CLEAN TECH JOB TRENDS 2009

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For nearly a decade, Clean Edge has issued its annual *Clean Energy Trends* report series in which we present the latest clean-energy trends; report on the current and projected size of the global market for solar, wind and biofuels; and provide insights and intelligence on the broader clean-energy market. This year, we are launching a new report series, focusing on employment in the clean-tech industry, in which we hope to do for clean-tech jobs what we did for clean energy in our earlier reports.

Admittedly, we aren't alone in being interested in the topic of clean-tech jobs.

U.S. President Obama and Chinese President Hu Jintao have both made clean-tech development and deployment a cornerstone of their leadership, targeting the creation of millions of new clean-tech jobs in the process. Brazil, the European Union, India, Japan, and other nations are also aggressively pursuing clean-tech job creation – investing dollars and human capital and implementing supportive policies. And the clean-technology sector is now one of the largest recipients of venture capital (VC) dollars – alongside biotech, software, and medical devices – with clean energy alone raking in $3.35 billion in the U.S. in 2008, according to New Energy Finance. Globally, VC and private equity totaled $13.5 billion in clean-energy investments last year.

The unprecedented level of interest and activity in clean-tech jobs is considerable, but there's a reason for it.

Private investments, while declining in 2009 and certainly under pressure in the current economic climate, are creating jobs among a host of startups such as smart grid networking company Silver Spring Networks in California; high efficiency window and green building materials manufacturer Serious Materials, with plants in California and around the U.S.; and thin-film solar photovoltaic (PV) manufacturer Odersun in Germany. TV stations, newspapers, and magazines across the globe are focused on the emerging phenomenon, with near daily coverage. And dozens of websites and social media outlets are now dedicated to the clean-tech jobs market, including our own jobs board, Clean Edge Jobs.

The unprecedented level of interest and activity in clean-tech jobs is considerable, but there's a reason for it. Many believe we are just at the beginning of the clean-tech jobs creation era, with clean tech offering the greatest opportunity for wealth and job creation (and global economic competitiveness) since the advent of the computer and the Internet.

In a Pew Charitable Trusts report published in June 2009, clean-energy jobs, defined as jobs in renewable energy, energy efficiency, environmentally friendly production, conservation and pollution mitigation, plus related training and support, accounted for half a percent of total employment in the U.S. – 770,000 jobs in 2007. While this number might seem small, it falls into a comparable sphere with such mature U.S. industries as biotech (200,000 jobs), telecommunications (989,000), and traditional energy including utilities, coal mining and oil and gas extraction (1.3 million). The Pew report also found that clean-energy jobs are growing faster than other sectors, increasing by 9.1 percent from 1998 to 2007 compared to 3.7 percent growth for all U.S. jobs over that same time period. According to Clean Edge research, the solar PV industry alone now represents approximately 200,000 direct and indirect jobs globally, while the wind power sector includes more than 400,000 direct and indirect jobs globally.

Defining Clean Tech

But what exactly is a clean-tech job?

We define clean-tech jobs as those that are a direct result of the development, production, and/or deployment of technologies that harness renewable materials and energy sources; reduce the use of natural resources by using them more efficiently and productively; and cut or eliminate pollution and toxic wastes. There's no mistaking the types of jobs we're talking about – they include solar photovoltaic (PV) system installers, wind-turbine technicians, energy-efficiency software developers, green building designers, and clean-energy marketers. While some of these jobs may seem exotic, they are increasingly becoming the norm. The table below shows some of the key sectors in which clean-tech jobs are now emerging.

Top Clean-Tech Job Sectors

Energy	Transportation
Renewable Energy (e.g., Solar, Wind)	Hybrid-Electric Vehicles
Energy Storage	All-Electric Vehicles
Energy Conservation and Efficiency	Electric Rail
Smart Grid Devices and Networks	Hydrogen Fuel Cells for Transport
Electric Transmission and Grid Infrastructure	Advanced Transportation Infrastructure
Biomass and Sustainable Biofuels	Advanced Batteries for Vehicles

Water	Materials
Energy-Efficient Desalination	Biommicry
UV Filtration	Bio-Based Materials
Reverse Osmosis Filtration	Reuse and Recycling
Membranes	Green Building Materials
Automated Metering and Controls	Cradle-to-Cradle Systems
Water Recovery and Capture	Green Chemistry

Some of these sectors are rising to the top. According to Clean Edge research, the top five sectors for clean-tech job activity in the U.S., based on a combination of job placements, job postings, and public and private investments, are solar; biofuels and biomaterials; conservation and efficiency; smart grid; and wind power.

Top 5 Sectors for Clean-Tech Job Activity (U.S.)

Rank	Sectors
1	Solar
2	Biofuels & Biomaterials
3	Conservation & Efficiency
4	Smart Grid
5	Wind Power

Source: Clean Edge, Inc., 2009

Show Me the Money: Clean-Tech Job Compensation Survey

But for clean-tech jobs to matter, they need to pay well and provide job security – part of long-term and sustainable clean-tech *careers*. For this report, Clean Edge conducted the first annual survey of clean-tech jobs with PayScale, a leading publisher of global compensation data, to determine the median salary and wage compensation for a range of clean-tech jobs. Our survey shows that clean-tech jobs often compete where it matters most – on pay levels.

Below is a sampling of median annual salary compensation data that we uncovered for select jobs within a number of clean-tech sectors worldwide.

Clean-Tech Compensation Overview

Job Title	Clean-Tech Industry	Median Pay	Typical Job Level	Typical Degree Level
Boiler Operator	Biofuels / Biomaterials	$61,100	Mid-Level	High School/Associate's Degree
Refuse, Garbage, and Recyclable Material Collector	Biofuels / Biomaterials	$38,100	Mid-Level	High School/Associate's Degree
Research Associate, Molecular Biology	Biofuels / Biomaterials	$46,600	Entry-Level	Bachelor's Degree
Geothermal Power Engineer	Geothermal	$71,799	Entry-Level	Engineering Bachelor's Degree
Architect (LEED Certified)	Green Building	$58,700	Mid-Level	Bachelor's Degree
Building Maintenance Engineer	Green Building	$43,300	Mid-Level	High School/Associate's Degree
Energy Field Auditor	Green Building	$48,500	Entry-Level	Bachelor's Degree
HVAC Service Technician	Green Building	$49,500	Mid-Level	High School/Associate's Degree
Instrumentation & Controls Technician	Green Building	$72,900	Mid-Level	High School/Associate's Degree
Insulation Worker	Green Building	$36,100	Mid-Level	High School/Associate's Degree
Project Manager, Construction (LEED Certified)	Green Building	$80,000	Senior-Level	Bachelor's Degree
Manufacturing Engineer	PHEV / EV	$60,300	Entry-Level	Engineering Bachelor's Degree
Mechanical Engineer	PHEV / EV	$63,600	Entry-Level	Engineering Bachelor's Degree
Accountant	Renewable Energy, General	$46,400	Mid-Level	Bachelor's Degree
Business Analyst	Renewable Energy, General	$61,500	Entry-Level	Bachelor's Degree
Financial Analyst	Renewable Energy, General	$60,200	Entry-Level	Bachelor's Degree
Marketing Coordinator	Renewable Energy, General	$39,300	Entry-Level	Bachelor's Degree
Project Developer	Renewable Energy, General	$106,000	Mid-Level	Master's Degree
Embedded Systems Engineer	Smart Grid	$77,100	Mid-Level	Engineering Bachelor's Degree
Hardware Design Engineer	Smart Grid	$87,700	Mid-Level	Engineering Bachelor's Degree

Clean-Tech Compensation Overview

Job Title	Clean-Tech Industry	Median Pay	Typical Job Level	Typical Degree Level
Journeyman Lineman	Smart Grid	$67,900	Mid-Level	High School/Associate's Degree
Network Operations Center Technician	Smart Grid	$46,400	Mid-Level	High School/Associate's Degree
Software Engineer	Smart Grid	$65,500	Entry-Level	Bachelor's Degree
Construction Foreman	Solar PV	$53,500	Senior-Level	High School/Associate's Degree
Electrical Design Engineer	Solar PV	$65,000	Mid-Level	Engineering Bachelor's Degree
Maintenance Technician	Solar PV	$44,100	Mid-Level	High School/Associate's Degree
Research and Development (R&D) Lab Technician	Solar PV	$41,400	Mid-Level	Bachelor's Degree
Solar Energy System Installer	Solar PV	$40,000	Entry-Level	High School/Associate's Degree
Solar Energy Systems Designer	Solar PV	$42,600	Entry-Level	Bachelor's Degree
Solar Fabrication Technician	Solar PV	$43,800	Entry-Level	High School/Associate's Degree
System Integration Engineer	Solar PV	$75,100	Mid-Level	Engineering Bachelor's Degree
Construction Superintendent	Wind Power	$74,000	Senior-Level	Bachelor's Degree
Field Service Engineer	Wind Power	$62,400	Mid-Level	Engineering Bachelor's Degree
Sheet Metal Worker	Wind Power	$50,300	Mid-Level	High School/Associate's Degree
Welder, Cutter, Solderer, or Brazer	Wind Power	$50,300	Mid-Level	High School/Associate's Degree
Wind Turbine Technician	Wind Power	$52,600	Entry-Level	Bachelor's Degree

Source: PayScale and Clean Edge, Inc., 2009

Definitions:

Median Pay: *The median pay is the national median (50th Percentile) annual total cash compensation (TCC). TCC combines base annual salary or hourly wage, bonuses, profit sharing, tips, commissions, overtime pay (when typical for a given job), and other forms of cash earnings, as applicable. It does not include equity (stock) compensation, cash value of retirement benefits, or value of other non-cash benefits (e.g., healthcare). Half the people doing the job earn more than the median, while half earn less.*

Range in pay within a job can be very wide depending upon years of experience, scope of responsibility, number of employees, etc. For example, pay can be higher than the stated median pay if the worker has higher levels of experience and responsibility or they work at a larger company.

Typical Job Level: *There are three categories: 1) Entry-Level Positions where workers typically have less than 5 years of experience, 2) Mid-Level Positions where workers typically have between 5 and 10 years of experience, and 3) Senior-Level Positions where workers typically have more than 10 years of experience. Years of experience refers to the number of years the respondent has spent in the field/career. Therefore the years of experience will incorporate all applicable jobs in the field, not just the current job.*

Typical Degree Level: *This is the degree held by the majority of respondents.*

Where Are the Jobs?

For first-time job seekers, mid-career changers, or anyone else interested in this sector, where are the jobs in clean tech? In our research, we've identified the top 15 metro areas in the U.S. for clean-tech job activity. This list of cities includes well-touted clean-tech centers such as San Francisco and Boston as well as less obvious contenders such as Chicago and Houston. To come up with our list of top U.S. clean-tech job cities, we evaluated a number of datasets, including current and historical job postings, early stage and public market investment activity, clean-tech job presence, and clean-energy patent activity. These metro areas stand at the forefront of clean-tech job activity in the U.S.

Clean-Tech Job Activity – Top 15 U.S. Metro Areas*

Rank	Metro Area
1	San Francisco-Oakland-San Jose, CA
2	Los Angeles-Riverside-Orange County, CA
3	New York-Northern New Jersey-Long Island, NY-NJ-CT-PA
4	Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH
5	Washington-Baltimore, D.C.-MD-VA-WV
6	Denver-Boulder-Greeley, CO
7	Seattle-Tacoma-Bremerton, WA
8	Portland-Salem, OR
9	Chicago-Gary-Kenosha, IL-IN-WI
10	Sacramento-Yolo County, CA
11	San Diego, CA
12	Austin-San Marcos, TX
13	Phoenix, AZ
14	Detroit-Ann Arbor, MI
15	Houston-Galveston-Brazoria, TX

Source: Clean Edge, Inc., 2009

**Job rankings are based on a proprietary weighting of job postings, investment activity, job presence, and patent activity collected from the following datasets:*
- *Job postings including historical data from executive recruiter Hobbs & Towne and from Clean Edge Jobs and other leading job boards*
- *Investment activity provided by New Energy Finance, including early stage investments (number of deals, money invested) and public market investments (number of deals, money invested) by U.S. metro region*
- *State level business & job presence published in a number of research reports including Pew Center's "The Clean Energy Economy" (based on data from the National Establishment Time Series database by Walls & Associates)*
- *Patent activity – Clean Energy Patent Growth Index published by Heslin Rothernberg Farley & Mesiti P.C.*

Although the 15 metro areas listed above are current hotbeds of clean-tech job activity, they are far from the only places to find quality employment in the sector. The clean-tech revolution is a highly dispersed phenomenon – unlike the earlier high-tech revolution with its epicenter of Silicon Valley. No one place or region will control any one clean-tech sector. Clusters of clean-tech activity, supported by local technology development, capital flows, and supportive public policies, are springing up across the U.S. and around the world. The table below highlights this point – showcasing examples of cities around the world (not including any of our top 15 U.S. centers, many of which have extensive activities in the following sectors) that are having a major impact in the world of clean tech.

A Highly Dispersed Revolution: Clean-Tech Activities Emerging in Cities Around the Globe

Sector	Centers of Expertise/Jobs
Solar PV Manufacturing	· Freiberg, Germany · Kansai, Japan · Toledo, OH · Singapore · Wuxi, China
Wind Turbine Manufacturing	· Randers, Denmark · Newton, IA · Daman, India · Tianjin, China
Green Building Design Services	· St. Louis, MO · Stuttgart, Germany · Abu Dhabi, UAE · Trondheim, Norway
Plug-in Hybrid Vehicles and Infrastructure	· Tel Aviv, Israel · Copenhagen, Denmark · London, United Kingdom · Amsterdam, The Netherlands
Smart Grid Networking, Controls, and Devices	· Spokane, WA · Zug, Switzerland · Rome, Italy · Miami, FL

Source: Clean Edge, Inc., 2009

In addition to highlighting key regional centers of clean-tech employment, it's illustrative to look at which companies are doing the hiring. Globally, clean-tech pure plays -- companies dedicated to clean-tech activities such as solar, wind, water filtration, and energy intelligence -- are a leading source of clean-tech jobs. Of the top 10 companies, four are headquartered in the U.S., three are based out of China, and three are European. Below is a list of the top 10 publicly traded clean-tech pure play employers worldwide – along with their most recent employee count.

Top 10 Clean-Tech Employers (Publicly Traded Pure Plays)

Rank	Company	Headquarters	Sector/Activity	Employees
1	Vestas Wind Systems	Randers, Denmark	Wind	21,100
2	LDK Solar	Xinyu, China	Solar	14,100
3	Nalco	Naperville, IL	Water	11,700
4	Suntech Power	Wuxi, China	Solar	9,000
5	Itron	Liberty Lake, WA	Smart Grid	8,700
6	China BAK Battery	Shenzhen, China	Energy Storage	8,200
7	Baldor Electric	Fort Smith, AR	Electric Motors	7,800
8	Gamesa	Vitoria, Spain	Wind	7,200
9	Kingspan Group	Kingscourt, Ireland	Green Building	5,500
10	SunPower	San Jose, CA	Solar	5,400

Source: Clean Edge, Inc., 2009

Based on companies' reported claims and publicly available Q2 2009 financial filings/most recent annual reports

In addition to these pure plays, diversified multinational corporations are also adding to the ranks of emerging clean-tech jobs. Siemens currently has 5,500 employees working for its wind business, BP has more than 2,200 solar employees, and GE Energy, with a diverse portfolio of both conventional and rapidly expanding clean-energy activities, employs 40,000. Other multinationals with significant clean-tech workforces, among a growing list, include Sharp, Toyota, and ABB. And, as we point out later in the report, major entities such as utilities are hiring more clean-tech workers as they transform their businesses.

Manufacturing: A Showcase for Clean-Tech Transition

The move toward a clean-tech economy is also becoming evident in the transition taking place in communities across the U.S. and abroad. Formerly shuttered manufacturing facilities, often in hard-hit industrial areas, are being retrofitted from traditional old-line industry roles into new and emerging clean-tech activities. Clean-tech manufacturers are setting up shop in places where they can hire skilled workers laid off in previous plant shutdowns, with minimal retraining. Not all the indicators are positive. Along with the downturn in the broader economy, many clean-tech deployments have been put on hold or completely scrapped. But many positive developments are moving forward nonetheless.

U.S. MANUFACTURING JOBS IN TRANSITION:

Examples of old-line manufacturing losses replaced by new clean-tech manufacturing gains

Location	Old Manufacturer	Job Loss	New Manufacturer	Job Gain
Newton, Iowa	Maytag (Whirlpool): Home appliances	1,800 people laid off in 2007	TPI Composites: Wind turbine blades	Has hired 325 people since 2008, aiming for 500 total jobs by 2010
West Branch, Iowa	Sauer Danfoss: Hydraulic pumps	130 people laid off in 2003	Acciona: Wind turbines	130 employed at the plant, with plans to expand as demand grows
New Bedford, Massachusetts	Polaroid/Multilayer Coating Technologies (MCT)	In 2006, Polaroid sold its film negative manufacturing facility to MCT, which then closed the plant just one year after the sale, terminating 250 jobs	Konarka: Thin film solar PV	Facility reopened in October 2008, now employs about 20 Konarka workers; the company plans to hire 100 more in the next three years
Vandergrift, Pennsylvania	Kensington Windows: Window manufacturer	150 laid off when plant closed in 2008	Serious Materials: Ultra energy efficient windows	Plant reopened after Serious Materials bought Kensington in January 2009, now employs 40; hopes to employ more than 100
Wixom, Michigan	Ford Motor Company	More than 1,500 jobs lost when plant closed in 2007	The 320-acre facility was recently bought by Xtreme Power (power systems for wind and solar) and Clairvoyant Energy (solar panel manufacturing)	With reopening planned for 2011, the plant is to become a renewable energy business park and could potentially employ thousands

Source: Clean Edge, Inc., 2009

From Crisis to Opportunity

We stand at a unique crossroads. The recent global financial crisis has been disastrous for already struggling old-line industries in the U.S., with the bankruptcy of General Motors heading a long list of business and employment woes. As has been quoted often, "A crisis is a terrible thing to waste." We believe this crisis can accelerate the transition to a clean-energy economy, with the creation of millions of new jobs in a wide range of clean-tech sectors. Those countries that take an active role will move out of the current crisis better positioned to lead in the next industrial revolution: clean technologies.

Indeed, although the numbers are relatively small today, employment in clean tech is moving solidly into the mainstream. From wind-turbine production line workers in central Pennsylvania and ethanol distillers in São Paulo, Brazil, to smart-grid software designers in northern California and PV manufacturers in China's Jiangsu province, clean tech has come a long way from the "alternative energy" pioneers of off-the-grid solar and other first-generation commercial technologies of the 1970s. And the clean-tech field is hot, particularly among younger students and graduates of community colleges, universities, and business schools and those in the high-tech centers of Abu Dhabi, Silicon Valley, Singapore, and Tokyo. At the same time, clean tech has invigorated social justice and labor groups to help extend these new jobs to historically disenfranchised groups. All of today's major global forces – action on carbon emissions reduction, lessening dependence on volatile fossil fuel supplies and prices, the sea change in government leadership on clean energy from Washington, D.C. to Canberra, Australia – point to huge potential growth in clean-tech employment.

Employment in clean tech is moving solidly into the mainstream.

In the following pages we highlight five major trends that we see reshaping the clean-tech jobs landscape. These include how conservation and efficiency are creating tens of thousands of new jobs and leading the clean-tech pack; how utilities facing an aging workforce are turning to a new stable of workers trained in clean tech and the smart grid; and how new educational programs are opening up clean-tech career paths. We then look at a number of emerging public financing models, such as Victory Bonds and the Green Bank, that could help fuel the next wave of innovation and job growth in clean tech.

Finally, at the end of the report, we provide an online resource guide for clean-tech job seekers and employers alike – with references to clean-tech books, reports, web sites, jobs boards, job fairs, networking organizations, educational programs from trade schools to MBAs, and more. We hope that our report will be a useful annual guide to job seekers, employers, and investors as the transition to a clean-tech economy moves forward.

FIVE TRENDS TO WATCH

1. ENERGY EFFICIENCY –THE MOST BANG FOR YOUR BUCK

In an otherwise bleak job market, energy efficiency companies around the world are proudly proclaiming, "Now Hiring!" This trend is catalyzed by stimulus dollars and a growing realization by companies, utilities, and governments that volatile energy costs make energy efficiency a highly competitive option for meeting their new energy needs, and a cost-effective job creator.

The Political Economy Research Institute, in a June 2009 publication, reported that the number of U.S. direct jobs created per million dollar investment in building retrofits and smart grid is far greater than direct jobs created in the coal industry, by a factor of 8:1 and 5:1 respectively. Even compared to wind and solar, at 4.3 and 5.4 direct jobs created per million dollars invested respectively, building retrofits' seven direct jobs per million dollars invested shows how the 'fifth fuel' – as energy efficiency is known – has the potential to pack the most bang for the buck.

The number of U.S. direct jobs created per million dollar investment in building retrofits and smart grid is far greater than direct jobs created in the coal industry.

The Northwest Planning and Conservation Council, for example, has projected that Idaho, Montana, Oregon, and Washington can meet 85 percent of their new electricity needs over the next 20 years solely through conservation, and do so at half the cost of building new power plants. Energy efficiency attracted more than 35 percent of the estimated $470 billion in green stimulus funding worldwide from January to May 2009, according to global financial firm HSBC. The firm defines efficiency as funding for buildings and grid infrastructure.

"Efficiency is the quickest way to meet our energy needs cost-effectively while making the U.S. a world leader in clean-energy technologies across multiple sectors." says Skip Laitner, director of economic and social analysis at the American Council for an Energy Efficient Economy.

In the face of economic turmoil, European efficiency leader Germany has allocated approximately 10% of its total (and more than 60% of climate-related) recovery funds to building retrofits. Since 2006, 6.4 billion euros (U.S. $8.5 billion) have

Profile:

Portland Energy Conservation, Inc. (PECI)

Location

Portland, Oregon

www.peci.org

Founded

1980

Employees

320 expected by the end of 2009

Industry Role

PECI provides energy conservation services for organizations ranging from grocery stores to utilities.

The Buzz

Diane Levin, director of the company's commercial retail program, says that utilities are beginning to shift their thinking toward efficiency measures to help meet increased energy demand. "What's emerging as prevalent thought," she says, "is considering the energy savings from efficiency and conservation as a resource itself – one that's far cheaper with greater potential to fill the demand needs than other alternatives."

Bankrollers

PECI was originally created by the City of Portland as a public agency. As public policy and the energy conservation field evolved, PECI was reorganized as a private, not-for-profit corporation.

Jobs Story

Proving the economics of efficiency work in good times and bad, PECI is an example of a company that has not sought stimulus dollars and is still growing rapidly and creating jobs. The company has added 100 employees since mid-2008, and expects to add another 40 by year's end for a total of nearly 320 employees – a 75% increase in staff during the worst financial crisis in decades.

Our Take

We expect to see exciting growth in the energy efficiency sector as utilities and large companies increasingly realize that it is the most cost-effective source for procuring new electricity. Also keep an eye on utilities on the hunt to acquire leading energy efficiency firms to bring that cost-saving expertise in house.

been invested in the country's CO2 Building Rehabilitation Programme. That's helped renovate 800,000 homes and created approximately 220,000 jobs in medium-sized construction companies, according to the German Ministry of Transport, Building and Urban Affairs.

In the U.S., while stimulus funds have been slow to actually roll out in some cases, workforce development agencies' efforts to administer weatherization training programs are well underway. The Weatherization Training Center at Pennsylvania Technical College in Williamsport will train 2,000 installers, crew chiefs, and energy auditors in the next two to three years, up from less than 400 annually in the past. And with the U.S. Department of Energy targeting one million homes to be weatherized in the next decade, they will likely be busy for years to come.

Meanwhile, venture-backed startups such as Hycrete and Serious Materials are developing new construction materials that require less energy and toxins to produce while delivering superior performance and efficiency. As LEED certification becomes more stringent, and eventually incorporated into building codes, these and other companies will likely need to continue to scale their workforce to meet growing demand.

The real test, however, will be the economy's uptake of these newly trained workers in the years ahead. Critics point out that a big short-term infusion of stimulus dollars in relatively low-paying jobs does not qualify weatherization and lighting upgrades as viable long-term industries. New financing models such as revolving loan funds are being looked at closely by governments across the country as a mechanism that could help to turn these jobs into careers.

Top Headlines

Energy Efficiency Provisions in Waxman-Markey Act Could Create 500,000 Jobs

Texas Energy Efficiency Industry Gets Stimulated

U.K. Government Unveils Plans to Meet 2016 Zero-Carbon Homes Target

Energy Efficiency Effort a Boost to N.C. Jobs

U.S. and China Join Forces on Energy Efficient Buildings

South Korea to Spend $84 Billion on Clean Energy and Energy Efficiency, Add Jobs

Related Job Titles

- Commercial Green Building & Retrofit Architect
- Energy Efficiency Finance Manager
- Energy Field Auditor
- Instrumentation Controls Technician
- Insulation Installer
- Lighting & HVAC Energy Engineer
- Weatherization Operations Manager

Select Organizations to Watch

Hycrete
www.hycrete.com

Orion Energy Systems
www.oriones.com

Portland Energy Conservation, Inc.
www.peci.org

RWE Effizienz GmbH
www.rwe.com/web/cms/de/249838/effizienz

Serious Materials
www.seriousmaterials.com

2. AGING WORKFORCE, NEW CLEAN TECHNOLOGIES TRANSFORM UTILITY INDUSTRY LANDSCAPE

The utility industry is looking for ways to attract a new generation of employees.

For some time, there have been warnings that the global workforce will struggle to replace vast amounts of knowledge and experience once the baby boomer generation reaches the age of retirement. The electric utility industry, with below-average turnover and thousands of career-long employees, is one of the most telling examples of this trend. While utilities frantically prepare for widespread retirements, they also have to acclimate to the growing presence of clean technologies. New business activities – smart grid deployments, large solar thermal power purchase agreements, and utility-owned and operated renewable energy projects – will necessitate vast retraining campaigns and novel hiring strategies. In the face of mass retirement and adoption of clean technologies, the utility industry's workforce is undergoing a significant transformation, one that will present great opportunities for those hoping to work on the front lines of the clean-energy economy.

Although job seekers will focus on the great potential behind this trend, utilities don't have the luxury of optimism and will be forced to intensify hiring and training efforts to make the most of a fleeting worker supply. An industry labor shortage seems counterintuitive given today's steep unemployment rates, yet the challenge is real. Almost half (46%) of the more than 20,000 employees at California's largest utility, Pacific Gas & Electric (PG&E), for example, will reportedly be eligible to retire in the next four years.

To avoid these crippling labor constraints, the utility industry is looking for ways to attract a new generation of employees. One group dedicated to this effort is the Center for Energy Workforce Development (CEWD). Formed in 2006, the nonprofit consortium of utilities and their associations works with contractors, unions, and educators to implement strategies to build a skilled workforce and ease the impact of an industry labor shortage. CEWD's Get Into Energy Career Pathways Model is designed to provide a roadmap for entry into skilled utility technician positions. Individual utilities' efforts, like PG&E's PowerPathway Bridge Programs, are also bolstering the workforce pipeline. In 2008 and 2009 PG&E

Profile:
Pacific Gas & Electric

Location

San Francisco, California

www.pge.com

Founded

1905

Employees

21,000

Industry Role

PG&E serves customers in northern and central California – approximately 5.1 million electric customer accounts and 4.2 million natural gas accounts. Over the next 10 years, the utility plans to meet almost half of new energy demand through energy efficiency.

The Buzz

PG&E, already a leader in wind energy and solar PV, has garnered attention for its efforts to integrate newer clean technologies. The company plans to install 10 million SmartMeter electric and gas meters by the end of 2011, has entered into agreements to buy 1,310 MW of solar thermal power from BrightSource Energy, and has hopes to build a 300 MW compressed air energy storage system to store wind and solar power underground.

Bankrollers

PG&E Corporation is an investor-owned utility, with stocks traded on the New York Stock Exchange (NYSE:PCG). With more than 370 million issued shares, the company has a market cap exceeding $15 billion.

Jobs Story

PG&E has catered a portion of its PowerPathway employee training program to help communities and educational institutions attract and train a clean-energy workforce. This effort will be crucial, considering that PG&E will need a large, specialized workforce to deploy and maintain new clean-technology projects.

Our Take

If PG&E can tap the state's vast education system while also luring environmentally conscious citizens by positioning itself as a facilitator of clean energy, it will be in a good position to reenergize its labor force.

offered courses at local community colleges designed to prepare students to pass the company's pre-employment test for maintenance and construction jobs.

Traditional utility recruiting efforts have satisfied human resource needs in the past, but as the number of clean-energy utility jobs grows, new training sources – like those mentioned in the "Coming to a Campus Near You: Clean-Tech Career Training" trend on page #14 – are beginning to play a bigger role. Clean-tech education programs are great career feeder systems for sector-specific jobs with wind or solar companies, but they are also closely intertwined with the utility industry. At Oklahoma State University's Oklahoma City campus, the wind turbine technology program trains students to work in electric power transmission and distribution. The program began classes in January 2009 and will be a boon for Oklahoma Gas & Electric's (OG&E) growing wind energy capacity, which is slated to swell from 170 megawatts at the end of 2008 to nearly 800 MW by 2012. Graduates of the university's wind program will be equipped to build and maintain OG&E's transmission infrastructure, and veteran OG&E special project engineer Jim Stengle is among the program's instructors.

Utility companies are rapidly adapting to a reality in which clean power sources like wind, solar, and geothermal are not "alternative" energy, but an integral part of the mainstream energy mix. At the same time, utilities are approaching a large wave of employee retirements that will reshape the industry. Given these two factors, we expect the utility industry's clean-tech revolution to unfold from the bottom up – led by the hiring of younger, clean-tech savvy workers, and the promotion of current employees with a knack for new technologies.

Top Headlines

Fresno City College Class Helps Boost PG&E Applicants
Survey: Reliability, Aging Workforce, Infrastructure Tops Electric Utilities' Concerns
For Community Colleges, Wind Technician Training is a Growth Business
Stimulus Funds May Help Alleviate Utility Worker Shortage
Utility Grant Helps Pay for "Green Jobs"
With Training, New Mexico Workers are Making the Shift to Clean-Energy Jobs

Related Job Titles

- Distribution & Transmission Specialist
- Environmental Engineer
- Manager - Solar Interconnection
- Network Systems Administrator
- Renewable Power Program Manager
- Solar Thermal Generation Specialist
- Wind Energy Technician

Select Organizations to Watch

Center for Energy Workforce Development
www.cewd.org

National Commission on Energy Policy
www.bipartisanpolicy.org

NextEra Energy Resources
www.nexteraenergyresources.com

Oklahoma Gas & Electric
www.oge.com

Pacific Gas & Electric
www.pge.com

3. COMING TO A CAMPUS NEAR YOU: CLEAN-TECH CAREER TRAINING

Flush with interest and government funding, new clean-tech educational initiatives are rapidly sprouting up and expanding across the globe, creating opportunities for students and instructors alike. Driving this trend is an unprecedented alignment of leading stakeholders – universities, trade groups, companies, and students. With governments largely footing the bill – to the tune of hundreds of billions in new stimulus-backed programs – investment in clean-tech human capital is now a leading strategy to a sustained global economic recovery in the short term, and a targeted engine of growth through the 21st century.

One group at the forefront is U.S. community colleges, which are initiating new programs in high-demand fields that include energy auditing, home weatherization, solar fabrication, and wind turbine manufacturing and maintenance. The nation's second largest generator of wind power among states, Iowa, is home to six wind turbine manufacturers including Vestas and Clipper Windpower, plus the wind developer Acciona, who compete for graduates of Iowa Lakes Community College's two-year wind energy program in Estherville that has grown from 15 students in 2004 to 102 students this fall. Community colleges provide an excellent on-ramp to clean-tech jobs for those traditionally disenfranchised economically, including minorities, youth, military veterans, and women.

Community colleges provide an excellent on-ramp to clean-tech jobs for those traditionally disenfranchised economically.

Oregon Institute of Technology was the first educational institution in the U.S. to offer a four-year degree in renewable energy engineering at its Klamath Falls and Portland locations. The program has seen meteoric growth from 5 students enrolled in 2005 to 210 students enrolled this fall. Green MBA programs at the University of Michigan, the Presidio School of Management, and many others aspire to turn out the next generation of clean-tech entrepreneurs, corporate managers, and financiers. In the EU, the European Master's in Renewable Energy offered through Oldenburg University (U.K.), University of Zaragoza (Spain), and others provides multi-country post-doc training opportunities in a number of clean-tech sectors to feed the demand for high-level engineers worldwide.

University-industry partnerships are catalyzing innovation and creating regional clean-tech hubs. Ohio's Toledo Univer-

Profile:

National University of Singapore (NUS)

Location

Singapore

www.nus.edu.sg

Founded

1905

Students

30,000

Technology Programs

The flagship clean-energy initiative at the university is the Solar Energy Research Institute of Singapore (SERIS), which plans to produce 50 PhD and 20 Masters students in its first five years. The institute houses state-of-the-art facilities for characterization and calibration of PV materials and devices, solar cell R&D, solar building R&D, and PV module performance analysis. It aims to create a high-level talent pool of solar energy specialists to spur industry development and spinoffs.

The Buzz

The Singapore Economic Development Board expects 7,000 clean-tech jobs to be created across all clean-tech sectors by 2015. The NUS solar and clean water programs are a major opportunity for the small but highly innovative island nation to add clean-tech innovation to its already impressive technology pedigree.

Bankrollers

Between 2008-2013 the Singapore Economic Development Board (EDB) and the National University of Singapore (NUS) will invest $130 million in SERIS.

Jobs Story

SERIS currently employs 40 researchers and professionals from 14 countries and is targeting 100 people by 2010. With professor Joachim Luther, former director of the renowned Fraunhofer Institute in Germany, at the helm, the institute is already building global acclaim.

Our Take

Singapore is already home to facilities of Oerlikon Solar, Vestas, GE, and Renewable Energy Corporation, which is building one of the world's largest solar manufacturing plants at 1.5 GW capacity. With a highly educated labor pool drawing from around the world, the NUS research and training programs will be a key part of attracting additional clean-tech investment dollars to the country.

sity, for example, is expanding its solar engineering department as the city becomes a hub for solar companies, with Xunlight and First Solar manufacturing thin-film photovoltaics on opposite sides of the Maumee River. Similar developments are taking place in Colorado for wind; in Freiberg, Germany for solar PV; and Singapore for solar and clean water technologies.

But no matter how much is invested in educational initiatives and research in the U.S. and Europe, there is no guarantee that the jobs – particularly in manufacturing – will follow, because the growth of clean-tech educational initiatives is a global trend. Market forces will continue to push many clean-tech jobs to the highly educated and increasingly professional, yet significantly lower-cost, global labor pool. According to a 2006 Duke University study, Indian universities and technical schools graduate over 200,000 engineers each year, comparable to the number of engineers educated by U.S. schools. These graduates are now eyeing jobs at Indian clean-tech companies like REVA Motors, Moser Baer, and Suzlon, which alone has grown from 20 to 14,000 employees since 1995. Similarly, many of China's 1,500-plus universities and institutes are rapidly building up their clean-tech related programs, such as the Beijing Solar Energy Research Institute and the Guangzhou Institute of Energy Conversion. With six of the world's top 15 solar manufacturers now located in China, engineering graduates can make around $7,000 per year at these companies – three and half times the national average.

Make no mistake, there is a risk that there will not be enough jobs in some sectors to accommodate the rapid influx of newly minted clean-tech graduates. But as clean-tech activities rise globally, options for finding clean-tech training at a campus nearby will be easier to come by, no matter where you live.

See our resource section at the end of this report for a list of clean-tech educational opportunities.

Top Headlines

Classes Start for First Students at Masdar Institute of Science and Technology

Siemens Opens Wind Training Center in Germany

Ghana to Set Up Solar Testing and Training Centers

Arizona State University Announces New Renewable Energy Technology Program

SolarWorld to Recruit Workers From Portland Community College

National Renewable Energy Laboratory Partners with RES Americas for Balance-Of-Plant Research

Related Job Titles

- Energy Storage Research Sr. Technician
- Lecturer, Renewable Energy Law
- Post-Doctoral Researcher – Solar Photovoltaics
- Professor of Engineering and Renewable Energy
- Weatherization Training Program Manager
- Wind Energy & Turbine Technology Program Coordinator

Select Organizations to Watch

European Master in Renewable Energy
www.master.eurec.be

Guangzhou Institute of Energy Conversion
http://english.giec.cas.cn

Iowa Lakes Community College
www.iowalakes.edu

National University of Singapore
www.nus.edu.sg

Technical University - Bergakademiereiberg Freiberg
http://tu-freiberg.de/index.en.html?int_fav=en

4. CLEAN-TECH MANUFACTURING MOVES NEAR END-USE MARKETS

Throughout the U.S. and the world, many clean-tech companies are increasingly moving manufacturing near the end market for their products. In some cases it's becoming critical – because of financial incentives, carbon constraints, shipping costs, and other factors. As this trend toward localization continues, regional market demand and government support will play strong roles in the creation of clean-tech manufacturing jobs.

The most prominent evidence of localization can be seen in the wind industry, where manufacturers are faced with the logistical challenges of distributing massive products over vast market areas. For utility-scale wind turbines, a single blade typically ranges from 27 to 45 meters in length, according to the American Wind Energy Association. At this scale, the location of manufacturing can be the difference between business success and failure.

At this scale, the location of manufacturing can be the difference between business success and failure.

Denmark-based Vestas Wind Systems, the world's largest wind turbine maker, is placing manufacturing bets on where tomorrow's market demand will be. In April 2009, the firm revealed plans to lay off 1,900 European employees, citing a reduced demand for wind turbines in Northern Europe. But across the Atlantic, the company is eyeing growth. Vestas says it will spend $1 billion in capital investments in the U.S. over the next two years and is hoping to create thousands of new jobs in the process. The manufacturer is also expanding in China, where it is offering a Chinese-made 850 kW turbine designed to withstand the winters of Inner Mongolia.

Localization is also prompting moves within as well as across borders. In August 2009, German wind turbine manufacturer REpower Systems announced plans to move its U.S. headquarters from Oregon to Colorado, closer to the growing wind energy market across the Great Plains of mid-America. As Iowa has surged past California to become the nation's second largest producer of wind energy (behind Texas), turbine and blade manufacturers such as Acciona, Siemens, and TPI Composites have established facilities there.

Other clean-tech sectors are experiencing similar labor local-

Profile:
Vestas Wind Systems

Location

Randers, Denmark

www.vestas.com

Founded

1945

Employees

21,000

Industry Role

What started as a maker of household appliances is now the world's largest manufacturer of wind turbines. In 2008, the company reportedly installed a new turbine every three hours worldwide.

The Buzz

Vestas is chasing market demand with targeted expansion in China and other markets, but the closing of a U.K. blade factory earned the turbine manufacturer its hottest headlines of the year. A sit-in protest at the Isle of Wight plant was ultimately not enough to overcome decreased demand in Northern Europe. The company eventually said in a press release that "it does not make sense, from an environmental and cost perspective, to ship turbines overseas instead of providing them locally."

Bankrollers

In 1998, Vestas went public with an IPO on the Copenhagen Stock Exchange. The company now has a market cap of around $15 billion.

Jobs Story

More than 400 jobs were deemed "redundant" at the Isle of Wight factory, and more than 1,200 more people are expected to be laid off in the company's Denmark facilities. Meanwhile, Vestas Americas – with headquarters in Portland, Oregon – has several facilities in operation or under construction in Colorado, and plans to establish new R&D sites in Houston and Boston.

Our Take

We expect to see a continued effort from Vestas to establish manufacturing sites near the fastest-growing markets. Localization will be exceptionally important in markets like China, where the government is requiring wind farms to be constructed with a high percentage of domestically produced components.

ization. For the emerging wave and tidal energy sectors, manufacturing resembles the wind industry, with products' massive size and weight confining production – and jobs – to limited coastal areas like Oregon, New Jersey, Portugal, and Scotland. Although the wave and tidal energy industry is in its infancy, it still carries the potential to create a significant number of jobs. An August report by the Forum for Renewable Energy Development in Scotland estimated that scaling up of marine energy could add 12,500 jobs to the Scottish economy by 2020.

Even in the solar PV market, where supply chain activities are often scattered across the globe, there is evidence of efforts to localize final module assembly. Chinese PV module maker Suntech Power, encouraged by U.S. solar market conditions, says it will be opening an American assembly plant in 2010 in either Texas or Arizona that is expected to employ 75 to 150 people. By locating its facilities closer to its customers in the American Sunbelt, the company expects to decrease logistical costs, reduce transport-related carbon emissions, and combat increasingly protectionist policies that put foreign-manufactured products at a disadvantage.

To be sure, much large-scale production, especially of smaller form-factor clean-energy products like PV cells, will continue to migrate to lowest-cost manufacturing regions like China. Clean-tech manufacturing jobs will never be as location-specific as installer and maintenance jobs at the sites of clean-energy installations and energy-efficiency retrofits. But as customers become more concerned with a product's carbon footprint, and a price on carbon boosts shipping costs – a large diesel-powered cargo ship can emit as much CO2 in a year as a medium-sized coal plant – we do expect the localization of clean-tech manufacturing jobs to be a growing trend.

Top Headlines

REpower Announces New Denver Headquarters for U.S. Subsidiary

Vestas Expands Wind Turbine Manufacturing in China and U.S. as British Demand Collapses

Wind Energy Manufacturing Boom Taking Shape in The U.S.

Suntech Power Looks for Factory Space in the U.S.

Arizona-Made Solar Panels Hit Market

U.K. Consumers Continue to Demand Lower Carbon Despite Ongoing Financial Crisis

Related Job Titles

- Biomass Collector, Separator, and Sorter
- Senior Power Systems Engineer
- Solar Fabrication Technician
- Wind Turbine Blade Composite Material Specialist
- Wind Turbine Generator Builder

Select Organizations to Watch

Aquamarine Power
www.aquamarinepower.com

Clipper Windpower
www.clipperwind.com

REpower Systems
http://www.repower.de/index.php?id=347&L=1

Suntech Power
www.suntech-power.com

Vestas Wind Systems
www.vestas.com

5. THE NEXT BIG THING IN IT JOBS: NETWORKING THE GRID

The smart grid has become one of the hottest areas of clean tech. What is it? Well, it's a lot of things, ranging from enhanced grid monitoring and renewable energy integration to smart meter networking and consumer energy management. Deployment of these upgrades to the world's electrical grids will require an enormous amount of manpower – and this means jobs.

There will be plenty of opportunities for traditional grid workers: installing smart meters, building transmission and distribution networks, and integrating new generation capacity. But the heart of the smart grid is in the digital management of data, not unlike the Internet. With even more potential nodes than the Internet, however, the smart grid will be the mother of all networks, placing the work of creating smart grids largely on the shoulders of the IT community.

Recognizing the smart grid as an IT-related challenge, some high-level IT executives are leaving traditional industry posts for leadership roles at emerging smart grid startups, a trend that is sure to continue. In mid-2009, Silver Spring Networks, a leading developer of grid networks, lured Judy Lin away from Cisco Systems where she had been senior vice president of the company's Ethernet switching technology group. She now serves as chief product officer for Silver Spring. Not long before Lin's move, John Spirtos left his post as senior vice president of Comverse Technology – a communication and billing software provider – to become head of corporate development and strategy at GridPoint, one of the top grid network platform developers.

The smart grid will be the mother of all networks, placing the work of creating smart grids largely on the shoulders of the IT community.

In some cases, entrepreneurial spirit has led IT veterans to form their own companies. Consider Greenbox Technology (which was recently acquired by Silver Spring Network), founded by creators of the web multimedia platform Flash. Jon Gay, Peter Santangeli, Robert Tatsumi, and Gary Grossman left the Internet world behind in 2007 to pursue a solution to home energy management. Greenbox's web-based tool got a test run in early 2009 during an Oklahoma Gas & Electric smart grid pilot project. Ecologic Analytics is another example. Ecologic's current vice president and chief operating officer,

Profile:
Cisco Systems

Location

San Jose, California

www.cisco.com

Founded

1984

Employees

66,000 (100+ involved in smart grid)

Industry Role

The Internet technology giant serves many industries with its communication networking equipment and related services.

The Buzz

The company sees vast potential in smart grid technology and has been increasing exposure to the sector with its EnergyWise software, designed to reduce energy consumption for corporate customers, and the Cisco Smart Grid solution, a range of products and services to help utilities and energy companies deploy smart grid technologies.

Bankrollers

With a market cap exceeding $135 billion, Cisco trades on NASDAQ under the ticker CSCO. In June 2009, Cisco replaced General Motors as one of the thirty components in the Dow Jones Industrial Average.

Jobs Story

The company reports that it has more than 100 people working on smart grid-related activities and expects this number to grow as smart grid business escalates. Partnerships with Landis+Gyr and Duke Energy will catalyze smart-grid growth, creating additional opportunities across the industry.

Our Take

Cisco played a major role in the Internet revolution and wants to play a similarly significant role in the smart grid build-out. In May, Cisco said it expects smart grid technology to be a $20 billion a year market over the next five years. If the company hopes to capture a sizeable share of this opportunity, a good number of Cisco smart-grid jobs should be just around the corner.

Kristine Beck, cofounded the meter data management company in 2000 after spending nearly two decades in IT, most recently with the IT department of Minnesota-based utility Xcel Energy.

For non-executive IT professionals, grid-related jobs can be found at smart grid startups. But a growing number of opportunities are also emerging at traditional high-tech companies looking to capitalize on efforts to digitize the grid.

Cisco has emerged as an influential member of the smart grid community and currently offers a bundle of grid products, technologies, and services. The IP networking giant says it already has more than 100 employees dedicated to work on the smart grid and expects this number to grow as business picks up. In August, IBM announced a partnership with energy-data-network-developer Trilliant to improve integration of smart grid software. IBM 's grid ambitions can also be seen in the Mediterranean island nation of Malta, where the company is creating the world's first nationwide smart grid. And Google and Microsoft have taken their fight from search engines to home energy management with the release of competing energy management products, Google's PowerMeter and Microsoft's Hohm.

The growing smart grid market has some serious job creation potential. A January 2009 report by KEMA, Inc., an energy consulting firm, estimated that in the U.S. alone, smart grid development efforts could create up to 280,000 direct jobs between now and 2012. IT veterans and novices, recognizing the smart grid's potential, are shifting attention to this booming industry. The smart grid scale-up demands a workforce that can handle the technical challenges of bringing 21st century networking capabilities to our vast and largely antiquated energy infrastructure. Given these circumstances, it's easy to see that the future of the smart grid belongs to the IT professional.

Top Headlines

Trilliant and IBM Join Forces on Smart Grid Software Solutions

IT Companies Helping Make Smart-Grid Vision a Reality

Cisco Teams with Swiss Company on Smart Grid Projects

Grid Net Funding Round Includes Intel

San Diego Utility's Smart Grid Plans: Cisco, IBM, WiMAX, DOE Funds

Oracle Rumbles into Smart Grid Software Market

Related Job Titles

- Advanced Metering Engineer
- Energy Analytics Manager
- Grid Application Systems Analyst
- Lead Architect – AMI and Smart Grid Technology
- Network Operations Center (NOC) Technician
- Smart-Grid Solution Expert

Select Organizations to Watch

Cisco Systems
www.cisco.com

IBM
www.ibm.com

Silver Spring Networks
www.silverspringnetworks.com

Tendril Networks
www.tendrilinc.com

Trilliant
www.trilliantinc.com

THE ROAD AHEAD: FIVE U.S. MODELS FOR PUBLICLY FINANCING CLEAN-TECH JOB CREATION

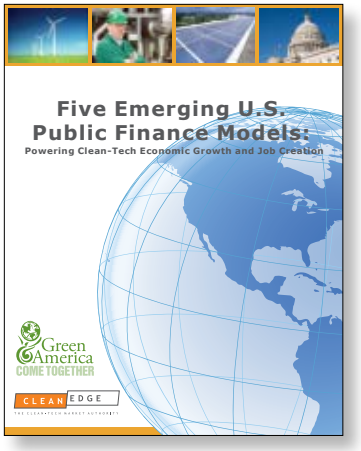
In today's challenging economic climate, government actions to get capital flowing again have taken center stage. The United States' $787 billion stimulus plan, officially the American Recovery and Reinvestment Act (ARRA) of 2009, is one of the most prominent examples, along with stimulus efforts in other countries such as Germany and Japan. And China, by all measures, is vying to be a clean-tech powerhouse by investing heavily in its nation's build out of clean technologies. China is now home to a plethora of solar photovoltaic (PV) manufacturers, burgeoning large-scale wind farms, and the largest concentration of solar hot water heaters in the world. According to numerous reports, the Chinese government could end up spending U.S. $440 billion to $660 billion toward its clean-energy build out over the next ten years.

The clean-energy sector also needs innovative new finance models that leverage public and private capital to fund industry growth.

But government stimulus plans alone cannot guarantee success. The clean-energy sector also needs innovative new finance models that leverage public and private capital to fund industry growth and projects large and small. In order to gain the benefits of the clean-tech revolution – from job creation and energy security to climate solutions and the creation of a 21st century economy – the United States needs new financial instruments that can provide the capital necessary for the rapid expansion of clean-tech industries. Fortunately, a growing number of innovative new ideas for U.S.-based public financing of clean tech provide both promise and hope.

Below is a quick overview of the five of the most promising public financing models:

- Clean Energy Deployment Administration (CEDA) aka The Green Bank
- Clean Energy Victory Bonds
- Tax Credit Bonds
- Federal Loan Guarantees
- Clean Tech City Funds



To learn more about the financing models overviewed on these pages, see our companion report *Five Emerging U.S. Public Finance Models: Powering Clean-Tech Economic Growth and Job Creation.* Published in partnership with Green America, the report can be downloaded at www.cleanedge.com and www.greenamericatoday.org. In the full report, we review each of the financing models in depth, including their history, current state of activity, and potential impact on clean-tech economic growth and job creation – along with visual flow charts and further recommended reading.

MODEL #1: CLEAN ENERGY DEPLOYMENT ADMINISTRATION (THE GREEN BANK)

The Clean Energy Development Administration (CEDA), aka The Green Bank, is a relatively new concept for public clean-energy financing. Plans for CEDA are working their way through the U.S. House and Senate, via provisions in both chambers' versions of pending energy legislation, and the idea has picked up considerable bipartisan support. The bank could fund a range of renewable energy, energy efficiency, and low-carbon solutions. And most important, the bank is projected to leverage public funding by a factor of 10 to 20, so $10 billion invested by the bank could result in $100-$200 billion in total public and private investment by utilizing traditional loans, loan guarantees, and credit enhancement provisions.

While the concept of a green bank is new to energy, it isn't new to the U.S. Similar government investments have supported private enterprise in the past, from the build out of railroads in the 19th century to the development of ARPANET, the precursor to the Internet. And there's a rich history of quasi-governmental organizations that support investments, including the Export-Import Bank of the United States, the Overseas Private Investment Corporation, and the CIA's not-for-profit venture capital arm In-Q-Tel.

MODEL #2: CLEAN ENERGY VICTORY BONDS

The concept of Victory Bonds isn't new. Most notably during World War II, similar bonds were sold in the U.S., Canada, and other nations to support the war effort. Between 1941 and 1946, 85 million Americans, approximately 60 percent of the total U.S. population at the time, invested a cumulative $185 billion in so-called "war bonds" (more than $2 trillion in todays dollars). In Canada, Victory Bonds raised approximately $12.5 billion for that nation's war effort during WWII, with rates ranging between 1.5 and three percent.

A number of initiatives are currently underway worldwide to replicate the war bond concept. The World Bank, along with Scandinavian bank SEB and several other institutions, raised more than $350 million for the first round of "green bonds" in late 2008 with interest rates of around 3 percent. Similarly, in 2007, the European Investment Bank (EIB), a nonprofit long-term lender in the EU, issued more than 1 billion euros worth of its AAA-rated Climate Awareness Bonds.

Clean Energy Victory Bonds could potentially democratize the financing of clean tech. In today's investment environment, a bond that returns between 3 to 5 percent annually, supports clean-energy development and national security, and is backed by the U.S government should prove popular.

MODEL #3: TAX CREDIT BONDS

There are several types of federal bonds that offer bondholders a federal tax credit partially or fully in lieu of interest payments. Three with the best potential to fund clean-energy projects and create jobs include Clean Renewable Energy Bonds; Qualified Energy Conservation Bonds; and Build America Bonds (BABs).

With each model, the Internal Revenue Service essentially authorizes a bonding authority (such as a city, state, or Native American tribal government) to issue federal tax credits as payments to a bond buyer. This gives the bonding authorities additional options for raising the money necessary to fund bonded projects in energy, transportation, construction, and other areas. BABs, in particular, have proven extremely popular, because in place of a tax credit, bond issuers may opt for a BAB-Direct Payment and receive a direct federal subsidy instead. BABs have not yet been used for clean-energy projects, but have plenty of untapped potential to make that happen.

MODEL #4: FEDERAL LOAN GUARANTEES

Government loan guarantees have a long history. Bringing this legacy to clean energy, the U.S. Department of Energy's Loan Guarantee Program, established in the Energy Policy Act of 2005, sounded great in theory and simple in concept. For a range of clean-energy-related projects, the feds would act as a guarantor for banks and other lenders who might balk at a loan because of project uncertainty, default risk, lack of traditional collateral, or other reasons. But an expensive and laborious application process, onerous red tape, lack of DOE emphasis, and the need to hire outside consultants, lobbyists, and legal counsel just to navigate the process kept most prospective recipients away from the program.

Recent deals, however, show a strong ray of hope for what the loan guarantee program can achieve. A recent DOE guarantee of $535 million to solar PV panel maker Solyndra will help fund the first phase of its new PV manufacturing plant in Fremont, California. President Obama and Secretary of Energy Dr. Steven Chu have been much more aggressive in supporting the program, and in July 2009 Chu announced an additional $30 billion in DOE loan guarantees, plus $750 million for electric transmission projects that commence before 2011. Other recent loan guarantee recipients include wind energy developer Nordic Windpower USA, energy storage technology provider Beacon Power, and auto manufacturers Ford, Nissan North America, and Tesla Motors to speed development of electric and fuel-efficient vehicles.

MODEL #5: CITY FUNDS

Among the more innovative clean-energy financing models in the U.S. are city-administered loan funds springing up from coast to coast. Particulars vary considerably from city to city, but in the basic model, homeowners borrow the funds necessary to pay for a solar array or an energy efficiency upgrade – then repay the loan (often at below-market rates) over a long-term period through their property tax or utility bill.

Cities at the forefront of this model include Berkeley, California; Portland, Oregon; Cambridge, Massachusetts; and Boulder, Colorado. Many examples are also emerging at the state level, with Colorado, Connecticut, New Jersey, Oregon, and Pennsylvania among those weighing plans.

To learn more about the financing models overviewed on these pages, see our companion report *Five Emerging U.S. Public Finance Models: Powering Clean-Tech Economic Growth and Job Creation*. Published in partnership with Green America, the report can be downloaded at www.cleanedge.com and www.greenamericatoday.org.

JOB RESOURCE GUIDE

Job Reports

Check out the reports below to learn more about clean-tech job growth potential and associated economic benefits **(titles link to the report PDFs)**.

The Clean Energy Economy

The Pew Charitable Trusts - June 2009
Pew's exploration of America's clean-energy economy includes a look at the growth of clean-energy jobs from 1998 to 2007. States are ranked by job and business presence, investment totals, patent activity, and rate of growth.

Defining, Estimating, and Forecasting the Renewable Energy and Energy Efficiency Industries in the U.S. and in Colorado

ASES and Management Information Services - December 2008
As the title explains, this report by the American Solar Energy Society defines, estimates and forecasts the renewable energy and energy efficiency industries in the U.S. and Colorado under three scenarios.

The Economic Benefits of Investing in Clean Energy

Center for American Progress and PERI - June 2009
This paper looks at how the American stimulus and proposed climate legislation will affect jobs, income, and the clean-energy economy.

How to Revitalize America's Middle Class With the Clean Energy Economy

Blue Green Alliance - June 2009
This policy brief is an update of a 2006 analysis and is designed to highlight the economic benefits that renewable energy development can bring to regions throughout the country.

U.S. Metro Economies: Current and Potential Green Jobs in the U.S. Economy

Global Insight - October 2008
This report examines the economic benefits of the 'Green Economy'. Current green jobs are discussed, along with potential future job growth in areas like renewable power generation, energy efficiency, and renewable transportation fuels.

Wind Energy and Green Jobs

Governors' Wind Energy Coalition - February 2009
GWEC profiles the economic benefits of wind energy and provides policy recommendations which it believes will help states meet the full economic potential from wind energy.

Books

These books are a useful way to navigate the clean-tech industry and find the best strategies to land a job.

Careers in Renewable Energy

Careers in Renewable Energy
With overviews of several renewable energy sectors and information about different career opportunities, this book is a good starting point for anyone looking for a job in the industry.

The Clean Tech Revolution

Ron Pernick and Clint Wilder – Collins Business, 2007 (Paperback 2008)
Provides an excellent overview of the key drivers behind the shift to clean technology and highlights eight emerging clean-tech opportunities. A business-oriented crash course in clean technology.

The Complete Idiot's Guide to Green Careers

Barbara Parks, Jodi Helmer – Alpha, 2009
The popular book series tackles green jobs with this book that explores opportunities in several sectors in the clean-tech industry.

Green Careers: Choosing Work for a Sustainable Future

Jim Cassio – New Society Publisher, 2009
This book provides several sector overviews, information on career opportunities, job search resources, and case studies on environmental jobs.

Green Careers – WetFeet Insiders Guide

Frank Marquardt – WetFeet.com, 2008
Marquardt, who more recently authored The Solar Job Guide e-book, looks at how to land a job in emerging green industries.

The Green Collar Economy

Van Jones – HarperOne, 2008
Written by Green for All founder Van Jones, this book presents a blueprint of how a "green new deal" can simultaneously tackle environmental and socio-economic challenges, creating thousands of jobs in the process.

Green Jobs: A Guide to Eco-Friendly Employment

A. Bronwyn Llewellyn – Adams Media, 2008
A useful text, this book breaks down opportunities in many industries for people interested in environmentally conscious careers.

The Solar Job Guide

Frank Marquardt – 2009
For those specifically interested in the solar field, this e-book gives a detailed look at the industry and provides useful information on how to land a solar job.

JOB RESOURCE GUIDE

Blogs

Blogs are a great way to keep up with the latest news and gather insight from some of the brightest minds following the industry. Below is a sampling of what we feel are some of the best clean-tech blogs. To track these and other industry blogs, visit www.cleanedge.com/blogs.

Apollo Alliance Blog	**Green Tech Pastures – ZDNet**
earth2tech	**R-Squared Energy Blog**
Green Collar Blog	**Clean Techies**
Green Tech – CNET	**Environmental Capital - WSJ**
Green Light – Greentech Media	**Gunther Portfolio**
Clean Technica	**Green Inc – NYT**
EcoGeek.org	**Venture Beat – Green Beat**
Green for All Blog	

Conferences/Career Fairs

Here are a few of the best events at which to explore clean-tech opportunities and support the clean energy economy.

Good Jobs, Green Jobs	**Green Career Conference (SD, SF, LA)**	**Green Professionals' Conference**

Networking Organizations & Nonprofits

Job postings aren't the only way to find jobs. Often times the best career opportunities are found through someone you know. Check out these organizations and events to make sure you're meeting the right people.

Networking	Nonprofits
Eco Tuesday	**Apollo Alliance**
Green Drinks	**Green America**
Net Impact	**Green For All**
Renewable Energy Business Network	**Repower America**

JOB RESOURCE GUIDE

Education/Training

As the clean-tech industry scales up, the number of job opportunities will grow significantly. Education and training programs will provide the necessary workforce to satisfy this growth. The collection below, while not a comprehensive list, is a sampling of existing clean-tech training and education programs.

Undergraduate Education

Appalachian State University (Boone, NC) – Bachelor of Science Degree in Appropriate Technology
Illinois State University (Normal, IL) – Renewable Energy Degree
Oregon Institute of Technology (Klamath Falls, OR) – Bachelor of Science Degree in Renewable Energy Engineering

Community College/Continuing Education/Training

Amarillo College (Amarillo, TX) – Associate in Applied Science, Renewable Energy
Bronx Community College (Bronx, NY) – Center for Sustainable Energy
California Sustainable Building Training Program (CA)
Coconino Community College (Flagstaff, AZ) - Associate of Applied Science in Alternative Energy Technology
Columbia Gorge Community College (The Dalles, OR) – Associate of Applied Science Degree in Renewable Energy Technology
Indian Hills Community College (Ottumwa, IA) – Associate in Advanced Technologies – Renewable Energy Technology & Smart Grid
Lane Community College (Eugene, OR) – Sustainability Program
Laramie Community College (Cheyenne, WY) – Associate of Applied Science Degree in Wind Energy
Oakland Community College (Bloomfield Hills, MI) – Environmental Systems Technology Program
San Juan College (Farmington, NM) – Associate of Applied Science Degree in Renewable Energy
Solar Living Institute (Hopland, CA)
South Plains College (Levelland, TX) – Renewable Energy – Wind Technology Program
Wayne-Finger Lakes Board of Cooperative Educational Services (NY) – New Vision Renewable Energy Program

Graduate Education

Antioch University (Keene, NH) – MBA in Organizational and Environmental Sustainability
Arizona State University (Tempe, AZ) – School of Sustainability
Bainbridge Graduate Institute (Bainbridge Island, WA) – MBA in Sustainable Business
Denmark Technical University (Copenhagen, Denmark) – MSc in Wind Power
Dominican University of California (San Rafael, CA) – MBA in Sustainable Enterprise
Duquesne University (Pittsburgh, PA) – MBA in Sustainability
Humboldt State University (Arcata, CA) – Bachelor of Science and Masters of Science in Environmental Resources Engineering
Illinois State University (Normal, IL) – Renewable Energy Program
Marylhurst University (Marylhurst, OR) – MBA in Sustainable Business
Oregon State University (Corvallis, OR) – MBA in Sustainable Business Practices
Oregon State University (Corvallis, OR) – Northwest Marine Renewable Energy Center (Master of Ocean Engineering
Portland State Univsersity (Portland, OR) – MBA with Sustainability Concentration
Presidio Graduate School (San Francisco, CA) – MBA in Sustainable Management
Slippery Rock University (Slippery Rock, PA) – M.S. in Sustainable Systems
Texas Tech University (Lubbock, TX) – Ph.d in Wind Science and Engineering
University of Michigan (Ann Arbor, MI) – MBA/MS Program in Global Sustainable Enterprise
University of Nebraska (Lincoln, NE) – Center for Energy Sciences Research
University of Washington (Seattle, WA) – Bioresource-Based Energy for Sustainable Engineering Laboratory
University of Wisconsin (Madison, WI) – Solar Energy Laboratory
Washington State University (Pullman, WA) – Renewable Energy Program

European Master in Renewable Energy (Core curriculum providers):

- Ecole des Mines de Paris, France
- Loughborough University, UK
- University of Zaragoza, Spain
- Oldenburg University, UK

Specializations for European Master in Renewable Energy:

- Energy Conservation in Buildings Specialization - University of Athens, Greece
- Hybrid Systems Specialization – Kassel University, Germany
- Wind Specialization – National Technical University of Athens, Greece
- Photovoltaics Specialization – University of Northumbria, UK
- Bioenergy –Specialization – University of Zaragoza, Spain

JOB RESOURCE GUIDE

Social Media

Social media websites are becoming a popular way for companies to find employees and job seekers to find jobs. LinkedIn, in particular, is a useful tool for anybody searching for the latest available clean-tech employment opportunities.

LinkedIn Groups:		
Clean Edge Jobs	Clean Technology Job Network	CleanTechies Around the World
Cool Climate Jobs	Energy Professionals	Green Jobs & Career Network
Greenfoot Jobs	Green Tech	Power Generation Careers
Renewable Energy Jobs	Renewables Job Market	Utility Jobs

Job Boards

The number of clean-tech specific job websites seems to be increasing exponentially, but there are some clear leaders. Listed below are twenty of the best online job boards where you can find the latest clean-tech job opportunities

ACORE Job Finder	Grist Jobs
Careers in Wind (AWEA)	RenewableEnergyWorld.com
Clean Edge Jobs	SolarJobs.com
CleanLoop	SustainJobs.com
CleanTechies	SustainLane: Green Collar Jobs Board
Cool Climate Jobs	Technical Green
Green Dream Jobs	TreeHugger: Job Board
GreenBiz.com	U.S. Green Building Council
GreenJobs.com	ECO Canada
GreenJobsSearch.org	RenewableEnergyJobs.com

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AUTHORS

Ron Pernick, co-founder and managing director of Clean Edge, is an accomplished market research, publishing, and business development entrepreneur with more than two decades of high-tech experience. He is also the co-author of the highly acclaimed book *The Clean Tech Revolution* (Collins).

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