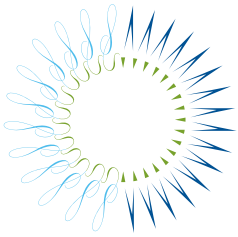
the Clean Energy Economy

Repowering Jobs, Businesses and Investments Across America



THE PEW CHARITABLE TRUSTS

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The Pew Charitable Trusts applies the power of knowledge to solve today's most challenging problems. Our Pew Center on the States identifies and advances effective policy approaches to critical issues facing states, and our Pew Environment Group promotes practical, meaningful solutions to some of the world's most pressing environmental problems.

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Dear Reader:

Public- and private-sector leaders are working hard to create a brighter economic future for our country, one in which new industries create well-paying, enduring jobs for Americans and spark growth from coast to coast.

The clean energy economy, still in its infancy, is emerging as a vital component of America's new economic landscape. That's the finding of *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America*, a groundbreaking analysis by The Pew Charitable Trusts that sheds light on an increasingly important part of the nation's economic recovery.

Pew counted actual jobs, companies and investments in every state and the District of Columbia aimed at developing clean, renewable sources of energy, increasing energy efficiency, reducing greenhouse gas emissions that cause global warming, and conserving water and other natural resources. We found that jobs and businesses in the emerging clean energy economy have grown at a faster rate than U.S. jobs overall. And they are poised for even greater growth, driven by increasing consumer demand, venture capital infusions by investors eager to capitalize on new market opportunities, and policy reforms by federal and state lawmakers seeking to spur America's fiscal recovery, reduce our dependence on foreign oil and protect the environment.

This report reflects the intersection of two of Pew's lines of work. The Pew Center on the States identifies and advances effective approaches to improve states' fiscal health and economic competitiveness, and the Pew Environment Group promotes practical, meaningful policy solutions to some of the world's most pressing environmental problems.

Across the country, state lawmakers also are pursuing the dual goals of economic growth and environmental sustainability. A growing number of states are implementing policies to capitalize on the clean energy economy, from renewable portfolio and energy efficiency standards to financial incentives for public- and private-sector innovation and investment.

At the federal level, the American Recovery and Reinvestment Act provides tens of billions of dollars to bolster those efforts. But to realize the clean energy economy's full potential, federal leaders must do more. The nation needs a comprehensive, economy-wide energy plan, a market-based system that will significantly reduce emissions that cause global warming and derive more of America's energy supply from clean, renewable sources. Strong federal policies will accelerate the growth of this economic sector by generating jobs and businesses that develop clean energy and increase energy efficiency.

As federal and state lawmakers consider these and other critical reforms, Pew will conduct follow-up research to determine which policy approaches most effectively help America achieve the double bottom line of economic growth and environmental sustainability. We hope this report will inform and guide our nation's leaders as they seek to expand our emerging clean energy economy.

Sincerely,

Susan Urahn
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Executive Summary

America's clean energy economy is dawning as a critical component of the nation's future.

Research by The Pew Charitable Trusts shows that despite a lack of sustained policy attention and investment, the emerging clean energy economy has grown considerably—extending to all 50 states, engaging a wide variety of workers and generating new industries. Between 1998 and 2007, its jobs grew at a faster rate than overall jobs. Like all other sectors, the clean energy economy has been hit by the recession, but investments in clean technology have fared far better in the past year than venture capital overall. Looking forward, the clean energy economy has tremendous potential for growth, as investments continue to flow from both the government and private sector and federal and state policy makers increasingly push for reforms that will both spur economic renewal and sustain the environment.

By 2007, more than 68,200 businesses across all 50 states and the District of Columbia accounted for about 770,000 jobs that achieve the double bottom line of economic growth and environmental sustainability (Exhibit 1).

In today's tough financial climate, when millions of jobs have been lost, those numbers may sound modest. Three quarters of a million jobs represent half a percent of all jobs in the United States today. But Pew's research shows that between 1998 and 2007, clean energy economy jobs—a mix of white- and blue-collar positions, from scientists and engineers to electricians, machinists and teachers—grew by 9.1 percent, while total jobs grew by only 3.7 percent. And although we expect job growth in the clean energy economy to have declined in 2008, experts predict the drop in this sector will be less severe than the drop in U.S. jobs overall.

Pew's research indicates a strong start for a new economy still very much in its infancy. To put our clean energy economy numbers in perspective, consider the following. Biotechnology, which has developed applications for agriculture, consumer products, the environment and health care and has been the focus of significant public policy and government and private investment, employed fewer than 200,000 workers, or about a tenth of a percent of total U.S. jobs in 2007, according to a 2008 Ernst & Young report. And the well-established traditional energy sector—including utilities, coal mining and oil and gas extraction, industries that have received significant government investment—comprised about 1.27 million workers in 2007, or about 1 percent of total employment.

Growing attention and financial support from both the private and public sectors indicate that the clean energy economy is poised to expand significantly. Signaling interest in new market opportunities, venture capital investment in clean technology crossed the $1 billion threshold in 2005 and continued to grow substantially, totaling about $12.6 billion during the past three years. Although they have dropped significantly in recent months because of the recession, investments in clean

technology are actually faring better than other industries: They were down 48 percent in the first three months of 2009 compared with a year earlier, while total venture capital across all sectors was down 61 percent for the same period. "It's important not to miss the forest for the trees," Nicholas Parker, executive chairman of the Cleantech Group, said in January 2009. "In 2008, there was a quantum leap in talent, resources and institutional appetite for clean technologies. Now, more than ever, clean technologies represent the biggest opportunities for job and wealth creation."

Between 2006 and 2008, 40 states and the District of Columbia attracted venture capital investments in technologies and industries aimed at economic growth and environmental sustainability. And all states will receive a major infusion of federal funds through the recently enacted American Recovery and Reinvestment Act (ARRA), which allocates nearly $85 billion in direct spending and tax incentives for energy- and transportation-related programs.

Every State Has a Piece of the Clean Energy Economy

With traditional manufacturing jobs declining during the past decade, states have been working aggressively to develop new industries and create jobs that will endure—and remain within U.S. borders. They also have been working to address the public's concerns about high energy prices, national security and our dependence on foreign oil, and global warming—all with an understanding that America is on its way to being a carbon-constrained country. "While our economic engine has for years been powered by relatively inexpensive energy, there is evidence that this era is coming to a close," a National Governors Association report noted in 2007. "Meanwhile, we are increasingly aware of the serious impacts of global climate change—and how America's consumption of fossil fuels is contributing to a warming Earth."

Pew's analysis shows that every state has a piece of America's clean energy economy. Texas, for instance, generates more electricity from wind than any other state, had more than 55,000 clean energy economy jobs in 2007, and attracted more than $716 million in venture capital funds for clean technology between 2006 and 2008. Tennessee has succeeded in cultivating jobs in recycling, waste treatment and water management, among other conservation industries; jobs in Tennessee's clean energy economy grew by more than 18 percent between 1998 and 2007, compared with 2.5 percent growth in all jobs in the state. Colorado has raised the amount of power electricity providers must supply from renewable energy sources to stimulate job growth in solar and wind power and other forms of clean energy generation. Ohio ranked among the top five states with the most jobs in clean energy, energy efficiency and environmentally friendly production in 2007. Idaho, Kansas, Mississippi and South Dakota are among more than a dozen states where the number of jobs in the clean energy economy in 2007 was modest, but the average annual growth rate of those jobs was among the highest in the country. All told, in 38 states and the District of Columbia, job growth in the clean energy economy outperformed total jobs growth between 1998 and 2007. In a number of states, job gains in the clean energy economy have helped lessen total job losses.

Defining the Clean Energy Economy

Pew partnered with Collaborative Economics, Inc., a public policy research firm based in California, on the research. While organizations on both sides of the political spectrum have weighed in with forecasts and economic modeling to estimate the size of the clean energy economy, Pew's analysis is the first of its kind to count actual jobs, businesses and investments for each of the 50 states and the District of Columbia. Our numbers are conservative and may be lower than some other reports for three reasons: First, we developed a stringent definition of the clean energy economy; second, we used a new, labor-intensive methodology that counted only companies that we could verify online as being actively engaged in the clean energy economy; and third, we counted businesses and jobs supplying products and services generated by the clean energy economy, not the companies using these products and services to make themselves "greener" (i.e., we counted only companies and jobs on the supply side, not the demand side, of the clean energy economy).

Policy makers, business leaders and the public need credible, reliable data to ground their policy deliberations and choices, and to understand where emerging economic opportunities lie. They also need a clear, concrete and common definition of what constitutes the clean energy economy so they can track jobs and businesses and gauge the effectiveness of public policy choices and investments.

Based on significant research and input from experts in the field, including the advisory panel that helped guide this study, Pew developed the following definition:

A clean energy economy generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources.

The clean energy economy cuts across five categories: (1) Clean Energy; (2) Energy Efficiency; (3) Environmentally Friendly Production; (4) Conservation and Pollution Mitigation; and (5) Training and Support.

While specific jobs and businesses will change in the coming decades, the five categories of the clean energy economy will not—providing a clear, practical and consistent framework for federal, state and local policy makers and the private sector to track investments, job and business creation, and growth over time.

Jobs of Today, and Jobs of Tomorrow

Pew's framework takes into account that technology, scientific research, market forces and public policy will continue to drive innovation and competition, so the largest segments of today's clean energy economy may not be its driving forces tomorrow.

Our data show that 65 percent of today's clean energy economy jobs are in the category of Conservation and Pollution Mitigation—a sector that reflects the growing recognition among the public, policy makers and business leaders of the need to recycle waste, conserve water and mitigate emissions of greenhouse gases and other pollutants. But three other categories—Clean Energy, Energy Efficiency and Environmentally Friendly Production—are growing at a far faster clip. And about 80 percent of venture capital investments in 2008 were in the sectors of Clean Energy and Energy Efficiency: businesses and jobs working to develop clean, renewable energy

sources such as wind and solar and products and services that reduce our overall energy consumption—all of which will help meet the demands of a carbon-constrained economy.

The flow of venture capital indicates which sectors are most attractive to investors and have the greatest growth potential. The number of jobs and businesses in Clean Energy and Energy Efficiency will grow over time—and as the country increases the amount of power it draws from renewable sources, we will generate less waste, reduce our reliance on foreign oil and produce fewer carbon emissions that cause global warming. That does not mean that jobs in the Conservation and Pollution Mitigation category will disappear. As other countries seek to follow America's lead, they increasingly will need help managing their finite natural resources and addressing the adverse effects of their use of fossil-fuel energy sources—creating a new market for our products, technology and know-how.

Public Policy's Role in Driving the Clean Energy Economy

Public policy is another important indicator of the future of the clean energy economy.

Policies intended to advance the clean energy economy—from comprehensive energy plans, renewable energy standards and energy efficiency measures to the development of alternative fuels, job retraining and waste reduction efforts—have been adopted or are being actively considered by both the federal government and states. It is too early to tell to what degree these efforts will succeed in stimulating U.S. job growth, strengthening America's competitiveness, curbing pollution and conserving resources. But Pew's analysis indicates such policies have great potential because they create significant incentives for both the private and public sectors to develop new technologies, infrastructure and processes for clean energy, efficiency and conservation. Now that we have baseline data in hand, Pew will conduct follow-up research to assess which approaches are particularly effective in generating jobs, businesses and investments in the clean energy economy.

State policies. Governors and legislators across the country are seeking to get to the double bottom line of economic growth and environmental sustainability by adopting policies to advance the clean energy economy.

- *Financial incentives.* Forty-six states offer some form of tax incentive to encourage corporations and residents to use renewable energy or adopt energy efficiency systems and equipment. Thirty-three states provide residential, commercial and industrial loan financing for the purchase of renewable energy or energy efficiency systems or equipment. And 22 states and the District of Columbia offer rebate programs to promote the installation of solar water heating or solar panels for electricity generation.
- *Renewable portfolio standards.* Twenty-nine states and the District of Columbia have adopted renewable portfolio standards, which require electricity providers to supply a minimum amount of power from renewable energy sources.
- *Energy efficiency standards.* Nineteen states have established energy efficiency standards for energy generation, transmission and use.

- *Regional clean energy initiatives.* Twenty-three states are participating in three major regional initiatives seeking to increase renewable energy generation and reduce carbon pollution from power plants that causes global warming.
- *Vehicle emissions standards.* Fourteen states and the District of Columbia have adopted (and three more states are poised to adopt) California's vehicle emissions standards, which allow states the right to require automakers to reduce carbon emissions from new cars and light trucks more aggressively than federal standards mandate. On May 19, 2009, President Barack Obama established national limits on vehicle emissions by adopting fuel efficiency standards that match California's.

Federal policies. The federal government also has played a critical role, adopting policies and making investments that have spurred economic growth and environmental protection from coast to coast. Laws enacted in the 1960s and 1970s helped develop the recycling, waste reduction and waste management industries. The EPA's Energy Star and Water Sense certification and labeling initiatives long have helped consumers choose and use products that conserve energy and water. And for almost two decades, the U.S. Department of Commerce has helped manufacturers improve efficiency, reduce waste and develop clean technologies and products.

In the last three years, federal policy makers have taken major steps to drive the clean energy economy forward. President Obama's recent efforts to enact stronger fuel efficiency standards built on earlier legislation. In 2007, President George W. Bush signed into law the first congressionally mandated increase in fuel efficiency standards for cars and light trucks in more than 30 years. The Energy Independence and Security Act of 2007 is projected to save consumers $25 billion at the gas pump, save 1.1 million barrels of oil a day and reduce greenhouse gas emissions.

Enacted in February 2009, ARRA—the federal stimulus bill—includes an array of provisions to spur clean energy generation and energy efficiency businesses, jobs and investments. Among the almost $85 billion the package allocates to energy- and transportation-related spending, about $21 billion is dedicated to extending tax incentives for wind, solar and other renewable energy manufacturers. ARRA also provides more than $30 billion for direct spending on clean energy programs, including $11 billion to modernize the nation's electricity grid; $2 billion for advanced battery technology; more than $6 billion for state and local efforts to achieve energy efficiency; $5 billion for weatherization of low-income homes; $500 million for job training to help workers participate in the clean energy economy; and $300 million to purchase thousands of new, fuel-efficient vehicles for the federal fleet from American auto companies.

Moving forward. Given America's need to create enduring jobs and industries while conserving natural resources and reducing carbon emissions, federal leaders are deliberating additional measures to spur the clean energy economy.

President Obama has signaled his support for a federal clean energy plan to reduce greenhouse gas emissions by at least 80 percent by 2050, and a national renewable

portfolio standard that would require that 25 percent of the nation's energy supply be derived from renewable sources by 2025. At this writing, the U.S. House of Representatives is considering the American Clean Energy and Security Act, a market-based proposal that would limit overall greenhouse gas emissions and distribute tradable federal allowances for each ton of pollution emitted. The program would apply to electric utilities, oil companies and other entities that produce more than 25,000 tons of carbon dioxide each year. The bill would increase significantly the amount of energy derived from low- or zero-carbon sources, including renewables—meaning that businesses and jobs would be generated to develop clean energy sources to meet the demand.

EXHIBIT 1
THE U.S. CLEAN ENERGY ECONOMY BY THE NUMBERS

By 2007, 68,203 businesses in the United States had generated more than 770,000 jobs in the clean energy economy. And between 2006 and 2008, about $12.6 billion of venture capital investments was directed toward clean technology businesses in 40 states and the District of Columbia. The U.S. clean energy economy is an emerging source of jobs that achieve the double bottom line of economic growth and environmental sustainability. Every state has a piece of America's clean energy economy.

	CLEAN BUSINESSES 2007	CLEAN JOBS 2007	CLEAN JOB GROWTH 1998-2007	OVERALL JOB GROWTH 1998-2007	VENTURE CAPITAL 2006-2008 (thousands)
Alabama	799	7,849	2.2%	1.6%	$0
Alaska	350	2,140	9.4	15.7	0
Arizona	1,123	11,578	21.3	16.2	31,106
Arkansas	448	4,597	7.8	3.5	22,845
California	10,209	125,390	7.7	6.7	6,580,427
Colorado	1,778	17,008	18.2	8.2	622,401
Connecticut	857	10,147	7.0	-2.7	30,050
Delaware	211	2,368	-2.3	-8.9	3,342
District of Columbia	280	5,325	18.8	-7.1	89,877
Florida	3,831	31,122	7.9	22.4	116,980
Georgia	1,827	16,222	10.8	15.7	179,686
Hawaii	356	2,732	43.6	7.3	12,304
Idaho	428	4,517	126.1	13.8	27,890
Illinois	2,176	28,395	-2.5	-2.5	108,519
Indiana	1,268	17,298	17.9	-1.0	26,000
Iowa	729	7,702	26.1	3.6	149,237
Kansas	591	8,017	51.0	-0.3	13,275
Kentucky	778	9,308	10.0	3.6	0
Louisiana	995	10,641	19.5	3.0	0
Maine	725	6,000	22.7	3.3	0
Maryland	1,145	12,908	-2.4	1.3	323,996
Massachusetts	1,912	26,678	4.3	-4.4	1,278,462
Michigan	1,932	22,674	10.7	-3.6	55,099
Minnesota	1,206	19,994	11.9	1.9	49,938
Mississippi	454	3,200	24.8	3.6	30,384
Missouri	1,062	11,714	5.4	2.1	24,480
Montana	408	2,155	0.2%	12.7%	$0
Nebraska	368	5,292	108.6	-4.9	0
Nevada	511	3,641	28.8	26.5	19,804
New Hampshire	465	4,029	2.0	6.8	66,917
New Jersey	2,031	25,397	-9.6	-2.7	282,568
New Mexico	577	4,815	50.1	1.9	147,913
New York	3,323	34,363	-1.9	-2.6	209,590
North Carolina	1,783	16,997	15.3	6.4	82,571
North Dakota	137	2,112	30.9	9.4	0
Ohio	2,513	35,267	7.3	-2.2	74,224
Oklahoma	693	5,465	6.8	2.4	5,192
Oregon	1,613	19,340	50.7	7.5	70,002
Pennsylvania	2,934	38,763	-6.2	-3.1	232,897
Rhode Island	237	2,328	0.7	0.6	22,845
South Carolina	884	11,255	36.2	2.2	0
South Dakota	169	1,636	93.4	4.9	0
Tennessee	1,090	15,507	18.2	2.5	16,329
Texas	4,802	55,646	15.5	6.7	716,894
Utah	579	5,199	-12.4	10.8	26,957
Vermont	311	2,161	15.3	7.4	53,747
Virginia	1,446	16,907	6.0	6.6	70,828
Washington	2,008	17,013	0.5	1.3	635,109
West Virginia	332	3,065	-4.1	0.7	5,741
Wisconsin	1,294	15,089	-5.2	3.4	46,743
Wyoming	225	1,419	56.4	14.0	6,942
U.S. Total	68,203	770,385	9.1	3.7	12,570,110

NOTE: Venture capital values are adjusted for inflation and reported in 2008 dollars. See appendices for the complete data sets.
SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database and data from the Cleantech Group™ LLC; analysis by the Pew Center on the States and Collaborative Economics

The Clean Energy Economy: A Definition and Framework

Manufacturing plants of old—the destination for thousands of workers and lifeblood of whole communities—have been on the decline for years. In 2007, there were just under 14 million manufacturing jobs, but the industry has shrunk every year over the last decade. Between 1998 and 2007, manufacturing jobs declined by nearly 21 percent, an average of 2.6 percent annually.[1] Many companies have shut down as consumers turned to newer products and innovations or as more profitable business models emerged in other states or countries. This long, steady decline accelerated during the past year as the recession hit, leaving workers in need of jobs—and states in need of new industries to serve as their economic engines.[2] Today, a growing number of states are looking to identify and cultivate new industries and areas of economic growth to help them better compete in the 21st century global marketplace. The public and policy makers alike want more than a short-term fix for the immediate fiscal crisis. They want new lines of business that will create jobs, generate revenues for many years to come and help America re-emerge as a technological leader.

With three quarters of Americans describing climate change as a serious problem,[3] states also have been working to address the public's concerns about our shrinking supply of traditional energy sources, the nation's overreliance on foreign oil and global warming pollution. "While our economic engine has for years been powered by relatively inexpensive energy, there is evidence that this era is coming to a close," a National Governors Association report noted in 2007.[4] "Meanwhile, we are increasingly aware of the serious impacts of global climate change—and how America's consumption of fossil fuels is contributing to a warming Earth." Nearly half the states have joined regional initiatives aimed at reducing carbon dioxide emissions from power plants and increasing clean energy generation. Twenty-nine states and the District of Columbia have adopted renewable portfolio standards, which require utilities to generate a certain percentage of their power—ranging from 10 percent to 25 percent—from renewable energy sources by a target date.[5] And 19 states have established standards for energy efficiency.[6]

Driven by fiscal interests and concerns about energy and climate change, a growing number of public- and private-sector leaders are seeking to expand their share of the clean energy economy: jobs, businesses and investments that achieve a double bottom line—economic growth and environmental sustainability. This approach is not new; in the late 1990s businesses and policy makers began to recognize that consumer demand for clean products, supplies and activities represented a significant market opportunity. But the promise and priority of the clean

energy economy have risen sharply in response to the current economic recession and our increasing dependence on fossil fuels.

Through the American Recovery and Reinvestment Act (ARRA), which was signed into law in February 2009, President Barack Obama and Congress have pumped substantial federal funds into cultivating the clean energy economy—nearly $85 billion in direct spending and tax credits for energy- and transportation-related programs.[7] But even before ARRA, a growing number of states, from Tennessee and Texas to Colorado, Michigan and Ohio, were beginning to capitalize on the clean energy economy's double bottom line of economic growth and environmental sustainability.

Michigan has lost jobs since 2000 as the Detroit-based auto manufacturers have faltered; by March 2009, the state's unemployment rate was the highest in the country, at 12.6 percent—an increase of 5 percentage points in just one year.[8] Today, the clean energy economy is a central component of Michigan's recovery strategy. Part of Governor Jennifer Granholm's "No Worker Left Behind" program aims to create clean energy jobs for Michigan residents, and she tasked Skip Pruss, director of the state's Department of Energy, Labor and Economic Growth, with making that goal a reality.[9] "Every state wants to be a leader in the area for clean energy generation and energy efficiency," said Pruss. "There's keen competition; it's very dynamic. But there's enough opportunity for everyone to really improve and diversify their economies."[10]

Given the burgeoning interest in the clean energy economy, policy makers, business leaders and the public need credible, reliable data to ground their policy deliberations and choices, and to understand where growth is heading. And both government and the private sector need a clear and concrete definition of this market so they can track jobs, businesses and investments aimed at both economic growth and environmental sustainability and gauge the effectiveness of public policy choices to support such efforts.

Pew sought first to clearly define the clean energy economy and then count the actual number of jobs, businesses and investments in it. Pew's accounting of the clean energy economy was developed from the ground up. Our analysis is conservative relative to other studies because we count actual clean energy economy businesses and jobs rather than entire occupations (such as all jobs in mass transit, or all electricians).[11] For example, our report counts the workers who manufacture hybrid cars and buses, technicians who construct wind turbines, electricians who install solar panels on homes and engineers who research fuel cell technology, but it does not include all auto manufacturers, electricians, technicians and engineers. In addition, we focus exclusively on producers and suppliers in the clean energy economy. We do not count jobs that use these products and services—for example, jobs within utilities responsible for purchasing energy monitoring equipment or the mass transit operations that buy hybrid buses—because data limitations prevented the disaggregation of specific jobs within these types of companies.

Although our numbers are conservative, our report provides the most precise depiction to date of the clean energy economy in the United States.[12]

The Clean Energy Economy, Defined

Based on significant research and input from experts in the field, including the advisory panel convened to help guide this study, Pew has developed the following definition:

A clean energy economy generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources.

The clean energy economy comprises five categories: (1) Clean Energy; (2) Energy Efficiency; (3) Environmentally Friendly Production; (4) Conservation and Pollution Mitigation; and (5) Training and Support. Pew's researchers organized these five categories from 16 economic sectors (see Appendix A for a complete list).

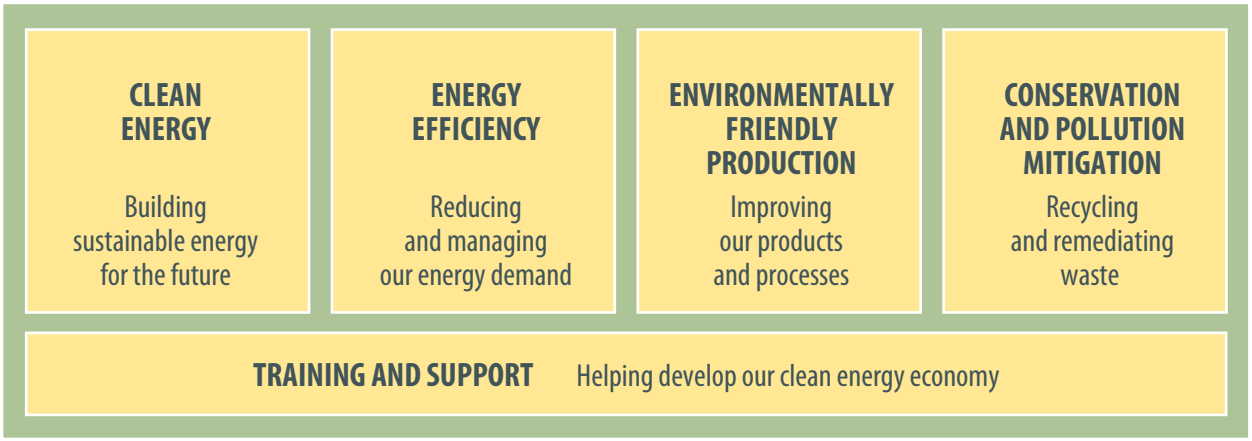
This framework (Exhibit 2) was designed to describe what the clean energy economy looks like today while leaving room for inevitable future changes. Technology, scientific research, market forces and public policy will continue to drive innovation and competition. A company that supplies natural gas engines for buses, for instance, may supply a fundamentally different type of engine a decade from now. But while specific jobs and businesses will change, the five categories that make up the clean energy economy will not. Our framework provides a clear, practical and consistent tool for federal, state and local policy makers and the private sector to track investments, job and business creation, and growth over time.

EXHIBIT 2

THE CLEAN ENERGY ECONOMY—A DEFINITION

The clean energy economy generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources.

The clean energy economy comprises five categories:



Although specific jobs and businesses will change over time, the categories themselves will not—providing a clear, practical and consistent framework for federal, state and local policy makers and the private sector to track investments, job and business creation, and growth over time.

SOURCE: Pew Charitable Trusts, 2009.

The Five Categories of the Clean Energy Economy

Clean Energy. These are jobs, businesses and investments that produce, transmit and store clean, renewable power from solar, wind, low-impact hydro, hydrogen fuel cells, marine and tidal, geothermal[13] and small-scale biopower[14] energy sources.

This category's jobs, businesses and investments meet a stringent set of requirements. Clean energy must have a positive net energy yield, reduce greenhouse gas emissions compared with other sources of energy, and be produced and distributed in a sustainable and safe manner. Nuclear power is not included in this category because of significant, ongoing questions about how and where to safely store its waste; a system to safely dispose of nuclear waste has not been implemented anywhere in the world (see Appendix F).[15] Additionally, we do not include the jobs and businesses associated with the production and distribution of liquid biofuels such as corn-based ethanol in the Clean Energy category because they do not meet its requirements.[16] As explained in more detail below, these jobs and businesses are included in the Environmentally Friendly Production category instead.

Examples of jobs: Electricians, electrical engineers and plumbers help install new energy systems, while plant operators ensure that renewable sources such as wind and solar are being converted to electricity. Mechanics rebuild ailing energy infrastructure by installing sensors and controls that monitor and distribute clean energy more effectively (i.e., making the grid smarter). Researchers and technicians perfect and implement battery technologies that improve how we store and distribute clean energy.

Energy Efficiency. These are jobs and businesses that help Americans reduce the amount of energy we use, whether to run a manufacturing plant or heat and cool an office building or home. Expanding the use of clean, renewable energy sources will take time, so improved energy efficiency helps reduce our use of fossil fuels in the short term and use less energy—from both fossil fuels and renewable sources—in the long term.

Examples of jobs: Engineers develop energy-efficient lighting, meters, software programs and other products that help curb and monitor energy usage, while electricians and others install them in homes, businesses and government buildings.

Environmentally Friendly Production. These are jobs, businesses and investments that seek to mitigate the harmful environmental impacts of existing products and develop and supply alternatives that require less energy and emit fewer greenhouse gases. Environmentally friendly production comprises six areas: transportation, manufacturing, construction, agriculture, energy production and materials.

Examples of jobs:

- Transportation includes jobs that produce hybrid diesel buses, traffic monitoring software and liquid biofuels. This includes only facilities where feedstocks are distilled into biofuels and centers that distribute them—i.e., the biofuels infrastructure; it does not include agricultural jobs that supply feedstocks to produce liquid biofuels.[17] We include biofuels infrastructure because the commercialization of second-generation biofuels from the cellulose in plants and waste holds the potential to produce an energy source that does

not divert substantial amounts of land from growing food or damage the environment.

- Manufacturing includes chemists who produce environmentally sound packaging, equipment and surface cleaning products that are less caustic than traditional products.
- Construction includes workers who produce and install green building material such as alternative cement and manufactured wood products made from scraps, and consultants who provide green building design and construction services.
- Agriculture includes plumbers and technicians who install smart irrigation systems, as well as chemists who design alternative pest controls and consultants who provide agricultural sustainability planning.
- Energy production includes jobs that design and apply cleaner technologies to coal such as gasification, pyrolysis, and carbon capture and sequestration (CCS). Coal provides nearly 50 percent of America's electricity,[18] but it also produces about 80 percent of the electricity sector's carbon dioxide emissions.[19] CCS technology is still under development, but our definition includes efforts that seek to reduce the adverse impacts of coal in the near future while the country works to develop clean, renewable energy sources.[20]
- Materials includes product designers and engineers who develop biodegradable products and chemical engineers who research new chemical catalysts to break down wastes and reduce toxins naturally.

Conservation and Pollution Mitigation. These are jobs, businesses and investments that enable the United States to manage water and other finite natural resources more effectively and to mitigate emissions of greenhouse gases and other pollutants that result from the continued use of fossil fuels.[21] Also included are efforts to recycle materials used in production processes, which can save energy. For example, recovering aluminum from scrap (from manufacturing plants as well as from aluminum products) to refine and produce aluminum a second time uses less than 5 percent of the energy required to produce primary aluminum.[22]

Examples of jobs: Trained workers safely remediate hazardous materials from industrial sites; scientists and technicians develop, install and supply products to capture and treat noxious greenhouse gases and pollutants; machinists and system operators treat water and waste; and environmental consultants help companies and governments improve emissions monitoring, water conservation and recycling.

Training and Support. These are jobs, businesses and investments that provide specialized services to the other four categories of the clean energy economy.

Examples of jobs: Financial analysts and consultants specialize in clean tech investments, lawyers and paralegals provide legal services, researchers and engineers develop new energy generation technologies, and vocational teachers train new workers for the clean energy economy.

Methodology

This report counts jobs, companies, patent registrations and venture capital investments that are part of the clean energy economy, as Pew defines it, across all 50 states and the District of Columbia. Because a perfect data set with which to count these jobs and businesses does not exist, and obtaining an accurate count of this emerging economic activity is difficult, Pew used data that provide detailed information on individual companies.

As a first step, Pew's researchers identified companies receiving clean technology venture capital. Next, we used the National Establishment Time Series (NETS) database—a time series database of U.S. public and private establishments based on data from Dun & Bradstreet—to identify similar and related companies. This approach enabled us to capture the different sets of activities that result in products and services produced and supplied by the clean energy economy, creating the most comprehensive and accurate count of jobs yet available. For the purposes of this analysis, we studied jobs and businesses between 1998 and 2007.

As noted earlier, there is no straightforward classification of jobs and businesses in the clean energy economy. To compensate for this, Collaborative Economics Inc., Pew's research partner, created a new database to track businesses in the clean energy economy and, in combination with NETS, identified companies in the clean energy economy across the nation. The research team designed a Web search engine to find company Web sites and to verify that these businesses were still actively engaged in the clean energy economy, based on our definition. Then a team of analysts manually checked the validity of the 50-state data. Given the methodology and standards employed, our count of businesses and jobs is probably conservative.

Venture capital investment data were provided by the Cleantech Group, which tracked investments by industry category. We obtained new patent registrations, based on U.S. Patent and Trade Office records, with the help of intellectual property experts at 1790 Analytics. Both patent and venture capital data were collected for the period from 1999 to 2008.

See Appendix B for a more detailed description of our methodology.

The Clean Energy Economy: National Numbers

Businesses and Jobs

Driven by growing consumer demand, public policy decisions and public- and private-sector investments, America's clean energy economy today comprises more than three quarters of a million jobs. By 2007, the last year for which data are available, 68,203 businesses across all 50 states and the District of Columbia had created 770,385 jobs in the clean energy economy. While this represents half a percent of all jobs in the United States, Pew's research shows that between 1998 and 2007, jobs in the clean energy economy grew by 9.1 percent, while total jobs grew by just 3.7 percent. And although we expect the national recession to have caused a decline in jobs that are part of the clean energy economy in 2008, experts predict it will be less severe than the drop in overall U.S. jobs.[23]

To put these numbers in perspective, consider the following. Biotechnology, which has developed applications for agriculture, consumer products, the environment and health care and has been the focus of significant public policy[24] and private investment,[25] employed fewer than 200,000 workers, or about a tenth of a percent of total U.S. jobs in 2007.[26] And the well-established traditional energy sector—including utilities, coal mining and oil and gas extraction, industries that have received significant government investment—comprised about 1.27 million workers in 2007, or about 1 percent of total employment.[27]

Workers from all walks of life and diverse professional backgrounds are the engine of the clean energy economy. Plumbers, machinists, scientists, engineers, bankers and marketing consultants all contribute to it—with annual incomes ranging from approximately $21,000 to $111,000.[28] "The range of jobs will be from entry level to high level and they will all evolve as the industry evolves," Kathy Krepcio, executive director of the John J. Heldrich Center for Workforce Development at Rutgers University, told members of Congress in March 2009.[29]

One national company that illustrates the potential of the clean energy economy is Hemlock Semiconductor,[30] the world's largest producer of polysilicon, a key material in photovoltaic devices such as solar panels. For decades, the 48-year-old company primarily produced semiconductors, but solar panels have taken off, and Hemlock with them. The company, based in Hemlock, Michigan, has expanded rapidly during the past five years—doubling from 600 to 1,200 employees. In December 2008, Hemlock announced a $1.2 billion investment to launch a new Clarksville, Tennessee, plant that will employ 900 people once it opens in 2012. Tennessee Governor Phil Bredesen and the Tennessee Department of Economic and Community Development created an attractive package to lure Hemlock, including tax incentives, a shovel-ready location, and sound roads and other transit to ship materials in and products out. The package also featured a partnership

with Austin Peay State University, which committed to offering a program to train skilled manufacturing workers in meeting the specific needs of a company such as Hemlock.[31]

"As the solar industry grows domestically and internationally, we'd expect both of our sites [in Michigan and Tennessee] to continue to grow," said Jarrod Erpelding, a company spokesman. "We have this tremendous operation set up to serve the world's solar electricity generation needs. But solar comprises less than 1 percent of the world's total electricity generation. We're as large as we are now to serve this very small fraction. We are working as hard as we can to grow the domestic market for solar energy."

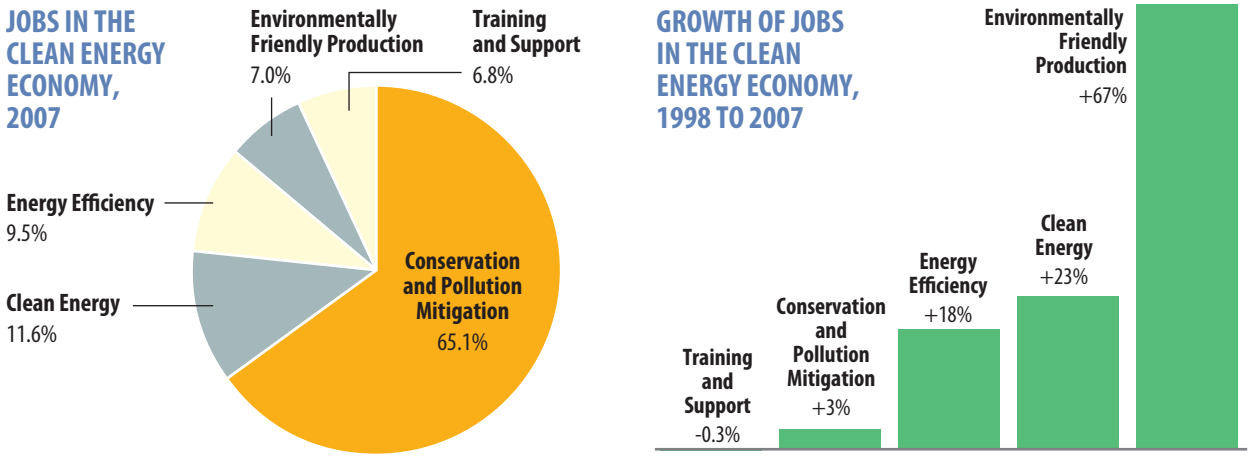
Where the Jobs Are Now, and Where They Are Heading

The Jobs of Today: Conservation and Pollution Mitigation. In 2007, 65 percent—501,551—of all jobs in the clean energy economy were in the category of Conservation and Pollution Mitigation, which includes the recycling industry (Exhibit 3). These jobs are spread across all 50 states and the District of Columbia. The industries and businesses represented in this sector are capital intensive—requiring large investments in plants and equipment—and they respond to the demand to recycle and reuse water and other natural resources more efficiently. The dominance of this sector to date makes sense, given recognition among consumers, policy makers and business leaders of the need to recycle waste, conserve water and mitigate emissions of greenhouse gases and other pollutants.[32]

EXHIBIT 3

THE U.S. CLEAN ENERGY ECONOMY: Jobs of Today and Jobs of Tomorrow

65 percent of today's clean energy economy jobs are in the category of Conservation and Pollution Mitigation. Growing recognition among the public, policy makers and business leaders of the need to recycle waste, conserve water and work to mitigate emissions of greenhouse gases and other pollutants has led to growth in this category. But growth trends paint a different picture for the future of the clean energy economy. Jobs in Environmentally Friendly Production, Clean Energy and Energy Efficiency are growing much faster in response to new market demands.



SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

A CONSERVATION AND POLLUTION MITIGATION FIRM: RECYCLEBANK

To be cost effective for municipalities, recycling must occur on a large enough scale to yield savings at the landfill.

RecycleBank, which operates in 18 states and 100 cities and towns, encourages recycling while helping consumers and local governments save money.[33] The company collects recyclable materials in bins equipped with computer chips that record the amount recycled and send the information to the RecycleBank's Web site, where it is converted into points for the bin owner's account. The customer can log into the account and convert points to coupons for stores such as Target and brands such as Kraft.

As a result of these incentives, areas that use the program have seen recycling increase by 50 percent or more along with significant savings at the landfill, which often charge per ton.[34] Wilmington, Delaware, for instance, cut its $2.1 million annual waste removal tab by 40 percent.[35]

RecycleBank's roughly 105 employees include operations managers, technology specialists, marketing professionals and salespeople. The staff does not include truck drivers, garbage collectors or recycling plant workers because the company tries to help existing recycling operations stay in business. Once a deal is signed, RecycleBank retrofits existing trucks with mechanical arms that read the chips in the new bins. Upfront costs are paid by RecycleBank in return for an agreement to share the long-term savings with the city.[36]

Some communities are not traditionally recyclers—especially low-income areas where it is not easy for individuals without the means to invest in solar panels, electric cars and the like. But RecycleBank CEO Ron Gonen said the company has done well in these neighborhoods. "We've been able to come in on a mass scale and say we're going to help you become part of this environmental movement today, and we're going to reward you for it," Gonen said. "If you give people the opportunity, they're going to take advantage of it."[37]

The Jobs of Tomorrow: Clean Energy; Energy Efficiency; and Environmentally Friendly Production. While the Conservation and Pollution Mitigation sector contains the majority of today's jobs and businesses in the clean energy economy, Pew's data indicate that three different categories represent the jobs of tomorrow: Clean Energy; Energy Efficiency; and Environmentally Friendly Production. Together, these categories make up more than one in four jobs in today's clean energy economy—and they are growing at a fast clip. They represent businesses and jobs that are looking ahead to develop renewable, efficient energy sources and technologies to meet the demands of a carbon-constrained economy (Exhibit 3).

Clean Energy. The Clean Energy sector contains a variety of different workers, from electricians and engineers to plumbers, who help create, distribute and store clean, renewable energy. In 2007, this sector accounted for about 89,000 jobs. While this category is small relative to the more established and geographically dispersed Conservation and Pollution Mitigation sector, it is growing rapidly and promises to form the backbone of tomorrow's clean energy economy. Investors see great potential in this burgeoning sector. As explained below, it attracted the vast majority of clean venture capital between 2006 and 2008. The jobs in this category are located in three main areas: energy generation, transmission and storage.

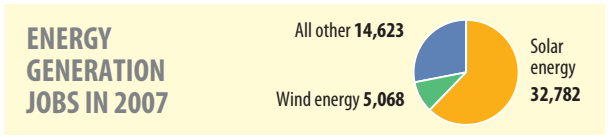
Nearly six out of 10 jobs in this sector fall specifically in the area of energy generation, which includes jobs responsible for producing clean forms of energy such as wind, solar, geothermal, low-impact hydro, hydrogen, marine and tidal, and small-scale biopower. Jobs responsible for solar power generation dominate this subgroup: 62.5 percent of all energy generation jobs in 2007 were in the solar industry. Jobs in wind power were second overall, making up 9.7 percent of energy generation jobs in 2007, but they grew more rapidly—by 23.5 percent between 1998 and 2007, compared to 19.1 percent growth for solar power jobs during the same period (Exhibit 4).

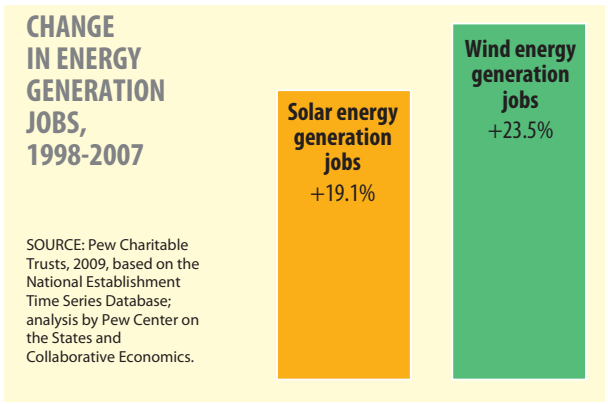
Energy transmission jobs, focused on building tomorrow's energy delivery systems, represent one of every nine jobs in the overall Clean Energy sector. GridPoint, a Virginia-based technology firm with 130 employees, is among the businesses seeking to make those systems smarter. Much of America's electricity grid currently sits unused except at peak times, when the system exceeds capacity. "As we get closer to the consumer, we don't have any ability to measure and control the electricity at that level," said Steven Hauser, head of GridPoint's market development.[38] As a result, the grid is not very smart. Better consumption patterns and pricing signals between producers and end users could change that dynamic, making the grid work optimally and provide better feedback to end users. In March 2008, GridPoint began collaborating with the City of Boulder, Colorado, and other energy companies to make Boulder a smart grid laboratory. Smart meters have been installed in about 15,000 homes—ultimately, about 50,000 will have them—and GridPoint has installed software and other tracking devices to monitor and control energy consumption in real time, allowing consumers and the utility to better understand patterns of energy use. Providers can then price energy accordingly, and consumers can reduce their energy consumption during the most expensive hours. "It is really important that states develop their own smart grid plans—and better green energy plans for that matter—to encourage investment at the state level," said Hauser.

The remaining 31 percent of jobs in the Clean Energy sector concentrate on developing and implementing new and more effective energy storage technologies, such as those that capture excess renewable energy supply and release it on demand. Renewable energy

EXHIBIT 4
SOLAR AND WIND ENERGY

Nearly six out of 10 jobs in the category of Clean Energy are responsible for the generation (versus transmission or storage) of clean and renewable energy. Jobs in solar energy generation account for 62.5 percent of all energy generation jobs. Jobs in wind energy generation are second overall, making up 9.7 percent. Jobs in wind and solar are expanding at promising rates—wind power jobs grew 23.5 percent between 1998 and 2007, outpacing solar jobs, which grew 19.1 percent during the same time period.





SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

A CLEAN ENERGY FIRM: GAMESA

Gamesa, a Spanish-owned wind turbine manufacturer, arrived in Pennsylvania in early 2005. Its first plant was a former U.S. Steel factory in Ebensburg, outside Pittsburgh—and some of its first hires were former steel workers from the old plant. Within a few years, Gamesa opened a second plant in Fairless Hills and a Philadelphia development office. The company currently employs about 1,000 Pennsylvanians.

Gamesa spokesperson Michael Peck said the company was drawn to Pennsylvania by the state's bipartisan legislative commitment to renewable energy, its proximity to large and accessible energy markets, and its native resources—wind, and a large, skilled workforce, the legacy of the once-mighty steel industry.[39] The state's renewable energy portfolio standard—which requires electricity providers to supply at least a certain amount of power from renewable sources—was set earlier and more aggressively than similar policies in other states, an encouraging signal to Gamesa that there would be local demand for its product, Peck said. In addition, Pennsylvania is situated among many other states with large energy demands, limited wind resources or land for wind farm development and renewable portfolio standards, he said. "We've had an opportunity through the challenge that's facing our environment to take this manufacturing DNA and attain world leadership in green energy and manufacturing," Peck said.

sources such as wind and solar power are intermittent, so finding ways to store and transmit energy when the sun is not shining and wind is not blowing is critical.[40]

Energy Efficiency. As U.S. Energy Secretary Steven Chu has said, "maximizing energy efficiency and decreasing energy use will remain the lowest hanging fruit of the next several decades."[41] In 2007, this sector represented approximately 73,000 jobs in the clean energy economy. The jobs and businesses in the Energy Efficiency category work hand-in-hand with those in the Clean Energy sector. Energy-efficient products and services use the current supply of energy more effectively, decreasing Americans' consumption of carbon-emitting energy while clean, renewable energy sources are developed that can meet a greater share of U.S. energy needs.[42] Energy efficiency is one of the most cost-effective ways of reducing the consumption of carbon-emitting energy supplies, and U.S. consumers have responded by increasing demand for more efficient products and services.[43] In 2007 alone, Americans purchased more than 500 million Energy Star® products—labeled as energy efficient by the U.S. Department of Energy and Environmental Protection Agency—across 50 categories, up 67 percent from the previous year.[44]

Increased demand for energy-efficient products and services has spurred job growth for workers who make and distribute software and meters to monitor energy consumption and who manufacture and install efficient glass and lighting, along with service-related jobs that help companies and individuals improve home or business energy use. Many of these jobs are white-collar positions, including energy management and energy consulting services. The two groups are closely connected; the demand for energy-efficient products drives a corresponding demand for energy management and consulting services and related jobs.

AN ENERGY EFFICIENCY FIRM: HONEYWELL

Honeywell International, based in Morris Township, New Jersey, and inventor of the iconic round thermostat found in homes around the world, has a $38 billion portfolio—and nearly half of it is tied to energy efficiency products and services, according to Kurt Anson, vice president of Global Energy and Environment for Honeywell Building Solutions.[45] Sales in Honeywell's Automation and Control Solutions division, which includes the Building Solutions section and many energy efficiency products such as sensors and switches for lights and other appliances, jumped at a rate twice that of total company sales in 2008.[46]

In a typical contract, Honeywell engineers audit building systems for potential energy efficiency improvements and oversee comprehensive retrofits that can save thousands of dollars and tons of emissions and create or sustain a range of jobs for Honeywell engineers, local subcontractors and manufacturing workers in supplier companies, said Anson. All told, a $10 million contract can create or sustain 95 jobs, according to the National Association of Energy Services Companies.[47] The audit process often leads to a combination of bringing in renewable energy sources and tightening up the efficiency of sources old and new. For example, a Honeywell contract launched last fall with the Housing Authority of the City of Pittsburgh is expected to save the city $3.2 million annually in utility costs by switching communities to geothermal HVAC systems (systems that store air from the earth's natural heating and cooling processes), sealing buildings to reduce loss of hot and cold air and retrofitting lights and appliances with more efficient models.[48] The improvements also are expected to cut annual carbon emissions by nearly 16 million pounds—equivalent to removing more than 1,300 vehicles from the road.[49] "By developing projects that have environmental and financial drivers, we will see the type of widespread adoption that will have a lasting impact on greenhouse gas emissions," said Anson.[50]

AN ENERGY EFFICIENCY FIRM: JOHNSON CONTROLS

Johnson Controls, a Fortune 500 auto parts manufacturer headquartered in Milwaukee, Wisconsin, is one of the country's fastest-growing companies in the clean energy economy and is a recognized leader in energy-efficient building solutions.[51] In fact, as Joy Clark-Holmes, the company's director of Local Government and Market Solutions explained, growth in its building efficiency business is outpacing its other divisions, accounting for more than one third of the company's 140,000 employees and $38 billion in sales in 2008.[52] "We are benefiting from the expansion of the public's general interest in energy efficiency and its willingness to invest," Clark-Holmes said.

Johnson Controls recently launched a campaign to educate consumers about energy efficiency and sustainability. "'Green' is a marketing word for what people feel is doing the right thing," said Clark-Holmes. "If you truly want to become green you have to become energy efficient."

AN ENERGY EFFICIENCY FIRM: AUSTIN ENERGY

Austin Energy[53] has been actively promoting conservation since 1982, "before it was on everyone's radar," according to spokesman Ed Clark. Its Power Saver program has encouraged customers to make their homes and businesses more energy efficient through rebates and low-interest loans for improvements from weather stripping to solar panel installation. Austin Energy works with 80 independent local heating and air-conditioning services to make the improvements in the Austin, Texas, metropolitan area. In addition, the utility company has a two-year-old partnership with Austin Community College, in which students intern with Austin Energy and other area utilities in preparation for post-graduate jobs.

Austin Energy is a city department. Because it is publicly owned and its profits become part of the city's general fund, every investment the group makes of more than $50,000, such as the purchase of its $2.3 billion biomass plant, must be reviewed and approved by the Austin City Council before it can be implemented. The short-term costs of moving to renewable energy sources can cause concerns for constituents—but energy efficiency and ultimate cost savings to consumers and the city benefit everyone, said Clark. The city council recently passed a new Energy Conservation Audit and Disclosure Ordinance that will go into effect June 1, 2009, requiring energy audits of all homes more than 10 years old before they are sold, and disclosure of the results to prospective buyers. Clark predicted that in addition to increasing the demand for efficiency improvement products and services, the ordinance will create a need for about 100 certified inspectors to perform the audits.[54]

AN ENVIRONMENTALLY FRIENDLY PRODUCTION FIRM: PROJECT FROG

San Francisco, California-based Project FROG (Flexible Response to Ongoing Growth)[55] provides customizable, prefabricated "smart buildings" that incorporate science, technology and human behavior at as much as 40 percent less than the cost of traditional construction projects, according to company founder Mark Miller.[56]

Three years ago, Miller and his colleagues at a San Francisco architecture firm established Project FROG with two goals: to reduce money, time and materials associated with traditional construction and to create efficient, affordable and environmentally neutral buildings.[57] With the support of venture capital firms, they developed prefabricated components to create buildings suited to different sites and user needs. For its first commercial projects, Project FROG targeted American school districts. To date, the company has constructed buildings across two campuses, and it has three more campuses under construction that will open this fall. Project FROG employs a staff of 20 and works with 10 full-time consultants from the architecture, energy, manufacturing and engineering fields. To maintain the brand's low-cost, sustainable ethos, the company buys its materials—primarily steel and large panels that become walls—from local suppliers, and it favors producers that have strong efficiency and sustainability practices in place, said Adam Tibbs, president of Project FROG.

A TRAINING AND SUPPORT FIRM: MANKO, GOLD, KATCHER & FOX

Pennsylvania's Land Recycling Program, which encourages owners of brownfield sites to clean them up by providing uniform standards, liability relief, standardized reviews and financial assistance, is a major source of business for the law firm of Manko, Gold, Katcher & Fox. The firm, which is based in Pennsylvania but represents clients in every state and all over the world, provides legal services related to the Land Recycling Program and other environmental policies. For example, the firm's lawyers counsel businesses and municipalities on compliance with environmental regulations, and they help clients determine whether their projects qualify for environment-related funding through ARRA and other programs. The federal stimulus has boosted demand for environmental legal services as companies and municipalities jostle for funding with "green" stipulations attached to it. Managing Partner Robert Fox predicts the market for environmental lawyers is "going to be much hotter over the next 10 years than it was over the last."[58] Manko Gold's staff includes 28 lawyers and two full-time technical consultants who are experienced engineers.

Environmentally Friendly Production. Ten years ago, relatively few jobs focused on supplying alternative products and services, such as environmentally friendly construction materials and compressed natural gas bus engines, aimed at reducing carbon emissions and conserving natural resources. In 2007, the Environmentally Friendly Production sector comprised 53,700 jobs—7 percent of all jobs in the clean energy economy—but that share reflects growth of 67 percent during the past decade, driven by the transition Americans are making toward more environmentally sustainable products and practices. Products traditionally made from derivatives of fossil fuels are now being produced from organic materials such as complex sugars and starches; the production of these bioproducts has increased and will continue to grow as the demand for fossil fuel replacements grows.

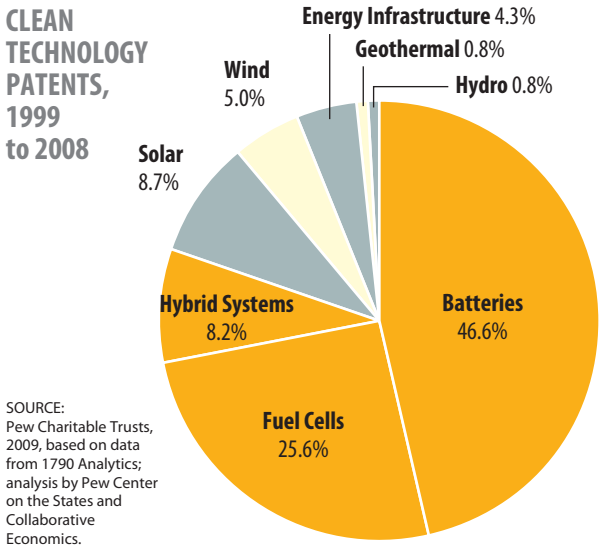
Training and Support. In 2007, there were more than 50,000 jobs in the Training and Support sector, the only category in the clean energy economy that experienced a negative annual growth rate between 1998 and 2007. Employment in this area peaked in 2002 and declined during the next three years, but it has been on the rise again since 2006. Despite its small size and slow growth, the skills and specialized services of the jobs in this category are vital to the other four sectors of the clean energy economy. Teachers train plumbers and electricians to install clean energy systems, researchers develop new energy-generating technologies, and legal and business firms consult with companies to ensure that their products and services thrive in the growing clean energy economy.

Patents and Venture Capital Investments

The clean energy economy is still young. As Pew's data show, jobs and businesses in the clean energy economy have multiplied rapidly during the past decade—yet the numbers reflect early efforts by investors, entrepreneurs, researchers and policy makers. "Clean tech is where IT was 30 years ago and biotech was 20 years ago; we're way earlier in the innovation cycle," said David Prend, managing general

EXHIBIT 5
CLEAN TECHNOLOGY PATENTS

During the past 10 years, clean technology patents have been registered across eight different areas of technology development. A majority of all clean technology patents have been registered in energy storage technologies, including batteries, fuel cells and hybrid systems.



SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

partner at RockPort Capital and director of the National Venture Capital Association. "We're just now starting to see the most exciting, true innovation. It has taken time to attract entrepreneurs and scientists. That's all just starting to hit its stride, with more game-changing opportunities."[59]

Today's research and venture capital spending will generate tomorrow's clean energy opportunities. Innovation drives job growth: New companies can form around a clean technology, and more established firms can respond to new market demands and expand their range of products and services. Pew took a closer look at patent registrations and venture capital investments to get a preview of where the clean energy economy is headed.

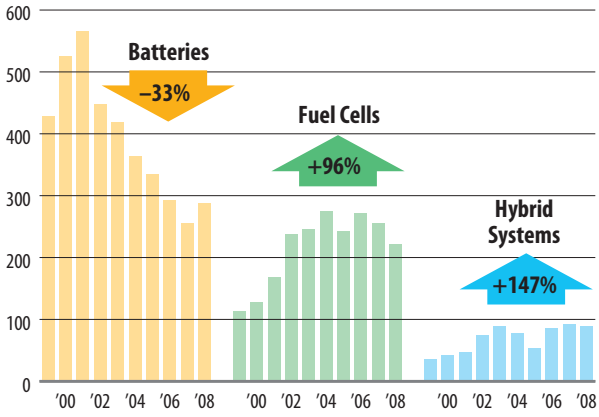
Patents

Patent registration statistics point to the types of technologies that may be introduced into the market in the coming years (Exhibit 5). Registering a patent to protect and control the technology is one of the most important early steps in bringing an innovation to market.[60] Patents are particularly important for expensive energy generation and advanced energy storage technologies. "Due to large, upfront capital requirements, dependable patent protection is an absolute necessity for the development and commercialization of the job-creating technologies and industries of the future," said William Klehm, president and CEO of Fallbrook Technologies, which designs and manufactures drivetrains for bikes and light electric vehicles.[61] Patents are not only for entrepreneurs who are building a new company around new products; they also enable established businesses to advance their

EXHIBIT 6
ENERGY STORAGE PATENTS

During the past 10 years, patents for energy storage technologies have accounted for a majority of all clean technology patent registrations. The types of energy storage patents have shifted over time. Traditional battery technologies have been replaced in recent years with growth in fuel cells and hybrid systems.

TRENDS IN ENERGY STORAGE PATENTS, 1999-2008

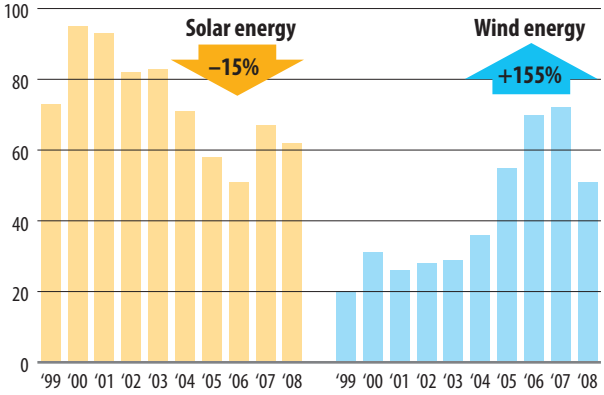


SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

EXHIBIT 7
WIND AND SOLAR PATENTS

Patents in energy generation—solar, wind, hydro and geothermal—have accounted for less than a fifth of all clean technology patents registered in the past 10 years. Patents for solar technologies have historically dominated, but recently an increasing number of patents have been registered for wind energy technologies.

GROWTH OF WIND AND SOLAR PATENTS, 1999-2008



SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

existing product lines and gain advantages over their competition.

Between 1999 and 2008, 8,384 clean energy technology patents were registered in the United States. Although traditional battery technology patents have accounted for nearly half of all registered clean energy technology patents in the last 10 years, registrations for hybrid systems and fuel cells[62] have begun to gain ground (Exhibit 6). Among clean energy generation patents—which have accounted for 15.3 percent of all patents registered in the past 10 years—solar technologies historically have outpaced other parts of the sector, but they have declined in recent years as the solar industry has begun to focus more on implementing and scaling up existing technologies rather than creating new ones. The number of wind technology patents has climbed rapidly (Exhibit 7). Geothermal and hydro technology patents have accounted for a small number of overall patents—only 1.6 percent thus far—but their growth and the growth in wind patents demonstrate burgeoning private-sector interest in a diverse renewable energy portfolio.

Venture Capital

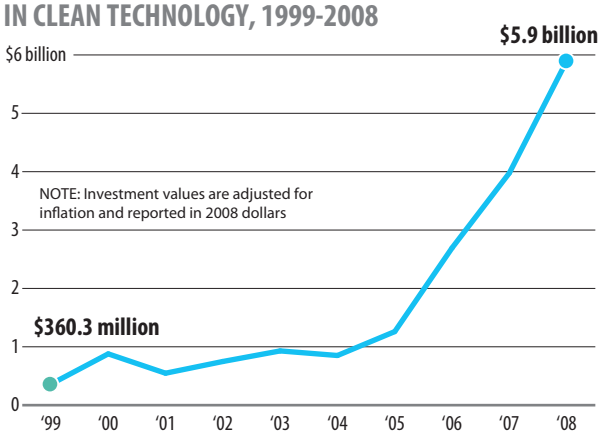
Tracking venture capital investments across all 50 states shows where investors see market opportunities. Beginning in 2006, venture capital investments in businesses that are drivers of the clean energy economy grew dramatically, increasing annually by an average of $1.6 billion (Exhibit 8). In fact, in 2008 clean venture capital investments accounted for 15 percent of all global venture capital investments, up from 9 percent in 2007,[63] and domestic clean venture capital investments outpaced international investments.[64] In 2008 alone, investors directed $5.9 billion into American businesses in the clean energy economy, a 48 percent increase over 2007 investment totals.

Given the national recession, the news was not as encouraging in the last quarter of 2008 and first quarter of 2009. In April, the Cleantech Group reported that investments in clean technology were down 48 percent in the first three months of 2009, compared with a year earlier.[65] But clean tech actually fared better than other industries: Total venture capital across all sectors for the first quarter of 2009 was down 61 percent from the first quarter of 2008, according to the National Venture Capital Association.[66] The Cleantech Group projects that clean technology investments will rebound quickly. "The long-term drivers for cleantech are still intact," the group reported in April 2009. These include the growing demand for energy services, the stress on water supplies, the need to reduce

EXHIBIT 8
VENTURE CAPITAL INVESTMENTS

Since 2006, venture capital investments in clean technology businesses have grown dramatically. Between 2006 and 2008, investments increased by an average of $1.5 billion annually. In 2008 alone, $5.9 billion of venture capital was invested in clean technology businesses.

VENTURE CAPITAL INVESTMENTS IN CLEAN TECHNOLOGY, 1999-2008



SOURCE: Pew Charitable Trusts, 2009, based on data from The Cleantech Group™ LLC; analysis by Pew Center on the States and Collaborative Economics.

greenhouse gas emissions, and a limited supply of traditional fossil fuels, according to the report.[67] "It's important not to miss the forest for the trees," Nicholas Parker, executive chairman of the Cleantech Group, said in January 2009. "In 2008, there was a quantum leap in talent, resources and institutional appetite for clean technologies. Now, more than ever, clean technologies represent the biggest opportunities for job and wealth creation."[68]

Investments in Clean Energy companies accounted for 69 percent of all clean venture capital investments between 2006 and 2008 (Exhibit 9). In fact, 54 percent of all investments have gone to energy generation companies alone. Many of those dollars went to solar technologies; in 2008, funding for solar companies accounted for 40 percent of all venture capital raised globally for businesses in the clean energy economy.[69]

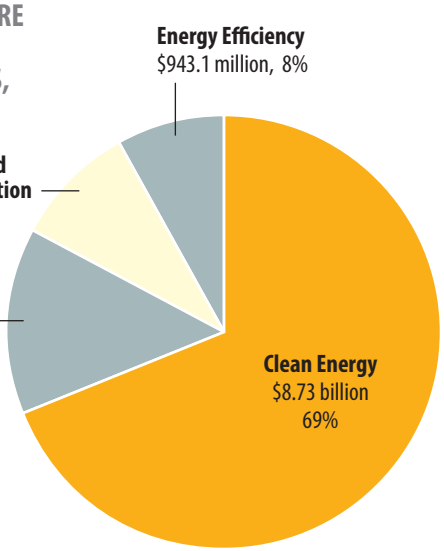
Venture capital is an essential source of private equity for emerging technologies. For business startups in the clean energy economy, it is indispensable. "You have to have VC backing in order to bring the product to commercialization," said Tibbs, president of Project FROG. "It's what greases the wheel." Unlike many other types of investors, venture capitalists target early-stage companies and cutting-edge technologies with high growth potential. They are willing to take significant risks in exchange for potentially substantial gains.

Innovation in the form of new clean energy technologies is neither cheap nor easy. For

EXHIBIT 9
AREAS OF VENTURE CAPITAL INVESTMENT

Venture capital funding in clean technology over the last three years has totaled nearly $12.6 billion. Investments in Clean Energy companies dominated all venture capital investments, accounting for 69 percent of investments between 2006 and 2008. Companies in Environmentally Friendly Production and Conservation and Pollution Mitigation attracted more than $2 billion in investment during the same time period.

CLEAN VENTURE CAPITAL INVESTMENTS, 2006-2008



SOURCE: Pew Charitable Trusts, 2009, based on data from The Cleantech Group™ LLC; analysis by Pew Center on the States and Collaborative Economics.

NOTE: Investment values are adjusted for inflation and reported in 2008 dollars. The category of Training and Support is not represented because it is not a category of investments tracked by The Cleantech Group LLC.

every breakthrough, hundreds more fall short, necessitating ongoing, capital-heavy investments in research and development. Still more capital is required to bring them to market at a scale that makes them competitive with carbon-intensive forms of energy. "Energy is a $6 trillion market worldwide. It is the mother of all markets," John Doerr, a partner at Kleiner Perkins Caufield & Byers, one of the country's largest venture capital firms, told the nation's governors in February 2008.[70] "Our investments, our policies, and our government R&D must match the scale of this problem. And we've got to work together: If we don't scale, we're going to fail."

For example, Solyndra, a Fremont, California-based solar company, developed and patented technology for commercial rooftops that captures more hours of optimal sunlight per day and allows the panels to lie flat instead of on an angle, making installation easier and less expensive.[71] Recognizing the commercial viability and scalability of the technology, venture capital firms have poured more than $920 million into the company since its founding in 2005.[72] Investments also have enabled aggressive research and development; Solyndra tested its manufacturing processes at the National Renewable Energy Laboratory through a public-private partnership with the federal government.[73]

In March 2009, Solyndra became the first beneficiary of the U.S. Department of Energy's loan-guarantee program, introduced in 2005 to encourage the development and adoption of new clean energy technologies.[74] The $535 million loan guarantee will enable the company to build a second factory in Fremont. Solyndra CEO and founder Chris Gronet said the additional funding will help the company achieve the economies of scale needed to deliver solar electricity at prices that are competitive with utility rates.[75] These economies of scale also mean more jobs. The new plant will employ 1,000 full-time employees upon its completion, and 3,000 construction workers will be put to work immediately to build it. Solyndra representatives expect their product to be cost-competitive with coal in the next two to three years.[76]

A VENTURE CAPITAL FIRM: MOHR DAVIDOW VENTURES

Will Coleman's venture fund, Mohr Davidow Ventures, with $2 billion under management, is putting money into emerging energy generation technologies for a pragmatic reason: it believes there's a lot of money to be made there. "Cleantech venture capital is not a mission-driven business," said Coleman, a partner at Mohr Davidow. "It's focused on real opportunities and real markets. We wouldn't be here investing if we didn't believe that."[77]

> "Cleantech venture capital is not a mission-driven business. . . It's focused on real opportunities and real markets. We wouldn't be here investing if we didn't believe that."
>
> —Will Coleman
> Mohr Davidow Ventures

Mohr Davidow Ventures, based in Menlo Park, California, focused exclusively on Internet-related technology investments when it was created in the 1980s, and has since broadened its portfolio to include technologies related to the life sciences, and, most recently, businesses in the clean energy economy. The firm's current investments include support for Nanosolar, a solar panel manufacturer in California, and Hycrete, a developer of more sustainable construction materials.[78]

Coleman said he pays close attention to a company's location when deciding whether to invest. The state's policy climate plays a major role in his decision, he said, and he is interested in everything from potential tax incentives to the existence of a strong renewable portfolio standard, which he said helps create market stability. He also believes government investments are essential to stimulate and support the research and development that is necessary before technological innovations can be brought to market. "We play a catalyzing role in developing technologies that can be deployed commercially," he said. "But in order to do that you have to have a deep pool of research and development going on in universities and other research centers. The opportunities for us really depend on the health and depth of those pools."

The Clean Energy Economy: State-By-State Numbers

Jobs

Every state and the District of Columbia have a piece of the 770,385 jobs and 68,203 businesses in America's clean energy economy (see Exhibit 1, page 8). Yet no two states look the same in terms of the type or number of jobs. For example, California has more jobs in the clean energy economy than any other state—more than 125,000—a number that grew annually by an average of 0.9 percent between 1998 and 2007. Wyoming has the fewest of these jobs nationally, at just more than 1,400, but they have grown annually by an average of 5.2 percent, indicating strong momentum and potential.

Each state has different competitive advantages when it comes to growing jobs and businesses in the clean energy economy, attracting private venture capital investments and incubating research and development. Some states have abundant natural resources such as wind and sunshine, while others are home to dozens of research universities. What is important is that policy makers understand and capitalize on their states' unique strengths to expand their share of the clean energy economy.

Pew conducted three analyses to provide an effective way of comparing states' clean energy economies. First, we looked at the total number of jobs in each state's clean energy economy in 2007 and the annual growth rate of those jobs between 1998 and 2007. Second, we looked at the total number of jobs in the clean energy economy in the context of each state's total jobs, which presents a baseline understanding of how the clean energy sector relates to overall economic performance in the states. And third, we compared the growth rate of jobs in each state's clean energy economy to the growth rate of its overall jobs. Looking ahead, these analyses offer lawmakers, business leaders and the public a way to measure the return on investment of current and future clean energy policy decisions.

Analysis One: States' Clean Energy Economies—How Big Are They, and How Fast Are They Growing?

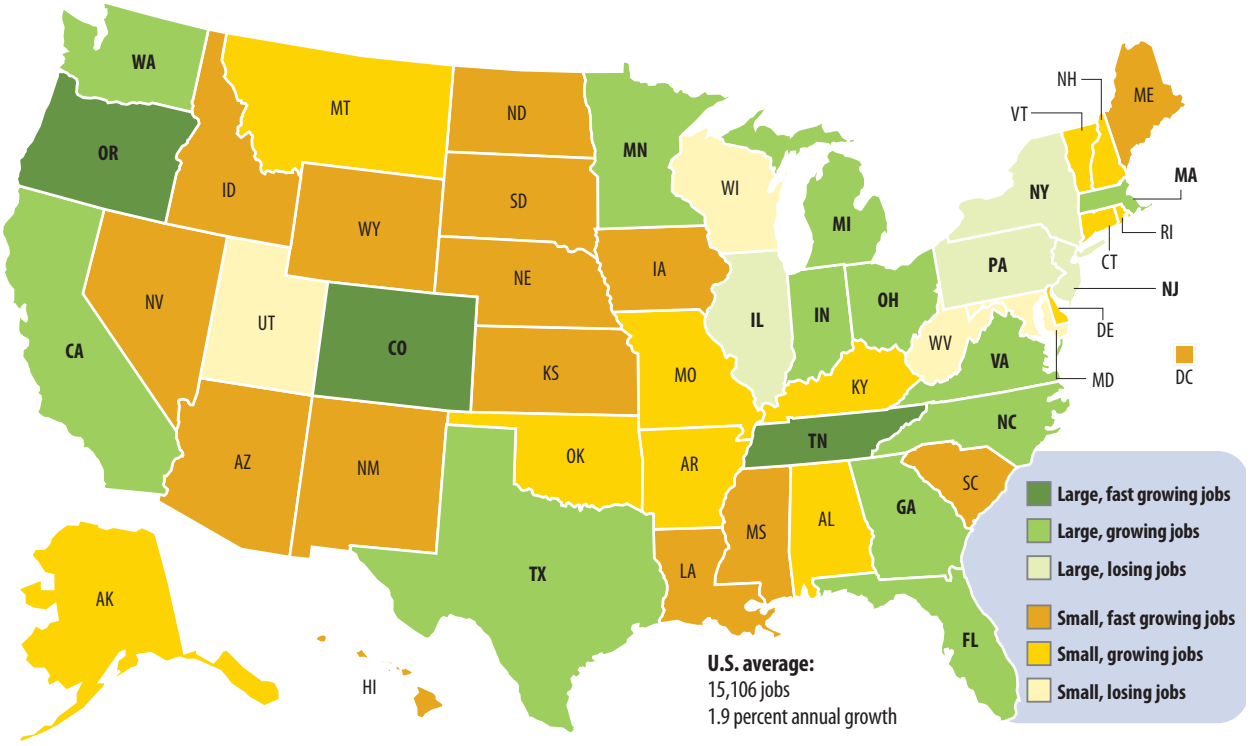
Looking simultaneously at the total number of jobs and businesses (large or small) and average annual growth rate of the jobs (fast growing, growing or losing), states' clean energy economies fall into six groups: large and fast growing, growing or losing; and small and fast growing, growing or losing (Exhibit 10).

Large and fast growing. Three states have large and fast-growing clean energy economies: Colorado, Oregon and Tennessee. In 2007, each of these states exceeded the national averages for both the number of jobs in the clean energy economy (15,106) and the average annual growth rate for those jobs (1.9 percent). These states are geographically dispersed, demonstrating that location is not the sole factor in the success and

EXHIBIT 10

WHERE ARE THE JOBS IN THE CLEAN ENERGY ECONOMY?

Looking simultaneously at the total number of jobs (large or small) and their average annual growth rate (fast growing, growing or losing), states' clean energy economies fall into six groups: large and fast-growing jobs, growing jobs or losing jobs; and small and fast-growing jobs, growing jobs or losing jobs. Large states had more jobs in their clean energy economies in 2007 than the national average of 15,106 jobs. Small states had fewer than the national average of clean energy economy jobs. States with fast-growing clean energy economies experienced average annual growth between 1998 and 2007 that exceeded the national average of 1.9 percent. Growing states had a positive average annual rate of growth less than 1.9 percent and losing states have experienced negative growth.



STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007	STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007	STATE	TOTAL CLEAN JOBS 2007	AVG. ANNUAL GROWTH 1998-2007
Alabama	7,849	0.31%	Kentucky	9,308	1.09%	North Dakota	2,112	3.17%
Alaska	2,140	1.14	Louisiana	10,641	2.06	Ohio	35,267	0.85
Arizona	11,578	2.19	Maine	6,000	2.34	Oklahoma	5,465	0.89
Arkansas	4,597	0.99	Maryland	12,908	–0.11	Oregon	19,340	4.77
California	125,390	0.88	Massachusetts	26,678	0.52	Pennsylvania	38,763	–0.48
Colorado	17,008	1.98	Michigan	22,674	1.20	Rhode Island	2,328	0.37
Connecticut	10,147	1.11	Minnesota	19,994	1.38	South Carolina	11,255	3.56
Delaware	2,368	0.23	Mississippi	3,200	2.57	South Dakota	1,636	7.89
District of Columbia	5,325	2.13	Missouri	11,714	0.71	Tennessee	15,507	2.14
Florida	31,122	0.90	Montana	2,155	0.15	Texas	55,646	1.70
Georgia	16,222	1.18	Nebraska	5,292	10.00	Utah	5,199	–1.31
Hawaii	2,732	4.29	Nevada	3,641	3.15	Vermont	2,161	1.69
Idaho	4,517	10.11	New Hampshire	4,029	0.44	Virginia	16,907	0.66
Illinois	28,395	–0.25	New Jersey	25,397	–1.08	Washington	17,013	0.23
Indiana	17,298	1.88	New Mexico	4,815	4.73	West Virginia	3,065	–0.36
Iowa	7,702	2.66	New York	34,363	–0.14	Wisconsin	15,089	–0.55
Kansas	8,017	4.74	North Carolina	16,997	1.62	Wyoming	1,419	5.16

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

vitality of a state's clean energy economy. Tennessee has had success developing jobs in the Conservation and Pollution Mitigation category, which includes recycling, waste treatment and water management; more than three quarters of the state's jobs in the clean energy economy are in this category. Colorado has capitalized on its natural wind and sun resources to stimulate job growth in Clean Energy, while Oregon has become a leader in Energy Efficiency, with a quarter of its jobs in the clean energy economy in this category.

Large and growing. Twelve states have large and growing clean energy economies: Their numbers of jobs in the clean energy economy in 2007 exceeded the national average and have grown by an average of 1 percent annually. These states' clean energy economies are expanding at a moderate but steady rate, and they have a strong foundation on which to build. These states are California, Florida, Georgia, Indiana, Massachusetts, Michigan, Minnesota, North Carolina, Ohio, Texas, Virginia and Washington.

Large and losing. Illinois, New Jersey, New York and Pennsylvania have large clean energy economies that are losing jobs. Difficult economic conditions have led to a net loss of these jobs in these four states during the past 10 years. Still, Illinois, New Jersey, New York and Pennsylvania each rank among the top 10 states for total jobs in the clean energy economy across several of Pew's five categories (Exhibit 11).

Small and fast growing. Comprising the largest group, 15 states and the District of Columbia are categorized as having small and fast–growing clean energy economies. These states had fewer than the national average of jobs in the clean energy economy in 2007 but exceeded the national average for annual rate of job growth. For example, Idaho and South Dakota each had fewer than 5,000 of these jobs, but their average annual growth rates are among the top in the nation at 10.1 percent and 7.9 percent, respectively. The other 13 states are Arizona, Hawaii, Iowa, Kansas, Louisiana, Maine, Mississippi, Nebraska, Nevada, New Mexico, North Dakota, South Carolina and Wyoming.

Small and growing. Another 12 states have small and growing clean energy economies, with fewer than average jobs and some annual job growth, although their rates of growth—less than 2 percent—lag behind states with similarly sized clean energy economies. These states are Alabama, Alaska, Arkansas, Connecticut, Delaware, Kentucky, Missouri, Montana, New Hampshire, Oklahoma, Rhode Island and Vermont.

Small and losing. Maryland, Utah, West Virginia and Wisconsin had fewer than average jobs in the clean energy economy in 2007 and experienced net losses in these jobs during the past 10 years. In Maryland, at least, that trend may change in coming years. New legislation that aims to reduce greenhouse gas emissions by 25 percent by 2020 was enacted by Maryland lawmakers in May 2009, and it may drive greater demand for environmentally friendly products and services in the state.[79]

Analysis Two: States' Clean Energy Economies as a Share of Their Overall Economies

Jobs in the clean energy economy accounted for 0.49 percent of all jobs nationally in 2007. Twenty-two states exceeded that U.S. average, including several by a large margin (Exhibit 12). Oregon led the nation with just more than 1 percent of all of its jobs focused on the clean energy economy in 2007. Although Maine had just 6,000 jobs in the clean energy

EXHIBIT 11

STATE LEADERS IN JOBS ACROSS THE CLEAN ENERGY ECONOMY BY CATEGORY

Although California leads in overall employment in each category, a closer look reveals other notable trends. Arizona makes the top 10 in Clean Energy but in no other category. Massachusetts, New York and Ohio are among the top 10 in all but one category.

While Arizona, Arkansas, Iowa, Maine, Nebraska, Wisconsin and the District of Columbia each have fewer than 15,106 jobs in the clean energy economy—the national average—they rank among the top 10 states in one of the five categories. In all, nearly half the states rank among at least the top 10 states in at least one category of the clean energy economy.

Clean Energy	JOBS 2007	Energy Efficiency	JOBS 2007	Environmentally Friendly Production	JOBS 2007	Conservation and Pollution Mitigation	JOBS 2007	Training and Support	JOBS 2007
California	27,672	California	10,510	California	13,666	California	64,799	California	8,743
Pennsylvania	10,099	Texas	6,353	Minnesota	3,815	Texas	40,617	New York	3,499
Minnesota	4,030	Ohio	5,367	Oregon	3,304	Pennsylvania	24,703	Illinois	3,216
Ohio	3,653	Oregon	4,893	Ohio	2,800	Florida	24,686	Massachusetts	3,155
Texas	3,479	New York	3,311	Iowa	2,237	New York	23,082	District of Columbia	3,130
New York	3,421	Wisconsin	2,801	Texas	2,223	Ohio	22,296	Texas	2,974
Michigan	2,941	Maine	2,560	Nebraska	2,162	New Jersey	20,060	Florida	2,249
Massachusetts	2,890	Massachusetts	2,553	Illinois	1,921	Illinois	19,631	Virginia	1,755
District of Columbia	2,728	Virginia	2,135	Colorado	1,361	Massachusetts	17,374	Pennsylvania	1,742
Colorado	2,639	Florida	2,071	Arkansas	1,303	Michigan	15,852	North Carolina	1,659

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

economy as of that year, it was a close second with 0.85 of its overall jobs dedicated to the clean energy economy. At the other end of the spectrum, 0.24 percent of Mississippi's total jobs were part of the clean energy economy in 2007, although the state's number of jobs in this area was growing.

Analysis Three: Growth of Jobs in the Clean Energy Economy Compared with Overall Jobs Growth

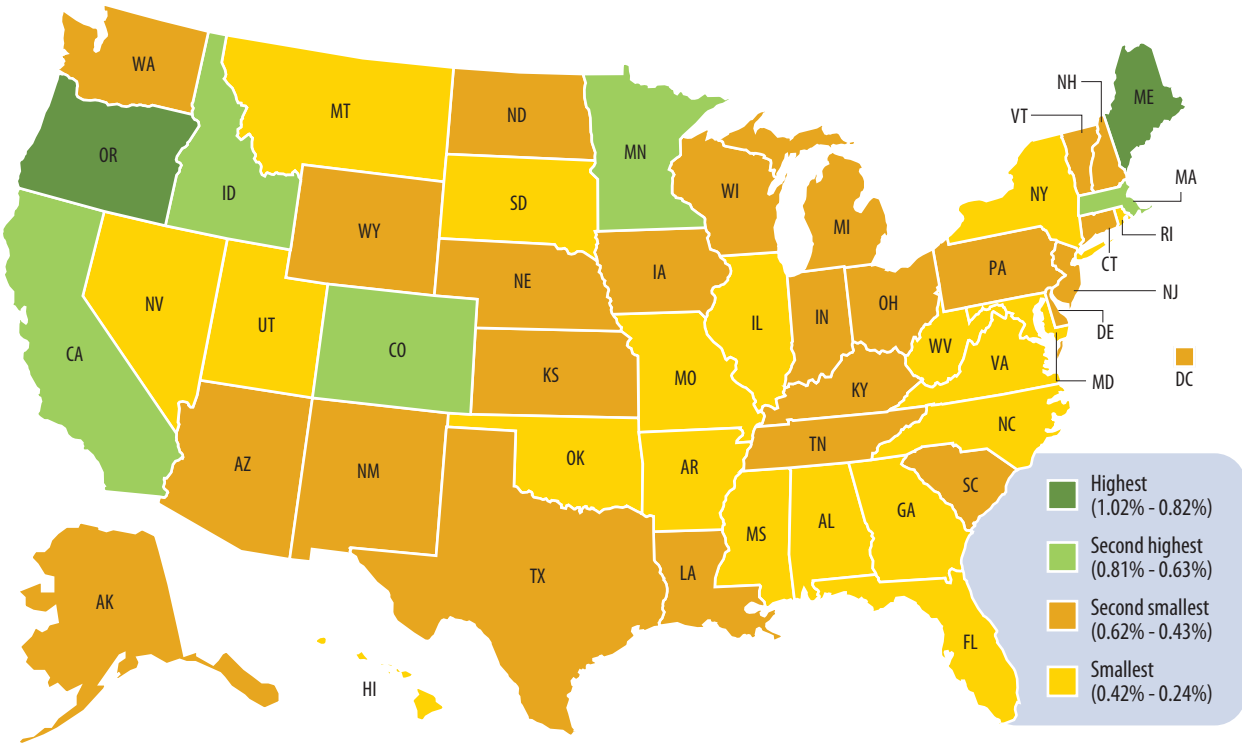
Nationally, jobs in the clean energy economy grew by an average of 1 percent annually during the past 10 years, while total employment grew by an average of 0.4 percent annually. In 38 states and the District of Columbia, job growth in the clean energy economy outperformed total job growth between 1998 and 2007. In a number of states, job gains in the clean energy economy have helped lessen total job losses.

Job growth in the clean energy economy eclipsed growth for all jobs by more than 2 percent in 11 states: Hawaii, Idaho, Iowa, Kansas, Mississippi, New Mexico, North Dakota, Oregon, South Carolina, South Dakota and Wyoming. Oregon's large and fast–growing clean energy economy, for example, has dwarfed the growth of overall jobs in the state, expanding by an average of 4.8 percent compared with an average of less than 1 percent annually. This growth is not limited to one industry or job type: Oregon's jobs in the clean energy economy have experienced marked growth during the past 10 years in all five of Pew's categories. And although North and South Dakota have very small clean energy economies, the growth of these jobs in both states has outpaced their growth of total jobs. In North Dakota, overall jobs grew by 1.0 percent, but jobs in the clean energy economy grew by an average of 3.2 percent. In South Dakota, overall jobs grew by

EXHIBIT 12

CLEAN ENERGY ECONOMIES AS A SHARE OF STATES' OVERALL ECONOMIES

It is important for states to know just how many of their total jobs fall within the clean energy economy. Nationally, jobs in the clean energy economy accounted for 0.49 percent of all jobs in 2007; 22 states exceeded that national average.



	TOTAL JOBS	PERCENT CLEAN
Alabama	2,193,589	0.36%
Alaska	388,361	0.55
Arizona	2,661,437	0.44
Arkansas	1,366,809	0.34
California	17,556,872	0.71
Colorado	2,668,069	0.64
Connecticut	2,150,723	0.47
Delaware	502,773	0.47
District of Columbia	1,021,958	0.52
Florida	9,903,922	0.31
Georgia	4,955,677	0.33
Hawaii	651,894	0.42
Idaho	718,373	0.63
Illinois	6,792,326	0.42
Indiana	3,348,351	0.52
Iowa	1,800,264	0.43
Kansas	1,531,164	0.52

	TOTAL JOBS	PERCENT CLEAN
Kentucky	2,069,602	0.45%
Louisiana	2,326,888	0.46
Maine	707,195	0.85
Maryland	3,108,256	0.42
Massachusetts	3,870,356	0.69
Michigan	5,279,234	0.43
Minnesota	3,143,012	0.64
Mississippi	1,356,603	0.24
Missouri	3,178,657	0.37
Montana	512,093	0.42
Nebraska	1,038,673	0.51
Nevada	1,280,532	0.28
New Hampshire	735,051	0.55
New Jersey	4,957,892	0.51
New Mexico	970,632	0.50
New York	9,964,700	0.34
North Carolina	4,629,118	0.37

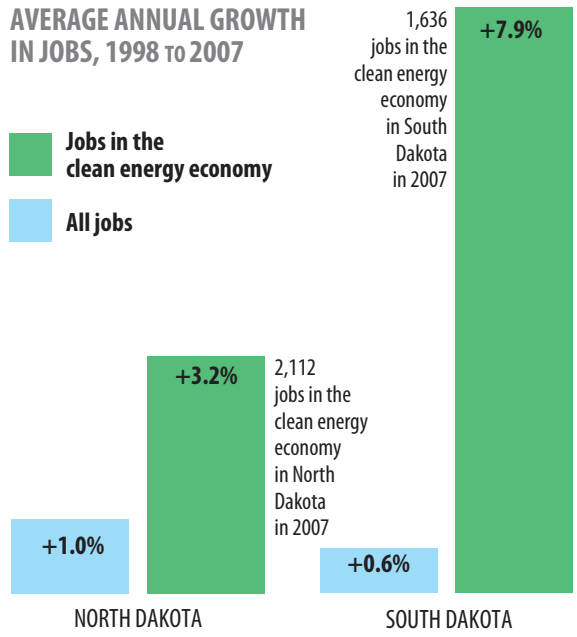
	TOTAL JOBS	PERCENT CLEAN
North Dakota	422,054	0.50%
Ohio	6,304,302	0.56
Oklahoma	1,784,492	0.31
Oregon	1,902,294	1.02
Pennsylvania	6,542,137	0.59
Rhode Island	549,754	0.42
South Carolina	2,059,151	0.55
South Dakota	444,659	0.37
Tennessee	3,144,614	0.49
Texas	11,726,811	0.47
Utah	1,291,211	0.40
Vermont	365,646	0.59
Virginia	4,238,337	0.40
Washington	3,098,042	0.55
West Virginia	792,474	0.39
Wisconsin	3,150,000	0.48
Wyoming	302,245	0.47

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

an average of only 0.6 percent annually, while jobs in the clean energy economy grew by an average of 7.9 percent during the past 10 years (Exhibit 13).

EXHIBIT 13
THE CLEAN ENERGY ECONOMIES OF THE DAKOTAS

North Dakota and South Dakota have very small clean energy economies. The number of jobs in the clean energy economy in each state was less than 2,200 in 2007. Despite the small overall size of their clean energy economies, the growth of these jobs in both states outpaced their growth of total jobs between 1998 and 2007. In North Dakota, overall jobs grew by 1.0 percent, but jobs in the clean energy economy grew by an average of 3.2 percent annually over the past 10 years. In South Dakota, overall jobs grew by an average of only 0.6 percent annually, while jobs in the clean energy economy grew by an average of 7.9 percent during the past 10 years.



SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

Job growth in the clean energy economy has had a slight edge over total job growth in 18 states: Alabama, Arizona, Arkansas, California, Colorado, Kentucky, Louisiana, Maine, Minnesota, Missouri, Nevada, North Carolina, Oklahoma, Rhode Island, Tennessee, Texas, Vermont and Washington. The difference between the average annual growth of jobs in the clean energy economy and total jobs is less than 2 percentage points in these states. The growth trends in these 18 states underscore the fact that jobs in the clean energy economy are an important contributor to states' fiscal health and a growing source of employment.

Seven states—Connecticut, Delaware, Indiana, Massachusetts, Michigan, Nebraska and Ohio—and Washington, D.C., suffered overall job losses but gained jobs in the clean energy economy between 1998 and 2007. In Nebraska, for example, total jobs have remained relatively constant, declining slightly by an average of 0.5 percent annually, but during the same time period, jobs that are part of the clean energy economy increased rapidly, growing an average of 10 percent. The federal government wants to replicate this pattern nationwide with its tens of billions in energy-related stimulus spending, designed to help replace some lost jobs with new ones that are part of the clean energy economy.[80]

Finally, in New York and Illinois, both clean energy economy jobs and overall jobs had negative growth rates between 1998 and 2007, although clean energy economy job growth shrank at a slower rate.

Venture Capital

Venture capital investments help drive states' clean energy economies, allowing companies to grow, hire new employees and scale up the production and distribution of goods and services (Exhibit 14). Clean startups began attracting venture capital in the 1990s, a trend that accelerated in recent years. By 2006, clean investments had become a

significant force in the world of venture capital, and between 2006 and 2008, 40 states and the District of Columbia attracted venture capital investments. See Appendix E for the 50-state table.

California was by far the largest recipient of venture capital investments, attracting more than $6.5 billion between 2006 and 2008. Most of the states that attracted venture capital investments have either large and fast-growing or large and growing clean energy economies. The number of jobs in the clean energy economy a state has, and how fast that number is growing, are signals to potential investors—both public and private—of promising market opportunities. That said, venture capital is important but not essential to a state's ability to develop strong industries in the clean energy economy; existing technologies offer potential for growth and are not as reliant on venture capital investment. Ten states have not attracted venture capital funding during the past three years but have developed jobs and businesses in the clean energy economy: Alabama, Alaska, Kentucky, Louisiana, Maine, Montana, Nebraska, North Dakota, South Carolina and South Dakota. Some of these states, such as Kentucky, Maine and North Dakota, have noteworthy shares of jobs in the Clean Energy and Energy Efficiency categories, which accounted for 81 percent of venture capital in the clean technology sector in 2008—meaning that they may be well positioned to attract venture capital funds in the future.

Patents

The states that led in patent registrations between 1999 and 2008 also led in venture capital funding and overall employment. Technology patents help states pioneer new clean products and incubate research and development to help stimulate businesses and jobs in the clean energy economy within their borders. All 50 states and the District

THE POWER OF A STATE'S RESEARCH INVESTMENT: SOUTH CAROLINA

Dr. Kenneth Reifsnider directs the University of South Carolina's Solid Oxide Fuel Cell program, which designs processes that convert chemical energy to electrical power. Hydrogen happens to be the fuel that Reifsnider specializes in, but he does not believe in a single solution to cleaner, alternative energy needs. His work aims to answer the question, "How can we use energy in its many forms?"[81]

Reifsnider's program is just one component of the university's Future Fuels initiative, which develops cleaner energy options, including solar and hydrogen, to successfully replace fossil fuels. The University of South Carolina has established partnerships with 15 private companies, the Savannah River National Laboratory and the City of Columbia, South Carolina, to bring scientists and engineers together to determine how future fuels can be integrated into everyday lives. The State of South Carolina has invested more than $11 million in this comprehensive research partnership, which has made it a national leader among states in future fuel technology. In 2009, Columbia hosted the National Hydrogen Association's annual conference, at which the city showcased its fuel cell district—the first in the southeast—and a hybrid-electric fuel cell bus that begins service this fall. Those and other activities have drawn Reifsnider and other top researchers to South Carolina's program. "This is the very best place to make a step forward," said Reifsnider.[82]

of Columbia have had at least one registered clean technology patent in the past 10 years. Exhibit 15 shows the 10 states with the highest number of patent registrations from 1999 to 2008. See Appendix E for the 50-state table.

EXHIBIT 14
VENTURE CAPITAL INVESTMENTS

Top 10 states attracting venture capital investments in companies in the clean energy economy, 2006-2008. In millions.

California	$6,580
Massachusetts	1,278
Texas	717
Washington	635
Colorado	622
Maryland	324
New Jersey	283
Pennsylvania	233
New York	210
Georgia	180

NOTE: Investment values are adjusted for inflation, reported in 2008 dollars and rounded to the nearest $1,000,000.

SOURCE: Pew Charitable Trusts, 2009, based on data from The Cleantech Group™ LLC; analysis by Pew Center on the States and Collaborative Economics.

EXHIBIT 15
CLEAN TECHNOLOGY PATENTS

Top 10 states in clean technology patent registrations 1999-2008

California	1,401
New York	909
Michigan	749
Texas	414
Connecticut	404
Massachusetts	384
Ohio	309
Illinois	297
Georgia	256
New Jersey	248

SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

Public Policy and the Future of the Clean Energy Economy

Policies intended to advance the clean energy economy—from comprehensive energy plans, renewable energy standards, energy efficiency measures and tailpipe reduction requirements to the development of alternative fuels, job retraining and waste reduction efforts—have been adopted or are being actively considered by both the federal government and states. It is too early to tell to what degree these efforts will succeed in stimulating U.S. job growth, strengthening America's competitiveness, curbing pollution and conserving resources, or which approaches are particularly effective. But Pew's analysis indicates that they have great potential because they create significant incentives for both the private and public sectors to develop new technologies, infrastructure and processes for clean energy, efficiency and conservation.

State Policies

Although every state has a piece of today's clean energy economy, clear winners and losers will emerge going forward. Policy makers who act quickly and effectively could see their states flourish, while others may lose opportunities for new jobs, businesses and investments. "The keys to our economic potential as a state and as a country—not to mention our survival as a species—will likely rest in our ability to unlock, harness and advance green technologies," Maryland Governor Martin O'Malley told his state's Clean Energy Center in March 2009.[83]

Financial Incentives: Every state offers some form of financial incentive to drive its clean energy economy. Thirty-two states provide residential, commercial and industrial loan financing for the purchase of renewable energy or energy efficiency systems or equipment. Twenty-three states and the District of Columbia offer rebate programs to promote the installation of renewable energy systems and energy efficiency measures such as solar water heating and photovoltaic systems. Forty-six states offer some form of tax incentive to encourage residents and corporations to use renewable energy or adopt energy efficiency systems and equipment.[84]

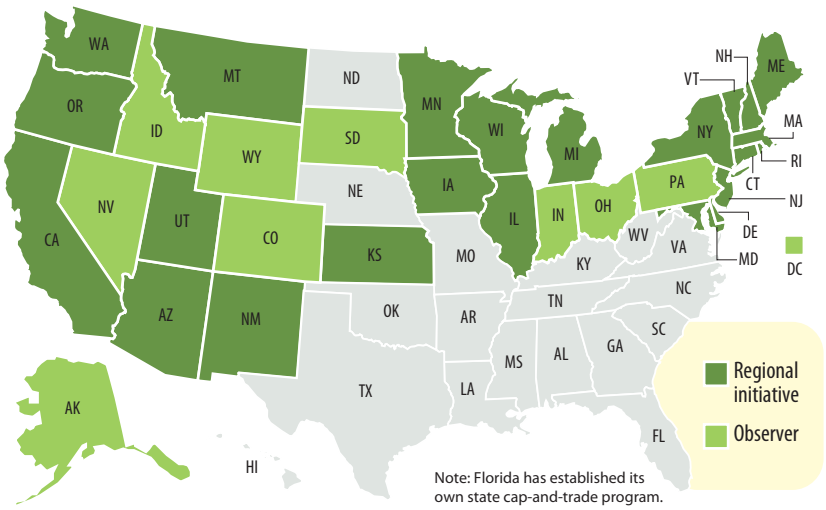
Regional Clean Energy Initiatives: States have banded together to develop regional initiatives to reduce carbon dioxide emissions from power plants, increase renewable energy generation, track renewable energy credits and research and establish baselines for carbon sequestration. Regional initiatives can be more efficient than programs at the state level, because they encompass broader geographic areas and create more uniform regulatory environments. Twenty-three states are members of three major regional initiatives: (1) Midwestern Greenhouse Gas Reduction Accord (MGGRA); (2) Regional Greenhouse Gas Initiative (RGGI); and (3) Western Climate

EXHIBIT 16
STATES' CLEAN ENERGY POLICIES

Regional Initiatives

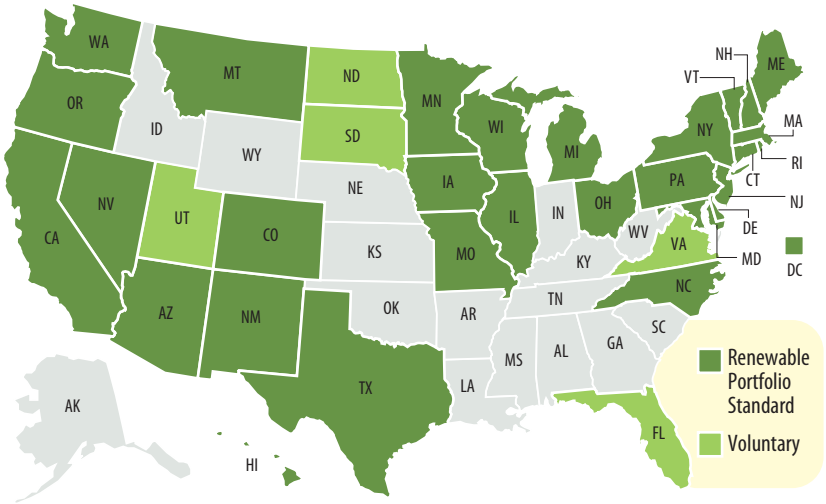
States have banded together to develop regional initiatives to reduce carbon dioxide emissions, increase renewable energy generation, track renewable energy credits and research and establish baselines for carbon sequestration. Twenty-three states are members of three major regional initiatives*. Nine additional states and the District of Columbia are observers of regional initiatives. Florida has established its own individual state cap-and-trade program.

* Midwestern Greenhouse Gas Reduction Accord (MGGRA); Regional Greenhouse Gas Initiative (RGGI); and Western Climate Initiative (WCI).



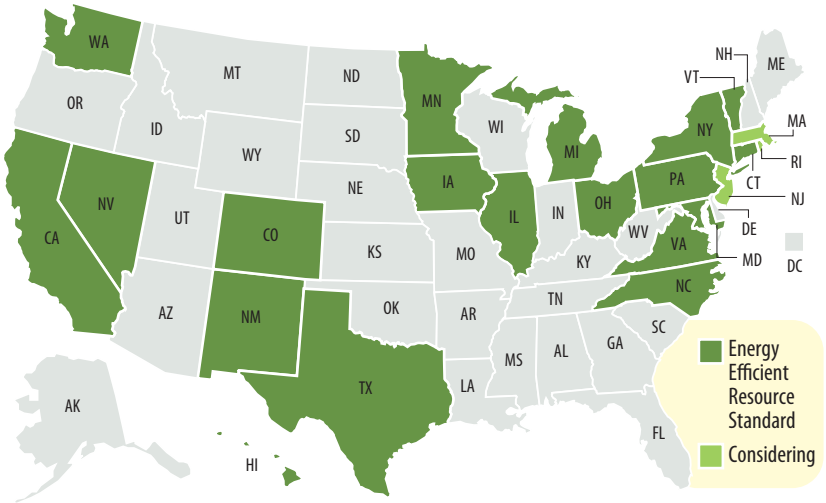
Renewable Portfolio Standards

Twenty-nine states and the District of Columbia have established renewable portfolio standards requiring electricity providers to supply a minimum percentage or amount of customer power from a renewable source of electricity. Five additional states have set voluntary renewable portfolio standards.



Energy Efficiency Resource Standards

Nineteen states have established a stand-alone energy efficiency resource standard or included a provision for energy efficiency within their renewable portfolio standard. Three additional states, New Jersey, Massachusetts and Rhode Island, are considering energy efficiency resource standards.



NOTE: Policies current as of May 8, 2009

SOURCE: Pew Charitable Trusts, 2009; based on analysis by Pew Center for Global Climate Change, Database of State Incentives for Renewables and Efficiency, and American Council for an Energy Efficient Economy.

Initiative (WCI). Florida has established its own individual state cap-and-trade regulatory program.

Renewable Portfolio Standards: Twenty-nine states and the District of Columbia have established renewable portfolio standards (RPS) since 1983, requiring electricity providers to supply a minimum percentage or amount of customer power from a renewable source of electricity. Florida, North Dakota, South Dakota, Utah and Virginia have set voluntary RPS goals. These renewable energy targets are expected to drive growth in already fast-growing areas of the clean energy economy. In Colorado, for example,

A STATE POLICY LEADER: TEXAS STATE REPRESENTATIVE WARREN CHISUM

Texas State Representative Warren Chisum (R-Pampa) is best known for his outspoken conservative positions on hot-button issues such as evolution and gay marriage. Chisum spent most of his non-legislative career working on drilling rigs and truck yards.

About a year ago, however, Chisum created the Texas Carbon Caucus, a bipartisan group of legislators who meet periodically to discuss issues related to carbon reduction and job creation and hear from leading thinkers from around the country. "The one and only rule is that we do not discuss global warming," Chisum said. "There will be no debate about whether it is caused by man or not as long as I'm in charge. We are only allowed to discuss what we are going to do about it."[85] Now that some of the potential solutions—namely wind energy—are proving not only viable but economically advantageous in Texas, legislators of all stripes are eager to talk about them. "Wind is a growing business and creates a lot of jobs," said Chisum. "The industry takes some of our smallest, most rural towns and makes them pretty active."[86] Today, Texas would rank sixth in the world for wind energy generation if it were a country. According to the American Wind Energy Association, it dwarfs all other states in wind capacity, and added more capacity than any other state in 2008.[87]

> Texas' wind industry would not be what it is today if the state had not put in place an aggressive renewable portfolio standard and other public policy measures 10 years ago, Chisum said.

Texas' wind farms did not sprout up overnight, as Chisum knows well from the 10 years he has spent on the House Environmental Regulations Committee. According to Chisum, before wind could take on a major role in powering the state, a strong natural gas infrastructure had to be in place to provide back-up power when necessary. And Texas' wind industry would not be what it is today if the state had not put in place an aggressive renewable portfolio standard and other public policy measures 10 years ago, he said.

Chisum would like to see Texas be more proactive as it looks toward its energy future. He sees solar power and carbon sequestration as the state's next big opportunities, and said he is sponsoring legislation this session that would create an underwater well for carbon sequestration off the coast of Houston. "We're preparing Texas," he said. "We're the largest carbon emitter, but we're going to be the first ones to take that carbon and put it where it needs to be."[88]

lawmakers recently doubled the standard after seeing the ease with which a lower target was met. "The standards created an economy based on renewable energy, creating demand for workers to build and maintain wind farms in areas that have suffered from a shrinking tax base," said state Representative Jack Pommer (D-Boulder). "Some rural areas are now growing from the economic influx."[89]

Energy Efficiency Resource Standards: Since 1999, 19 states have established a stand-alone Energy Efficiency Resource Standard (EERS) or included a provision for energy efficiency within the state's RPS.[90] EERS focus on natural gas and electric utilities, encouraging continually increasing energy savings over time. At this writing, three additional states—Massachusetts, New Jersey and Rhode Island—are actively considering similar policies. All state-based EERS include end-use energy savings improvements.[91]

California Vehicle Emissions Standards: Fourteen states—Arizona, Connecticut, Florida, Maine, Maryland, Massachusetts, New Jersey, New Mexico, New York, Oregon, Pennsylvania, Rhode Island, Vermont and Washington—and the District of Columbia have adopted California's vehicle emissions standards, which require automakers to improve the fuel efficiency new cars and light trucks that resulting in a 30 percent reduction in carbon emissions by 2016. On May 19, 2009, President Obama announced that the Administration would establish the first-ever national limits on vehicle emissions that match California's while raising fleet-wide fuel efficiency standards to approximately 35.5 miles per gallon by 2016.

Eleven states—Arkansas, Alabama, Georgia, Kentucky, Louisiana, Mississippi, Nebraska, Oklahoma, South Carolina, Tennessee and West Virginia—offer financial incentives to drive their clean energy economies, but as of this writing do not participate in any regional initiatives and do not have either renewable portfolio or energy efficiency resource standards in place.

Federal Policies

The federal government has helped spur the development of the clean energy economy through policy reform and strategic investments. The Solid Waste Disposal Act, enacted in 1965, and the Resource Conservation and Recovery Act, enacted in 1976, fostered the development of the recycling, waste reduction and waste management industries, and the EPA's Energy Star and Water Sense certification and labeling initiatives long have helped encourage consumers to use products that save energy and water. And for almost two decades, the U.S. Department of Commerce has helped manufacturers improve efficiency, reduce waste and develop clean technologies and products.

In the past three years, federal policy makers have taken major steps to drive the clean energy economy forward. In 2007, President George W. Bush signed into law the first increase in fuel efficiency standards for cars and light trucks in more than 30 years, as part of the Energy Independence and Security Act.[92] This feat was unimaginable to many Congressional observers when just two years earlier, 67 members of the Senate opposed any increase in fuel efficiency. The legislation enacted in 2007 was supported by a majority of Republicans and Democrats, the United Auto Workers union, environmentalists and 89 percent of American voters. The Energy Independence and Security Act is expected to save 1.1 million barrels of oil

a day, save consumers $25 billion at the pump and achieve reductions in greenhouse gas emissions equal to taking more than 28 million cars off the road.[93]

Enacted in February 2009, ARRA—the federal stimulus bill—includes an array of provisions to spur clean energy generation and energy efficiency businesses, jobs and investments. Among the almost $85 billion the package allocates to energy- and transportation-related spending, about $21 billion is dedicated to extending tax incentives for wind, solar and other renewable energy manufacturers. ARRA also provides more than $30 billion for direct spending on clean energy programs, including $11 billion to modernize the nation's electricity grid, $2 billion for advanced battery technology, more than $6 billion for state and local efforts to achieve energy efficiency, $5 billion for weatherization of low-income homes, $500 million for job training to help workers participate in the clean energy economy, and $300 million to purchase thousands of new, fuel-efficient vehicles for the federal fleet from American auto companies (Exhibit 17).

EXHIBIT 17

THE AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009

Energy- and transportation-related spending

The federal stimulus bill enacted in February 2009 includes an array of provisions to spur clean energy generation and energy efficiency businesses, jobs and investments. A total of $84.8 billion has been set aside for energy- and transportation- related spending. Amounts are in thousands.

AREA OF INVESTMENT	TOTAL INVESTMENT
Energy efficiency and conservation	$16,470,000
Improving the grid	$11,000,000
Energy research	$7,900,000
Clean energy generation	$6,000,000
Jobs training	$500,000
Vehicle spending	$2,600,000
Transportation spending	$18,400,000
Climate science research	$570,000
Tax credits for renewable energy and energy efficiency	$19,668,000
Tax credits for alternative fuel pumps	$54,000
Investment credits in energy generation and energy efficiency technologies	$1,600,000
Total	**$84,762,000**

SOURCE: Pew Center on Global Climate Change, Key Provisions: American Recovery and Reinvestment Act, March 2009 (updated April 16, 2009), http://www.pewclimate.org/docUploads/Pew-Summary-ARRA-Key-Provisions.pdf (accessed April 28, 2009).

Measuring Policy Effectiveness

How effective has each of these policy approaches been in generating jobs, businesses and investments in the clean energy economy? Given that most of the policy actions we examined were instituted in the last three years, there was not sufficient time between then and 2007, the year of the latest available jobs data, to analyze to what degree each has driven the clean energy economy to date. But our data do suggest a relationship. For instance, of the 18 states that have both renewable portfolio and energy efficiency standards in place, 11 states (61 percent) had more jobs in the clean energy economy than the national average. Similarly, in 12 of those 18 states, clean energy jobs made up a larger share of all jobs when compared to the U.S. average. Additionally, a number of venture capitalists, business leaders and policy makers we interviewed (see, e.g., profiles in this report of clean energy company Gamesa, venture capitalist Will Coleman and Texas State Representative Warren Chisum) cited state policies such as renewable portfolio standards as important factors in driving investments, attracting companies and growing new industries and jobs because they help create market demand for clean energy technologies, products and services.

With significant state and federal policy actions now in place or proposed—and our baseline count in hand—Pew will conduct follow-up research to assess how these measures are likely to affect the growth of U.S. jobs, businesses and investments in the clean energy economy moving forward.

Need for Comprehensive, Economy-wide Clean Energy Plan

Given America's need to create new and enduring jobs while conserving natural resources and reducing carbon emissions, federal leaders are deliberating additional measures to spur the clean energy economy.

President Obama has signaled his support for a federal market-based system to reduce greenhouse gas emissions by at least 80 percent by 2050; a national renewable portfolio standard that would require that 25 percent of the nation's energy supply be derived from renewable sources by 2025; and an energy efficiency resource standard that would require saving 15 percent of electricity and 10 percent of natural gas by 2020.[94] At this writing, the U.S. House of Representatives is considering the American Clean Energy and Security Act, a proposal that would limit overall greenhouse gas emissions and distribute tradable federal allowances for each ton of pollution emitted. The market-based program would apply to electric utilities, oil companies and other entities that produce more than 25,000 tons of carbon dioxide each year. The number of allowances would diminish over time, and the legislation would set a goal to reduce emissions to 83 percent below 2005 levels by 2050.[95] The bill would increase significantly the amount of energy derived from low- or zero-carbon sources, including renewables—meaning that businesses and jobs would be generated to develop clean energy sources to meet the demand.

Conclusion

Pew's first-of-its-kind analysis shows that the clean energy economy, still in its infancy, is emerging as a vital component of America's economic landscape. Across the country, jobs and businesses in the clean energy economy are being driven by consumer demand, venture capital infusions by private-sector investors eager to capitalize on new market opportunities, and policy reforms by federal and state lawmakers who want to spur economic growth while sustaining the environment.

Today, every state has a piece of the clean energy economy. But there will be winners and losers going forward. Policy makers who act quickly and effectively could see their states flourish, while others may lose opportunities for new jobs, businesses and investments. State leaders recognize this, and a growing number are pursuing measures such as financial incentives for clean energy generation and energy efficiency, renewable energy and energy efficiency standards, and laws to reduce vehicle emissions.

Through ARRA, the federal government has made an extraordinary investment that will give these and other efforts a significant boost. But to realize the clean energy economy's full potential, the nation needs a comprehensive, economy-wide energy plan. President Obama has expressed his support for a federal market-based system that would substantially reduce greenhouse gas emissions, and national standards that would help America draw more of its energy supply from clean, renewable sources and achieve greater energy efficiency. Those federal and state policies, together with continued private-sector support, will position the United States as a leader in the global clean energy economy.

Exhibit A1. U.S. Clean Energy Economy Segments

The clean energy economy has 16 segments (highlighted in green) that fall into five categories (highlighted in dark blue).

	Subsegment	Examples of Occupations
CLEAN ENERGY		
Energy Generation	**Energy consulting**	Electrical engineering technicians
	Energy management (software, services, devices)	Computer systems analysts
	Biomass (hydrogen, other, waste-to-energy)	Power plant operations technicians, process engineers
	Geothermal (geothermal drilling, generation, development, hardware)	Operating engineers and other construction equipment operators, drilling engineers (Geothermal)
	Hydro	Plumbers, power plant operators
	Marine and tidal	Mechanical engineering technicians
	Hydrogen	Mechanical engineering technicians, chemists
	Multiple	Solar and wind system installers
	Other (combined heat/power, hydrogen production, natural gas, on-site systems, waste heat, renewable energy providers)	Plumbers, electrical engineers
	Research and testing	Electrical engineers
	Solar (material feedstock supplier, PV: thin film, PV: polysilicon, concentrated PV, BIPV, solar thermal, solar installers and contractors, equipment sales and distribution)	Photonics engineers, solar power plant technicians
	Co-generation	Mechanical engineering technicians, boiler process engineers
	Accessory equipment and controls (solar, wind)	Electricians
	Other generation equipment	Mechanical engineering technicians
	Wind (consulting, water pumping systems, wind plant operators and developers, turbine and tower manufacturing, equipment sales and distribution)	Electricians, wind turbine service technicians
Energy Transmission	**Cable and equipment**	Electrical power-line installers and repairers
	Services (power monitoring and metering, power quality and testing)	Electricians, power distributors and dispatchers
	Transmission (sensors and controls, Smart Grid)	Electrical and electronic equipment assemblers
Energy Storage	**Advanced batteries** (Li-Ion, NiMH, advanced PB-acid, charging and management, nickel zinc, other technologies, thin film, ultra capacitors, multiple)	Electrical and electronic engineering technicians
	Battery components and accessories	Electrical and electronic equipment assemblers, tool and die makers
	Fuel cells (methanol, PEM, solid oxide, systems Integrators, zinc air)	Electro-mechanical technicians
	Hybrid systems (flywheels, heat storage, hydrogen storage)	Mechanical engineers
	Uninterruptible power supply	Electrical engineers
ENERGY EFFICIENCY		
Energy Efficiency	**Machinery** (geothermal heating and cooling, HVAC-R, boilers, water heating, efficient motors)	Heating and air conditioning mechanics and installers, thermal engineers
	Energy conservation consultant	Energy auditors
	Energy conservation software	Network systems and data communications analysts
	Energy conservation products	Electrical drafters, weatherization technicians/installers
	Glass	Press operators
	Lighting (CFL, solid state lighting, smart lighting systems, ballasts and controls)	Electricians; lighting design engineer; mixing and blending machine setters, operators, tenders (e.g. CFL/LED manufacturing)
	Meters and measuring devices (wireless)	Electrical engineering technicians
	Energy research	Electrical engineers
	Solar appliances and devices (solar cooker, solar heating, lighting)	Electrical and electronic equipment assemblers
ENVIRONMENTALLY FRIENDLY PRODUCTION		
Transportation	**Alternative fuels** (fueling Infrastructure, biodiesel, ethanol, hydrogen)	Fuel system specialists
	Logistics (fleet tracking, traffic monitoring software)	Operations managers, logistic engineers
	Motor vehicles and equipment (electric bicycles and scooters, electric and hybrid vehicles, logistics/public transit vehicles, natural gas vehicles, diesel technology, vehicle components/engines, water transport, catalytic converters)	Electromechanical equipment assemblers, engine and chassis test engineers, engine and other machine assemblers
Manufacturing/ Industrial	**Advanced packaging** (containers, packing)	Materials scientists
	Industrial surface cleaning	Lab technicians
	Process management (construction/fabrication, process efficiency, resource utilization, toxin/waste minimization)	Mechanical engineering technicians, robotics technicians
	Monitoring and control (sensors, software, systems)	Systems analysts

APPENDIX A

Construction	**Building materials** (e.g., alternative cement)	Operating engineers and other construction equipment operators
	Design and construction (nonresidential architectural and engineering services, nonresidential building construction, residential architectural and engineering services, residential building construction, software)	Architect, roofer, construction and building inspectors (e.g. LEED Certification)
	Site management (deconstruction)	Environmental protection technicians
	Real estate and development	Construction and building inspectors
Agriculture	**Aquaculture** (farms, health and yield)	Environmental science technicians
	Land management (crop yield, precision agriculture, smart Irrigation, sustainable forestry)	Irrigation system installers, precision agriculture technicians
	Supplies and materials (alternative pest control, fertilizer)	Environmental science technicians
	Agribusiness consultant	Agricultural sustainability consultants
Energy Production	**Biofuel** (distillation and distribution)	Installers of industrial equipment, fuel distillers and distributors
	Coal gasification and pyrolysis	Geologists to assess basins for CO2 storage, chemists creating catalysts/ enzymes to remove CO2 from coal power generation, power plant operators that operate equipment that transports CO2
Materials	**Bio** (bioplastics, advanced processes, biodegradable products, catalysts)	Mixing and blending machine setters, operators and tenders
	Chemical (coatings, composites, polymer)	Coating, painting, and spraying machine setters, operators and tenders
	Nano (catalysts and additives, detectors and sensors, gels and coatings, lubricants and films, powders)	Laboratory technicians
	Other (adhesives, ceramics, electro textiles)	Laboratory technicians
CONSERVATION AND POLLUTION MITIGATION		
Air and Environment	**Emissions monitoring and control** (air quality, chemical sensors, carbon dioxide sensors, wireless sensors, sorbents, measurement and testing, software/systems)	Environmental science technicians
	Environmental consulting (environmental engineering, management and public relations, permitting, regulation and documentation, testing and certification, sustainable business/development consultant)	Environmental sustainability consultants, environmental compliance coordinators
	Environmental remediation (remediation equipment, ocean restoration)	Environmental engineering technicians
	Cleanup/safety (EHS and ERM, hazardous waste/toxins control, leak detection)	Hazardous materials removal workers, industrial hygienists
Recycling and Waste	**Consulting**	Materials scientists
	Recycling (Waste paper, paperboard and cloth materials, waste materials, metal, plastics and rubber scrap, bottles, automotive wrecking and recovery, oil and lubricants, electronic waste, recycling machinery manufacturing)	Refuse and recyclable material collectors, solids control technicians
	Waste treatment (environmental disposal, hazmat and plasma destruction)	Water and liquid waste treatment plant and system operators
Water and Wastewater	**Consulting**	Environmental science and protection technicians, including health; wetlands environmental biologists
	Pumps	Mechanical engineering technicians
	Research and testing	Geological science technicians
	Water conservation (recycling and management, metering and control)	Soil and water conservationists
	Water and wastewater treatment (contaminate detection, desalination, filtration and purification, plant and equipment, biological)	Chemical laboratory technicians, groundwater engineers
TRAINING AND SUPPORT		
Business Services	**Legal services**	Lawyers, paralegals and legal assistants
	Marketing/public relations	Public relations specialists
	Green firm business portal	Marketing analysts
	Staffing services	Human resources assistants
Finance/ Investment	**Project financing** (e.g., solar)	Financial accountants
	Project insurance	Credit risk analysts
	Venture capital/private equity	Investment bankers
	Emissions trading and offsets (carbon/emissions)	Statistical assistants, carbon credit traders
Research and Advocacy	**Alternative fuels** (hydrogen)	Biological technicians
	Geothermal	Geological sample test technicians
	Public education, job training	Vocational education teachers in postsecondary institutions, grant writers, environmental education specialists
	Solar	Heating and air conditioning mechanics and installers
	Wind	Mechanical engineering technicians
	Energy generation	Electrical engineering technicians
	Energy storage	Chemical laboratory technicians, fuel cell engineers
	Green building	Cost estimators
	Transportation	Mechanical engineering technicians

APPENDIX B

Methodology

This report counts jobs, companies, patents and venture capital investments that are part of the clean energy economy across all 50 states and the District of Columbia. We define the clean energy economy as one that generates jobs, businesses and investments while expanding clean energy production, increasing energy efficiency, reducing greenhouse gas emissions, waste and pollution, and conserving water and other natural resources.

Pew researchers partnered with Collaborative Economics (CEI), a public policy research firm that has produced the *California Green Innovation Index* for the past two years. The *Index* comprises a series of reports that examine the intersection of economic growth and environmental policy in California; a central component of this work tracks the growth of businesses, jobs, investments and patents that make up the state's clean energy economy. The series is published by Next 10, a nonprofit research and advocacy group based in California.

For this study, Pew and CEI applied CEI's original methodology for assessing California to all 50 states and the District of Columbia.

Counting Jobs and Businesses

There are no perfect data sets with which to count jobs or businesses in the clean energy economy, and accurately counting this emerging economic activity is difficult. The U.S. Bureau of Labor Statistics (BLS) and the U.S. Census of Manufacturers are valuable resources for analyzing well-established industries, but these data do not classify jobs in the "clean energy economy" as a separate sector. As a result, Pew used micro-level establishment data to analyze the clean energy economy across the 50 states and the District of Columbia. For the purpose of this analysis, we count these businesses as those that produce or provide products and services that leverage renewable energy sources, conserve energy and natural resources, reduce pollution and recycle waste.

Public data on industries and employment are insufficient for examining this growing area of economic activity. Existing industry classification codes provide no straightforward industrial classification of jobs and businesses in the clean energy economy. Therefore, building on prior research of the clean energy economy, Pew's researchers constructed a database, using multiple sources and leveraging advanced Internet search technology.

As a first step in building the database, Pew's researchers identified companies receiving venture capital based on information provided by two membership organizations—Cleantech Group, LLC, and New Energy Finance—that track investment in the environment and clean energy technology. In addition, information about companies in the clean energy economy was gathered from industry associations and green business directories, press coverage, published articles, and databases of government incentive programs for renewable energy. As part of the process of

identifying companies, we examined the Standard Industrial Classification (SIC) codes associated with each of these companies and mined the National Establishment Time Series database for other business units that could also be classified as a company in the clean energy economy.

National Establishment Time Series (NETS) Database. As mentioned above, we ran our list of companies through the NETS database published by Walls & Associates. NETS is a time series database based on Dun & Bradstreet (D&B) data, which are intended to cover the universe of business establishments—serving as a Yellow Pages of sorts for all known U.S. businesses. Our team analyzed the broad range of companies in the clean energy economy, allowing our researchers to identify similar and related companies that provide the clean energy economy's supply chain (e.g., manufacturers and suppliers of LED lighting), distribution networks (e.g., warehouses) and support activities (e.g., marketing professionals, lawyers) that deliver the products and services that respond to consumer demand. We limited our analysis to a set of core companies and jobs in the clean energy economy because it is difficult to separate the limited number of these jobs that reside in traditional companies (e.g., technicians working in utility companies to install energy monitoring devices in homes; a sustainability officer in Google, Inc., or another company whose job it is to help "green" the company's office space and operations). Because our analysis focused on identifying businesses in the clean energy economy and the jobs associated with these specific firms, Pew's count of these jobs is conservative.

Pew's research partner, CEI, developed the database, and the resulting business units fell into three categories: 1) businesses that fall into SIC codes that are completely part of the clean energy economy (e.g., energy conservation equipment); 2) businesses that fall into SIC codes that are partially green (e.g., plumbing contractors, electricians); and 3) businesses that are active in some area of the clean energy economy but have an SIC code that primarily represents a much broader scope of activities than clean energy (e.g., commercial nonphysical research).

The process resulted in two sets of eight-digit SIC codes: 1) SIC codes that were fully part of the clean energy economy (Exhibit B-1), and 2) SIC codes where a portion of the business units in that code were part of the clean energy economy. This second set of SIC codes required the additional process of identifying the companies in the clean energy economy through an Internet search platform using sets of keyword searches (see section on *QL2 Search Platform* below). The SIC codes for businesses units that are completely part of the clean energy economy make up about 60 percent of all companies and jobs in this emerging sector.

Pew relied on NETS to track trends in business growth from 1998 to 2007 across all 50 states and the District of Columbia. NETS includes an eight-digit SIC code, which was developed from the four-digit SIC code supported by the U.S. government prior to the six-digit North American Industry Classification System (NAICS)—the current coding system used by the U.S. government and BLS. The eight-digit SIC code allows far greater detail than NAICS to classify businesses and count the jobs associated with those companies.[96]

Pew researchers chose to use NETS based on its strengths relative to other datasets—providing the most detailed and comprehensive set of business unit information necessary for identifying business activities in the clean energy economy. D&B has established a sophisticated quality

EXHIBIT B-1: Establishments in the U.S. Clean Energy Economy

Standard Industrial Classification Codes that are fully part of the clean energy economy.

8-digit SIC	Description
1810103	Mats, preseeded: soil erosion, growing of
8510102	Reforestation services
13110201	Coal gasification
13110203	Coal pyrolysis
16290505	Waste water and sewage treatment plant construction
17110403	Solar energy contractor
17310202	Energy management controls
17310203	Environmental system control installation
17420204	Solar reflecting insulation film
17819901	Geothermal drilling
17969906	Pollution control equipment installation
17990210	Weather stripping
28210401	Carbohydrate plastics
28210407	Soybean plastics
28690104	Ethyl alcohol, ethanol
28739901	Fertilizers: natural (organic), except compost
28759901	Compost
28999913	Desalter kits, sea water
32110302	Insulating glass, sealed units
32310401	Insulating glass: made from purchased glass
34339904	Solar heaters and collectors
34430304	Economizers (boilers)
35110207	Wheels, water
35239906	Windmills for pumping water, agricultural
35590403	Desalination equipment
35599937	Recycling machinery
35890300	Sewage and water treatment equipment
35890301	Sewage treatment equipment
35890306	Water treatment equipment, industrial
36219909	Windmills, electric generating
36290102	Electrochemical generators (fuel cells)
36740305	Photovoltaic devices, solid state
36740306	Solar cells
36749901	Fuel cells, solid state
37110104	Cars, electric, assembly of
38220000	Environmental controls
38220206	Temperature controls, automatic

8-digit SIC	Description
38220300	Thermostats and other environmental sensors
38229900	Environmental controls, nec
38229905	Energy cutoff controls, residential or commercial types
38269907	Environmental testing equipment
38290218	Solarimeters
49119908	Hydro electric power generation
49520000	Sewerage systems
49539905	Recycling, waste materials
49539907	Sewage treatment facility
49590300	Toxic or hazardous waste cleanup
49590301	Oil spill cleanup
49590302	Environmental cleanup services
50399912	Soil erosion control fabrics
50740208	Heating equipment and panels, solar
50750103	Air pollution control equipment and supplies
50840706	Pollution control equipment, air (environmental)
50840707	Pollution control equipment, water (environmental)
50849914	Recycling machinery and equipment
50930000	Scrap and waste materials (all related codes)
52110300	Insulation and energy conservation products
52110301	Energy conservation products
52110303	Solar heating equipment
73890201	Air pollution measuring service
73899931	Meter readers, remote
76990304	Thermostat repair
81110208	Environmental law
86419903	Environmental protection organization
87110101	Pollution control engineering
87110403	Heating and ventilation engineering
87119906	Energy conservation engineering
87310302	Environmental research
87340300	Pollution testing
87349911	Water testing laboratory
87449904	Environmental remediation
87489904	Energy conservation consultant
87489905	Environmental consultant
89990703	Natural resource preservation service

SOURCE: Pew Charitable Trusts, 2009; analysis by Collaborative Economics, Inc.

control system and engages in extensive quality and consistency checks. Access to alternative data sources collected by federal and state government agencies that can be used to study some features of businesses and employment dynamics, such as BLS or the U.S. Census, is highly restricted because of confidentiality and requires a long and complex application and approval process. In contrast, NETS data are accessible and no confidentiality restrictions are imposed on users. And unlike public industry data, NETS covers companies with and without employees. NETS has been criticized in earlier research for both overstating total employment and for undercounting new businesses.[97] Its higher jobs numbers result from its better coverage of small businesses and the inclusion of small business owners in the count of employees; in fact, the NETS numbers are highly correlated with alternative data sources including the Quarterly Census of Employment and Wages, the Current Employment Statistics and the Size of Business data.[98] In other words, the NETS numbers describe the same trends as other data sources. And while NETS is sometimes slow to detect new businesses, it revises the establishment and jobs numbers in subsequent years' data, which corrects any previous undercount of new businesses.

QL2 Search Platform. To carry out a comprehensive Internet search of businesses in the clean energy economy across the 50 states, CEI designed the parameters of an Internet search infrastructure developed by QL2, a Seattle-based software engineering firm. The Internet search platform, created from a detailed set of search criteria and filters, allowed Pew to more comprehensively mine the Internet-based sources, link the results to NETS and verify the information collected. We used the QL2 platform to conduct an Internet search for company Web sites and to verify that these businesses were engaged in the clean energy economy, based on our definition. If a company did not have a Web site, it was not included in our final count of jobs and businesses because we were unable to systematically verify its clean energy economic activities.[99]

After the NETS and QL2 processes were complete, a team of analysts manually double checked the validity of the 50-state data.

Categories of Clean Energy Economy Jobs and Businesses. As part of the Internet and NETS-mining processes using the QL2 platform, business establishments were grouped in 15 segments:[100] energy generation; energy infrastructure; energy storage; energy efficiency; air and environment; recycling and waste; water and wastewater; agriculture; research and advocacy; business services; finance and investment; advanced materials; clean building; transportation; and manufacturing and industrial.

We then converted these 15 segments into five thematic categories for capturing and organizing clean energy economy businesses and jobs: (1) Clean Energy; (2) Energy Efficiency; (3) Environmentally Friendly Production; (4) Conservation and Pollution Mitigation; and (5) Training and Support.

While specific jobs and businesses will change—for example, a company that supplies hybrid diesel engines for buses may supply a fundamentally different type of engine a decade from now—these five sectors of the clean energy economy should remain constant.

Tracking Investments and Patent Registrations

Venture capital investments and patent registrations reveal where innovation in the clean energy economy is taking place and where regional specializations are emerging. Venture capital investment data were provided by the Cleantech Group™, LLC, and tracked investments by industry segment.[101] Working with 1790 Analytics, a research firm that specializes in intellectual property evaluation, Pew's researchers developed search criteria for tracking patent registrations in clean technology over time. 1790 Analytics processes U.S. Patent and Trade Office (USPTO) data on a weekly basis. Using terms related to clean technologies, 1790 Analytics provided the data for new patent registrations related to solar energy, wind energy, batteries, fuel cells and hybrid systems. Both patent and venture capital data were collected from 1999 to 2008.

State Policies

Both the report and our supplemental fact sheets for each of the 50 states and the District of Columbia highlight the strengths of each state's clean energy economy—jobs, companies and investments. Pew's researchers also examined the public policies likely to drive future clean energy economy growth in each state. We looked at states' provision of financial incentives, participation in regional initiatives, implementation of renewable portfolio standards and energy efficiency resource standards, and adoption of California's vehicle emissions standards.

Pew's researchers obtained information about state renewable energy and energy efficiency financial incentives such as tax credits and deductions, bonds, grants, loans and rebate programs from the Database of State Incentives for Renewables and Efficiency, a project sponsored by the North Carolina Solar Center and the Interstate Renewable Energy Council and funded by the U.S. Department of Energy.[102]

Pew's researchers tracked state participation in the three active regional initiatives—(1) Regional Greenhouse Gas Initiative (RGGI); (2) Midwestern Greenhouse Gas Reduction Accord (MGGRA); and (3) Western Climate Initiative (WCI)—by consulting the Pew Center on Global Climate Change's Web site (http://www.pewclimate.org/what_s_being_done/ in_the_states/regional_initiatives.cfm). Researchers then confirmed each state's participation by reviewing state governors' press releases from each initiative's Web site: (1) RGGI - http://www.rggi.org; (2) MGGRA - http://www.midwesternaccord.org/; and (3) WCI - http://www.westernclimateinitiative.org/. We also noted which states had signed on as "observers" to the regional initiatives.

To draw attention to states that had mandatory renewable portfolio standards (RPS) in place, we consulted the Pew Center on Global Climate Change's Web site (http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm). We verified the states' RPS policies using the U.S. Environmental Protection Agency's (EPA) Web site (http://www.epa.gov/solar/energy-programs/state-and-local/supply_actions.html#rps). The EPA credits 34 states with RPS policies, including states with voluntary standards or RPS goals; Pew's analysis does not count those latter states. To identify states that have or are considering adopting energy

efficiency resource standards, we consulted a March 2009 report by the American Council for an Energy-Efficient Economy (http://aceee.org/pubs/e091.pdf?CFID=3657226&CFTOKEN=86100118).

Other Studies

Several organizations recently have published reports about the growth in "green jobs" and the "green economy." Among them (in order of publication date):

- Center for American Progress and the Political Economic Research Institute at the University of Massachusetts Amherst (CAP/PERI), *Job Opportunities for the Green Economy: A State-by-State Picture of Occupations that Gain from Green Investments* (June 2008).
- Center for American Progress and the Political Economic Research Institute at the University of Massachusetts Amherst (CAP/PERI), *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy* (September 2008).
- U.S. Conference of Mayors and Global Insight, *Current and Potential Green Jobs in the U.S. Economy* (October 2008).
- Gary Gereffi, Kristen Dubay and Marcy Lowe, *Manufacturing Climate Solutions: Carbon-Reducing Technologies and U.S. Jobs*, Center on Globalization, Governance & Competitiveness, Duke University (November 2008).

Three principal differences distinguish Pew's report from these and other, similar efforts. First, previous efforts looked only at jobs and either provided numbers for a specific industry, such as solar, or estimates generated by statistical modeling; our report analyzes jobs at the business-unit level, businesses, venture capital investments and patent registrations over time. By examining different aspects of the clean energy economy—not just jobs—Pew highlights investments being made today that will drive growth in the future. Second, using jobs numbers based on NETS data and a sophisticated software platform that enabled Pew to search and verify the activities of firms, we count actual jobs and businesses in the clean energy economy, rather than relying on estimates. The businesses included in the database are based on evidence of actual business activities. Finally, previous efforts focused on energy generation and efficiency; we also counted jobs and businesses that enable the United States to manage water and other finite natural resources more effectively, to mitigate emissions of greenhouse gases and other pollutants that result from the continued use of fossil fuels, and to recycle materials and resources to help businesses reduce their carbon footprint.

Exhibit C1. Businesses in the U.S. Clean Energy Economy, 1998-2007

State	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Alabama	765	764	768	789	819	815	806	782	804	799
Alaska	327	331	333	345	367	367	360	359	350	350
Arizona	1,009	1,027	1,039	1,047	1,093	1,099	1,088	1,122	1,139	1,123
Arkansas	434	424	416	420	440	435	444	440	445	448
California	8,906	8,971	8,899	9,248	9,848	10,066	10,213	10,195	10,348	10,209
Colorado	1,463	1,468	1,505	1,564	1,676	1,706	1,699	1,682	1,760	1,778
Connecticut	799	804	780	806	801	818	825	829	864	857
Delaware	204	205	207	213	220	213	207	205	213	211
District of Columbia	243	244	253	263	280	274	286	291	295	280
Florida	3,121	3,131	3,121	3,214	3,582	3,643	3,663	3,664	3,801	3,831
Georgia	1,483	1,533	1,536	1,576	1,690	1,702	1,688	1,679	1,824	1,827
Hawaii	288	294	291	309	328	333	334	333	355	356
Idaho	365	376	387	410	436	434	436	437	434	428
Illinois	2,111	2,043	2,008	2,038	2,125	2,133	2,134	2,131	2,170	2,176
Indiana	1,135	1,107	1,101	1,144	1,226	1,231	1,225	1,214	1,259	1,268
Iowa	637	634	641	670	730	716	708	699	736	729
Kansas	570	563	570	577	588	595	581	564	596	591
Kentucky	697	679	675	701	722	724	718	722	750	778
Louisiana	949	947	933	949	1,007	993	1,003	975	994	995
Maine	691	710	703	703	721	733	728	736	743	725
Maryland	1,044	1,042	1,028	1,040	1,134	1,104	1,122	1,134	1,162	1,145
Massachusetts	1,819	1,773	1,753	1,777	1,836	1,852	1,842	1,903	1,921	1,912
Michigan	1,858	1,808	1,788	1,811	1,906	1,890	1,882	1,897	1,952	1,932
Minnesota	1,120	1,106	1,116	1,107	1,189	1,235	1,247	1,205	1,208	1,206
Mississippi	387	387	394	395	434	439	437	449	447	454
Missouri	1,026	1,020	987	986	1,036	1,023	1,022	1,028	1,057	1,062
Montana	311	316	328	355	365	380	382	405	409	408
Nebraska	312	312	317	322	332	359	348	353	359	368
Nevada	345	347	350	384	465	480	489	502	521	511
New Hampshire	414	418	414	416	456	470	470	453	462	465
New Jersey	2,157	2,127	2,078	2,093	2,164	2,121	2,083	2,045	2,026	2,031
New Mexico	502	525	515	544	557	557	559	570	581	577
New York	3,258	3,195	3,150	3,186	3,473	3,481	3,440	3,320	3,304	3,323
North Carolina	1,449	1,493	1,518	1,563	1,652	1,641	1,665	1,705	1,794	1,783
North Dakota	124	122	123	132	142	144	148	141	142	137
Ohio	2,388	2,342	2,344	2,414	2,503	2,512	2,469	2,476	2,514	2,513
Oklahoma	726	724	703	694	724	712	726	715	712	693
Oregon	1,323	1,356	1,383	1,410	1,508	1,531	1,553	1,569	1,608	1,613
Pennsylvania	2,893	2,893	2,879	2,890	3,223	3,222	3,135	2,929	2,939	2,934
Rhode Island	234	234	232	242	252	256	250	249	243	237
South Carolina	775	789	785	806	849	870	874	872	889	884
South Dakota	122	121	129	131	144	148	155	157	164	169
Tennessee	955	970	974	1,001	1,034	1,026	1,039	1,062	1,080	1,090
Texas	4,247	4,309	4,346	4,473	4,801	4,802	4,806	4,773	4,819	4,802
Utah	473	478	485	509	587	588	589	562	575	579
Vermont	279	286	281	295	319	319	319	319	317	311
Virginia	1,237	1,251	1,263	1,323	1,413	1,436	1,457	1,451	1,472	1,446
Washington	1,920	2,032	1,992	2,029	2,102	2,082	2,062	2,012	2,022	2,008
West Virginia	348	338	341	350	371	360	352	327	325	332
Wisconsin	1,249	1,245	1,225	1,248	1,291	1,272	1,291	1,299	1,297	1,294
Wyoming	197	212	212	228	251	240	237	234	234	225
U.S. Total	61,689	61,826	61,599	63,140	67,212	67,582	67,596	67,175	68,435	68,203

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

Exhibit D1. Jobs in the U.S. Clean Energy Economy, 1998-2007

State	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Alabama	7,678	7,388	7,640	7,825	8,325	8,089	7,678	7,667	7,678	7,849
Alaska	1,956	1,947	1,930	2,040	2,270	2,310	2,174	2,048	2,043	2,140
Arizona	9,547	9,458	10,050	10,455	10,686	10,841	11,214	11,549	11,463	11,578
Arkansas	4,266	4,353	4,130	4,461	4,491	4,043	4,116	4,040	4,326	4,597
California	116,441	117,610	123,475	125,221	128,832	122,959	120,153	117,114	122,903	125,390
Colorado	14,393	15,804	16,595	17,218	16,903	16,736	15,711	15,547	16,022	17,008
Connecticut	9,484	9,677	8,814	10,715	11,287	10,976	11,248	11,203	10,052	10,147
Delaware	2,424	2,548	2,779	2,775	2,917	2,904	2,314	2,638	2,395	2,368
District of Columbia	4,483	4,306	4,594	5,289	5,608	5,599	5,140	5,254	5,426	5,325
Florida	28,845	29,138	29,254	28,467	30,739	30,292	30,568	29,437	30,527	31,122
Georgia	14,645	14,799	14,623	14,689	15,786	16,207	16,121	16,513	16,243	16,222
Hawaii	1,903	2,064	2,175	2,256	2,396	2,455	2,281	2,303	2,710	2,732
Idaho	1,998	2,252	2,648	2,803	3,447	4,537	4,462	4,141	4,146	4,517
Illinois	29,136	28,773	27,278	27,474	27,662	27,497	27,420	26,820	27,025	28,395
Indiana	14,666	15,467	16,033	16,521	16,823	16,238	16,200	16,338	16,840	17,298
Iowa	6,106	6,272	6,600	6,959	7,157	7,053	6,942	6,999	7,553	7,702
Kansas	5,308	5,262	5,483	6,055	6,444	6,572	6,631	6,993	7,444	8,017
Kentucky	8,465	8,577	8,777	9,187	9,049	9,224	9,330	8,952	9,123	9,308
Louisiana	8,908	9,600	9,762	10,272	10,512	10,491	10,130	10,271	9,984	10,641
Maine	4,888	5,010	5,005	5,006	5,364	5,719	5,827	5,754	5,805	6,000
Maryland	13,224	13,465	13,226	13,240	14,741	13,886	12,632	12,932	12,445	12,908
Massachusetts	25,580	24,604	23,842	24,057	24,742	25,220	24,444	24,630	26,381	26,678
Michigan	20,489	20,385	21,546	23,064	23,328	22,068	21,618	21,706	22,185	22,674
Minnesota	17,868	18,037	18,696	18,303	20,095	20,660	20,694	18,947	18,764	19,994
Mississippi	2,564	2,591	2,618	2,848	3,028	2,911	2,926	3,115	3,060	3,200
Missouri	11,116	12,494	12,472	12,959	13,132	12,360	12,240	11,501	11,525	11,714
Montana	2,151	2,158	2,166	2,255	2,173	2,083	1,891	1,899	2,086	2,155
Nebraska	2,537	2,639	2,768	2,758	3,127	3,347	3,262	5,403	5,391	5,292
Nevada	2,826	2,899	2,582	2,667	3,056	3,112	2,933	2,961	3,347	3,641
New Hampshire	3,950	3,882	3,478	3,368	3,887	3,850	3,741	3,959	4,045	4,029
New Jersey	28,097	27,555	27,412	27,917	28,658	27,283	25,917	25,146	25,048	25,397
New Mexico	3,208	3,358	3,443	3,896	4,165	4,174	4,238	4,247	4,254	4,815
New York	35,028	35,849	37,606	37,861	39,296	37,774	36,774	34,044	34,016	34,363
North Carolina	14,742	14,771	15,832	16,012	16,176	16,501	16,305	17,026	16,929	16,997
North Dakota	1,613	1,814	1,803	1,821	1,875	2,009	1,955	1,909	2,099	2,112
Ohio	32,874	32,902	33,413	35,882	37,294	34,788	34,349	34,705	35,513	35,267
Oklahoma	5,119	5,499	6,238	6,033	6,039	6,036	6,030	5,608	5,633	5,465
Oregon	12,833	13,552	13,910	14,333	14,931	15,678	16,386	19,191	19,010	19,340
Pennsylvania	41,336	46,741	47,767	44,666	46,846	46,018	44,594	39,013	39,047	38,763
Rhode Island	2,311	2,476	2,437	2,879	2,982	2,822	2,800	2,529	2,401	2,328
South Carolina	8,264	8,647	8,777	9,807	10,339	10,655	11,323	11,092	11,291	11,255
South Dakota	846	779	826	913	1,069	1,087	1,200	1,423	1,471	1,636
Tennessee	13,123	15,314	15,704	17,690	16,399	16,546	16,491	16,409	16,594	15,507
Texas	48,199	51,775	51,024	52,063	55,143	51,942	50,825	52,110	55,470	55,646
Utah	5,938	5,100	5,233	5,290	5,047	4,824	4,871	5,170	5,207	5,199
Vermont	1,875	1,854	1,733	1,899	2,029	2,119	2,073	2,133	2,166	2,161
Virginia	15,947	16,256	16,366	16,531	16,656	16,733	16,946	16,639	16,906	16,907
Washington	16,928	18,215	18,405	19,201	19,620	16,990	16,935	16,264	16,384	17,013
West Virginia	3,197	3,064	3,244	3,201	3,432	3,251	3,336	3,086	3,065	3,065
Wisconsin	15,921	16,172	15,881	16,630	16,399	16,302	16,377	15,691	15,929	15,089
Wyoming	907	990	1,072	1,129	1,201	1,202	1,199	1,222	1,351	1,419
U.S. Total	706,151	726,142	739,165	756,861	783,603	764,973	752,965	743,291	758,721	770,385

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

APPENDIX E

Exhibit E1. U.S. Clean Energy Patents, 1999-2008

State	Total Patents, 1999-2008
Alabama	26
Alaska	1
Arizona	178
Arkansas	8
California	1,401
Colorado	161
Connecticut	404
Delaware	43
District of Columbia	9
Florida	236
Georgia	256
Hawaii	16
Idaho	73
Illinois	297
Indiana	174
Iowa	46
Kansas	15
Kentucky	17
Louisiana	22
Maine	8
Maryland	134
Massachusetts	384
Michigan	749
Minnesota	218
Mississippi	3
Missouri	25
Montana	5
Nebraska	15
Nevada	71
New Hampshire	74
New Jersey	248
New Mexico	95
New York	909
North Carolina	179
North Dakota	5
Ohio	309
Oklahoma	36
Oregon	163
Pennsylvania	241
Rhode Island	51
South Carolina	49
South Dakota	4
Tennessee	47
Texas	414
Utah	47
Vermont	12
Virginia	68
Washington	195
West Virginia	14
Wisconsin	214
Wyoming	15
U.S. Total	8,384

SOURCE: Pew Charitable Trusts, 2009, based on data from 1790 Analytics; analysis by Pew Center on the States and Collaborative Economics.

Exhibit E2. U.S. Clean Energy Venture Capital, 2006-2008

State	Venture Capital, 2006-2008
Alabama	$0
Alaska	$0
Arizona	$31,105,879
Arkansas	$22,844,701
California	$6,580,426,908
Colorado	$622,400,734
Connecticut	$30,050,286
Delaware	$3,342,057
District of Columbia	$89,877,117
Florida	$116,980,006
Georgia	$179,685,738
Hawaii	$12,303,914
Idaho	$27,890,265
Illinois	$108,519,023
Indiana	$26,000,000
Iowa	$149,237,274
Kansas	$13,274,882
Kentucky	$0
Louisiana	$0
Maine	$0
Maryland	$323,995,916
Massachusetts	$1,278,461,918
Michigan	$55,099,376
Minnesota	$49,937,944
Mississippi	$30,383,955
Missouri	$24,479,634
Montana	$0
Nebraska	$0
Nevada	$19,804,386
New Hampshire	$66,917,018
New Jersey	$282,567,651
New Mexico	$147,912,504
New York	$209,590,500
North Carolina	$82,570,734
North Dakota	$0
Ohio	$74,224,203
Oklahoma	$5,191,978
Oregon	$70,001,922
Pennsylvania	$232,897,084
Rhode Island	$22,844,701
South Carolina	$0
South Dakota	$0
Tennessee	$16,328,927
Texas	$716,894,200
Utah	$26,957,250
Vermont	$53,746,890
Virginia	$70,828,261
Washington	$635,108,739
West Virginia	$5,740,751
Wisconsin	$46,742,521
Wyoming	$6,941,813
U.S. Total	$12,570,109,562

SOURCE: Pew Charitable Trusts, 2009, based on data from The Cleantech Group™ LLC; analysis by Pew Center on the States and Collaborative Economics.

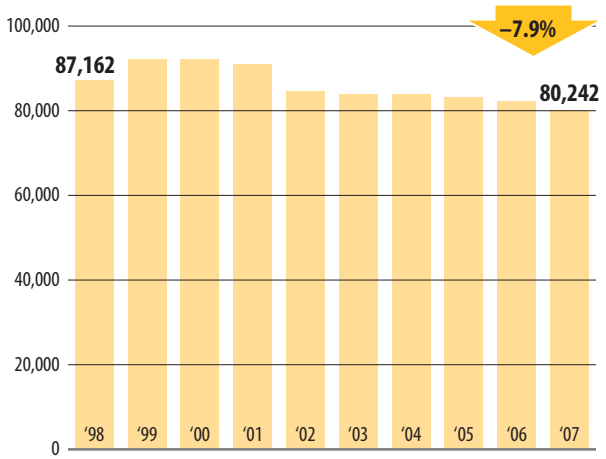
Nuclear Energy in the United States

In 2007, there were 574 nuclear energy establishments in the United States accounting for a total of 80,242 jobs, including jobs in power generation, plant and equipment production, public administration and nuclear consulting.

During the past 10 years, the nuclear energy industry has lost jobs at an average annual rate of 0.9 percent. In 2007 jobs in the nuclear energy industry reached a 10-year low after peaking in 1999 with just more than 92,000 total nuclear energy jobs.

These jobs and establishments are located in 46 states and the District of Columbia. Alaska, Hawaii, Montana and North Dakota had no jobs in the nuclear energy industry as of 2007. Delaware, Indiana, Kentucky, Maine, Oklahoma, Rhode Island, South Dakota, Utah and West Virginia all had fewer than 100 nuclear energy jobs as of 2007. A majority of the jobs in nuclear energy are concentrated in a small number of states. California, Illinois, New York, North Carolina, Maryland, Massachusetts, Pennsylvania, South Carolina, Texas and Virginia are the 10 states with the most jobs in nuclear energy.

U.S. NUCLEAR ENERGY JOBS 1998-2007



SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics.

U.S. NUCLEAR ENERGY JOBS

States with the Most Nuclear Energy Jobs, 2007

Illinois	7,605
New York	6,223
Texas	5,839
California	4,608
North Carolina	4,234
Virginia	4,197
Maryland	4,058
Pennsylvania	4,025
South Carolina	3,749
Massachusetts	3,443

SOURCE: Pew Charitable Trusts, 2009, based on the National Establishment Time Series Database; analysis by Pew Center on the States and Collaborative Economics

Endnotes

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6 American Council for an Energy-Efficient Economy (ACEEE), *Laying the Foundation for Implementing a Federal Energy Efficiency Resource Standard*, March 2009, http://aceee.org/pubs/e091.pdf?CFID=3657226&CFTOKEN=86100118 (accessed May 19, 2009).

7 Pew Center on Global Climate Change, Key Provisions: American Recovery and Reinvestment Act, March 2009 (updated April 16, 2009), http://www.pewclimate.org/docUploads/Pew-Summary-ARRA-Key-Provisions.pdf (accessed April 28, 2009).

8 Michigan Department of Energy, Labor and Economic Growth, "Michigan Fast Facts," http://www.milmi.org/ (accessed April 28, 2009).

9 Pew interview with Skip Pruss, director of the Michigan Department of Energy, Labor and Economic Growth, April 3, 2009.

10 Ibid.

11 *See* Center for American Progress and the Political Economic Research Institute at the University of Massachusetts Amherst (CAP/PERI), *Job Opportunities for the Green Economy: A State-by-State Picture of Occupations that Gain from Green Investments* (June 2008) and *Green Recovery: A Program to Create Good Jobs and Start Building a Low-Carbon Economy* (September 2008). *See also* U.S. Conference of Mayors (USCM) and Global Insight, *Current and Potential Green Jobs in the U.S. Economy* (October 2008).

12 Despite the popularity of the term "green economy," there has been no consensus to date about what it actually means. No government data source counts green businesses or jobs as such, and as a result, the "green economy" is not classified as an industry. The "green" label has become so ubiquitous that it has lost, rather than gained, meaning, focus and value. A growing number of policy, business and opinion leaders prefer the term "clean energy economy," which reflects the critical focus on developing renewable energy sources that expand market opportunities, strengthen America's fiscal health, reduce our nation's dependence on traditional fossil fuels, and mitigate pollution from global warming.

13 *Low-impact hydropower.* Low-impact hydropower is hydroelectric power generated with fewer environmental impacts; it must meet criteria such as minimally obstructing river flows, maintaining water quality, easing fish passage, and protecting the watershed. Such hydropower facilities often operate using the natural flow of rivers, rather than storing water in a reservoir and releasing it to create greater currents. *See* U.S. Department of Energy, Energy Efficiency and Renewable Energy, Federal Energy Management Program; EPA Green Power Partnership; World Resources Institute, Sustainable Enterprise Program; and Center for Resource Solutions, Green-e Renewable Energy Certification Program, *Guide to Purchasing Green Power: Renewable Electricity, Renewable Energy Certificates, and On-Site Renewable Generation*, September 2004, p. 35.
Hydrogen fuel cells. As an energy carrier, hydrogen can be used to store and deliver clean and renewable energy. Hydrogen can be produced from a variety of domestic reserves including natural gas, coal, wind and solar power. Once extracted, hydrogen gas is combined with oxygen in fuel cells to create energy. Hydrogen power fuel cells can meet a spectrum of energy demands, from small-scale portable energy used to power private transportation to large-scale baseload energy generators. *See* U.S. Department of Energy Hydrogen Program, http://www.energy.gov/energysources/hydrogen.htm (accessed April 29, 2009).
Marine and tidal. Marine and tidal, also known as hydrokinetic, power sources seek to capture energy from waves, tides, ocean currents and the natural flow of water in rivers as well as marine thermal gradients, without building new dams or diversions. Emerging technologies seek to capture and convert these sources of kinetic energy into renewable power. *See* U.S. Department of Energy, Energy Efficiency and Renewable Energy Program: Wind and Hydropower Technologies, http://www1.eere.energy.gov/windandhydro/hydro_about.html (accessed April 29, 2009).
Geothermal. Geothermal energy harnesses the heat trapped below the earth's immediate surface. Geothermal heat pumps can use shallow ground energy (less than 10 feet below the earth's surface) to direct heat and cool office buildings and homes. Large-scale geothermal plants can harness the steam released even further below the surface to drive turbines and generate electric power. *See* U.S. Department of Energy, Energy Efficiency and Renewable Energy Program: Geothermal Technologies Program, http://www1.eere.energy.gov/geothermal/geothermal_basics.html (accessed April 29, 2009).

14 *Small-scale biopower.* Our definition and data capture only jobs and services that enable small-scale biopower energy generation activities such as wood combustion in power plants and the burning of biomethane for energy. The jobs we capture include those that make it possible for dairy farmers to offset their energy needs by using biomethane from manure, for paper plants to burn their scraps and reduce energy demands, and for plants such as the BMW factory in Spartanburg, South Carolina, to meet a percentage of its energy demands by capturing and burning biomethane released at a nearby landfill (*see* http://www.bmwusa.com/Standard/Content/Uniquely/BMWInTheCommunity/CommunityandEnvironment.aspx).

15 *See* Steve Olson and Robert W. Fri, eds., "National Academies Summit on America's Energy Future," The National Academies Press, Washington, D.C., 2008, pp. 44-48. Also, nuclear power plants are capital intensive, much like coal-fired plants. Cost estimates for new nuclear plants range from $9 billion to $13 billion; *see* Peter Behr, "A key energy industry nervously awaits its 'rebirth'," *The New York Times*, April 27, 2009, http://www.nytimes.com/cwire/ 2009/04/27/27climatewire-a-key-energy-industry-nervously-awaits-its-r-10677.html?pagewanted=1 (accessed April 29, 2009) and Terry Macalister, "Westinghouse Wins First U.S. Nuclear Deal in 30 Years," *The Guardian*, April 10, 2008, http://www.guardian.co.uk/world/2008/apr/10/nuclear.nuclearpower (accessed April 29, 2009). In addition, the technology to reprocess spent fuel is at least 40 to 50 years away and international proliferation resistant measures/agreements are not in place for nuclear power to be rapidly expandable; thus, it remains a highly centralized form of energy production and delivery can be problematic if plants go offline.

16 Research suggests that biofuel production can have a positive net energy balance, particularly if the newest and most efficient production facilities are utilized. But biomass used to produce these fuels face sustainability challenges over where the biomass will come from (e.g., food for fuel and other land use decisions). *See* Adam J. Liska, Haishun S. Yang, Virgil R. Bremer, Terry J. Klopfenstein, Daniel T. Walters, Galen E. Erickson and Kenneth G. Cassman, "Improvements in Life Cycle Energy Efficiency and Greenhouse Gas Emissions of Corn-Ethanol," *Journal of Industrial Ecology* (13) 1, pp. 58-74; Alexander E. Farrell, Richard J. Plevin, Brian T. Turner, Andrew D. Jones, Michael O'Hare and Daniel M. Kammen, "Ethanol Can Contribute to Energy and Environmental Goals," *Science*, January 27, 2006 (311), pp. 506-508. However, other research suggests that biomass can be generated sustainably, such as from agricultural residue and waste products, including forestry waste, storm and pest-damaged trees, forest thinning for fire risk reduction, municipal waste or food industry waste, or by using perennial crops on degraded/abandoned cropland or pasture that is no longer suitable for other agricultural purposes. *See* Robert D. Perlack, Lynn L. Wright, Anthony F. Turhollow, Robin L. Graham, Bryce J. Stokes and Donald C. Erbach, *Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply*, U.S. Department of Energy and U.S. Department of Agriculture, Washington, D.C., 2005; J. Elliot Campbell, David B. Lobell, Robert C. Genova and Christopher B. Field, "The Global Potential of Bioenergy on Abandoned Agriculture Lands," *Environment Science Technology* (42), 2008, pp. 5791–5794.

17 Pew's Environmentally Friendly Production category excludes agricultural jobs and focuses only on infrastructure for biofuel production—distillation and distribution centers. Venture capital firms are investing heavily in second generation biofuels, technologies that seek to use more sustainable feedstocks, such as switchgrass—and distillation and distribution centers are an important, job-generating part of how we might develop biofuels that are more sustainable than corn-based ethanol moving forward (*see* Cleantech Group™ LLC, *Cleantech Investment Monitor 2008 Annual Review and 4Q08 Quarterly,* 2009). In addition, in the transportation portion of the Environmentally Friendly Production category, we capture jobs that produce and supply alternative products and services to mass transit operators, including compressed natural gas engines and monitoring systems that allow for more effective deployment of public transit. Pew does not include bus drivers, mechanics or administrators who work for public transit agencies.

18 Board on Energy and Environmental Systems, National Research Council and Curt Suplee, "What You Need to Know About Energy," Washington, D.C., The National Academies Press, 2008, p. 14.

19 U.S. Environmental Protection Agency, "2009 U.S. Greenhouse Gas Inventory Report: Inventory of U.S Greenhouse Gas Emissions and Sinks 1990-2007," April 2009, http://www.epa.gov/climatechange/ emissions/usinventoryreport.html (accessed April 16, 2009).

20 Rather than being burnt directly, during gasification and pyrolysis, coal is exposed to steam and oxygen under high temperatures and pressures. This heat and pressure breaks down coal into its basic chemical parts—in a gaseous form in gasification and in a liquid form in pyrolysis. Once broken down into these components, the noxious outputs of coal burning (carbon dioxide, sulfur and nitrogen) can be better trapped and the resulting gases and liquids can be used to make cleaner energy. Information from the U.S. Department of Energy, "Clean Coal and Natural Gas Power Systems," http://fossil.energy.gov/programs/powersystems/gasification/, last updated December 8, 2008.

21 Olson and Fri, eds., "National Academies Summit on America's Energy Future," Washington, D.C., The National Academies Press, 2008, p. 80.

22 William Choate, "U.S. Energy Requirements for Aluminum Production: Historical Perspectives, Theoretical Limits, and New Opportunities," in John A.S. Green (ed.), *Aluminum Recycling and Processing for Energy Conservation and Sustainability*, Materials Park, OH: ASM International, 2007, p. 204.

23 Joel Makower, Ron Pernick and Clint Wilder, "Clean Energy Trends 2009," *Clean Edge*, March 2009, http://www.cleanedge.com/ reports/reports-trends2009.php (accessed March 30, 2009).

24 Jeffrey T. Macher and David C. Mowery, eds., Committee on the Competitiveness and Workforce Needs of U.S. Industry, in "Innovation in Global Industries: U.S. Firms Competing in a New World," Washington, D.C., The National Academies Press, 2008, http://books.nap.edu/openbook.php? record_id=12112&page=231 (accessed May 2, 2009).

25 Biotechnology Industry Organization, "Biotechnology Industry Facts," 2008, http://www.bio.org/speeches/pubs/er/statistics.asp (accessed May 2, 2009).
26 Ernst & Young LLP, *Beyond Borders: Global Biotechnology Report 2008*, 2008, http://www.ey.com/Publication/vwLUAssets/Industry_Biotechnology_Beyond_Borders_2008/$file/Biotechnology_Beyond_Borders_2008.pdf (accessed April 28, 2009).
27 U.S. Bureau of Labor Statistics, Current Employment Statistics, http://www.bls.gov/ces/ (accessed April 16, 2009).
28 U.S. Bureau of Labor Statistics (BLS), Occupational Employment Survey, May 2007. Pew's researchers matched NETS data with the BLS occupational data to estimate the earnings for jobs in the clean energy economy. Annual wages have been calculated by multiplying the hourly mean wage by a "year-round, full-time" hours figure of 2,080 hours; for those occupations where there is not an hourly mean wage published, the annual wage has been directly calculated from the reported survey data.
29 Kathy Krepcio, executive director of the John J. Heldrich Center for Workforce Development at Rutgers University, testimony before the U.S. House of Representatives Committee on Education and Labor, March 31, 2009, http://edlabor.house.gov/documents/111/pdf/testimony/20090331KathyKrepcioTestimony.pdf (accessed May 2, 2009).
30 Hemlock Semiconductor highlights the conservative nature of Pew's count of businesses and jobs in the clean energy economy. Although Hemlock is one of the country's largest producers of polysilicon used to produce solar photovoltaic devices, a large portion of Hemlock's polysilicon business is rooted in the semiconductor industry, which we could not classify as a part of the clean energy economy. Because these two areas of polysilicon activity are not divided into two separate business units, we were not able to isolate the jobs at Hemlock related to the production of polysilicon for solar photovoltaics. Unless we were able to classify an entire establishment or isolate one of its business units as part of the clean energy economy, it was not included in our analysis. As a result, Hemlock Semiconductor was not included in our establishment and jobs count.
31 Pew interview with Jarrod Erpelding, a spokesperson for Dow Corning Corporate Communications, April 7, 2009.
32 In 2007, the United States recycled 33 percent of its municipal solid waste. *See* U.S. Environmental Protection Agency Office of Solid Waste, *Municipal Solid Waste in the United States: 2007 Facts and Figures,* Nov. 2008, p. 13, http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw07-rpt.pdf (accessed April 15, 2009).
33 Pew e-mail exchange with Melody Serafino, spokesperson for RecycleBank, April 21, 2009.
34 Pew interview with Ron Gonen, co-founder and CEO of RecycleBank, April 7, 2009; presentation by John Doerr, partner, Kleiner Perkins Caufield & Byers, "Seeking Salvation and Profit in Green Tech," March 2007, http://www.ted.com/index.php/talks/john_doerr_sees_salvation_and_profit_in_greentech.html (accessed April 15, 2009).
35 Celeste LeCompte, "Down in the Dumps," *Sustainable Industries*, March 30, 2009, http://www.sustainableindustries.com/recycledmarkets/42019787.html (accessed April 28, 2009).
36 Pew interview with Gonen, April 7, 2009.
37 Ibid.
38 Pew interview with Steven Hauser, head of market development, GridPoint, March 20, 2009.
39 Pew interview with Michael Peck, director of Media, Institutional and Labor Relations in North America for GamesaUSA, April 3, 2009.
40 U.S. Department of Energy, "Electricity Delivery and Energy Reliability: Distributed Energy Program," May 17, 2006, http://www.eere.energy.gov/de/energy_storage.html (accessed April 26, 2009).
41 Steven Chu, quoted in Olson and Fri, eds., "National Academies Summit on America's Energy Future," Washington D.C., The National Academies Press, 2008, p. 63.
42 Cleantech Group™ LLC, *Cleantech Investment Monitor 2008 Annual Review and 4Q08 Quarterly,* 2009.
43 McKinsey & Company, "Pathways to a Low-Carbon Economy: Version 2 of the Global Greenhouse Gas Abatement Cost Curve," January 2009, http://globalghgcostcurve.bymckinsey.com/ (accessed March 10, 2009).
44 Energy Star® is a joint program of the U.S. departments of Environment and Energy that labels homes and household products (such as appliances, lighting, etc.) that meet their energy efficiency standards, helping consumers save energy. The program also offers planning tools and resources for homeowners who want to make energy-efficient improvements and partner with businesses to implement energy management strategies, http://www.energystar.gov/index.cfm?c=about.ab_index (accessed April 15, 2009). Statistics from the U.S. Environmental Protection Agency Energy Star Program, Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431 (August 2, 2007).
45 Pew interview with Kurt Anson, vice president of Global Energy and Environment for Honeywell Building Solutions, May 1, 2009.
46 Sari Krieger, "Honeywell's Building Automation Business Stands Out," *Clean Technology Insight,* February 2, 2009.
47 Honeywell International Inc. brochure, "Leveraging the Stimulus," April 2009, p. 2.
48 Honeywell International Inc. press release, "Honeywell Helps Pittsburgh Housing Authority Cut Utility Bills and Carbon Emissions," October 23, 2008, http://buildingsolutions.honeywell.com/Cultures/en-US/NewsEvents/NewsReleases/HACP.htm (accessed May 1, 2009).
49 Ibid.
50 Honeywell International Inc. press release, "Honeywell and Lewis and Clark College Team to Harness Solar Energy," February 19, 2008, http://buildingsolutions.honeywell.com/Cultures/en-US/NewsEvents/NewsReleases/LewisandClark0208.htm (accessed April 24, 2009).
51 "Fortune 500," *Fortune*, May 5, 2008, http://money.cnn.com/magazines/fortune/fortune500/2008/snapshots/236.html (accessed April 17, 2009). Among its awards, Johnson Controls won the U.S. Environmental Protection Agency's 2005 Clean Air Excellence Award, which recognizes programs, projects or technologies that reduce emissions of

pollutants or hazardous/toxic air pollutants; are innovative and unique; provide a model for others to follow; and result in positive outcomes that are continuing/ sustainable. http://www.johnsoncontrols.com/publish/us/en/ sustainability/awards_and_recognition.html (accessed May 2, 2009).

52 Pew interview with Joy Clark-Holmes, director of Local Government and Market Solutions, Johnson Controls, March 23, 2009.

53 Companies that help drive demand for products and services in the clean energy economy, such as Austin Energy, are important to note. Austin Energy, like other utilities, invests in developing clean, renewable energy sources and provides incentives for its customers and suppliers to adopt energy-efficient technologies and practices, thereby creating a market demand for the clean energy economy. But while these businesses are critical to growing the clean energy economy, they are not included in our count of businesses and jobs. As noted in Appendix B, Pew's analysis captures only the producers and suppliers of the products and services in the clean energy economy, not the companies or institutions that drive demand—underscoring the fact that our count is conservative.

54 Pew interview with Ed Clark, public information officer for Austin Energy, April 6, 2009; certifications are given by the Building Performance Institute and the Residential Energy Services Network.

55 While Project FROG was established in 2006, NETS data did not pick up the company as part of our business or jobs count. As described in the methodology (Appendix B), NETS does not always pick up new businesses immediately. Once a new business is identified, however, the NETS data are subsequently updated to reflect the dates the missed company was in business, and it is included in future counts.

56 Project FROG Web site gallery, http://projectfrog.com/gallery/ movies/ (accessed April 3, 2009).

57 Pew interview with Adam Tibbs, president of Project FROG, April 3, 2009.

58 Pew interview with Robert Fox, managing partner, Manko, Gold, Katcher & Fox, April 8, 2009.

59 Pew interview with David Prend, managing general partner, RockPort Capital and director, National Venture Capital Association, April 31, 2009.

60 Heslin Rotherberg Farley & Mesiti P.C., "Clean Energy Patent Growth Index," 2009, http://cepgi.typepad.com/heslin_rothenberg_farley/ (accessed April 13, 2009).

61 The Innovation Alliance, "Development of Green Technologies Reliant on Strong Patent Protections," February 25, 2009, http://www.innovationalliance.net/media-center/news/development-green-technologies-reliant-strong-patent-protections (accessed May 3, 2009).

62 Types of fuel cells are similar to traditional battery technologies; small-scale fuel cells have the ability to power portable electronics more efficiently. Other fuel cells differ from traditional battery technologies because they can serve as large-scale continuous sources of power in the presence of a fuel source. Hydrogen powered fuel cells can power cars and even provide backup power generation in remote locations. *See* U.S Department of Energy Hydrogen Program, http://www.hydrogen.energy.gov/.

63 MoneyTree™, *Venture Investments in Clean Technology Accelerates Significantly in 2008, Despite Economic Uncertainty,* PricewaterhouseCoopers and the National Venture Capital Association, based on data from Thomas Reuters, 2009.

64 Ibid.

65 Cleantech Group™ LLC, "Clean technology venture investment falls to $1 billion in 1Q09," April 1, 2009, http://cleantech.com/about/pressreleases/040109.cfm (accessed May 3, 2009).

66 See PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Data: Thomson Reuters, "Total U.S. Investments by Year Q1 1995 - Q1 2009," http://www.nvca.org/index.php?option=com_content&view=article&id=78:latest-industry-statistics&catid=40:research&Itemid=102, VC Investments, Q1 2009—Money Tree—National Data, (accessed May 4, 2009). Venture capital in the first quarter of 2008 was $7.74 billion; venture capital in the first quarter of 2009 was $3 billion. Pew calculates a 61 percent overall drop between those quarters.

67 Cleantech Group™ LLC, *Cleantech 2009: The Emergence of Low Carbon Economy*, p. 2, April 18, 2009.

68 Cleantech Group™ LLC, "Clean technology venture investment reaches record $8.4 billion in 2008 despite credit crisis and broadening recession," January 6, 2009, http://cleantech.com/about/pressreleases/010609.cfm (accessed May 3, 2009).

69 Cleantech Group™ LLC, *Cleantech Investment Monitor 2008 Annual Review and 4Q08 Quarterly,* 2009.

70 Speech at the National Governors Association Winter Meeting, February 25, 2008 (video at www.kpcb.com/team/doerr).

71 Emma Ritch, "Solyndra reveals thin-film solar tubes," Cleantech Group™, LLC, October 6, 2008, http://www.cleantech.com/news/3647/solyndra-cigs-thin-film-solar-panel-tube-cylinder (accessed April 16, 2009).

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75 Solyndra press release, March 20, 2009, http://www.solyndra.com/News/Press-Release-032009 (accessed May 2, 2009).

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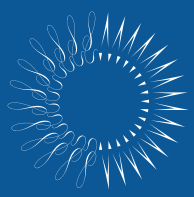
81 Pew interview with Kenneth Reifsnider, director, University of South Carolina's Solid Oxide Fuel Cell program, April 1, 2009.
82 Ibid.
83 Maryland Clean Energy Center Announcement (as prepared), Office of Governor Martin O'Malley, March 31, 2009, http://www.governor.maryland.gov/speeches/090331.asp (accessed April 27, 2009).
84 Database of State Incentives for Renewables and Efficiency, http://www.dsireusa.org (accessed April 14, 2009).
85 Pew interview with Texas State Representative Warren Chisum, March 27, 2009.
86 Ibid.
87 American Wind Energy Association, *Annual Wind Industry Report*, 2008, http://www.awea.org/publications/reports/AWEA-Annual-Wind-Report-2009.pdf (accessed April 16, 2009).
88 Pew interview with Chisum, March 27, 2009.
89 Glenn Anderson, "Green 2.0," *State Legislatures*, April 2009.
90 An EERS requires electric utilities and natural gas distributors to attain a required level of energy efficiency savings while an RPS requires utilities to obtain a certain amount of energy from renewable resources (i.e., wind, biomass, solar, etc.). RPS and EERS are complementary policies that when properly implemented can contribute to the reduction of a state's energy demand and dependency on fossil fuels.
91 There are 19 state-based EERS: California, Colorado, Connecticut, Hawaii, Illinois, Iowa, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York, North Carolina, Ohio, Pennsylvania, Texas, Washington, Vermont and Virginia. At this writing, three states are considering similar policies: Massachusetts, New Jersey and Rhode Island. American Council for an Energy-Efficient Economy (ACEEE), *Laying the Foundation for Implementing a Federal Energy Efficiency Resource Standard*, March 2009, http://aceee.org/pubs/e091.pdf?CFID=3657226&CFTOKEN=86100118 (accessed May 19, 2009).
92 Presidential Memorandum - The Energy Independence and Security Act of 2007, January 26, 2009, http://www.whitehouse.gov/the_press_office/The_Energy_Independence_and_Security_Act_of_2007/ (accessed April 29, 2009).
93 The Pew Campaign for Fuel Efficiency Web site, http://pewfuelefficiency.org/ (accessed April 29, 2009).
94 The White House Web site, http://www.whitehouse.gov/agenda/energy_and_environment/, http://change.gov/agenda/economy_agenda/ (accessed April 17, 2009).
95 "Highlights of House Cap and Trade Plan," *CQ Today*, April 1, 2009.
96 Among other categories of data, the NETS database provides the following types of information that allow for a micro-analysis of the clean energy economy: (1) business name, address and contact information (including officer, title, phone number, Federal Information Processing Standards [FIPS] codes and longitude and latitude); (2) number of related establishments in the same state; (3) industry classification (primary SIC and up to five secondary SICs; whether the primary three-digit SIC changed between 1990 and present); (4) type of establishment (single location, headquarters, or branch; public or private; and legal status: proprietorship, partnership, corporation or nonprofit); (5) employment at location and job growth relative to peers (three-digit SIC); and estimated annual sales at the establishment and its sales growth relative to peers.
97 *See* Sue Birley, "Finding the New Firms," *Proceedings of the Academy of Management Meetings,* vol. 47, 1984, pp. 64–68; Howard Aldrich, Arne Kalleberg, Peter Marsden and James Cassell, "In Pursuit of Evidence: Sampling Procedures for Locating New Businesses," *Journal of Business Venturing*, vol. 4, 1989, pp. 367–386; Steven J. Davis, John C. Haltiwanger, and Scott Schuh, "Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts," *Small Business Economics*, vol. 8, 1996, pp. 297–315.
98 David Neumark, Junfu Zhang and Brandon Wall, "Business Establishment Dynamics and Employment Growth," Hudson Institute Research Paper No. 05-02 (November 2005), p. 15.
99 The QL2 search platform could verify only the clean energy economy activities of companies that self-identified as producing or processing clean energy economy products or services. As a result, our verification process produced a conservative count of businesses and jobs in the clean energy economy.
100 Our 15 segments were based on 11 original segments identified by the Cleantech Group™, LLC, a trade association and consulting and research firm. *See* http://cleantech.com.
101 As defined by the Cleantech Group™, LLC, clean technology, or "cleantech," "represents a diverse range of products, services, and processes, all intended to provide superior performance at lower costs, while greatly reducing or eliminating negative ecological impact, at the same time as improving the productive and responsible use of natural resources." http://cleantech.com/about/cleantechdefinition.cfm (accessed May 3, 2009).
102 Database of State Incentives for Renewables and Efficiency database, http://www.dsireusa.org (last accessed on April 14, 2009).



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