sales, Revenues and Average revenue per Kilowatthour by State and by Sector (Form EIA-826). Consumption does not include self-generation, but only the amount of electricity sold to end users. Population data is from the U.S Census Bureau U.S., Population Estimates Branch. Population data was used to calculate per capita figures.

Alternative Fuel and Conventional Gas Consumption: Alternative Fuel Consumption data from 2005-2009 is provided by the Coal, Nuclear, Electric, and Alternate Fuels Division of the Energy Information Administration (EIA) in Table C3, "Estimated Consumption of Alternative Fuels by State." Data from 2010 is provided from the Energy Information Administration Renewable & Alternative Fuels Alternative Fuel Vehicle Data. Motor Gasoline data is collected from the EIA State Energy Data Systems (SEDS), Consumption in Physical Units; the SEDS series used in this indicator is identified as MGACP, "Motor gasoline consumed by the transportation sector." As SEDS petroleum data is provided in 'Thousand barrels', this data was converted to gallons using 42 gallons per barrel.

RISING CLEAN ECONOMY INVESTMENT AND INNOVATION

Total Venture Capital Investment: Data for total annual venture capital investment is provided by PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Data: Thomson Reuters. Data is adjusted into first half 2012 dollars, using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Small Business Innovation Research & Small Business Technology Transfer Awards (SBIR/STTR): Data for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards are from the U.S. Small Business Administration, Office of Technology Small Business Innovation Research Program. Small businesses must be American-owned and independently operated, for-profit, principal researcher employed by business, and company size limited to 500 employees to participate in the program. Data for phase 1 and phase 2 awards are included in totals. Data as of June 26, 2012. Award values are inflation adjusted into first half 2012 dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics.

Clean Technology Patents: 1790 Analytics developed and performed the search of detailed U.S. Patent data from the U.S. Patent & Trade Office based on search criteria defined by Collaborative Economics for the nine technology areas: solar, wind, hydro and geothermal, energy generation, batteries, fuel cells, hybrid systems, water, and energy infrastructure.

Patent Registrations by Technology Area: Patent data are provided by the U.S. Patent and Trademark Office, and consists of only Utility patents. Geographic designation is given by the location of the first inventor named on the patent application. Patents include only those patents filed by residents of each region. Technology Areas are based on the Unites States Patent Classification System (USPCS) and grouped according to certain technologies and/or classes. Other includes Transportation/Vehicles, Ammunition & Weapons, and Superconducting Technology.

GROWING CLEAN ECONOMY BUSINESSES AND JOBS

Employment Growth Relative to 1996, Employment by Clean Segment, Establishments by Clean Segment, Clean Employment Along The Value Chain and Value Chain Employment: Data from the Green Establishments Database (see below).

Green Business Establishments Database: Collaborative Economics (CEI) has developed an approach for identifying and tracking the growth of businesses with primary activities in the Clean Economy. This methodology was originally developed for work carried out on behalf of Next 10 and published in the California Green Innovation Index (2008, 2009, 2010 and 2012). Building on this work, CEI designed and conducted the nationwide analysis of green business activity on behalf of the Pew Charitable Trusts. The Pew Center on the States reformatted the results of the analysis and developed the report, The Clean Energy Economy (June 2009).

The accounting of clean business establishments and jobs is based on multiple data sources (including New Energy Finance and the Cleantech GroupTM, LLC) for the identification and classification of clean businesses and also leveraged a sophisticated internet search process. Collaborative Economics designed the parameters of the internet search platform which was engineered by PlanetMagpie, a Bay Area-based IT service company. The National Establishments Time- Series (NETS) database based on Dun & Bradstreet business-unit data was sourced to extract business information such as jobs. The operational definition of clean is based primarily on the definition of cleantech defined by the Cleantech Network.

The jobs numbers reported in the database reflect all jobs at each business location. In the case of multi-establishment companies, only the clean establishments are included. While this approach does not examine specifically clean occupations that are appearing across the entire economy (such as Chief Sustainability Officer), it does account for the businesses behind the products and services that these new professionals need to use in their jobs (such as advanced metering devices, co-generation equipment, and various high-efficiency materials).

The multilayered process involves both automated and manual verification steps of business establishments and their activities. In cases where the results were uncertain and the activities of a business establishment could not be verified (e.g. on a company's website), the establishment was dropped from the database. Therefore, the database offers a conservative estimate for the numbers of establishments and jobs in the Clean Economy.

National Establishment Time-Series (NETS) Database: The NETS database is constructed from 20 "snapshots" taken every January since 1990 of all active Dun and Bradstreet establishments (currently 41.7 million unique establishments with over 24 million still active). That data is then put through rigorous quality control, statistical analysis, and additional estimation procedures to create the resulting time-series in the NETS Database. These snapshots use the Duns Marketing Information (DMI) file to determine which establishments were active. Other archival files (e.g., the Credit Rating file) were utilized to provide annual raw establishment data that allowed us to create time-series information. Each summer the NETS Database is updated with another year of establishment information. No establishments are ever deleted from the Database; but their "LastYear" is indicated, so one can explore the dynamics of "births" and "deaths" of establishments. Walls & Associates maintains the NETS Database and continues to update and improve estimates before the next annual update.